

# A Cross-sectional Study on Anaemia Related Knowledge and Dietary Practices: Insights from School-going Adolescents in Mulshi Taluka, Pune, Maharashtra, India

NEHA ROKADE<sup>1</sup>, MANISHA GORE<sup>2</sup>, SAMMITA JADHAV<sup>3</sup>, ARTI MULEY<sup>4</sup>

## ABSTRACT

**Introduction:** Anaemia is a global public health concern affecting individuals of all ages, particularly adolescents who are in a stage of rapid growth and development, making them more susceptible to iron deficiency anaemia. In India, the prevalence of anaemia among adolescents is high, with significant variations across regions. Literature regarding knowledge about anaemia and related dietary practices is scarce in Pune district, especially in Mulshi taluka.

**Aim:** To study knowledge related to anaemia and assess the dietary practices in terms of consumption of iron-rich foods among adolescents aged between 14 to 17 years enrolled in public schools of Mulshi Taluka, Pune District.

**Materials and Methods:** This cross-sectional study was conducted among school-going adolescents aged 14 to 17 years in Mulshi taluka, Pune district, Maharashtra, India, from June 2023 to August 2023. Data were collected from public schools using a pretested structured questionnaire administered through one-on-one interviews. A total of 285 responses were obtained. Descriptive statistics and the Chi-square test were

applied to analyse the collected data using Microsoft (MS) Excel and Statistical Package for the Social Sciences (SPSS).

**Results:** The study revealed that more than half of the adolescents were familiar with anaemia (59.6%). However, a lower percentage considered it a health problem (45.6%). Only a few adolescents had taken Iron-folic Acid (IFA) tablets within the past year (13%), while a higher percentage had consumed deworming tablets in the past six months (70.2%). Adolescents consumed roti or rice daily (90.2%), pulses (54.7%), and Dark Green Leafy Vegetables (DGLV) (73.7%) weekly. Fruits were consumed mainly weekly (46%) and occasionally (39.6%), whereas fried food and aerated drinks were regularly consumed. The findings revealed poor implementation of the National Iron Plus Initiative (NIPI) program.

**Conclusion:** The study highlighted a lack of anaemia-related knowledge and observed inadequate dietary practices among adolescents. Thus, comprehensive efforts are required to bridge the knowledge gaps, improve dietary practices, and strengthen program implementation to ensure the comprehensive health and well-being of adolescents in Mulshi Taluka.

**Keywords:** Adolescent health, Iron-folic acid tablets, Intensified national iron plus initiative

## INTRODUCTION

Anaemia is a global public health issue that affects individuals of all ages and genders. It is a medical condition in which the total number of red blood cells or their capacity to carry oxygen is insufficient to meet the physiological needs of the body [1]. Anaemia affects over two billion people worldwide and is especially prevalent in developing countries, commonly due to a deficiency of iron, folate, and vitamin B12 [2,3]. Today, the world has 1.3 billion adolescents, accounting for 16% of the global population [4]. India has 253 million adolescents, making it one of the world's largest cohorts [5].

Adolescence is the period of life between childhood and adulthood. The age group ranges from 10-19 years. It is a particular stage of human development and a critical time for laying the groundwork for good health [2,6]. Adolescents are more likely to develop anaemia. One of the primary reasons is that they are in a stage of rapid growth and development, which increases their need for iron. During this time, if their dietary iron intake falls short of meeting their increased requirements, it may lead to iron deficiency anaemia, which is a prevalent concern among adolescents. Adolescents often have suboptimal nutrition intake due to factors like meal skipping, reliance on snacks, unconventional eating habits, and the influence of peer pressure and independent lifestyles [7,8]. Additionally, engaging in risky behaviours such as tobacco, alcohol, or drug use can further hinder the body's ability to absorb essential nutrients [9].

Along with good dietary practices, personal hygiene is essential in maintaining good health. Poor personal hygiene practices, such as inadequate handwashing after using the toilet or neglecting oral care, can lead to infections and gastrointestinal diseases like diarrhoea. These illnesses can disrupt nutrient absorption and digestion, further exacerbating the risk of anaemia in adolescents with suboptimal dietary habits [10,11]. Therefore, fostering proper personal hygiene among adolescents is essential for their overall health and plays a vital role in preventing and managing anaemia during this critical stage of development.

Recognising the urgency of addressing anaemia in this demographic, initiatives like the Intensified National Iron Plus Initiative (I-NIPI) program play a vital role. The program focuses on intensifying efforts to combat anaemia among adolescents. Through the provision of iron and folic acid supplements, biannual deworming, alongside targeted interventions and awareness campaigns, it aims to improve the nutritional status of adolescents and mitigate the risk of anaemia [12].

The study draws attention to the significant knowledge gaps and dietary practices that may contribute to the prevalence of anaemia among adolescents in Mulshi taluka. It examines factors such as awareness of anaemia, knowledge of its causes and prevention, the implementation of health programs, and dietary choices. By shedding light on these aspects, the research adds to a comprehensive understanding of the health and the current nutritional status of adolescents in the region.

This knowledge can be used to design and implement interventions aimed at improving anaemia-related awareness and dietary behaviours among adolescents, thereby advancing progress toward Sustainable Development Goal (SDG), specifically addressing SDG 3 (good health and well-being) by enlightening on the knowledge gap and dietary habits related to anaemia among adolescents. Additionally, the study also addresses SDG 2, which aims to end hunger, improve food security, and promote sustainable agriculture by focusing on dietary practices related to iron-rich foods, a vital component of a nutritious diet. It highlights the importance of health education and interventions to promote better nutritional practices among this vulnerable population, aligning with SDG 4 (Quality Education) and SDG 5 (gender equality) by supporting comprehensive health education programs that reach both boys and girls. Additionally, addressing the gaps in the implementation of healthcare programs aligns with SDG 17 (partnerships for the goals), emphasising the need for collaborative efforts among stakeholders to improve adolescent health outcomes [13].

The literature available is mostly focused on school-going girls, and there is a lack of comprehensive research encompassing both boys and girls in specific geographic areas [14-19]. This information regarding knowledge related to anaemia and existing dietary patterns can help identify areas where educational interventions may be necessary to improve awareness and subsequent prevention. Thus, the present study was planned among adolescents enrolled in selected public schools of Mulshi taluka in the Pune district. This geographic specificity provides valuable information that can be utilised for targeted interventions and policy-making at the local level.

The study focuses on assessing students' knowledge of anaemia, dietary habits, and personal hygiene practices. Its goal is to elevate awareness and encourage healthier lifestyles, contributing to improved well-being and sustainable development.

## MATERIALS AND METHODS

A cross-sectional study was conducted among school-going adolescents aged 14 to 17 in schools from five villages, purposively selected by the Symbiosis Community Outreach Programme and Extension (SCOPE) activities. The study was carried out from June 2<sup>nd</sup> 2023 to August 31<sup>st</sup>, 2023, for a period of three months. The SCOPE department of Symbiosis International University has been working since 2012 to enhance conditions in the 35 identified villages in Mulshi taluka of Pune district, Maharashtra, India through its healthcare and non healthcare initiatives. The study received approval from the Institutional Ethics Committee of Symbiosis International University (No. SIU/IEC/543). Written consent forms from the parents and assents from the students were obtained before the study. For the present study, five villages with higher secondary schools, providing education from 7<sup>th</sup> to 12<sup>th</sup> grade, were selected using a purposive sampling technique.

**Sample size calculation:** The sample size was calculated based on a study conducted in Karnataka, which reported that 25.2% of adolescents knew about anaemia [20]. Using the Cochran formula:  $\text{Sample size} = Z(1 - \alpha/2)^2 \times p \times (1 - p) / d^2$

Where,

Z=the Z score for the corresponding confidence interval (1.96 for a 95% confidence interval).

p=expected proportion in the population based on previous studies (25.2%).

d=Absolute error or precision (5% or 0.05).

The estimated sample size was 290.

**Inclusion and Exclusion criteria:** Students studying from 7<sup>th</sup> to 12<sup>th</sup> standard who were willing to participate and had provided consent were included in the study. Students who were absent from class on the day of data collection were excluded from the study. Initially, 1,114 participants were enrolled from the five schools

identified in the villages. Out of these, 285 students who were school-going adolescents between the age of 14 to 17 years old, who gave consent to be a part of the study were included, while 829 were excluded due to absence, unwillingness to participate, or failure to sign the consent form.

## Study Procedure

**Study tool and pilot testing:** The data was collected using a structured interview schedule. A pilot study was conducted with ten participants, and they were not excluded from the main study, as there was no modification needed in the questionnaire after conducting the pilot study; the participants were considered in the total sample. This research output originates from a student dissertation project, acknowledging its inherent limitations.

**The questionnaire was subdivided into four sections:** Demographics of the respondents (6 questions), Knowledge about anaemia (10 questions), Health practices related to anaemia (8 questions), and food frequency questionnaires (9 food groups) which is a validated tool of the National Family Health Survey, NFHS-4 Diet Questionnaire [14,19,21-23].

**Data collection:** Firstly, permission was taken from the respected principals of the five public schools of the selected villages. Once permission was granted, two visits for each school were planned according to the timetable of the two Medical Mobile Unit vans (MMU) of the SCOPE department. During the 1<sup>st</sup> visit, a session was conducted for the students to explain the study, and content of the consent, and assents forms. Students were given one day to get their parent's consent form signed by their parents/guardians. After the consent and assents form were signed, data was collected during the 2<sup>nd</sup> visit by conducting one-on-one interviews.

## STATISTICAL ANALYSIS

The collected data were compiled in a Microsoft Excel worksheet, followed by data cleaning, and then the data were imported to SPSS software for analysis. The following tests were used for data analysis:

Descriptive statistics were used to illustrate the participants' demographic characteristics and knowledge about anaemia, practices, health-seeking behaviour, and Food Frequency Questionnaire (FFQ). The mean and standard deviation were used to summarise continuous variables, whereas counts and percentages were used to summarise categorical variables. The Chi-square test was used with a significance level set at a p-value <0.05 to test the association between categorical variables. The independent variables were demographic characteristics of the participants (age, gender, and education), and the dependent variables were knowledge about anaemia, practices, and health-seeking behaviour towards anaemia.

## RESULTS

**Demographic profile of the participants:** In the present study, it was observed that out of 285 adolescents, the majority of them fell in the age range of 14 to 17 years (78.9%). Specifically, 167 participants were females (58.6%), and most of them were in 9<sup>th</sup> and 10<sup>th</sup> standards (50.5%). A higher percentage of participants belonged to nuclear families (68.8%) than those in joint families (31.2%), and both parents had completed their secondary education (mother=55.4% and father=63.1%) [Table/Fig-1].

**Knowledge about anaemia:** Anaemia-related knowledge among adolescents is described in [Table/Fig-2]. The study revealed that more than half of the adolescents were familiar with the term anaemia (59.6%). However, a lower percentage considered it to be a health problem (45.6%). The majority of the adolescents mistakenly believed that a reduced count of White Blood Cells (WBC) in the blood leads to anaemia (26%), and a significant percentage of adolescents acknowledged their lack of knowledge regarding the factors leading to anaemia (40.7%).

Demographic profile	n	%
<b>Age (years)</b>		
14 to 16	225	78.9
16 and above	60	21.1
<b>Gender</b>		
Male	118	41.4
Female	167	58.6
<b>Standard</b>		
7 to 8 <sup>th</sup>	92	32.3
9 to 10 <sup>th</sup>	144	50.5
11 to 12 <sup>th</sup>	49	17.2
<b>Family type</b>		
Nuclear	196	68.8
Joint	89	31.2
<b>Mother's education</b>		
Primary	126	44.2
Secondary	158	55.4
Not educated	1	0.4
<b>Father's education</b>		
Primary	104	36.5
Secondary	180	63.1
Not educated	1	0.4

[Table/Fig-1]: Demographic profile of the participants.

Questions	n	%
<b>Have you heard about the term anaemia?</b>		
Yes	170	59.6
No	115	40.4
<b>Anaemia: Is it a health problem?</b>		
Yes	130	45.6
No	155	54.4
<b>What factors, in your opinion, lead to anaemia?</b>		
Decreased number of RBC in blood	61	21.4
Increased number of RBC in blood	34	11.9
Decreased number of WBC in blood	74	26.0
I don't know	116	40.7
<b>Causes for anaemia? (Multiple responses)</b>		
Poor diet	91	32.2
Severe blood loss	39	13.8
Intestinal worm infection	45	15.9
All the above	28	9.9
I don't know	108	38.2
Total	311	109.9
<b>Signs and symptoms of anaemia? (Multiple responses)</b>		
Tiredness and fatigue	150	52.8
Vomiting	67	23.6
Pale skin, nails, eyes	74	26.1
All the above	27	9.5
Total	318	112.0
<b>How can anaemia be treated? (Multiple responses)</b>		
Iron supplementation	125	44.2
Vitamin supplementation	51	18
Deworming	82	29
All the above	40	14.1
Total	298	105.3
<b>How can anaemia be prevented? (Multiple responses)</b>		
Increase dietary iron consumption	145	51.1

Increase dietary Vit C, B12, folate consumption	87	30.6
Avoiding tea and coffee after meals	5	1.8
Maintaining personal hygiene	89	31.3
All the above	77	27.1
Total	403	141.9

[Table/Fig-2]: Knowledge about anaemia among adolescents (N=285).

When questioned about the causes of anaemia, a significant portion of the participants admitted not knowing (38.2%), while others attributed it to a poor diet (32.2%). A considerable percentage associated tiredness and fatigue (52.8%) with being the major signs and symptoms of anaemia. Adolescents expressed the belief that anaemia can be treated through iron supplementation (44.2%) and can be prevented by increasing the dietary intake of iron-rich foods (51.1%).

As shown in [Table/Fig-3], it was found that none of the participants were aware of the I-NIPI program. Furthermore, most of the participants' schools offered biannual deworming tablets (82.8%), while none provided Weekly Iron-folic Acid (WIFA) tablets. This shows a very poor implementation of the I-NIPI program in the public schools of Mulshi Taluka.

Questions	n	%
<b>Are you aware of the NIPI program?</b>		
Yes	0	0
No	285	100
<b>Does your school provide you with a WIFA tablet?</b>		
Yes	0	0
No	285	100
<b>Does your school provide you with biannual deworming?</b>		
Yes	236	82.8
No	49	17.2

[Table/Fig-3]: Implementation of the I-NIPI program (N=285).

### Health Practices Related to Anaemia

The health practices among adolescents. It was observed that a significant majority of adolescents used soap to wash their hands after defecation (95.4%) and before consuming meals is discussed in [Table/Fig-4]. A large group of students frequently trimmed their nails (61.4%). However, few of them brushed their teeth twice daily (45.4%). Many adolescents admitted to going barefoot outside their homes (68.1%). Regarding health screenings, the study found that a

Questions	n	%
<b>Do you use soap to wash your hands after defecation?</b>		
Yes	272	95.4
No	13	4.6
<b>Do you use soap to wash your hands before consuming meals?</b>		
Yes	277	97.2
No	8	2.8
<b>Do you frequently trim your nails?</b>		
Yes	175	61.4
No	110	38.6
<b>Do you brush your teeth twice a day?</b>		
Yes	130	45.6
No	155	54.4
<b>Do you go barefoot outside the house?</b>		
Yes	194	68.1
No	91	31.9
<b>Have you tested your Hb levels in the past 1 year?</b>		
Yes	103	36.1
No	182	63.9

Have you consumed any IFA tablets in the past 1 year?		
Yes	37	13.0
No	248	87.0
Have you consumed a deworming tablet in the last six years?		
Yes	200	70.2
No	85	29.8

[Table/Fig-4]: Health practices related to anaemia (N=285).

relatively low percentage of the participants had their Haemoglobin (Hb) levels tested in the previous year (36.1%). Additionally, a very low percentage of adolescents had taken IFA tablets within the past year (13%), while a higher percentage had consumed deworming tablets in the past six months (70.2%).

## Dietary Pattern of Adolescents

The observation of the FFQ revealed that adolescents were not adequately incorporating iron-rich sources into their daily diet. Most adolescents consumed roti or rice daily (90.2%), but it was observed that adolescents were consuming pulses (54.7%) and DGLV (73.7%) weekly. Ideally, pulses and DGLV should be consumed daily since both are recognised as iron-rich sources [24,25]. Fruits, which serve as rich sources of Vitamin C that enhance iron absorption in the body, were consumed majorly weekly (46%) and occasionally (39.6%). Non vegetarian items are excellent sources of heme-iron and should be consumed weekly, but most participants consumed them occasionally. Moreover, a significant portion of the participants indulged in fried food and aerated drinks daily and weekly, which is considered an unhealthy dietary habit [Table/Fig-5]. [Table/Fig-6] highlights the association between the demographic profile of the participants and knowledge related to anaemia. A significant association (p-value of <0.001) was observed between participants' education and their knowledge about anaemia. The findings indicate that most of the participants enrolled in the 9<sup>th</sup> to 10<sup>th</sup> standard possessed better knowledge compared to students in the 7<sup>th</sup> to 8<sup>th</sup> standard. Furthermore, significant associations (p-value of <0.001) were found between participant age, education, and the availability of deworming tablets in their schools. This finding lends support to the implementation of the NIPI program, as evidenced by the provision of deworming tablets to students.

Food groups	Daily n (%)	Weekly n (%)	Occasionally n (%)	Never n (%)
Roti/Rice	257 (90.2%)	25 (8.8%)	3 (1%)	-
Pulses	116 (40.7%)	156 (54.7%)	9 (3.2%)	4 (1.4%)
DGLV	62 (21.8%)	210 (73.7%)	7 (2.5%)	6 (2%)
Fruits	32 (11.2%)	131 (46.0%)	113 (39.6%)	9 (3.2%)
Egg	19 (6.7%)	124 (43.5%)	77 (27.0%)	65 (22.8%)
Fish	2 (0.7%)	52 (18.2%)	123 (43.2%)	108 (37.9%)
Chicken/Meat	3 (1.1%)	106 (37.2%)	117 (41.1%)	59 (20.7%)
Fried foods	110 (38.6%)	135 (47.4%)	29 (10.1%)	11 (3.9%)
Aerated drinks	77 (27.0%)	144 (50.5%)	25 (8.8%)	39 (13.7%)

[Table/Fig-5]: Dietary pattern of adolescents (N=285).

\*\*The questionnaire was adjusted to prioritise understanding the primary intake consumption of roti/rice, staple foods prevalent in the diet of the target population in public schools in rural areas with low or middle socio-economic status therefore intake of milk is replaced by Roti/Rice

The association between the demographic profile of the participants and health practices related to anaemia is presented in [Table/Fig-7]. A significant association (p<0.002) was identified between participant gender and the frequency of nail trimming. It was found that the majority of boys (72%) cut their nails more frequently than girls (53.3%). When girls were asked why they keep long nails, they expressed that they find it beautiful and attractive. On the other hand, when boys were questioned about the same, a few mentioned that they work

Questions	Participants education	Yes n (%)	No n (%)	Chi-square (p-value)
Have you heard the term anaemia?	7 to 8 <sup>th</sup>	38 (41.3%)	54 (58.7%)	≤0.001*
	9 to 10 <sup>th</sup>	102 (70.8%)	42 (29.2%)	
	11 to 12 <sup>th</sup>	30 (61.2%)	19 (38.8%)	
	Total	170 (59.6%)	115 (40.4%)	
Anaemia: is it a health problem?	7 to 8 <sup>th</sup>	30 (32.6%)	62 (67.4%)	≤0.001*
	9 to 10 <sup>th</sup>	78 (54.2%)	66 (45.8%)	
	11 to 12 <sup>th</sup>	22 (44.9%)	27 (55.1%)	
	Total	130 (45.6%)	155 (54.4%)	
Does the school provide you with biannual deworming?	7 to 8 <sup>th</sup>	92 (100%)	0 (0.0%)	≤0.001*
	9 to 10 <sup>th</sup>	144 (100%)	0 (0.0%)	
	11 to 12 <sup>th</sup>	0 (0.0%)	49 (100%)	
	Total	236 (82.8%)	49 (17.2%)	
Question	Participants age	Yes n (%)	No n (%)	Chi-square (p-value)
Does the school provide you with biannual deworming?	14 to 16 years	222 (98.7%)	3 (1.3%)	≤0.001*
	16 and above	14 (23.3%)	46 (76.7%)	
	Total	236 (82.8%)	49 (17.2%)	

[Table/Fig-6]: Association between demographic profile and knowledge about anaemia.

\*Chi-square test; p-value considered significant at level <0.05; (For analysis all the socio-demographic variables were considered)

in Kirana shops, making it easier to cut papers and remove stapler pins. Furthermore, another significant association (p<0.009) emerged between gender and the consumption of IFA tablets within the past year. The data revealed that females had a higher rate of IFA tablet consumption compared to males. Moreover, a significant association (p<0.001) was observed between the age and education of the participants and their consumption of deworming tablets in the past six months. Notably, deworming tablets are made available to school students. However, it is concerning to note that a portion of students from 7<sup>th</sup> to 10<sup>th</sup> standard (25.7%) have not taken the tablets despite their availability. Upon inquiry, it was revealed that students were concerned about potential episodes of loose motions, and a few participants mentioned that their parents had advised against taking such tablets.

Questions	Gender	Yes n (%)	No n (%)	Chi-square (p-value)
Do you frequently trim your nails?	Male	85 (72.0%)	33 (28.0%)	0.002*
	Female	90 (53.9%)	77 (46.1%)	
	Total	175 (61.4%)	110 (38.6%)	
Have you consumed any IFA tablets in the past one year?	Male	8 (6.8%)	110 (93.2%)	0.009*
	Female	29 (17.4%)	138 (82.6%)	
	Total	37 (13%)	248 (87%)	
Question	Participants age	Yes (n, %)	No (n, %)	Chi-square (p-value)
Have you consumed deworming tablet in the last six months?	14 to 16 years	177 (78.7%)	48 (21.3%)	≤0.001*
	16 and above	23 (38.3%)	37 (61.7%)	
	Total	200 (70.2%)	85 (29.8%)	
Question	Participants Education	Yes (n, %)	No (n, %)	Chi-square (p-value)
Have you consumed deworming tablet in the last six months?	7 to 8 <sup>th</sup>	79 (85.9%)	13 (14.1%)	≤0.001*
	9 to 10 <sup>th</sup>	107 (74.3%)	37 (25.7%)	
	11 to 12 <sup>th</sup>	14 (28.6%)	35 (71.4%)	
	Total	200 (70.2%)	85 (29.8%)	

[Table/Fig-7]: Association between demographic profile and health practices related to anaemia.

\*Chi-square test; p-value considered significant at level <0.05; (For analysis all the socio-demographic variables were considered)

A significant association between participants' knowledge about anaemia and their health practices related to anaemia is shown in [Table/Fig-8]. A significant association (p<0.05) was found. Nearly



71.8% did not consider anaemia as a health disease and had not checked their Hb levels in the past year ( $p<0.006$ ), 92.3% of the participants had not consumed IFA tablets in the past one year ( $p<0.004$ ) and whether or not adolescents were aware of anaemia, the majority of them took deworming tablets since it was provided in the schools.

Questions	Anaemia: Is it a health disease?		Chi-square (p-value)
	Yes n (%)	No n (%)	
Have you tested your Hb levels in the past 1 year?	58 (56.3%)	45 (43.7%)	0.006*
	72 (39.6%)	110 (60.4%)	
Total	130 (45.6%)	155 (54.4%)	
Have you consumed IFA tablets in the past 1 year?	25 (67.6%)	12 (32.4%)	0.004*
	105 (42.3%)	143 (57.7%)	
Total	130 (45.6%)	155 (54.4%)	
Have you consumed a deworming tablet in the last 6 months?	80 (40%)	120 (60%)	0.004*
	50 (58.8%)	35 (41.2%)	
Total	130 (45.6%)	155 (54.4%)	

[Table/Fig-8]: Association between knowledge and health practices towards anaemia.  
\*Chi-square test; p-value considered significant at level  $<0.05$ ; (For analysis all the socio-demographic variables were considered)

DISCUSSION

The study was conducted to assess students’ knowledge of anaemia, dietary habits, and personal hygiene practices. The study sample consisted of 285 adolescents, predominantly aged between 14 to 17 years (78.9%). Females constituted 58.6% of the participants, with a majority in 9<sup>th</sup> and 10<sup>th</sup> standards (50.5%). Nuclear families were more prevalent (68.8%) than joint families (31.2%), and a significant proportion of participants’ parents had completed secondary education (mother=55.4%, father=63.1%). These demographic characteristics provide context for interpreting our results and underscore the need for considering these factors in understanding adolescent behaviours and experiences.

The present study found that most adolescents had heard the term “anaemia” (59.6%) but lacked knowledge about it. A lower percentage considered it to be a health problem (45.6%). For instance, less than one-fourth of the adolescents knew that fewer red blood cells lead to anaemia (21.4%). Similar findings have been echoed in various studies. A study conducted in Hyderabad on adolescent girls by Pareek P and Hafiz A found that only one-fourth (25%) of the girls in their sample size had good knowledge about anaemia, including its causes, symptoms, treatment, and prevention [22]. In contrast, a study conducted in Karnataka by Angadi N and Ranjitha A observed that the majority of girls had heard about anaemia (91%) and were aware that it was a health problem [23]. Furthermore, a study carried out in Delhi by Singh M et al., found that out of 210 participants, only a few had heard the term “anaemia” (28.5%), and among them, the majority considered anaemia to be a health problem (83.3%) [14]. Additionally, an international study conducted in Saudi Arabia by Bassam S El A and Elgazzar SE revealed that most adolescent girls had good knowledge related to anaemia (70.9%) but lacked adequate knowledge about its causes, signs, and symptoms [15].

In this study, it was noted that none of the participants were aware of the NIPI program. In contrast, a study conducted in Hyderabad revealed that only 17% of girls were familiar with the anaemia prophylaxis program in India [24]. Moreover, poor implementation of the I-NIPI program was observed in the public schools of Mulshi Taluka, as none provided WIFA tablets to adolescents. A nationwide study conducted by Ahmad K et al., across 29 states in India aimed to investigate the bottlenecks in the supply chain of IFA supplements. The study’s findings revealed that out of the total 704 districts in India, only 140 districts received the necessary IFA

blue tablet supplementation. The study identified several significant issues, including the lack of effective management, the absence of a fixed distribution schedule, and inadequate transportation availability, which contributed to this problem [26].

When adolescents were questioned about their health practices, it was found that nearly all (35.4%) adolescents used soap to wash their hands after defecation and before consuming meals (97.2%). A significant proportion of adolescents (61.4%) frequently trimmed their nails, while a smaller percentage (45.4%) brushed their teeth twice daily. Furthermore, many adolescents (68.1%) went barefoot outside their homes. However, only a few adolescents (36.1%) had checked their Hb levels in the previous year and taken IFA tablets (13%). In support of the current study’s findings, Singh M et al., found that the majority of participants washed their hands with soap before consuming food (52%). Only a small percentage of participants walked barefoot outside (28.5%). Additionally, very few participants had their Hb levels checked in the past year (4.8%) or had consumed IFA tablets (2.8%) [14]. In contrast, a 2017 study in West Bengal by Pal J and Pal AK, involving 327 adolescent girls, found that the majority of the girls did not wash their hands before consuming food (87.5%), did not brush their teeth twice daily (99.7%), and had long, dirty nails (89.3%) [10].

The FFQ revealed that adolescents were not adequately incorporating iron-rich sources into their daily diets. Pulses (54.7%), DGLV (73.7%), and fruits (46%) were consumed weekly. Ideally, they should be consumed daily [27]. Non vegetarian options were consumed occasionally. Participants frequently indulged in fried foods and aerated drinks, considered unhealthy dietary habits. A study by Pareek P and Hafiz A revealed inadequate consumption of iron-rich food sources among adolescents. Less than one-third of the participants consumed pulses (29%), green leafy vegetables (18%), and very few were consuming fruits daily (5%) [22]. Another study in rural Bangladesh by Alam N et al., found that adolescents did not frequently consume food such as fruits, eggs, meat, and leafy vegetables [28]. Hariyanto N et al., found that 88.8% of 98 participants had poor eating patterns, with 41.8% experiencing anaemia. Spearman’s Rho test showed a significant correlation ( $p=0.003$ ,  $p=0.05$ ) between diet and anaemia among adolescent girls at SMA GIKI 1 Surabaya [29]. Unhealthy dietary patterns can cause anaemia among adolescents.

This study includes both boys and girls, shedding light on the knowledge and dietary practices related to anaemia among school-going adolescents of diverse gender backgrounds. However, it remains noteworthy that the existing research landscape primarily focuses on school-going girls, highlighting an urgent need for more extensive investigations dedicated to boys to bridge this knowledge gap effectively.

Limitation(s)

The calculated sample size was 290, but with a high number of student absences and challenges in obtaining permissions due to scheduling constraints, the sample size was reduced to 285 to ensure practical feasibility during data collection. As respondents may have based their responses on perceived knowledge, the findings may not fully generalise to diverse adolescent populations beyond Mulshi Taluka. Additionally, since this is a dissertation study as a partial fulfilment of a Master’s degree, there is scope for improvement for future research, such as expanding the sample size or exploring other geographical areas, to further enhance the validity and generalisability of the findings.

CONCLUSION(S)

The present study delved into anaemia-related knowledge and dietary practices among school-going adolescents in Mulshi Taluka, Pune District, revealing a significant gap in understanding causes and symptoms. While positive aspects such as good hygiene practices

emerged, concerns about the I-NIPI program's implementation and limited awareness of anaemia-related screenings highlighted areas for improvement. Targeted interventions for both genders are crucial, necessitating enhanced anaemia education and healthier dietary practices. Proactive measures include regular nutrition sessions, an integrated health curriculum, and robust health campaigns to ensure effective intervention delivery. These efforts hold the potential to significantly reduce anaemia prevalence and elevate overall adolescent health in the region.

## REFERENCES

- [1] Abu-Baker NN, Eyadat AM, Khamaiseh AM. The impact of nutrition education on knowledge, attitude, and practice regarding iron deficiency anaemia among female adolescent students in Jordan. *Heliyon*. 2021;7(2):e06348. Doi: 10.1016/j.heliyon.2021.e06348.
- [2] World Health Organisation. Anaemia. World Health Organisation, 2022.
- [3] Rose N, Goel M, Patil R, Motwani B, Shrivastava J. Haemogram and iron profile in children suffering from severe acute malnutrition at a tertiary care centre, Bhopal: A cross-sectional study. *J Clin Diagn Res*. 2023;17(7):SC29-SC32. Available from: <https://doi.org/10.7860/JCDR/2023/62949.18194>.
- [4] UNICEF. Adolescents statistics. UNICEF data, May 2023.
- [5] Scott S, Lahiri A, Sethi V, Wagt AD, Menon P, Yadav K, et al. Anaemia in Indians aged 10-19 years: Prevalence, burden and associated factors at national and regional levels. *Matern Child Nutr*. 2022;18(4):e13391. Doi: 10.1111/mcn.13391.
- [6] Sivagurunathan C, Umadevi R, Rama R, Gopalakrishnan S. Adolescent health: Present status and its related programmes in India. Are we in the right direction? *J Clin Diagn Res*. 2015;9(3):LE01-06. Doi: 10.7860/JCDR/2015/11199.5649.
- [7] Lew K, Barlow PJ. Dietary practices of adolescents in Singapore and Malaysia. *Singap. Med. J*. 2005;46(6):282.
- [8] Kanjilal M, Kumar U, Gupta GK, Agrawal D, Arya RK, Batra J. Dietary habits and their impact on the physical status of school going adolescents in Delhi: A cross-sectional study. *J Clin Diagn Res*. 2021;15(7):OC43-OC47. Doi: 10.7860/JCDR/2021/48202.15158.
- [9] Lassi Z, Moin A, Bhutta Z. Nutrition in middle childhood and adolescence. In: Bundy DAP, Silva Nd, Horton S, et al., editors. *Child and adolescent health and development*. 3<sup>rd</sup> edition. Washington (DC): The International Bank for Reconstruction and Development/The World Bank; 2017 Nov 20. Chapter 11. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK525242/>. Doi: 10.1596/978-1-4648-0423-6\_ch11.
- [10] Pal J, Pal AK. Knowledge, attitude and practice of personal hygiene and its predictors: A school-based study among adolescent girls in an urban slum. *Int J Med Sci Public Health*. 2017;6(9):1411-17. Doi: 10.5455/ijmsph.2017.0617706072017.
- [11] Han L, Gao X, Liao M, Yu X, Zhang R, Liu S, et al. Hygiene practices among young adolescents aged 12-15 years in low-and middle-income countries: A population-based study. *J. Glob. Health*. 2020;10(2):020436. Doi: 10.7189/jogh.10.020436.
- [12] Ministry of health and family welfare government of India. Intensified national iron plus initiative (I-NIPI) operational guidelines for programme managers. 2018 April.
- [13] United Nations. The 17 Sustainable Development Goals. United Nations, 2015.
- [14] Singh M, Rajoura OP, Honnakamble RA. Anaemia-related knowledge, attitude, and practices in adolescent schoolgirls of Delhi: A cross-sectional study. *Int J Health Allied Sci*. 2019;8(2):144-48. Doi: 10.4103/ijhas.IJHAS\_97\_18.
- [15] Bassam SEIA, Elgazzar SE. Assess knowledge and attitude of students about iron deficiency anaemia in Buridah city, Ksa. *J Pharm Negat Results*. 2022;13(6):3558-66. Available from: <https://doi.org/10.47750/pnr.2022.13.S06.00>.
- [16] Ghosh S, Kabir MR, Alam AR, Chowdhury AI, Mamun MA. Balanced diet related knowledge, attitude and practices (KAP) among adolescent school girls in Noakhali district, Bangladesh: A cross sectional study. *International Journal of Adolescent Medicine and Health*. 2020;34(5):319-25. Doi: 10.1515/ijamh-2020-0106.
- [17] Sulistiyanti A, Ayu SM, Widiastuti YP, Nunes CFDC. Effectiveness of nutrition education on anaemia on the level of knowledge in adolescents girls. *International Conference on Nursing and Health Sciences*. 2022;3(1):131-38. Available from: <https://doi.org/10.37287/picnhs.v3i1.1138>.
- [18] Munira L, Viwattanakulvanid P. Knowledge, attitude, and practice towards anaemia prevention among female students in Indonesia: A mixed method study. *International Journal of Evaluation and Research in Education (IJERE)*. 2024;13(1):361-68. Doi: 10.11591/ijere.v13i1.25750.
- [19] Chaluvavaraj TSI, Satyanarayana PT. Change in knowledge, attitude, and practice regarding anaemia among high school girls in rural Bangalore: A health educational interventional study. *National Journal of Community Medicine*. 2018;9(05):358-62.
- [20] Poudel S, Mubashir A, Naik V. Impact of nutritional education on knowledge, attitude and practice regarding anaemia among school children in Belgaum, India. *Global Health Journal*. 2022;6(4):91-94. Available from: <https://doi.org/10.1016/j.glohj.2022.04.001>.
- [21] International Institute for Population Sciences (IIPS) and ICF. 2017. *National Family Health Survey (NFHS-4)*. 2015-16: India. Mumbai: IIPS.
- [22] Pareek P, Hafiz A. A study on anaemia related knowledge among adolescent girls. *International Journal of Nutrition and Food Sciences*. 2015;4(3):273-76. Doi: 10.11648/ij.nfns.20150403.14.
- [23] Angadi N, Ranjitha A. Knowledge, attitude, and practice about anaemia among adolescent girls in urban slums of Davangere city, Karnataka. *International Journal of Medical Science and Public Health*. 2016;5(3):416-19. Doi: 10.5455/ijmsph.2016.2007201570.
- [24] Semwal P, Painuli S, Begum JPS, Jamloki A, Rauf A, Olatunde A, et al. Exploring the nutritional and health benefits of pulses from the Indian Himalayan region: A glimpse into the region's rich agricultural heritage. *Food Chemistry*. 2023;422:136259. Available from: <https://doi.org/10.1016/j.foodchem.2023.136259>.
- [25] Sarkar T, Salauddin M, Roy S, Chakraborty R, Rebezov M, Shariati MA, et al. Underutilized green leafy vegetables: Frontier in fortified food development and nutrition. *Critical Reviews in Food Science and Nutrition*. 2023;63(3):11679-733. Doi: 10.1080/10408398.2022.2095555.
- [26] Ahmad K, Singh J, Singh RA, Saxena A, Varghese M, Ghosh S, et al. Public health supply chain for iron and folic acid supplementation in India: Status, bottlenecks and an agenda for corrective action under Anaemia Mukht Bharat strategy. *PLOS ONE*. 2023;18(2):e027982718. Doi: 10.1371/journal.pone.0279827.
- [27] Kaartinen N, Paalanen L, Back S, Kortetmäki T, Lamminen M, Maukonen M, et al. Diets are part of solving health and environmental challenges: New nutrition recommendations support sustainability transition. *THL*. 2024. 01-04. Available from: [https://www.julkari.fi/bitstream/handle/10024/148134/PT2024\\_001\\_Diets%20are%20part%20of%20solving%20health%20and%20environmental%20challenges\\_s.pdf?sequence=4&isAllowed=y](https://www.julkari.fi/bitstream/handle/10024/148134/PT2024_001_Diets%20are%20part%20of%20solving%20health%20and%20environmental%20challenges_s.pdf?sequence=4&isAllowed=y).
- [28] Alam N, Roy SK, Ahmed T, Ahmed AM. Nutritional status, dietary intake, and relevant knowledge of adolescent girls in rural Bangladesh. *Journal of Health, Population, and Nutrition*. 2010;28(1):86-94. Doi: 10.3329/jhpn.v28i1.4527.
- [29] Hariyanto N, Fatimawati I, Hastuti P, Budiarti A, Poddar S. Relationship between diet patterns and the incidence of anaemia among adolescent girls at SMA Giki 1 Surabaya. *The Malaysian Journal of Nursing (MJN)*. 2022;14(2):14-19. Available from: <https://doi.org/10.31674/mjn.2022.v14i02.003>.

### PARTICULARS OF CONTRIBUTORS:

1. Student, Department of Nutrition and Dietetics, Symbiosis Institute of Health Sciences, Symbiosis International (Deemed University), Pune, Maharashtra, India.
2. Assistant Professor, Department of Symbiosis Community Outreach Programme and Extension (SCOPE), Symbiosis Institute of Health Sciences, Symbiosis International (Deemed University), Pune, Maharashtra, India.
3. Director, Symbiosis Institute of Health Sciences, Symbiosis International (Deemed University), Pune, Maharashtra, India.
4. Assistant Professor, Department of Nutrition and Dietetics, Symbiosis Institute of Health Sciences, Symbiosis International (Deemed University), Pune, Maharashtra, India.

### NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Arti Muley,  
Assistant Professor, Department of Nutrition and Dietetics, Symbiosis Institute of Health Sciences, Symbiosis International (Deemed University), Campus Hill Base, Lavale, Pune-412201, Maharashtra, India.  
E-mail: arti@sihs.edu.in

### PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Oct 22, 2023
- Manual Googling: Jan 10, 2024
- iThenticate Software: May 03, 2024 (11%)

### ETYMOLOGY: Author Origin

EMENDATIONS: 8

### AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Oct 17, 2023**  
Date of Peer Review: **Dec 29, 2023**  
Date of Acceptance: **May 04, 2024**  
Date of Publishing: **Jun 01, 2024**