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Prevalence of Iron Deficiency Anemia among Schools Adolescents in Bani Al-Harith District, Sana'a City -Yemen

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Abstract

Background: Globally, Iron deficiency anemia (IDA) is a common nutritional disorder and represents a significant public health concern, especially for adolescents in developing nations such as Yemen. This study aimed to assess the prevalence of IDA among adolescent students in Omar bin Abdul Aziz and Al-Fajr Al-Jadeed schools in Bani Al-Harith District, Sana'a City, Yemen. **Materials and methods:** This cross-sectional study included 358 adolescent students and was conducted from 2024 to 2025. Blood samples were examined for IDA using iron profile tests and complete blood count (CBC) using automated methods. The collected data were recorded in a pre-designed questionnaire and analyzed using SPSS version 24. **Results:** Among 358 adolescents, there were 217 (60.6%) males and 141(39.4%) females, aged 11–19 years. The rate of IDA was 53 (14.8%), of whom 45 (84.9%) were female and 8 (15.1%) were male. Statistical analysis showed a highly significant relationship ($p < 0.0001$) between the occurrence of IDA among adolescent students and excessive menstruation, overcrowcrowding, and low family income. **Conclusion**: The rate of IDA was higher in female than in male adolescent students in schools in Sana'a City, Yemen, which might be worsened by insufficient health awareness, poor nutrition, and behavioral factors.

الملخص العربي:

الأهداف: فقر الدم الناجم عن نقص الحديد هو أحد أكثر أنواع فقر الدم الغذائي شيوعاً في جميع أنحاء العالم ويعتبر مشكلة صحية كبيرة، و الذي يؤثر بشكل خاص على المراهقين في البلدان النامية وخاصة في اليمن. هدفت هذه الدراسة إلى تحديد معدل الانتشار لفقر الدم بنقص الحديد بين الطلاب المراهقين في مدرستي عمر بن عبدالعزيز والفجر الجديد بمديرية بني الحارث مدينة صنعاء اليمن. **المواد والطرق:** أجريت هذه الدراسة المقطعية على إجمالي ٣٥٨ طالبا وطالبه من المراهقين خلال الفترة من ٢٠٢٤ إلى ٢٠٢٥. حيث تم تشخيص فقر الدم الناتج عن نقص الحديد من خلال تحليل تعداد خلايا الدم بالكامل ومستوى الحديد لجميع المراهقين باستخدام جهاز الي للفحص ومن ثم تم تدوين البيانات التي جمعت من كل طالب وطالبه في استبيان مصمم مسبقًا ثم حللت إحصائيا باستخدام برنامج spss الإصدار ٢٤. **النتائج:** من بين ٣٥٨ طالبا وطالبه من المراهقين ، كان هناك ٢١٧ (60.6%) ذكرًا و141 (39.4%). أنثى، تتراوح أعمارهم بين ١١-١٩ عامًا. بلغ معدل فقر الدم الناتج عن نقص الحديد في مدينة صنعاء ٥٣ طالبا(14.8%), حيث كان الاكثر انتشارا بين الاناث (84.9%), حيث كان هناك دلاله احصائية كبيرة ($p=<0.0001$) بين فقر الدم الناجم عن نقص الحديد بين الطلاب المراهقين وبين الاناث اللاتي يعانين من فرط الحيض، والاكتظاظ السكاني، وانخفاض الدخل الشهري لاسرهم . **الاستنتاج:** يمكن الاستنتاج من هذه الدراسة ان معدل ن فقر الدم الناتج عن نقص الحديد كان عالي في مدينة صنعاء اليمن. واعلى لدى الاناث المراهقات منه لدى الذكور والتي قد تصبح أسوأ بسبب سوء التغذية وأنماط الحياة ونقص الوعي.

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1. INTRODUCTION

Iron deficiency anemia (IDA) is a major global health issue that affects both children and adolescents [1]. It represents one of the most widespread nutritional deficiencies globally and is particularly prevalent among adolescent girls, largely associated with inadequate dietary intake and insufficient iron supplementation [2, 3]. Adolescence is marked by rapid physical development, heightened nutritional needs, and the commencement of menstruation, all of which substantially increase the body's iron requirements, rendering adolescent girls more vulnerable to IDA [4]. Inadequate dietary intake, including micronutrient deficiencies, has been associated with anemia, particularly among children and adolescents. Dietary diversity, characterized by the consumption of various food groups, may contribute to adequate iron intake and a reduced likelihood of anemia [5].

Iron is crucial for adolescents as it supports oxygen transport and energy metabolism, both essential during periods of rapid growth. Adolescents require increased iron intake due to an increase in muscle mass and blood volume, particularly in athletes, who face even higher demands due to physical activity [5, 6]. Iron is a vital mineral, and its homeostasis is mainly regulated by dietary intake, intestinal absorption, and recycling mechanisms [7]. In adolescents, iron deficiency can lead to increased susceptibility to infections, reduced cognitive function, impaired growth, and a high risk of adverse pregnancy outcomes [8]. Poor nutrition accounts for more than 60% of iron deficiency cases [9].

Adolescents and children aged nine months to three years are at a higher risk of developing IDA, which can arise from inadequate iron intake, malabsorption, increased blood loss, increased iron needs, or, rarely, defective plasma iron transport [10]. Significant iron deficiency may disrupt erythropoiesis and cause anemia. IDA is defined as a hemoglobin concentration markedly lower than the average for healthy individuals of the same sex and age, along with serum ferritin levels below 15 ng/ml [11]. The prevalence of IDA among adolescents was 26.4% in Qatar [12] and 22.2% among Indonesian adolescent girls [13]. In southeastern Bangladesh, IDA was higher among female students (45.3%) than among male students (26.0%). In eastern Nepal, the prevalence of IDA among adolescent girls was 33.33% [14], while among Iranian adolescents, the prevalence of IDA was 7.9% for males and 8.5% for females [15].

In Yemen, prior research has demonstrated that the prevalence of IDA was 34.2% in rural areas [16]; 39.5% across five provinces, including Sana'a, Taiz, Dhamar, Hodeida, and Ibb [17]; 54.4% in Aden among pediatric patients who received blood transfusions [18]; 69.0% in Ibb city among individuals aged 5 weeks to 24 months and 37.0% among those aged 25-48 months [19]; 30.4% among medical university students in Hodeida province [20]; and approximately 38% among Yemeni adolescents in 2020 [21]. Our study provides data on the frequency of IDA and aims to determine its prevalence among adolescent students in Omar bin Abdul Aziz and Al-Fajr Al-Jadeed schools in the Bani Al-Harith District of Sana'a City, Yemen.

2. MATERIALS AND METHODS

2.1. STUDY AREA AND POPULATION

A cross-sectional study was performed on 358 adolescent students aged 11–19 years who were enrolled in public schools, including Omar bin Abdul Aziz and Al-Fajr Al-Jadeed, located in the Bani Al-Harith District, Sana'a City, Yemen, from August 1, 2024, to August 30, 2025. Adolescents were excluded if they were < 11 or > 19 years old, pregnant, had undergone treatment for anemia (within 4 weeks), had anemia caused by inherited or acquired diseases, or had undergone blood transfusions within 3 months prior to data collection.

2.2. DATA COLLECTION

The questionnaire used to collect the data required for this study was designed according to a previous study [22], with slight modifications. The questionnaire included demographic and socioeconomic information about the adolescent students, such as age, gender, monthly family income (low = < 50,000 YER, moderate = 50,000–200,000, and high = > 200,000; 1 YER = USD 0.00185), and crowding indices. Lifestyle characteristics (smoking and Khat chewing) were defined as "yes" or "no," and pubertal status (menarche and spermarche) was also recorded as "yes" or "no," along with the number of pads per day for females.

2.3. SAMPLE SIZE

A total of 358 adolescents aged 11–19 years who were enrolled in Omar bin Abdul Aziz and Al-Fajr Al-Jadeed schools were randomly selected. The sample size was calculated using Yamane Taro's formula ($n= N \div 1+Ne^2$) [23]. With a target population of 1600 adolescent student registrants in 2024, a confidence interval of 95%, and a margin of error of 0.05, the sample size (n) for the study was estimated to be 320 using the following formula: $n = 1600 \div 1 + 1600 \times 0.05 \times 0.05 = 320$. Approximately 11.5% was added to cater for potential non-response, resulting in a total sample size of 358 respondents.

2.4. SAMPLE COLLECTION

Using a vacutainer system, venous blood (5 ml) was drawn from each adolescent, of which two milliliters was placed into K2EDTA anticoagulated tubes for the measurement of hemoglobin (Hb) and red cell parameters,

and another 3 ml of venous blood was collected in a plain tube without anticoagulant for the measurement of total iron-binding capacity (TIBC), transferrin saturation (TSAT), serum ferritin, and serum iron. Iron profile tests were performed on each sample, and samples with low Hb, MCV, serum ferritin, TSAT, serum iron, and increased TIBC were diagnosed as IDA, based on the WHO guidelines [22].

2.5. LABORATORY INVESTIGATIONS

2.5.1. HEMOGLOBIN AND RBC PARAMETERS

Hb, red blood cell count (RBC), red cell distribution width (RDW), mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV), and mean corpuscular hemoglobin concentration (MCHC) were determined using a DH36 automated hematology analyzer (Dymind Biotechnology Limited, Shenzhen, China). The criteria for anemia in adolescent students were accepted as Hb levels less than 13 g/dL for boys and 12 g/dL for girls. Anemia severity was categorized according to WHO criteria: for boys, mild anemia was 11–12.9 g/dL, moderate 8.0–10.9 g/dL, and severe < 8.0 g/dL; for girls, mild was 11–11.9 g/dL, moderate 8.0–10.9 g/dL, and severe < 8.0 g/dL [24]. In addition to having low Hb levels, adolescent students were considered anemic if their MCV was less than 76 fl, MCH was less than 27 pg, and RDW was greater than 15%.

2.5.2. IRON PROFILE MEASUREMENTS

The unsaturated iron-binding capacity (UIBC), serum ferritin, and serum iron levels were measured automatically after calibration using a Mindray Biochemistry Analyzer (Mindray Medical International Limited, Shenzhen, China).

TIBC was estimated based on the manufacturer's instructions (QCA) using a colorimetric endpoint technique with a semi-autoanalyzer. The TIBC values were then confirmed by estimating the TIBC from the measured UIBC using a Mindray Biochemistry Analyzer (Mindray Medical International Limited, Shenzhen, China). TIBC was measured using the calculated using the following formula: TIBC (calculated) = serum iron + serum UIBC [25]. TSAT was derived from serum iron concentration and TIBC. [TSAT = (Fe/TIBC) × 100].

2.5.3. Criteria of IDA and Iron deficiency

IDA was defined as low hemoglobin (< 13 g/dl for boys and < 12 g/dl for girls) with ferritin < 15 ng/dl for girls and < 30 ng/dl for boys, serum iron < 45 μg/dl for male adolescents and < 37 μg/dl for girl adolescents, serum TIBC > 400 μg/dl, and TSAT less than 20% [26, 27]. Iron deficiency was defined as low serum ferritin and iron levels, while the hemoglobin concentration was normal.

2.6. STATISTICAL PROCESSING

All study data were subjected to statistical evaluation using SPSS software (version 24; IBM Inc., New York, USA). Numerical variables were expressed as the mean with standard deviation (SD) for normally distributed values or the median with range for skewed distributions. Categorical variables were described as percentages, and associations were examined using chi-square (χ^2) tests. Statistical significance was set at $p < 0.05$.

3. RESULTS

3.1. SOCIODEMOGRAPHIC CHARACTERIZATION OF STUDY SUBJECTS

Table (1) shows that the distribution of adolescent students was 60.6% males and 39.4% females. According to age, the highest distribution was found in the age group of 14-16 years, which constitutes 50.6%), followed by the age group of 17-19 years (43.8%), while the lowest distribution was 5.6%, which was found in the age group of 11-13 years. Moreover, the moderate income was 55.6%, followed by high income (26.0%) and low income (18.4%). Furthermore, a high distribution was found with fewer than three members in each room (75.7%), while the lowest frequency of IDA was found in those who had three or more members in each room (24.3%).

3.2. HEMATOLOGICAL PARAMETERS OF STUDY SUBJECTS

Table (2) reveals the Hb, RBC parameters, and iron profile of the adolescent students. The average hemoglobin value was 13.7 g/dL with SD 1.4, and the RBC count averaged 5.04 million/μL with SD 0.47. The mean MCH was 26.8 pg (SD 2.7), MCV was 82.8 fl (SD 6.8), MCHC was 32.3 g/dL (SD 1.2), and RDW was 14.7% (SD 0.95). The mean serum iron was 80.7 mcg/dl with SD 21.9, and the ferritin was 86.6 ng/ml with SD 35.1, while the TIBC was 332.2 mcg/dl with 38.8, and transferrin saturation was 25.0% with SD 8.8. With respect to IDA, the average hemoglobin value was 11.3 g/dL with an SD of 0.48, and the RBC count averaged 4.8 million/μL with an SD of 0.58. The mean MCH was 22.4 pg (SD 2.1), MCV was 70.5 fl (SD 3.1), MCHC was 31.0 g/dl (SD 0.92), and RDW was 16.3% (SD 0.91). The mean serum iron was 36.1 mcg/dl with SD 3.0, and the ferritin was 13.9 ng/ml with SD 4.1, while the TIBC was 403.7 mcg/dl with 26.1, and transferrin saturation was 8.9% with SD 0.85.

3.3. FREQUENCY OF IDA AMONG STUDY SUBJECTS

In Table (3), the IDA frequency within adolescent students in Sana'a was 53 (14.8%), of whom 45 (84.9%) were female and 8 (15.1%) were male.

Table[1]: Sociodemographic parameters of study subjects

Variables		No. of samples	%
Gender	Male	141	39.4
	Female	217	60.6
Age groups (years)	11–13	20	5.6
	14–16	181	50.6
	17–19	157	43.8
Monthly family income	Low	66	18.4
	Moderate	199	55.6
	High	93	26.0
Number of members in each room	< 3	271	75.7
	≥ 3	87	24.3

Table[2]: Distribution of blood values of hematological parameters among adolescents' students

	Total cases (n=358)			IDA (n=53)		
Parameters	**Mean**	**SD**	**Min & Max**	**Mean**	**SD**	**Min & Max**
HGH (g/dl)	13.7	1.4	10.4–17.4	11.3	0.48	10.4–12.7
RBC ($\times 10^6/\mu l$)	5.04	0.47	3.24–6.76	4.8	0.58	3.24–5.77
MCH (pg)	26.8	2.7	18.2–32.1	22.4	2.1	18.2–26.0
MCV (fL)	82.8	6.8	59.9–98.5	70.5	3.1	59.9–75.3
MCHC (g/dl)	32.3	1.2	28.2–34.6	31.0	0.92	28.2–33.2
RDW (%)	14.7	0.95	12.9–18.8	16.3	0.91	14.9–18.8
Iron (mcg/dl)	80.7	21.9	29.0–124.0	36.1	3.0	29.0–44.0
Ferritin (ng/ml)	86.6	35.1	10.0–146.0	13.9	4.1	10.0–28.0
TIBC (mcg/dl)	332.2	38.8	259.0–424.0	403.7	26.1	375.0–424.0
TSAT (%)	25.0	8.8	6.8–47.0	8.9	0.85	6.8–11.0

Table[3]: Frequency of IDA among the 358 adolescents' students

Gender	**IDA**				**Total (n=358)**	
	Yes (n=53)		**No** (n=305)			
	No.	%	No.	%	No.	%
Female	45	84.9	96	31.5	141	39.4
Male	8	15.1	209	68.5	217	60.6
Total	53	14.8	305	85.2	358	100.0

3.4. FREQUENCY OF THE IDA BY THE DEMOGRAPHIC CHARACTERISTICS

As shown in Table (4), IDA was significantly more common in women (84.9%) than in men (15.1%). Additionally, the age group of 14-16 years recorded a higher prevalence of IDA, with 29 cases (54.7%), while the 11-13 year age group reported a lower rate of seven cases (13.2%), showing significant differences (P = 0.013). Moreover, most of the IDA cases were observed among those with low family monthly income (73.6%), followed by moderate (22.6%) and high (3.8%) family incomes. Furthermore, the highest frequency of IDA was found in the adolescent students with $\geq$ 3 members in each room (84.9%), while the lowest frequency of IDA was found in those who had < 3 members in each room (15.1%). There was a highly statistically significant association between monthly family income, overcrowding, and IDA ($p < 0.0001$). Moreover, khat chewing was significantly correlated with IDA among adolescent students ($P = 0.029$), whereas smoking was not ($P = 0.138$).

3.5. DISTRIBUTION OF THE IDA AMONG STUDY SUBJECTS BY PUBERTAL HISTORY

As shown in Table (5), a significant correlation was observed between menarche-related factors in adolescent girls and IDA ($\chi^2 = 5.471$, $p = 0.019$). According to the

Table[4]: Frequency of the IDA according to the demographic characteristics

	IDA						χ^2	*p*
	Yes (n=53)		**No** (n=305)		**Total** (n=358)			
	No.	%	No.	%	No.	**%**		
Gender							53.995	< 0.0001
Female	45	84.9	96	31.5	141	39.4		
Male	8	15.1	209	68.5	217	60.6		
Age							8.648	0.013
11–13	7	13.2	13	4.3	20	5.6		
14–16	29	54.7	152	49.8	181	50.6		
17–19	17	32.1	140	45.9	157	43.8		
Income							126.584	< 0.0001
Low	39	73.6	27	8.9	66	18.4		
Moderate	12	22.6	187	61.3	199	55.6		
High	2	3.8	91	29.8	93	26.0		
Number of members in each room							124.21	< 0.0001
< 3	8	15.1	263	86.2	271	75.7		
≥ 3	45	84.9	42	13.2	87	24.3		
Lifestyle								
Khat chewing*							4.785	0.029
Yes	40	75.5	182	59.7	222	62.0		
No	NO	13	24.5	123	40.3	136		
Smoking							2.203	0.138
Yes	2	3.8	31	10.2	33	9.2		
No	51	96.2	274	89.8	325	90.8		

Chi-square (χ^2) $\geq$ 3.84 **(Significant),** Probability value $p < 0.05$ **(Significant),** Income **(**High = > 200,000, Moderate= 50.000-200,000, Low= < 50,000 YER, (YER1=USD 0.00185)

Overcrowding **=** $\geq$ **3** persons in each room **(< 5.5 m^2)** [28]

* Fresh leaves of *Catha edulis* (Khat) are commonly chewed for their euphoric effects.

number of pads, IDA was more common in the group with $\geq$ 3 pads (88.6%) and less common with < 3 pads (11.4%). A highly significant association was found between the number of pads used per day and IDA (χ^2 = 75.381 and $p < 0.0001$), whereas no significant association was detected between the age of the adolescents and IDA (χ^2 = 0.196 and $p = 0.658$).

4. DISCUSSION

IDA continues to be a widespread public health problem globally, particularly in the age group of adolescents, who are more susceptible [32]. Our study found that the overall prevalence of IDA among adolescent students in the study area was 14.8%. Similar findings have been reported in other countries, including Dharan [1], Nepal [14], multicultural countries, and among Iranian children [33]. However, the prevalence of IDA in this study was lower than that in previous studies in Yemen, which reported 34.2% of rural children aged $\leq$15 years [16] and 30.4% of medical university students [20]. This difference can be attributed to factors such as differences in the study population, sample size, and region. Adolescence represents a transitional stage between childhood and adulthood, characterized by increased nutritional requirements to support growth and development [14]. Accordingly, more attention should be paid to the adolescent age group regarding nutrition to improve their educational performance.

Furthermore, this study revealed that IDA was higher among female than male adolescent students. Similar findings have been reported in rural areas among Yemeni children aged $\leq$15 years [16] and in Hodeida Province, Yemen, among medical university students [20]. In contrast, studies conducted in Kenya and Zanzibar reported a higher prevalence of IDA and anemia among boys than among girls [34, 35]. Girls have higher iron needs because of the physiological demands associated with accelerated adolescent growth and the start of menstruation [36].

In this study, there was a highly statistically significant difference between menstruating adolescents who used $\geq$ 3 pads/day (p = < 0.0001) and the development of IDA. These findings are consistent with those of stud-

Table[5]: Distribution of the IDA among adolescents' students according to the pubertal history

Pubertal history		IDA						χ^2	*p*
		Yes		No		Total			
		No.	%	No.	%	No.	%		
Spermarche n=217 (60.6%)	Yes	8	3.7	204	94.0	212	97.7	0.196	0.658
	No	0	0.0	5	2.3	5	2.3		
	Total	**8**	**3.7**	**209**	**96.3**	**217**	**100.0**		
Menarche n=141 (39.4%)	Yes	44	31.2	81	57.4	125	88.7	5.471	0.019
	No	1	0.7	15	10.6	16	11.3		
	Total	**45**	**31.9**	**96**	**68.1**	**141**	**100.0**		
Number of pads / day		**IDA**						75.381	< 0.0001
		Yes (n=44)		**No** (n=81)		**Total** (n=125)			
		No.	**%**	No.	%	No.	%		
≥ 3		39	88.6	8	9.9	47	37.6		
< 3		5	11.4	73	90.1	78	62.4		
Total		**44**	**35.2**	**81**	**64.8**	**125**	**100.0**		

Chi-square (χ^2) ≥ 3.84 **(Significant)**, Probability value $p < 0.05$ **(Significant)**
Menarche; the first menstrual cycle in female humans (a central event of female puberty) [29, 30].
Spermache; The time at which a male experiences their first ejaculation and sexual maturity (male puberty) [31].

ies conducted in Qatar among adolescents aged 10–19 years [12], Indonesian adolescent girls [36], schoolchildren aged 9–13 years in Greece [37], adolescent girls in selected pre-university colleges in Mangaluru, India [38], and healthy individuals in Spain [39]. In contrast, this study had different results compared with studies in the Kavar urban area, southern Iran, among adolescent schoolgirls, and in northern India, which demonstrated no significant correlation between menarche or menstruation and the prevalence of anemia in adolescents [40, 41]. The discrepancy may be attributed to various factors, including sociodemographic variables, sample size, and study population characteristics, as well as the unique dietary patterns of vegans in specific regions, such as India.

This study showed that adolescents from families with low monthly incomes had the highest distribution of IDA (73.6%). A statistically significant correlation was found between family monthly income and IDA among adolescent students (p = < 0.0001). Studies conducted in rural India [42] and Malaysia [43] reported similar results, indicating a significant increase in IDA among students with low income. Dissimilar findings were reported in Manipur, India, where the prevalence of IDA was higher in the middle-income group, followed by the high-income group [44]. In contrast, a study conducted in Iran among adolescent girls reported no correlation between low income and IDA [45]. The study results may differ due to variations in the sample size, characteristics of the study population, or the prevalence of veganism, as observed in India.

In the present study, a highly statistically significant association was presented between adolescents with overcrowding (p < 0.0001) and IDA. A study from Qatar [12] reported similar findings. Adolescents living in households with five or more members were more likely to be anemic than those living in smaller families. So that. Larger family sizes may be associated with limited resources and reduced individual attention, leading to inadequate intake of micronutrient-rich foods, including iron [46].

In the current study, a significant association was observed between IDA and adolescent students who chewed khat daily (P = 0.029). These results were in line with findings obtained from Hodeida, Yemen, among adolescents, which reported that khat chewing was an independent predictor of anemia among adolescents [21], and were also consistent with findings from Eastern Ethiopia that reported that daily khat chewers were at greater risk of anemia than occasional or non-chewers [47]. The high tannin content of khat reduces the bioavailability of non-haem iron from the diet, and its appetite-suppressing effect may contribute to malnutrition and IDA [20, 48, 49]. It is important to implement awareness programs among various age groups regarding the harmful effects of khat on public health, as it can reduce food absorption.

No significant association (p = 0.138) was found between smoking and IDA in this study, in agreement with findings from Turkey (p = 0.51) [50], but in contrast to reports from Yemen that observed a highly statistically significant association between smoking and IDA (p < 0.001). The differences may be attributable to the coexistence of khat chewing and smoking in the Yemeni study population [20].

5. CONCLUSION

This study concluded that Sana'a City, Yemen, had a higher rate of IDA, particularly among female adolescents, than among male adolescents. In addition, the frequency of IDA was higher in adolescent students with overcrowding, low family income, and females who had excessive menstruation. Therefore, educational programs for adolescents, families, and communities should be implemented to improve public awareness of the causes of IDA and to promote healthy lifestyles. Early screening should be performed for the early identification of problems related to IDA to avoid the adverse consequences of chronic IDA, such as fatigue, developmental delays, and decreased academic performance in adolescence. Furthermore, awareness campaigns should be implemented to increase public awareness of the importance of consuming iron-rich foods and essential nutrients and to warn against behaviors that lead to iron deficiency or anemia. Extensive studies should also be conducted in various regions of Yemen to assess the prevalence of iron deficiency anemia and analyze its risk factors, thus providing a more accurate and reliable picture of its prevalence in the country.

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