

Original Research Article

A cross-sectional study to assess the prevalence and contributing factors of anaemia in private school children in Bengaluru

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ABSTRACT

Background: Anaemia is defined as an Hb concentration below the diagnostic reference range in children. Most school-aged children have anaemia, which is a common clinical disease. The effects of anaemia in school-age children include decreased resistance to disease, greater susceptibility to infection, poorer physical development, and poor academic performance. Consequently, the current study aimed to investigate the prevalence of anaemia among Bengaluru private school students. This involved being aware of the contributing elements or causes of anaemia, as well as teaching schoolchildren about the disease's complications and prevention.

Methods: A school-based cross-sectional study was conducted among children studying in private school from the 3rd to 8th standards in Bengaluru urban north division Karnataka state over a period of one year (March 2021 to March 2022). A total of 86 children were selected using a convenient sampling method.

Results: The overall prevalence of anaemia among school-going children was found to be (20.9%). Prevalence of anaemia was strongly significant among variables like; enlarged spleen or liver, pallor skin, splenomegaly and hepatomegaly, mizāj 'ām, chronic infection, pallor mucous membrane of mouth and consumption of milk respectively.

Conclusions: Anaemia remains a public health concern in our country. In our study, the overall prevalence of anaemia among school-going children was lower (20.9%) in comparison compared to recently published data by (NFHS-5), which showed a prevalence of 65.5% in children in Karnataka.

Keywords: Anaemia, Nutrition, School health program, Survey, Unani medicine

INTRODUCTION

The ability of blood to carry oxygen throughout the body is decreased in anaemia when the number and size of red blood cells, or the haemoglobin concentration, fall below the specified cut-off value.¹ anaemia is defined as an Hb concentration below the diagnostic reference range in children. Hb levels differ depending on the child's age and the laboratory diagnosis. Based on the age and the diagnostic laboratory, reference ranges (children, 6 months to 6 years normal Hb 11 gm/dl and children, 6 to

14 years normal Hb 12 mg/dl).² A haemoglobin level of 10-11 g/dl has been defined as early anaemia; a level below 10 gm/dl as marked anaemia.³ Unani believes that an abnormal humoral imbalance shift in body mijaz (temperament) can cause anaemia or sū'al-qinya. Normal blood production depends on the proper functioning of the stomach, kidneys, and spleen as well as adequate vital power. Humor production is affected, both in terms of quantity and quality, when liver function is disturbed due to a temperament shift. Additionally, it reduces immunity and weakens the ṭabī'at mudabbira'-i-badan (medicatrix

naturae).⁴ Anaemia is still common in India, and its prevalence has increased across all age groups. Anaemia has increased by 2-9% among infants, pregnant and non-pregnant women, and men, according to data from the National Family Health Survey 5 (NFHS-5) released on November 24, 2021. Karnataka is one of the worst-performing states, with a significant increase in occurrences of anaemia. Children's rates have increased from 60.9% (NFHS-4) to 65.5% (NFHS-5).⁵ Anaemia can also result from deficiencies in vitamins A, B₁₂, B₆, C, D, and E, folate, riboflavin, copper, and zinc. Iron deficiency is thought to be the most prevalent dietary deficiency. The correct formation of red blood cells (RBCs) depends on several nutrients, including riboflavin, folic acid, vitamins A, B₆, and B₁₂. Additionally, antioxidants like C and E may preserve RBCs. Enzymes involved in iron metabolism, such as ceruloplasmin and copper, contain trace amounts of zinc and copper in their structures.⁶ Anaemia in children can be caused by a variety of non-nutritional causes. Increase iron requirement during adolescent period, hookworm infestation, infections such as malaria, loss of blood in the case of heavy menstrual bleeding.⁷

METHODS

After obtaining ethical approval from institutional ethical committee (IEC) of the National Institute of Unani Medicine Bangalore, the study was initiated in the Department of Tahaffuzi Wa Samaji Tib, NIUM, Bangalore. This was a one-time point prevalence cross-sectional observational and epidemiological study conducted on children in Bangalore for a period of one year (March 2021 to March 2022). A total of 86 students from a private school in Bengaluru's urban north division were studied.

Inclusion criteria

Children of age group of 8 to 14 years were included.

Exclusion criteria

Below 8 and above 14 years of children were excluded.

Study design and sample size

It was a cross-sectional study. 86 students were randomly selected from class 3rd to 8th standard. The sample was selected from whole school population by using the convenient sampling method.

Tools for data collection

The questionnaire was designed to collect sociodemographic and personal data, including age, sex, socioeconomic status, and eating habits related to citrus fruit, meat, and green leafy vegetable consumption; systemic examination related to (respiratory system, cardiovascular system, and central nervous system);

abdominal examination related to (splenomegaly and hepatomegaly); vital examination related to (pulse rate, respiration rate, blood pressure, temperature, and mizaj).

Method of collection of data

Data of haemoglobin level was collected from the private school in the Bengaluru using the Hemo Cue (Hb 301) analyzer. Participants were classified as having normal, mild, moderate, and severe anaemia based on the WHO grading of anaemia. Samples were collected into microcuvettes and filled cuvettes to assess HB%. The Hb values were immediately recorded in proforma.⁸

Study variables

The following variables like sign and symptoms were used to assessed the anaemia in this study.

Sociodemographic variables

Students were asked about their name, sex, religion, and parents' occupation.

Socio-economic status

Kuppuswamy modified the classification of the socioeconomic status scale-2020 was used.

Diet

A history of dietary habits regarding vegetarian and non-vegetarian diets was obtained from the children. Questions were asked about skipping meals and the frequency of some foods (red meat, chicken, fish, legumes, green leafy vegetables, citrus fruits, whole grains, tea/coffee, and milk).

Chronic infection

Such as leukaemia, rheumatoid arthritis and rheumatic fever.

Menstrual history

Female students were asked about their cycle pattern (regular or irregular), the duration of flow in days, and the amount of blood flow. The following signs and symptoms were found among anaemic children.

Pallor signs

Were observed on the skin, lower palpebral conjunctiva, tongue, palm and nail.⁹

Splenomegaly

Examination by palpation of the left hypochondriac region.¹⁰

Hepatomegaly

Examination by palpation of the right hypochondriac region.¹⁰

Tachycardia

It is defined as a resting heart rate in an adolescent that is higher than 90 beats per minute.¹¹

Swollen tongue

Hypertrophic changes in the tongue were observed.¹²

Breathlessness/dyspnoea

It is defined as a respiratory rate of more than 40 breaths/min in children.¹⁰

Lack of energy

Defined as a feeling of being low, tired, lethargic, or fatigued.

Dizziness/vertigo

Described a range of sensations, such as fainting, unsteadiness, and weakness. Vertigo is the sensation of the spinning of oneself or one's surroundings.¹³

Headache

A painful sensation in any part of the head, ranging from sharp to dull.

Jaundice

A yellow discoloration of tissues and body fluids, examined on upper palpebral conjunctiva.¹⁰

Irregular menstrual cycle

Irregularities in menstrual cycle, e.g., menorrhagia, metrorrhagia.

Blood loss

Acute and chronic blood loss occurring due to any trauma, gastrointestinal tract lesions, or gynaecological disturbances.¹²

Mizaj

It was assessed by observing 10 parameters known as ajnās 'ashara mention in (questionnaire) and scored by maximum number of ticks in a particular column of mizaj denoted the dominant temperament or assessed mizaj.⁶

Statistical methods

The data was analysed using the SPSS version 16.0, Vassar Stat, and SISA for results. The significance of study parameters on a categorical scale between two or more groups was evaluated using the Chi-Square/Fisher's exact test. Tables and graphs were generated using the Microsoft Word and Excel.¹⁴

RESULTS

Table 1 shows total prevalence of anaemia was found 20.9%, children studied, with children without anaemia 79.0%, with mild anaemia accounting for 19.8% and moderate anaemia accounting for 1.2%, there was no any severe anaemic found in this study.

Table 1: Prevalence of anaemia of among school children.

Grade of anaemia	N	%
Children without anaemia (Hb ≥12 gm/dl)	68	79.0
Children with anaemia (Hb ≤12 gm/dl)		
Mild anaemia	17	19.8
Moderate anaemia	1	1.2
Severe anaemia	0	0
Total	86	100

The variables like socioeconomic status, diet, clinical presentation, chronic infection, pallor sign, dietary intake, mizaj e aam, menstrual history etc. are shown in Table 2.

Table 2: different variables of anaemia.

Variables	Anaemic (n=18), N (%)	Non-anaemic (n=68), N (%)	Total (n=86), N (%)	P value
Age in year				
11 to 13	12 (21.8)	43 (78.2)	55 (100)	0.07
14	6 (19.4)	25 (80.6)	31 (100)	
Gender				
Male	4 (10)	36 (90)	40 (100)	0.03*
Female	14 (30.4)	32 (69.6)	46 (100)	
Religion				
Hindu	18 (21.4)	66 (78.6)	84 (100)	1.0
Christian	0 (0)	1 (100)	1 (100)	
Other	0 (0)	1 (100)	1 (100)	

Continued.

Variables	Anaemic (n=18), N (%)	Non-anaemic (n=68), N (%)	Total (n=86), N (%)	P value
Kuppuswamy socio economic scale-2020.				
Upper middle	2 (28.6)	5 (71.4)	7 (100)	0.73
Lower middle	10 (23.3)	33 (76.7)	43 (100)	
Upper lower	6 (17.1)	29 (82.9)	35 (100)	
Lower class	0 (0)	1 (100)	1 (100)	
Dietary habits				
Veg	6 (35.3)	11 (64.7)	17 (100)	0.10
Mixed	12 (17.4)	57 (82.6)	69 (100)	
Clinical presentation of anaemia				
Increased heart rate				
Present	4 (50)	4 (50)	8 (100)	0.05*
Absent	14 (17.9)	64 (82.1)	78 (100)	
Breathlessness, or trouble catching a breath				
Present	2 (94.4)	5 (5.6)	7 (100)	0.63
Absent	16 (15.5)	63 (84.5)	79 (100)	
Lack of energy, or tiring easily				
Present	8 (42.1)	11 (57.9)	19 (100)	0.01*
Absent	10 (14.9)	57 (85.1)	67 (100)	
Dizziness, or vertigo, especially when standing				
Present	5 (50)	5 (50)	10 (100)	0.01*
Absent	13 (17.1)	63 (82.9)	76 (100)	
Headache				
Present	5 (27.8)	13 (72.2)	18 (100)	0.42
Absent	13 (19.1)	55 (80.9)	68 (100)	
Absent or delayed Menstruation (in total female students, n=46)				
Present	1 (50)	1 (50)	2 (100)	0.52
Absent	13 (29.5)	31 (70.5)	44 (100)	
Irregular Menstrual cycles (in total female students, n=46)				
Present	1 (50)	1 (50)	2 (100)	0.52
Absent	13 (29.5)	31 (70.5)	44 (100)	
Irritability				
Present	3 (75)	1 (25)	4 (100)	0.02*
Absent	15 (18.3)	67 (81.7)	82 (100)	
Sore or swollen tongue				
Present	2 (33.3)	4 (66.7)	6 (100)	0.60
Absent	16 (20)	64 (80)	80 (100)	
Jaundice, or yellowing of skin, eyes, and mouth				
Present	4 (30.8)	9 (69.2)	13 (100)	0.45
Absent	14 (19.2)	59 (80.8)	73 (100)	
Enlarged spleen or liver				
Present	4 (100)	0 (0)	4 (100)	<0.0001**
Absent	14 (17.1)	68 (82.9)	82 (100)	
Slow or delayed growth and development				
Present	3 (82)	2 (18)	5 (100)	0.05*
Absent	15 (18.5)	66 (81.5)	81 (100)	
Poor wound and tissue healing				
Present	1 (100)	0 (0)	1 (100)	0.209
Absent	17 (20)	68 (80)	85 (100)	
Anaemia due to chronic infection				
Blood loss				
Present	2 (100)	0 (0)	2 (100)	0.041*
Absent	16 (19)	68 (81)	84 (100)	
Worm infestation				
Present	0 (0)	0 (0)	0 (0)	1.0
Absent	18 (20.9)	68 (79.1)	86 (100)	
Chronic infection				
Present	5 (100)	0 (0)	5 (100)	0.0002**
Absent	13 (16)	68 (84)	81 (100)	

Continued.

Variables	Anaemic (n=18), N (%)	Non-anaemic (n=68), N (%)	Total (n=86), N (%)	P value
Anaemia according to pallor sign				
Pallor palpebral conjunctiva				
Present	8 (36.4)	14 (63.6)	22 (100)	0.039*
Absent	10 (15.6)	54 (84.4)	64 (100)	
Pallor mucous membrane of mouth				
Present	7 (58.3)	5 (41.7)	12 (100)	<0.0006**
Absent	11 (14.9)	63 (85.1)	74 (100)	
Pallor skin				
Present	10 (83.3)	2 (16.7)	12 (100)	<0.0001**
Absent	8 (10.8)	66 (89.2)	74 (100)	
Anaemia and splenomegaly and hepatomegaly				
Splenomegaly				
Present	9 (90)	1 (10)	10 (100)	<0.0001**
Absent	9 (11.8)	67 (88.2)	76 (100)	
Hepatomegaly				
Present	13 (92.9)	1 (7.1)	14 (100)	<0.0001**
Absent	5 (6.9)	67 (93.1)	72 (100)	
Anaemia according to dietary intake (frequency times/week)				
Red meat				
1-2 T/W	4 (13.8)	25 (86.2)	29 (100)	0.54
3 T/W	0 (0)	1 (100)	1 (100)	
4-6 T/W	0 (0)	1 (100)	1 (100)	
Never	14 (25.5)	41 (74.5)	55 (100)	
Chicken				
1-2 T/W	13 (24.1)	41 (75.9)	54 (100)	0.22
3 T/W	0 (0)	11 (100)	11 (100)	
4-6 T/W	0 (0)	4 (100)	4 (100)	
Daily	0 (0)	1 (100)	1 (100)	
Never	5 (31.3)	11 (68.7)	16 (100)	
Fish				
1-2 T/W	7 (15.6)	38 (84.4)	45 (100)	0.08
3 T/W	0 (0)	7 (100)	7 (100)	
Never	11 (32.4)	23 (67.6)	34 (100)	
Legumes				
1-2 T/W	5 (17.9)	23 (82.1)	28 (100)	0.71
3 T/W	7 (22.6)	24 (77.4)	31 (100)	
4-6 T/W	0 (0)	4 (100)	4 (100)	
Daily	3 (20)	12 (80)	15 (100)	
Never	3 (37.5)	5 (62.5)	8 (100)	
Green leafy vegetables				
1-2 T/W	4 (66.7)	2 (33.3)	6 (100)	0.08
3 T/W	5 (25)	15 (75)	20 (100)	
4-6 T/W	3 (13.6)	19 (86.4)	22 (100)	
Daily	6 (16.7)	30 (83.3)	36 (100)	
Citrus fruits (oranges)				
1-2 T/W	4 (16.7)	20 (83.3)	24 (100)	0.10
3 T/W	1 (7.1)	13 (92.9)	14 (100)	
4-6 T/W	0 (0)	3 (100)	3 (100)	
Daily	5 (18.5)	22 (81.5)	27 (100)	
Never	8 (44.4)	10 (55.6)	18 (100)	
Whole grains				
1-2 T/W	1 (25)	3 (75)	4 (100)	0.08
3 T/W	4 (57.1)	3 (42.9)	7 (100)	
4-6 T/W	3 (27.3)	8 (72.7)	11 (100)	
Daily	9 (15)	51 (85)	60 (100)	
Never	1 (25)	3 (75)	4 (100)	
Tea/coffee				
1-2 T/W	0 (0)	7 (100)	7 (100)	0.69
3 T/W	0 (0)	1 (100)	1 (100)	

Continued.

Variables	Anaemic (n=18), N (%)	Non-anaemic (n=68), N (%)	Total (n=86), N (%)	P value
4-6 T/W	0 (0)	2 (100)	2 (100)	
Daily	12 (24)	38 (76)	50 (100)	
Never	6 (23.1)	20 (76.9)	26 (100)	
Milk				
1-2 T/W	3 (60)	2 (40)	5 (100)	0.009**
3 T/W	2 (66.7)	1 (33.3)	3 (100)	
4-6 T/W	1 (100)	0 (0)	1 (100)	
Daily	9 (15.3)	50 (84.7)	59 (100)	
Never	3 (16.7)	15 (83.3)	18 (100)	
Anaemia according to mizaj e aam				
Sanguine (damvi)	3 (5.2)	55 (94.8)	58 (100)	<0.0001**
Phlegmatic (balghami)	4 (36.4)	7 (63.6)	11 (100)	
Choleric (safravi)	11 (84.6)	2 (15.4)	13 (100)	
Melancholic (saudavi)	0 (0)	4 (100)	4 (100)	
Anaemia according to menstrual history (female students)				
Menstrual cycle				
Regular	6 (20.7)	23 (79.3)	29 (100)	0.08
Absent	6 (42.9)	8 (57.1)	14 (100)	
Irregular	2 (66.7)	1 (33.3)	3 (100)	
Duration of flow				
1 to 3 days	0 (0)	1 (100)	1 (100)	0.37
3 to 5 days	6 (25)	18 (75)	24 (100)	
5 to 7 days	1 (16.7)	5 (83.3)	6 (100)	
Absent	6 (42.9)	8 (57.1)	14 (100)	
>7	1 (100)	0 (0)	1 (100)	
Amount of blood flow				
Normal flow	7 (23.3)	23 (76.7)	30 (100)	0.29
Increased	1 (50)	1 (50)	2 (100)	
Absent	6 (42.9)	8 (57.1)	14 (100)	

* - $p < 0.05$; ** - $p < 0.005$

DISCUSSION

Prevalence estimation of anaemia and impact of factors like socioeconomic status, diet, clinical presentation, chronic infection, pallor sign, dietary intake, mizaj e aam, menstrual history etc. on anaemia was ascertained by conducting the present study among school-going children in Bengaluru.

The current study indicated that 20.9% of children had anaemia overall. In this study 94.4% cases were of the mild grade anaemia; 5.6% cases were of the moderate grade anaemia and no case of severe anaemia was found during the study. Our present study showed almost similar Prevalence rate of anaemia to that of the study conducted by Kumar et al.¹⁵ A study conducted by the WHO showed the prevalence rate of 39.8% in which children were enrolled from the worldwide. In our study, there was an improvement in the prevalence rate, i.e., 20.9%, similar to the study by Kumar et al.¹⁵ The regular deworming and iron and folic acid supplementation by the school authorities in Bangalore since 2003 might be the reason for this comparatively low prevalence.^{15,16} Variation in the prevalence of anaemia among the male female was observed in the present study. There was significant difference ($p=0.03^*$) between anaemia and gender. The above results indicated that anaemia was

more prevalent among female (30.4%).¹⁷ According to statistical analysis anaemia, splenomegaly and hepatomegaly have a highly significant relationship ($p < 0.0001$). Anaemia and hepatosplenomegaly relationship was not reported till now but our findings are strongly connected with hepatosplenomegaly, which was known to be related to anaemia, possibly due to red blood cell sequestration in the spleen, which lowers the effective circulating mass of red blood cells.¹⁸ The best predictor site for pallor for diagnosing anaemia was skin as Statistical analysis revealed a significant relation between anaemia and pallor sign (skin $p < 0.0001$, mucous membrane of mouth $p = 0.0006$ and palpebral conjunctiva $p = 0.03$). Our study supported the results of study done by Keshav et al which revealed that pallor was found significant sign of anaemia.¹⁹ Statistical analysis revealed that the incidence of anaemia was extremely significant for both chronic infection ($p = 0.0002$) and blood loss ($p = 0.041$), respectively. Menstrual blood losses are a common cause of iron deficiency and IDA as it is already reported that a non-menstruating women lose about 1 mg of iron per day and menstruating women lose an additional 10 mg of iron per day during menses.²⁰ This study revealed that anaemia is significantly associated with the following clinical presentations like lack of energy or tiring easily and dizziness or vertigo ($p = 0.01$), irritability ($p = 0.02$), increased heart rate and slow or

delayed growth, ($p=0.05$). This study is also in the support that anaemia remains asymptomatic with non-specific signs and symptoms, unless the anaemia is severe. There was a statistically significant correlation ($p=0.009$) between the prevalence of anaemia and milk consumption. We observed the similar findings as of El Menchawy et al who found a significant effect ($p=0.037$) in Moroccan school children. As a result, reduction in the iron deficiency from 50.9% to 37.2% of dietary iron absorption was seen due to milk drinking.²¹ As per the statistical analysis there was a significant correlation between anaemia and mizaj ($p<0.0001$). This significantly high occurrence of choleric mizaj among anaemic school going children was in accordance with the Unani concept, which states that sanguinic mizaj was related to the higher production of khilt dum (blood) in comparison to other mizaj groups. This sequence of blood production decreases with phlegmatic mizaj as phlegm is considered as immature or unripped blood (kachcha khoon) to choleric and melancholic temperaments, respectively.²²⁻²⁴

The study has some limitations like the study was conducted during the COVID-19 period when schools were opened for a limited period in Karnataka. The school health survey was done during the pandemic period only in urban areas. The school management and principals were not fully cooperative to allow the investigators to conduct the study and to obtain blood and other investigations. So convenient sampling technique was used over a year's time. Anaemia diagnosis was based on Hb% and cell indices, and aetiologies were not further confirmed by serum ferritin or other tests due to lack of facilities and resources.

CONCLUSION

The study revealed the prevalence of anaemia was lower than that of recently shown by the NFHS-5. The gross improvement in the prevalence of anaemia in school-aged children could be attributed to regular deworming and iron and folic acid supplementation by the school authorities since 2003 and the effective functioning of the mid-day meal program in our study and selected government schools.

The findings of this study lead to the following conclusions.

The prevalence of anaemia among schoolchildren was found to be 20.9%. Strongly significant variations.

Prevalence of anaemia was strongly significant among variables like enlarged spleen or liver, pallor skin, splenomegaly and hepatomegaly and mizaj 'ām were ($p<0.0001$) respectively, chronic infection ($p=0.0002$), pallor mucous membrane of mouth ($p=0.0006$), consumption of milk ($p=0.009$). Moderately significant variations.

The prevalence of anaemia was moderately significant with lack of energy, dizziness or vertigo ($p=0.01$), irritability ($p=0.02$), different age groups, pallor palpebral conjunctiva ($p=0.03$), and blood loss ($p=0.04$). increased the heart rate and slow or delayed growth ($p=0.05$).

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REFERENCES

1. Husain S, Bibi C, Sherwani AM. Increased prevalence of anaemia (Faqr-al-dam) among teenagers and related control programs in India. *J Res Unani Med.* 2022;11(1):60-4.
2. Uppal N, Sharma A, Kukreja S. A study of prevalence of anaemia in pediatric population in a tertiary care hospital in Amritsar. *Int J Clin Biochem Res.* 2019;6(3):396-400.
3. Park K. Text Book of Preventive and Social Medicine. 25th Edition. Jabalpur: Banarsidas Bhanot Publisher; 2019:280,677-681,684,685,687.
4. Husain S, Sherwani AM, Ahmad A, Bibi C. Diagnostic manifestations (istedlal wa alamat) of anaemia (faqr al-dam) in ancient Unani literature- a review. *Chettinad Health City Med J.* 2023;12(1):84-7.
5. National family health survey (NFHS-5)-State fact sheet Karnataka. Mumbai: International institute for popular ion science. Ministry of health and family welfare 2019-20. Available from: <https://www.im4change.org/docs/Karnataka%20NFHS-5%20Factsheet.pdf>. Accessed on 1 May 2024.
6. Husain S, Sherwani AM. The prevalence and associated factors for anaemia in school children in Bengaluru, Karnataka, India: a cross-sectional study. *Christ J Glob Health.* 2023;10(2):22-36.
7. Anonymous. Technical Handbook on Anaemia in Adolescents. Available from: https://www.nhm.gov.in/images/pdf/programmes/wi fs/guidelines/technical_handbook_on_anaemia.pdf. Accessed on 1 May 2024.
8. Ramesh S, Kumar D, Bagavandas M. Prevalence of anaemia among school going adolescent girls and boys (10-18 years) in south India- a community based cross sectional study. *Ann Roman Soc Cell Biol.* 2021;25(6):7842-7.
9. Peterson P, Cornacchia MF. Anaemia: pathophysiology, clinical features, and laboratory evaluation. *Lab Med.* 1999;30(7):463-7.

10. Mehta SP, Mehta NP, Joshi SR. PJ Mehta's Practical Medicine. The National Book Depot; 2013;19,20,22,23,65,67,125.
11. Types of arrhythmias in children. 100 Years. Available from: <https://www.heart.org/en/health-topics/arrhythmia/about-arrhythmia/types-of-arrhythmia-in-children>. Accessed on 1 May 2024.
12. Kumar V, Abbas A, Aster J. Robbins and Cotran, Pathologic Basis of Disease: South Asia Edition. Vol.1. New Delhi: Elsevier India; 2014:1-29,630,652,633.
13. Dizziness. Mayo Clinic. Available from <https://www.mayoclinic.org/diseasesconditions/dizziness/symptomscauses/syc-20371787>. Accessed on 1 May 2024.
14. Rakesh PS, George LS, Joy TM, George S, Renjini BA, Beena KV. Anaemia among school children in Ernakulam district, Kerala, India. *Indian J Hematol Blood Transfus*. 2019;35(1):114-8.
15. Kumar T, Solanki S, Vadhera M, Joshi N. Analysis of incidence of anaemia among school going children. *J Adv Med Dent Sci Res*. 2021;9(4).
16. Mutthayya S, Thankachan P, Zimmermann MB, Andersson M, Eilander A, Misquith D, et al. Low anaemia prevalence in school-aged children in Bangalore, south India: possible effect of school health initiatives. *E J Clin Nutr*. 2007;61(7):865-9.
17. Kavthekar S, Kulkarni D, Kurane A, Chougule A. Association of BMI, socioeconomic status and menarche age with anaemia in rural school going adolescent girls. *Int J Pediatr Res*. 2016;3(7):486-92.
18. Mazigo HD, Lwambo NJ, Mkoji GM, Laurent LM, Kweka EJ, Waihenya R. Anaemia and organomegaly associated with parasitic infections among schoolchildren in Sengerema District, north-western Tanzania. *Tanzania J Health Res*. 2010;12(2):121-8.
19. Keshav K, Pathak SK, Kumar S, Kumar B. A case-control study to evaluate the precision of pallor in the diagnosis of Anaemia. *Eur J Mol Clin Med*. 2020;7(10):3728-34.
20. Wang W, Bourgeois T, Klima J, Berlan ED, Fischer AN, O'Brien SH. Iron deficiency and fatigue in adolescent females with heavy menstrual bleeding. *Haemophilia*. 2013;19(2):225-30.
21. El Menchawy I, El Hamdouchi A, El Kari K, Saeid N, Zahrou FE, Benajiba N, et al. Efficacy of multiple micronutrients fortified milk consumption on iron nutritional status in Moroccan schoolchildren. *J Nutr Metab*. 2015;1-8.
22. al-Rais IS, AbdAllah AA. *Al-Qanun fil Tibb* (Urdu Translation by Ghulam Hasnain Kinturi). Vol-1, Idara Kitab al-Shifa, New Delhi; 2010:28-30,33-34,137,884-85,892-93.
23. Ibn Hubal B. *Kitāb al-Mukhtārāt fi'l Tibb* (Urdu Translation by CCRUM). Part. I. New Delhi: CCRUM; 2005:29.
24. Husain S, Sherwani AM. Prevention and control of anaemia by Unani intervention. *Int J Plant Environ*. 2023;9(01):85-8.

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