Journal of Nutrition & Food Sciences
ISSN: 2155-9600

El-Ashry et al., J Nutr Food Sci 2018, 8:6
DOI: 10.4172/2155-9600.1000739

Research Article Open Access

Screening for Anemia among Children Attending Mansoura University Children's Hospital

El-Ashry RA*, Soliman OE, Fouda M, Abdel- Moneim M and Gad M

Department of Pediatrics and Clinical Pathology, Faculty of Medicine, Mansoura University, Egypt

Abstract

Background: Anemia is a serious public health problem as it mainly affects children growth and development. Prevalence of anemia in rural areas is more than urban areas due to poverty and poor dietary habits.

Aim of study: Detect correlation of anemia to nutritional status, socioeconomic status and parasitic infestation.

Patient and methods: 200 randomly selected children for taking dietetic history, food analysis for calculation of healthy eating index (HEI) score, CBC, serum iron, ferritin, TIBC and stool analysis.

Results: There is significant positive correlation between prevalence of anemia and socioeconomic status, healthy eating index-score and parasitic infestation.

Conclusion: Anemia is more common in lower SES population due to poor dietary habits that lead to poor HEI score. IDA is the most common type of anemia.

Keywords: Anemia; Parasitic infestation; Public health; Heart failure; Healthy eating

Introduction

Nutritional anemia is all pathological conditions associated with decrease blood hemoglobin level due to lack of substances which are essential for its synthesis: iron, folic acid and vitamin B12 [1].

Analysis of socioeconomic indicators as housing level, house hold possession and environmental sanitation essential to detect association between living condition and prevalence of anemia [2]. This might explain that, its higher prevalence in developing countries (3-4 folds) more than developed ones [3].

Iron deficiency anemia complicated by multiple hazard effects mainly vital organs defect as heart failure and decreased immunity which leads to increase risk of infection due to defective changes in body tissues. Global Burden of Disease ranged IDA in No 9 of total 26 risk factors as it leads to silent and premature death [4,5].

Prevention and control programs limited and fundamental as iron deficiency anemia progressively affect health, learning and school performance and reduces adult productivity so that efforts against it are limited [6,7].

Healthy eating index (HEI) is an index used to measure if the quality of diet is suitable for individual based on Dietary Guide lines for Americans [8]. HEI developed to rate diet quality in children by scoring food consumption and addressing dietary behaviors for healthy growth and development, such as eating breakfast, attending family dinners and avoiding snack foods and soft drinks. Higher HEI-scores indicate the consumption of healthy foods and detect eating behaviors [9]. The risk of chronic disease decreased after using HEI as an index of diet quality (Table 1) [10].

Aim of Study

1. Detect the frequency of anemia in preschool and school aged children attending the general outpatient clinic of Mansoura University Children's Hospital.
2. Determine the percentage of iron deficiency anemia among these children.
3. Analyze the relation of anemia to Healthy Eating Index (HEI), parasitic infections and social background.

Materials and Methods

In this cross sectional study two hundred children were included and they collected from general outpatient clinic of Mansoura University Children's Hospital.

Inclusion criteria

Children aged 2-12 years.

They will be randomly selected.

Exclusion criteria

- Chronic disease associated with anemia: congenital heart disease or chronic chest disease and chronic kidney disease.
- Hereditary or immune disease.
- Chronic drug recipient associated with anemia.

Intervention

History taking: Age, sex, residence, socioeconomic status (SES), History of parasitic infection and full dietetic history.

The dietetic history: Type of foods given to children (breakfast, lunch and the dinner) at the last three days before coming to hospital.

***Corresponding author:** Rasha Abdelmalek El-Ashry, Professor, Department of Pediatrics and Clinical Pathology, Faculty of Medicine, Mansoura University Children Hospital, El-gomhorya Street, Mansoura, Dakahlia 35511, Egypt, Tel: +2001001559244/ +2001002415396; Fax: +200502+2267016; E-mail: Rasha_elashery@yahoo.com

Received October 09, 2018; **Accepted** November 05, 2018; **Published** November 18, 2018

Citation: El-Ashry RA, Soliman OE, Fouda M, Moneim MA, Gad M (2018) Screening for Anemia among Children Attending Mansoura University Children's Hospital. J Nutr Food Sci 8: 739. doi: 10.4172/2155-9600.1000739

Copyright: © 2018 El-Ashry RA, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Component	Maximum points	Standard for maximum score	Standard for minimum score of zero
Adequacy			
Total fruits[2]	5	≥ 0.8 cup equiv. per 1,000 kcal	No Fruit
Whole fruits[3]	5	≥ 0.4 cup equiv. per 1,000 kcal	No Whole Fruit
Total vegetables[4]	5	≥ 1.1 cup equiv. per 1,000 kcal	No Vegetables
Greens and beans[4]	5	≥ 0.2 cup equiv. per 1,000 kcal	No Dark Green Vegetables or Legumes
Whole grains	10	≥ 1.5 Oz equiv. per 1,000 kcal	No Whole Grains
Dairy[5]	10	≥ 1.3 cup equiv. per 1,000 kcal	No Dairy
Total protein foods[6]	5	≥ 2.5 Oz equiv. per 1,000 kcal	No Protein Foods
Seafood and plant proteins[6,7]	5	≥ 0.8 Oz equiv. per 1,000 kcal	No Seafood or Plant Proteins
Fatty acids[8]	10	(PUFAs + MUFAs)/SFAs ≥2.5	(PUFAs + MUFAs)/SFAs ≤ 1.2
Moderation			
Refined grains	10	≤ 1.8 Oz equiv. per 1,000 kcal	≥ 4.3 Oz equiv. per 1,000 kcal
Sodium	10	≤ 1.1 gram per 1,000 kcal	≥ 2.0 grams per 1,000 kcal
Added sugars	10	≤ 6.5% of energy	≥ 26% of energy
Saturated fats	10	≤ 8% of energy	≥ 16% of energy

Table 1: HEI1–2015 components and scoring standards [12].

Food analysis: for determination of its constituents (Cho, lipid, iron &protein) to detect relation in between nutritional deficiency and anemia.

Basic steps in calculation of Healthy eating index (HEI): The HEI provides a score for diet quality not quantity as the quality was been chosen for comparison between scores of different age and sex groups [11].

HEI measures variety of healthy food by adding together the score of different foods eaten in amounts sufficient to contribute at least one-half of a serving in a food group. Ten points are given if at least half a serving of eight or more different types of food items were eaten daily. Zero points are given if at least half a serving of three or fewer different types of food items were eaten daily. Intermediate intakes calculated proportionately. Most components scored on density basis and standards for recommendations based on the least restrictive standards. HEI was calculated according to SAS steps program. Identifying the set of food under consideration as it should include, for example, the entire US food supply, the sum of choices available in particular environment, or the food consumed by a person or group of peoples over 24 hours or longer period and the database documented in its compartment of HEI- 2015 to detect dietary variable contents for score calculation and detection of amount of each dietary component according to food set then total score based on density values or ratio of intake/total energy and compared with applicable standard for scoring [12].

According to USDA, scoring standards are expressed as cup and ounce equivalents from the My Pyramid Equivalents Database (MPED) where 1oz. = 28.3 gm and 1 cup = 225 ml. HEI total score ranging from 0-100 and each compartment contributes equally to the overall score. Diet score more than 80 is considered good, diet score 50-80 is considered fair and diet score less than 50 is considered poor [13].

1. Intakes between the minimum and maximum standards are scored.
2. Fruit juice only.
3. All forms of fruit except juice.
4. Legumes (beans and peas).
5. l milk products, such as fluid milk, yogurt, cheese and fortified soy beverages.
6. Legumes (beans & peas).
7. Seafood, nuts, seeds, soy products (other than beverages), and legumes (beans and peas).
8. Ratio of poly- and monounsaturated fatty acids (PUFAs and MUFAs) to saturated fatty acids (SFAs).

Assessment of growth

Assessment of children weight and compared with WHO percentiles for detection of any SD and relation to anemia.

Investigations

CBC, CRP, serum iron, serum ferritin, TIBC, Reticulocyte count and stool analysis (Table 2).

Ethical Information

This work was approved from Institutional Review Board (IRB) of faculty of medicine Mansoura University.

Statistical Analysis

Data entered and statistically analyzed using the Statistical Package for Social Sciences (SPSS) version 16.

Quantitative data expressed as median, minimum and maximum values while qualitative data were expressed as numbers and percentages. Comparisons between mean values of anemic and healthy children were done using Chi-square test. Odds ratios and their 95% confidence interval were calculated. P value less than 0.05 was considered to be significant.

Discussion

Our results through studying prevalence of different types of anemia cleared that, prevalence of IDA is (88.5%), followed by hemolytic anemia (10.2%) and prevalence of other types of anemia (1.3%). So that, IDA is the most common cause of anemia (Table 3).

Our results by studying weight percentile according to presence or absence of anemia showed that, the percentage of less than 5th percentile (underweight) is 6.8% among non-anemic group and 29.5% among anemic group. Percentage of normal weight is 93.2% among non-anemic and 70.5% among anemic group (Table 4).

Our results by studying socioeconomic status according to presence or absence of anemia showed that, percentage of very low SES is 9.6% among anemic group and 0% among non-anemic group, low SES 50% among anemic group and 4.5%among non-anemic group, intermediate SES 35.5% among anemic group and 61.4% among non-anemic group

Test	Normal Value
Red blood cell	3.90–5.03 × 10^6/cm^3
Hemoglobin	10.5–13.3 g/dl
Hematocrit	31.7–39.6%
Mean corpuscular volume	72.7–86.5 fl
Mean corpuscular hemoglobin	24.1–29.4 pg
Mean corpuscular hemoglobin concentration	32.4–35.3%
Red cell distribution width	11.5-15%
Reticulocyte count	0.8–2.2%
Serum iron	50.4-128 µg/dl
Serum ferritin	25-280 ng/dl
TIBC	185-375 µg/dl
CRP	0.06-0.6 mg/dl

Table 2: Normal reference values of haematological tests for children aged 2-12 y [25].

Types of anemia	Anemic children Number=156	
	N	%
IDA	138	88.5
Hemolytic	16	10.2
Other types of anemia	2	1.3

Table 3: Types of anemia in studied anemic group.

Weight percentiles	Non anemic N=44		Anemia N=156		*P*
	N	%	N	%	
Normal weight	41	93.2	110	70.5	0.002
Under weight	3	6.8	46	29.5	
<5	3	6.8	46	29.5	<0.001
5	4	9.1	43	27.6	
10	5	11.4	46	29.5	
25	19	43.2	17	10.9	
50	12	27.3	3	1.9	
75	1	2.3	1	0.6	

Table 4: Comparison of weight percentiles according to presence or absence of anemia.

and high SES 5.1% among anemic group and 34.1% among non- anemic group. Lowest percentage in very low SES is due to limited hospitals and doctors' visits for screening (Table 5).

Our results through studying dietary components and its relation to prevalence of anemia showed that, anemic children showed significant lower protein, iron, fat, energy and HEI-score when compared with non-anemic group. Our study attributed to children who refuse eating food which contain vitally important compounds (play an important role in HB, RBCs synthesis) but they eat low nutritional value food (fast and sweet foods) that lead to increase prevalence of anemia (Table 6).

Our results through studying the laboratory findings showed that, lower level of hematological tests (HB, RBCs, HCT, MCV, MCH, MCHC, RDW%, serum iron and ferritin) showed low level among anemic children but high RDW, TIBC and CRP compared with non-anemic children (Table 7).

Our results by studying stool analysis results according to presence or absence of anemia cleared that; parasitic infestations associated with higher prevalence of anemia. Higher percentage of parasitic infestation among anemic group associated with *E histolytica* 36.7%, *Heminolepis nana* (26.7%), oxyuris (13.3%) and Ascaris (10%) while lower percentage associated with Giardia (6.7), Ancylostoma (3.3%) and Strongyloids (3.3%) (Table 8).

Our result by studying score of HEI as an indicator of diet quality and its relation to anemia reported that, among non-anemic children 50% of them had fair HEI-score (50-80) and other 50% had good score (more than 80) while anemic children 46.8% of them had poor score (less than 50), 53.2% of them had fair score and no children had good dietary score. So that, anemic children showed significant lower HEI-Score ($p<0.001$) when compared with non-anemic groups (Table 9).

Our results by studying correlations between HEI and other studied parameters cleared that, HEI showed significant positive correlation with percentile, SES, HB, RBC, hematocrit, MCV, MCH, serum iron, ferritin, protein, fiber, iron, zinc, total water, fat, carbohydrates, phosphorus and energy but it had significant negative correlations with RDW, reticulocyte count and TIBC (Table 10).

Our study according was in agreement with Teji et al. [14] who reported that, anemic children are at high risk of decrease their body weight and commonest type of anemia is IDA which mainly due to inadequate iron content in their feeds.

Also, our study was in agreement with Neeraj [15] who reported that, anemia is a serious health problem which is difficult to be controlled as it mainly affect children growth and development.

Our study was in agreement with Kozuki et al. [16]; WHO [17] where they reported that, SES is one of the main factors affecting prevalence of anemia as intermediate and poor level of SES characterized by increased prevalence of anemia due to insanitary food and nutritional conditions while higher and rich status of SES conditions were associated with decreased risk of anemia.

Our study was in agreement with Foot et al. [18] and El Gendy et al. [19] who reported that, prevalence of anemia is highly aggressive in Africa and south East Asia due to low SES. Also, prevalence of anemia is high in Egypt rural areas more than urban ones.

Our study was in agreement with Haider et al. [2] who concluded that, development of anemia related to decrease intake of iron rich

SES	Non anemic N=44		Anemia N=156		*P*
	N	%	N	%	
Very low	0	0	15	9.6	<0.001
Low	2	4.5	78	50	
Intermediate	27	61.4	55	35.3	
High	15	34.1	8	5.1	

Table 5: Comparison of socioeconomic status of according to presence or absence of anemia.

Dietary components	Non anemic N=44			Anemia N=156			*P*
	Median	Minimum	Maximum	Median	Minimum	Maximum	
Protein (g/day)	74.1	20.9	170.1	59.7	24.98	147.9	0.011
Fiber (g/day)	5.3	2	11.1	5.4	1.25	55	.399
Iron (mg/day)	11.3	4.3	16.6	9.8	3.16	98.2	<0.001
Zinc (mg/day)	12.9	4.6	144.4	9.2	0	280.8	0.079
Total water	629.8	285.4	1485.8	633.1	7.9	1313.3	0.444
Fat (g /day)	56.8	10.6	111.49	48.6	12.8	137.4	0.007
Calcium (mg/day)	592.7	154.3	3381.2	525.2	114.3	50567	0.339
Carbohydrates(g/day)	185.5	101.9	331.5	169.6	10.9	19394	0.091
Phosphorus (mg/day)	786	348.8	1418.7	675.9	176.6	1748.5	0.227
Energy (kcal/day)	1571.9	656.5	2631.5	1365.3	154.75	2562.5	0.003
HEI-score	79.5	65	86	51	31	74	<0.001

Table 6: Comparison of dietary components between anemic and non-anemic group.

Laboratory findings		Non anemic N=44			Anemia N=156			*P*
		Median	Minimum	Maximum	Median	Minimum	Maximum	
Hemoglobin concentration (g/dl)		12.3	11.5	14.1	10.2	5	11.8	<0.001
RBC (x10^6 /cm^3)		4.8	4.3	5.6	4.2	2.5	4.7	<0.001
Hematocrit%		41.9	37.5	45	27.3	12.5	41.4	<0.001
MCV (fl)		88.2	87.2	98.1	66.7	51	88	<0.001
MCH (pg)		31	26	33	25.6	22	29	<0.001
MCHC (%)		34.5	33	36	37.5	28.5	48	<0.001
RDW (%)		13	11.7	17.5	16.5	11.8	26	<0.001
Reticulocytes (%)		1.8	1	2.5	1	.5	10	.059
Serum iron (µg/dl)		116	59	149	67.5	12	285	<0.001
TIBC (µg/dl)		347	260	493	390	255	543	<0.001
Serum ferritin (ng/mL)		85	57	465	9.5	2	476	<0.001
		N	%		N	%		
CRP	Negative	40	90.9		130	83.3		0.214
	Positive	4	9.1		26	16.7		

Table 7: Comparison of laboratory findings between anemic and non-anemic groups.

Stool parasites	Non anemic N=44		Anemia N=156		*P*
	N	%	N	%	
Negative	42	95.5	126	80.8	0.019
Positive	2	4.5	30	19.2	
Ascaris	0	0	3	10.0	0.785
Oxyuris	0	0	4	13.3	
E histolytica	2	100	11	36.7	
Heminolepis nana	0	0	8	26.7	
Strongyloides	0	0	1	3.3	
Ancylostoma	0	0	1	3.3	
Giardia	0	0	2	6.7	

Table 8: Comparison of parasites in stool samples between anemic and non- anemic group.

HEI-Score	Non anemic N=44		Anemia N=156		*P*
	N	%	N	%	
Poor(<50)	0	0	73	46.8	<0.001
Fair(50-80)	22	50	83	53.2	
Good(>80)	22	50	0	0	

Table 9: Comparison of HEI-Score according to presence or absence of anemia.

All parameters	Health eating index	
	Total N=200	
	R	*P*
Age	0.128	0.171
Percentile	0.489	<0.001
SES	0.558	<0.001
Hemoglobin concentration (g/dl)	0.959	<0.001
RBC (x10^6 /cm^3)	0.497	<0.001
Hematocrit (%)	0.843	<0.001
MCV (fl)	0.760	<0.001
MCH (pg)	0.607	<0.001
MCHC (%)	0.204	0.076
RDW (%)	-0.676	<0.001
Reticulocytes (%)	-0.107	0.033
Serum iron (µg/dl)	0.540	<0.001
TIBC (µg/dl)	-0.289	<0.001
Serum ferritin (ng/ml)	0.585	<0.001
Protein (g/day)	0.276	<0.001
Fiber (g/day)	0.243	0.001

Iron (mg/day)	0.414	<0.001
Zinc (mg/day)	0.149	0.035
Water Total	0.247	<0.001
Fat(g/day)	0.179	0.011
Calcium(mg/day)	0.120	0.09
Carbohydrates (g/day)	0.307	<0.001
Phosphorus (mg/day)	0.189	0.008
Energy (kcal/day)	0.314	<0.001

Table 10: Correlations of HEI with other studied parameters.

food or defect in its absorption in malnourished individual due to gastrointestinal epithelium changes.

Our study was in agreement with Soh et al. [20] who reported that, main cause of childhood anemia is ID which associated with insufficient intake of essential nutrient.

Our study was in agreement with Yang et al. [21] who reported that, CBC is consider as the main method for diagnosis of anemia as its values decreased in anemic children and other indicators as serum ferritin level, transferrin saturation, TIBC and protoporphyrin used to ensure diagnosis.

Our study was in agreement with Kotecha [22] who reported that, there is three main causes of IDA in children: decrease iron intake, decrease bioavailability of dietary iron (due to lack of nutrient which accelerate iron absorption or consumption of nutrient that decrease iron absorption) and in addition, increased requirement for rapid growth and development during infancy and early childhood.

Our study was in agreement with Rezk et al. [23] and Curtale [24] who reported that, the intestinal parasites are one of the main causes of childhood anemia. Also, collected data about prevalence and intensity of intestinal parasitic infestation are available only from small unrepresentative sample surveys.

Our study was in agreement with Jessri et al. [10] who reported that, HEI is diet quality index which measure diet quality and associated with decreased risk of chronic disease. HEI-score showed significant positive correlation with prevalence and incidence of anemia as children who intake healthy foods (contain essential nutrients) had good HEI-score and decreased risk of their anemia

Conclusion

Anemia is one of the most common deficiency diseases among children 5-8 years 36.5% followed by 8-12 years 32.7% then 2-5 years 30.8% and its prevalence increased with female gender in IDA while its prevalence increased with male gender in other types of anemia. Also, prevalence of anemia increased in lower SES as its percentage in anemic children is 50% and in IDA children 55.1%. It mainly affects children growth and development as percentage of lower weight percentiles among anemic children is 29.5% and among IDA children 31.9%. Prevalence of anemia increased with parasitic infestation as its percentage among anemic children is 20.3%. Anemia children were associated with deficiency of essential nutrients in their feeds mainly iron, protein and fat so they had poor and fair HEI-score. IDA is commonest type of childhood anemia as its prevalence is 88.5% in anemic group followed by hemolytic anemia 10.2% and it mainly detected by blood analysis.

Recommendations

1. Correction of socioeconomic condition through health education and governmental programs for environmental sanitation, food and water sanitation.
2. Education programs about Food Guide Pyramid recommendations for more knowledge about healthy food that contain high amount of essential nutrients responsible for HB synthesis mainly iron, protein and fat.
3. Health education programs about HEI to limit consuming of foods with low nutritional values as fast and sweat foods and to achieve ideal dietary score suitable for children growth and development and to decrease risk of anemia and its undesired effects.
4. Periodic hematological screening by complete blood count and iron indices for early detection of anemia and iron supplementation.
5. Periodic stool analysis for early detection and control of parasitic infestation which mainly lead to asymptomatic anemia as it compete with the host who harbor it for essential nutrients.

References

1. Okafor I, Okpokam D, Antai A, Usanga E (2016) Iron status of pregnant women in rural and urban communities of cross river State, south-south Nigeria. Niger. J Physiol Sci 31: 121-125.
2. Haider BA, Olofin I, Wang M, Spiegelman D, Ezzati M, et al. (2013) Anaemia, prenatal iron use, and risk of adverse pregnancy outcomes: systematic review and meta-analysis. BMJ 346: f3443-f3443.
3. Karkar P, Kotecha P (2004) Prevalence of anemia among students of nursing school of Vadodara. Nurs J India 95: 257.
4. WHO (2001) WHO/UNICEF/UNU. Iron-deficiency anemia: assessment, prevention and control: a guide for program managers.
5. Miller JL (2013) Iron deficiency anemia: a common and curable disease. Cold Spring Harb Perspect Med 3: a011866-a011866.
6. Heidkamp R, Guida R, Phillips E, Clermont A (2017) The lives saved tool (LST) as a model for prevention of anemia in women of reproductive age. J Nutr 147: 2156S-2162S.
7. Iyoke CA, Emegoakor FC, Ezugwu EC, Lawani LO, Ajah LO, et al. (2017) Effect of treatment with single total-dose intravenous iron versus daily oral iron(III)-hydroxide polymaltose on moderate puerperal iron-deficiency anemia. Ther Clin Risk Manag 13: 647-653.
8. Kennedy ET, Ohls J, Carlson S, Fleming K (1995) The Healthy Eating Index. J Am Diet Assoc 95: 1103-1108.
9. Feskanich D, Rockett HRH, Colditz GA (2004) Modifying the healthy eating index to assess diet quality in children and adolescents. J Am Diet Assoc 104: 1375-1383.
10. Jessri M, Alena NgL, Abbé MR (2017) Adapting the healthy eating index 2010 for the Canadian population: evidence from the Canadian community health survey. Nutrients 9: 910.
11. Guenther PM, Reedy J, Krebs-Smith SM, Reeve BB (2008) Evaluation of the healthy eating index-2005. J Am Diet Assoc 108: 1854-1864.

12. National Cancer Institute (2017) National institutes of health overview and background of the healthy eating index.

13. Guenther PM, Casavale KO, Reedy J, Kirkpatrick SI, Hiza HAB, et al. (2013) Update of the Healthy Eating Index: HEI-2010. J Acad Nutr Diet 113: 569-580.

14. Teji K, Dessie Y, Assebe T, Abdo M (2016) Anaemia and nutritional status of adolescent girls in Babile District, Eastern Ethiopia. Pan Afr Med J 24: 155-159

15. Neeraj J (2012) Prevalence of anemia in school children. Med Pract Rev 3: 150-159.

16. Kozuki N, Lee AC, Katz J (2011) Moderate to severe, but not mild, maternal anemia is associated with increased risk of small-for-gestational-age outcomes. J Nutr 142: 358-362.

17. http://www.who.int/vmnis/database/en/

18. Foote EM, Suchdev PS, Williams TN, Sadumah I, Sullivan KM, et al. (2013) Determinants of Anemia among Preschool Children in Rural, Western Kenya. Am J Trop Med Hyg 88: 757-764.

19. El Gendy FM, El-Hawy MA, Shehata AMF, Osheba HE (2018) Erythroferrone and iron status parameters levels in pediatric patients with iron deficiency anemia. Eur J Haematol 100: 356-360.

20. Soh P, Ferguson E, McKenzie J, Homs M, Gibson R (2004) Iron deficiency and risk factors for lower iron stores in 6–24-month-old New Zealanders. Eur J Clin Nutr 58: 71.

21. Yang Z, Wang Z, Ma J (2017) Analysis of hemoglobin level and anemia prevalence in students aged 7-14 years in China, 2014. Zhonghua Liu Xing Bing Xue Za Zhi 38: 588- 591.

22. Kotecha P (2011) Nutritional anemia in young children with focus on Asia and India. Indian J Community Med 36: 8.

23. Rezk M, Marawan H, Dawood R, Masood A, Abo-Elnasr M (2015) Prevalence and risk factors of iron- deficiency anaemia among pregnant women in rural districts of menoufia governorate, Egypt. J Obstet Gynaecol 35: 663-666.

24. Curtale F (1998) Anaemia and intestinal parasitic infections among school age children in Behera Governorate, Egypt. J Trop Pediatr 44: 323-328.

25. Soldin SJ, Brugnara C, Wong EC (2003) Pediatric reference ranges Note all values are for the 2- to 12-year- old child. Laboratory values, 4th Edn. Washington, DC: AACC Press.