Journal of High Institute of Public Health 2015;45(1):25-31.

Original Article

Anemia among Secondary School Students in El-Kharga Oasis, New valley, Egypt

Ayiat Mouselhy[1], Iman Wahdan[2 ¥], Ali Hasab[2], Ezzat Amin[3]

[1] Fellow of Epidemiology, High Institute of Public Health, Alexandria University, Egypt,
[2] Department of Epidemiology, High Institute of Public Health, Alexandria University, Egypt,
[3] Department of Nutrition, High Institute of Public Health, Alexandria University, Egypt.

ABSTRACT

Background: Anemia constitutes a problem of serious public health significance, given its impact on psychological and physical development, behavior and work performance.
Objectives: The aim of the present study was to estimate the prevalence of anemia, its extent and determinants among secondary school students in El-Kharga, and to identify the effects of anemia on students' performance.
Methods: The study was conducted using a cross-sectional approach. It included 330 secondary school students allocated to different schools according to the number of secondary school students attending each school. A predesigned structured interviewing questionnaire was used to collect data from the students. Anthropometric measurements (weight and height), body mass index and laboratory investigations were done. School records were reviewed for the grades of the previous exams.
Results: The prevalence of anemia among secondary school adolescents in El-Kharga was 51.8%. Infection with parasites, total energy calories, plant protein, total carbohydrate and iron from plant origin were significantly higher among anemic school students than among normal students. The logistic regression model showed that only those who were infected with parasites had a higher significant risk of anemia and plant protein had a protective effect compared to relevant categories. Anemic students had more than four and half times less scholastic achievements than the normal students.
Conclusion: The prevalence of anemia among school adolescents in El-Kharga indicates a public health problem based on the WHO epidemiological criteria for diagnosis of anemia.

Key words: *Anemia, iron deficiency, prevalence, students, scholastic achievement*

Available on line at:
www.ebscohost.com/academic/arab-world-research-source

www.Askzad.com

¥*Correspondence*:
Email: imanwahdan@yahoo.com

Suggested Citations:
Mouselhy A, Wahdan I, Hasab A, Amin E. Anemia among Secondary School Students in El-Kharga Oasis, New Valley, Egypt. JHIPH 2015; 45(1):25-31.

INTRODUCTION

Anemia is a problem of serious public health significance, given its impact on psychological and physical development, behavior and work performance.[1,2] Anemia is defined as a decrease in the concentration of circulating red blood cells or in the hemoglobin concentration and a concomitant impaired capacity to transport oxygen.[1] Iron deficiency anemia (IDA) is the most prevalent type of anemia in the world.[1]

Globally, anemia affects about one quarter (24.8%) of the world population. The highest prevalence of anemia is in preschool children (47.4%), and the lowest prevalence is in men (12.7%). However, the population group with the greatest number of individuals affected is non pregnant women (56%).[3] The reported prevalence of anemia from Europe was 5% among adolescent males and 7% among females. In Northern America the corresponding figures were 8% and 7% respectively. Another study done in USA showed that the prevalence among males aged 12-14 years was 2.9% and among those aged 15-17 years was 2.7%. The corresponding figures were higher among females (3.6% and 5.9% respectively).[4] In Ireland, it was reported that the prevalence of anemia among adolescent males and females was 13% and 7% respectively.[5] In the Gulf region, the prevalence of anemia ranged between 40 and 45%.[1] In Egypt, a survey conducted in 1997, found that 47% of adolescents, which constitute 22% of the Egyptian population, were anemic while the results of another survey conducted in 2010 showed that 30% of adolescents were anemic. Anemia affects the growth, general health, and the health of the children. Poor eating habits were the main reason for the high rates of anemia among adolescents in Egypt. The typical Egyptian diet has few iron rich foods, or foods that enhance iron absorption, and often considerable amounts of foods that inhibit iron absorption such as tea and whole wheat bread.[6]

Anemia is the leading risk factor for disabilities and death worldwide.[7] According to WHO, in 2004, anemia

resulted in 273000 deaths: 45% in Southeast Asia, 31% in Africa, 9% in the Eastern Mediterranean, 7% in the Americas, 4% in the Western Pacific, and 3% in Europe, with 97% of deaths occurring in low and middle income countries. It also caused the loss of 19.7 million disability adjusted life years, accounting for 1.3% of the global total. Of these lost disability adjusted life years, 40% were in Southeast Asia, 25% in Africa, and 17% in the Western Pacific; 97% were lost in low and middle income countries.[8]

Anemia in adolescent females is the result of the rapid growth which takes place during adolescence and places extra nutritional requirements of iron. Adolescent girls also need 10% more iron as a result of menstrual blood loss. In addition, the discriminatory practices against the female child in some communities, lead to lack of adequate intake of iron which leads to protein energy malnutrition and anemia. Adolescent girls will also typically have heavy workloads at home in developing countries which in addition to poverty can play an important role in malnutrition among them. Also adolescent females in most Eastern Mediterranean Region countries, especially in rural populations, get married early and face numerous health hazards, the major one of which is very early pregnancy soon after marriage to prove their fertility. Pregnancy increases the need for energy, protein, vitamins and minerals; in particular iron and calcium.[9,10]

Iron has an important role in the normal development of functions of the brain.[11] Iron deficiency leads to lower educational attainments and reduced school attendance. Iron deficient children scored lower on tests of development, cognition, learning, school achievement, and intelligence tests.[12] The WHO estimated an impairment of performance equivalent to 5-10 points deficiency in IQ.[1,13] A study done among a group of Egyptian children about the effect of anemia in early childhood revealed that children who suffered anemia in childhood had lower IQ scores at school-entry than non anemic children.[1,13] Anemic children have a slower reaction time and poorer level of motivation and therefore poorer learning ability. A strong relationship between nutrition and intellectual development was found when three different groups were studied.[13] El-Kharga Oasis is the southernmost of Egypt's five western oases. It is located in the Libyan Desert, about 200 km to the west of the Nile valley. It is also the capital of New Valley Governorate. It is the most modernized of Egypt's western oases. Its weather is hot. There is extensive thorn palm, acacia, buffalo thorn and jujube growth in the oasis surrounding the modern town of Kharga. Many remnant wildlife species inhabit this region.

The study aims to study the prevalence of anemia, its extent and determinants among secondary school students in El-Kharga, and to identify the effects of IDA on students' performance.

METHODS

The study was conducted among secondary school students for a period of 8 months from November 2013 to June 2014 in all secondary (general, technical and nursing) schools in El-Kharga, New Valley governorate. A cross sectional study was used.

The sample size of the students was determined using EPI INFO version 7.1.1.14, 2013. On the assumption that the prevalence of anemia is 30%,[6] the required sample size at 95% confidence level was 323 students. The sample was rounded to 330. A multistage random sampling technique was used. A list of schools was taken from El-Kharga Directorate of Education. The sample was proportionately allocated to different schools according to the number of secondary school students attending each school (6 general, 3 technical and 1 nursing).

A predesigned structured interviewing questionnaire which was prepared by the researchers to collect data from secondary school students about their socio-demographic data including age, sex, type of school, school grade, education and occupation of parents; habits including exercise and nutritional habits (e.g. drinking coffee and tea, being on special diet); pubertal history (e.g. age of menarche, duration of menstruation and its amount for females and age of spermarche for males); general health status including presence of any disease whether acute or chronic and treatment intake; health services provided to students with IDA; and dietary intake. A 24 hour recall method was used. Each subject was asked to recall all consumed foods and beverages during the last 24 hours. Individual food intake was converted into nutrient intake using the Egyptian food consumption tables developed by the Nutrition Institute, Cairo.[14] Nutrient intake was compared to that of the National Research Council (NRC) and the Recommended Daily Allowance (RDA) for adolescents of respective age.[15]

Laboratory investigations were done including blood and stool examination. Hemoglobin level (Hb) and haematocrit value (Hct) [packed cell volume (PCV)] was done for each participant. A specimen of capillary blood for Hb and Hct estimation was obtained from fingertips by using a sterilized blood lancet. [16] The mean corpuscular hemoglobin concentration (MCHC) helped to diagnose the cause of anemia and was calculated using the determined Hb and Hct level. It is the average concentration of hemoglobin in individual red cell. It is the ratio of the weight of Hb to the volume of the red blood cell in g/dl using the formula: MCHC = Hb(gm/dl) / Hct (%) × 100.[17]

Stool analysis: A stool sample was obtained from each subject and was tested for the presence of occult blood (Fecal occult blood test) and for the presence of parasites using a simple sedimentation technique.[18]

Record Review: School records were reviewed for the grades of the previous exams (last school year).

Statistical analysis: The collected data were revised, coded, and analyzed using the statistical package for social sciences (SPSS version 21). Descriptive statistics were done including count and percentage. Arithmetic mean (x) and standard deviation (SD) were used as measures of central tendency and dispersion respectively for normally distributed quantitative data. Z-test was used for comparison between two proportions as percentages. Inferential analysis was done. Cross tabulation of the binary characteristics by the IDA status with testing the association by X^2 test. Odds ratio was calculated for each of the studied variables. Spearman's coefficient correlations to examine possible relationships between different factors and HB%. Multivariate logistic regression analysis was used to assess predictors of IDA. To correctly discriminate patients with and without IDA calculated from binary logistic model, Receiver Operating Characteristics (ROC) analysis was performed.

Ethical Statement

The researcher sought the approval of the Ethics Committee of the High Institute of Public Health for conducting the study and complied with the international ethical research guidelines. An informed written consent was taken from the students participating in the study and their parents after explanation of the purpose of research and its benefits. Confidentiality and voluntary participation were stressed upon when describing the purpose of the study to all participants. Anonymity and confidentiality were guaranteed and maintained.

RESULTS

The total number of students was 330 students. Their socio-demographic characteristics are presented in table (1). The mean age was 16.7 years ±1.2 SD. Two thirds (66.7%) of students were females. Male students constituted 33.3%. The educational years ranged from 1 to 3 years. First year students constituted 42.1% while second and third year students constituted 35.2% and 22.7% respectively. More than half of students (54.2%) were from urban areas while students from rural areas constituted 45.8%. About one third (34.0%) of students' fathers had primary education, while those who read and write and university graduates constituted 22.7% and 5.7% respectively. Nearly half (51.5%) of the fathers were manual workers while 15.8% were clerical workers respectively. Half of the mothers (50.3%) could read and write, and only 2.7% of them were university graduates. The majority of the mothers (83.6%) were housewives while only 16.4% were working. The blood examination showed that the mean hemoglobin level of the studied sample was 11.77±1.249 gm/dl. It was 12.19±1.347 gm/dl for males and 11.56±1.143 gm/dl for females.T his difference was statistically significant (F=19.781, p=O.000). The stool examination showed that school students who were positive for parasites had a significant risk of developing anemia than the negative ones. (cOR= 159.859 (21.877, 7.628), X^2MH= 101.826, p = .0000). (Table 2)

Table (3) shows the correlation of food analysis compared with the Hb (gm/dl).

Table (1): Distribution of students by their sociodemographic characteristics (El Kharga, 2014)

Socio demographic data (n=330)		No	%
Age (years)	▪ 15	85	25.7
	▪ 16	51	15.5
	▪ 17	88	26.7
	▪ 18+	106	32.1
Sex	▪ Male	110	33.3
	▪ Female	220	66.7
Educational year	▪ First secondary	139	42.1
	▪ Second secondary	116	35.2
	▪ Third secondary	75	22.7
Residence	▪ Rural	151	45.8
	▪ Urban	179	54.2
Fathers' education	▪ Illiterate or read and write	75	22.7
	▪ Primary	112	34.0
	▪ Preparatory	76	23.3
	▪ Secondary	48	14.3
	▪ University	19	5.7
Fathers' occupation	▪ Manual	170	51.5
	▪ Technical	108	32.7
	▪ Clerical	52	15.8
Mothers' education	▪ Illiterate or read and write	166	50.3
	▪ Primary	97	29.4
	▪ Preparatory	12	3.6
	▪ Secondary	46	14.0
	▪ University	9	2.7
Mothers' occupation	▪ Working	54	16.4
	▪ Housewife	276	83.6

It appears from the table that only plant protein and carbohydrate were significantly negatively correlated with the Hb (gm/dl) (p=0.020 and 0.046 respectively). The means intake of total energy calories, plant protein, carbohydrate, iron plant was significantly higher among normal school children than among anemic children.

Table (4) shows no significant correlation between all the epidemiological and nutritional variables included in the table and the Hb (gm/dl). The study revealed that the overall prevalence of IDA among secondary school students was 51.8%. Rural school children had about half the risk of developing anemia than urban students. This difference is statistically significant (cOR =.575 (.371, .891), X2MH= 5.629, p = 0.018). Concerning scholastic achievement, table (5) shows that the anemic group had more than four and half times less scholastic achievements than the normal group, (cOR = 4.695 (2.890, 7.628), X2MH= 39.897, p = .000).

Studying the variables related to prevalence of anemia among secondary school students simultaneously in a logistic regression model, with a model significance of 0.000 and an accuracy of the data of 75.5%, only those who were infected with parasites had a higher significant risk. Plant protein had a protective effect compared to relevant categories. The area under the curve (AUC) was estimated for ROC curves. The variables in the model had an 83% discrimination power for the occurrence of no anemia and a probability of anemia of 17% among secondary school students (Table 6 and figure 1).

Table (2): Anemia and parasites among secondary students (El-Kharga, 2014)

Parasites	Anemia		Total
	Anemia	Normal	
Positive	86 98.9%	1 1.1%	87 100.0%
Negative	85 35.0%	158 65.0%	243 100.0%
Total	171 51.8%	159 48.2%	330 100.0%

cOR = 159.859 (21.877, 7.628), X^2MH= 101.826, p = .000

Table (3): Correlation of food analysis components with Hb percent (El-Kharga 2014)

Variable		Hb(gm/dl)
Energy (kcal)	Pearson Correlation (r)	-.079-
	P	.154
Total protein (gm)	Pearson Correlation (r)	-.067-
	P	.222
Animal protein (gm)	Pearson Correlation (r)	-.003-
	P	.951
Plant protein (mg)	Pearson Correlation (r)	-.128-*
	P	.020
Total fat (gm)	Pearson Correlation (r)	.025
	P	.645
Animal fat (mg)	Pearson Correlation (r)	-.013-
	P	.814
Plant fat (mg)	Pearson Correlation (r)	.043
	P	.436
CHO (gm)	Pearson Correlation (r)	-.110-*
	P	.046
Total iron (mg)	Pearson Correlation (r)	-.070-
	P	.205
Animal iron (mg)	Pearson Correlation (r)	.027
	P	.623
Plant iron (mg)	Pearson Correlation (r)	-.097-
	P	.080
Vitamin B6 (mg)	Pearson Correlation (r)	.032
	P	.568
Vitamin C (mg)	Pearson Correlation (r)	-.031-
	P	.571

* $p < 0.05$ (significant)

Table (4): Correlation of some epidemiological and nutritional variables with Hb (gm/dl) (El-Kharga, 2014)

Variable	Hb (gm/dl)	
Age	Pearson Correlation (r)	-.035-
	P	.529
Income	Pearson Correlation (r)	-.083-
	P	.131
No. of practicing physical activity per week	Pearson Correlation (r)	.102
	P	.065
Time of drinking tea in relation to meal	Pearson Correlation (r)	.017
	P	.761
Age of starting the habit of drinking tea	Pearson Correlation (r)	.010
	P	.857
Timing of drinking coffee in relation to meal	Pearson Correlation (r)	-.088-
	P	.110
Duration of menstruation	Pearson Correlation (r)	.013
	P	.852
Amount number of towels day	Pearson Correlation (r)	-.016-
	P	.809
BMI	Pearson Correlation (r)	.013
	P	.820

Table (5): Relation between scholastic achievement and anemia (El-Kharga, 2014)

Education	Scholastic achievement		
	Poor, pass and good	Very good and excellent	Total
Anemic	136	35	171
	79.5%	20.5%	100.0%
Normal	72	87	159
	45.3%	54.7%	100.0%
Total	208	122	330
	63.0%	37.0%	100.0%

cOR = 4.695 (2.890, 7.628), X2MH= 39.897, P = .000

Table (6): Logistic regression analysis of anemia among secondary school children (El-Kharga, 2014)

Variable	B	S.E.	Sig.	Exp(B)	95% C.I. for EXP(B)	
					Lower	Upper
Parasite	5.166	1.030	.000	175.243	23.279	1319.208
Residence	-.407-	.278	.143	.666	.386	1.148
Energy (kcal)	.001	.001	.328	1.001	.999	1.002
Plant protein (mg)	-.035-	.016	.036	.966	.935	.998
CHO (gm)	.000	.004	.981	1.000	.993	1.007
Animal iron (mg)	.062	.050	.210	1.064	.965	1.174
Constant	-8.910-	2.134	.000	.000		

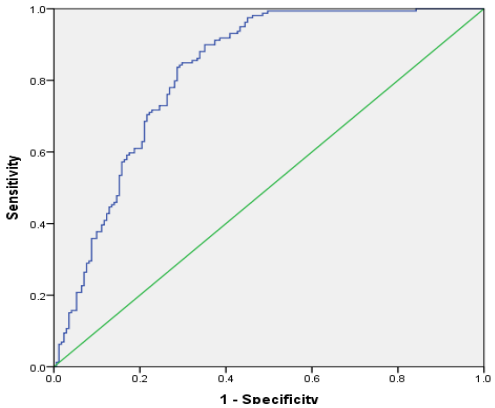

Figure (1): ROC Curve analysis of probability of no anemia calculated from binary logistic model

DISCUSSION

Anemia is the commonest nutritional problem all over the world. It affects about one third of the world population. [19,20] Results of the present study revealed that the overall prevalence of anemia among secondary school students was 51.8%. This result is in accordance with findings of a survey conducted in 1997 which found that 47% of adolescent girls and boys, which constitute 22% of the Egyptian population, are anemic. [21] The results of an Egyptian Demographic and Health Survey conducted in 2010 showed that 30% of adolescents were anemic. Results of these studies indicate that anemia represents a public health problem among adolescents in Egypt.[22]

The high prevalence of anemia in the present study may be attributed to the lack of nutritional awareness of both families and adolescents about the increased nutritional requirements of this vulnerable group. Low socioeconomic status, poor dietary habits as drinking tea with or immediately after meals and parasites are also contributing factors. A number of cross sectional studies conducted in the gulf area showed that the prevalence of anemia ranged from 40 to 45%.[1] Results of the present study are in the line with that of a study done in Saudi Arabia where the overall country prevalence of anemia among school students was 55.1%.[1] The prevalence among Palestinian school students was between 40- 67%.[1] On the other hand, the prevalence estimated in the present study is lower than of a multicenter study conducted in the Syria which revealed a prevalence of 73.0% [1] and another study done in Oman, where the prevalence was 78.0%.[1] The discrepancy between the results of the present study and the previous two studies may be due to differences in the studied age groups. The peak age for anemia among adolescents was 16-18 years (about 70% of cases). This may be explained by the fact that this age coincides with adolescents' growth spurt in both males and females.[23,24] The prevalence of anemia was higher among females (66.7%) than among males (33.3%) as a result of menstrual blood loss. Also the RDA of iron for females was 15 mg/day during adolescence while it was 12 mg/day for males.[25,26]

Results of the present study were similar to results of a study conducted among school children in Alexandria which found that the highest animal protein intake was consumed by children from high socioeconomic level.[27] The same result was also found among female adolescents in Saudi Arabia. The mean protein intake of adolescents from the lowest class was 154.1% compared to 181.3% among those from the highest one. The higher figures of protein intake in the Saudi study may be attributed to their affluent socioeconomic level.[28] Regarding scholastic achievement, results of the present study showed that the anemic group had more than four and half times less scholastic achievements than the normal group. Studies in Indonesia, Thailand and India revealed similar results. It was found that anemia in adolescence was associated with poor performance in academic tests, and that iron supplementation of anemic children over a period of 3 months or longer resulted in significant improvement of performance.[29] Parasitic infections lead to different forms of malnutrition.[30] They are an important contributing factor for the development of anemia.[31] Results of stool examination indicated that 98.9% of adolescents infected with parasites were anemic. A study done in government primary schools in the Eastern region of Alexandria showed a prevalence of intestinal parasitic infections of 31.5% among enrolled school children aged 6-13 years.[32] This prevalence is near the prevalence in the present study (26.3%) and this may be attributed to low socioeconomic class of students. A study among Ras Gharb school students in Alexandria showed that the overall prevalence of parasites in three grades was 33 %.[33,34] This discrepancy between the parasitic prevalence rates may be attributed to the accessibility of health services.

CONCLUSION AND RECOMMENDATIONS

The prevalence of anemia among school adolescents in El-Kharga was 51.8% which indicates a public health problem based on the WHO epidemiological criteria for diagnosis of anemia. Infection with parasites, total energy calories, plant protein, total carbohydrate and iron from plant origin were significantly higher among anemic school students than among normal students. The logistic regression model showed that only those who were infected with parasites had a higher significant risk of anemia and plant protein had a protective effect compared to relevant categories. Anemic students had more than four and half times less scholastic achievements than the normal students.

It is recommended to give supplementation with medical iron, especially to adolescent girls to build up iron stores before pregnancy, to fortify food with iron, increase iron intake through nutritional educational programs at schools, increase consumption of food rich in vitamin C together with food containing iron of non haem origin, avoid drinking tea with or shortly after meals.

Conflict of Interest

All authors declare no conflict of interest.

REFERENCES

1- World Health Organization. Worldwide prevalence of anaemia 1993-2005. WHO Global Database on Anaemia. Geneva: WHO; 2008. p. 4.

2-
3- Rammohan N, Awofeso C, Robitaille M. Addressing female iron deficiency anaemia in India: Is vegetarianism the major obstacle? ISRN. 2012; 5: 1-8.
4- World Health Organization. Iron deficiency anemia in adolescents. Geneva: WHO; 2011. 25p.
5- Chaparro C. Essential delivery care practices for maternal and newborn health and nutrition. Informational Bulletin. Washington DC: Pan American Health Organization: 2007. 4p.
6- George J, Yiannakis M, Main B, Devenish R, Anderson C, Gibson, RS, et al. Genetic hemoglobin disorders, infection, and deficiencies of iron and vitamin A determine anemia in young Cambodian children. J Nutr. 2012; 142:781-7.
7- World Health Organization. Global data base of anemia; Egypt: African region: WHO; 2014. 19p.
8- Nahla K. An epidemiologic study of nutritional anemia among school adolescents in Alexandria. High Institute of Public Health: Egypt; 1996. 194p.
9- Kirwan P, Asaolu SO, Molloy SF, Abiona TC, Jackson AL, Holland CV. Successful adolescent growth and development. BMC Infect Dis. 2009; 9:20.
10- Heitmann BL, Milman N, Hansen GL. Relationship between dietary iron intake corrected for diet reporting error and the serum ferritin. 2010; 75(6): 905-13.
11- Brabin L, Brabin BJ. The cost of successful adolescent growth and development in girls in relation to iron and vitamin A status. Am J Clin Nut. 2009; 55: 955-8.
12- Stephenson LS. Possible new development in community control of iron deficiency. Nutrition Review. 2008; 53:(2): 23-9.
13- Edgerton VR, Gardner GW, Ohira Y, Gunawardena KA, Senewiratne B. Iron deficiency anemia and its effect on worker productivity and activity patterns. Br J Nut. 2010; 2:1546-9.
14- World Health Organization. Serum ferritin concentrations for the assessment of iron status and iron deficiency in populations. Vitamin and Mineral Nutrition Information System. Geneva: WHO; 2011. 15p.
15- National Nutrition Institute. Food Composition Tables for Egypt. Cairo ARE, 2nd ed., 2006.
16- National Research Council. Recommended daily allowances: 10th edition. National Research Council: Washington D.C, National Academies Press; 1989.
17- U.S. Department of Health and Human Service, National Institute of Health, National Heart Lung and Blood Institute. Your guide to anemia: anemia healthy lifestyle changes, prevent, treat, control. New York: U.S. Department of Health and Human Service. 2011 Sep. 56 p.
18- World Health Organization. Use of multiple micronutrient powders for home fortification of foods consumed by pregnant women. Geneva: WHO; 2011. 24p.
19- Peña-Rosas JP, Viteri FE. Effects and safety of preventive oral iron or iron and folic acid supplementation for women during pregnancy. Cochrane Database of Systematic Reviews. 2009;(4):736.
20- Cook ID, Skikne BS, Lynch SR, Reusser ME. Estimates of iron sufficiency in US population. Blood. 2008; 68(3):726-31.
21- Population Council: Adolescence and social change: Health status, Educational achievement, economic roles and socialization of adolescents in Egypt. Population council, HIPH Alexandria University, American University and Assuit University,1998.
22- World Health Organization. Regional strategy on nutrition. Geneva: WHO; 2010. 34p.
23- Qaseem A, Humphrey LL, Fitterman Nl. Treatment of anemia in patients with heart disease: a clinical practice guideline from the American College of Physicians. Ann Intern Med. 2013;159(11):770-9.
24- World Health Organization. Preventative chemotherapy in human helminthiasis. Coordinated use of antihelminthic drugs in control interventions: A manual for health professionals and program managers. Geneva: WHO;2006.
25- Gera T, Sachdev HP, Nestel P. Effect of iron supplementation on haemoglobin response in children: Systematic review of randomised controlled trials. J Pediatr Gastroenterology Nutr. 2007;44(4):468-86.
26- Tolentino K, Friedman JF. An update on anemia in less developed countries. American Journal of Tropical Medicine and Hygiene, 2007;77(1):44-51.
27- Curtale F, Nabil M, El Wakeel A, Shamy MY. Anemia and intestinal parasitic infections among school age children in Behera Governorate, Egypt. J Trop Pediatrics. 1998; 44(6): 39.
28- Onken JE, Bregman DB, Harrington RA, Morris D, Buerkert J, Hamerski D, et al. Ferric carboxymaltose in patients with iron-deficiency anemia and impaired renal function: the REPAIR-IDA trial. Nephrol Dial Transplant. 2013.
29- Abalkhail B, Shawky S. Prevalence of daily breakfast intake, iron deficiency anemia and awareness of being anemic among Saudi school students. Int J Food Sci Nutr. 2002;53(6):519–28.
30- Administrative Committee on Co-ordination /Sub Committee on Nutrition (United States). Controlling iron deficiency. Nutrition policy discussion paper. Geneva: ACC/SCN. 2005. 12p.
31- Tolentino K, Friedman JF. An update of anemia in less developed countries. American Journal of Tropical Medicine and Hygiene. 2007; 77(1): 44-51.
32- Thankachan P, Muthayya S, Walczyk T, Kurpad AV, Hurrell RF. An analysis of the etiology of anemia and iron deficiency in young women of low socioeconomic status. Food Nutr Bull. 2007; 28(3): 328-36.
33- Bakr IM, Arafa MA, Mostafa MH, Mohamed MK. Prevalence of intestinal parasitosis in a rural population in Egypt, and its relation to sociodemographic characteristics . J Egypt Soc Parasitol. 2009; 39: 371-81.
34- Curtale F, Abdel-Fattah M, El-Shazly M, Shamy MY, El-Sahn F. Anaemia among young male workers in Alexandria. Eastern Mediterranean Health Journal. 2004; 7(6): 955.
35- El Sahn FF, El-Masry AG, El-Sahn AA. Anemia, parasitic infections and some risk factors among physical education female students in Alexandria. J Egypt Public Health Assoc. 2003; 78 (3-4): 191-207.