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Iron Deficiency Anemia and Associated Risk Factors among Teenagers in Najran, Saudi Arabia

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ABSTRACT

Background: *Anemia is a major health problem throughout the world, among teenagers it is considered as a critical global health problem.* ***Objective:*** *The main objective of this study was to assess the prevalence of iron deficiency anemia besides exploring the associated risk factors among the selected subjects.* ***Methodology:*** *It is a community-based cross-sectional survey that was carried out in Najran city during the period from April 2018 to December 2018. By adopting a convenient sampling technique, 240 subjects that aged 13-19 years old had been recruited to participate. Additionally, a blood sample was taken and analyzed for hemoglobin, mean corpuscular volume, mean corpuscular hemoglobin concentration, iron and ferritin levels.* ***Results:*** *The mean age of the study sample was 14.1 (± 3.4). The overall prevalence of anemia among teenagers in Najran was 22.5% with mean Hb value of 9.4 (± 1.36) g/dl, MCV mean value of 68 (± 9.11) fl and serum iron mean value of 13.7 (± 6.5) U/L. Among anemic subjects 3 (5.6%), 17 (31.5%) and 34 (63%) had severe, moderate and mild anemia respectively. More than 68% (n=164) of them don't consume red meat frequently and was not significantly associated with anemia (p>0.05). Additionally, frequent eating of vegetables, frequent eating of white meat and drinking tea or coffee were also found not to be significantly associated with anemia (OR=1.19, 0.83-1.73; OR=0.72, 0.47-1.12, and OR=1.32, 0.89-1.98) with p>0.05 respectively.* ***Conclusion:*** *Anemia is a moderate health problem in the current study area. Interventional health education programs should be conducted in schools, universities or at youth clubs to highlight the risk factors of anemia as well as to encourage the intake of miscellaneous diets which include iron-rich foods and fruits that contain vitamin C that enhances iron absorption.*

Keywords: Iron deficiency anemia, Teenagers, Hemoglobin, Risk factors

INTRODUCTION

Iron is an essential part of the hemoglobin, myoglobin and other various enzymes. Its deficiency leads mainly to anemia [1]. Iron is recognized as an essential nutrient that is required for oxygen transport, energy production and metabolism of many bioactive compounds in all living organisms [2].

Dietary iron exists into 2 forms, either haem which is found almost exclusively in meat, or in form of non-haem which is found in cereals, beans, pulses, dried fruits and dark leafy vegetables [3]. Haem-iron is generally well absorbed in the intestines, while non-haem iron is absorbed according to our iron needs. Iron absorption may be enhanced by the presence of vitamin C and may be inhibited by phytates, Grape seed extract (GSE) and phenolic compounds [4]. However, numerous studies have found that these compounds do not appear to have a large effect on iron status in the population as a whole [5,6]. Therefore if dietary intake of iron is low, there is an increased risk of developing iron deficiency anemia. Iron deficiency anemia is a global nutritional problem that mainly affects infants, children, adolescents and women of childbearing age [2,7,8].

Unfortunately, despite all efforts throughout the world, Iron deficiency anemia (IDA) continues to be one of the

major and critical public health problems globally, affecting both developing and developed countries, it affects approximately a third of the world's population, 50% of them are due to iron deficiency with adverse effects and major consequences for human physical as well as social, intellectual, psychological and economic development. In females, the highest prevalence of iron deficiency anemia is between 12-15 years old when requirements are at a peak [9,10].

The most frequent cause of iron deficiency anemia among girls is loss of iron in blood due to menstruation, poor dietary habits or due to certain intestinal infections [11]. World Health Organization (WHO) reported that the global prevalence of anemia among adolescent girls is 27% in developing countries and 6% in developed countries [12]. This fact is not far from that in Saudi Arabia, in which the overall country prevalence of iron deficiency anemia was 30% to 56% [13]. Additionally, a study conducted in Riyadh city among female adolescents reported that the prevalence of anemia was 40.5% [14].

Iron deficiency anemia has many etiologies, but the primary causes are impairment of iron absorption in the gut, loss of blood or hemorrhage and parasitic diseases which cause blood loss and contribute to the cause [15]. Camaschella highlighted that iron is crucial to biological functions in terms of respiration, energy production, DNA synthesis and cell proliferation [16].

Given the importance of this pathology in the world, numerous countries conduct interventions to reduce anemia, particularly in the most susceptible population to its devastating effects [17-19]. Therefore, the current study is aiming to determine the prevalence of anemia among teenagers aged 13-19 years old in Najran, Saudi Arabia.

MATERIALS AND METHODS

It was a community-based cross-sectional survey that was carried out in Najran city during the period from April 2018 to November 2018. By adopting a convenience sampling technique, 240 female teenage subjects that aged 13-19 years old had been recruited to participate in the current study to determine the prevalence of iron deficiency anemia along with the associated risk factors. The principal method for data collection was a pretested questionnaire besides interviews and blood samples that had been taken from the selected subjects and analyzed by a licensed and experienced female laboratory specialist. The necessary safety measures were considered during blood collection.

Sample Collection and Laboratory Analysis

About 4 ml of venous blood was collected from the selected participants by using a vacutainer from which 2 ml had been poured into a purple-tip tube which contains EDTA (Ethylene diamine tetraacetic acid) and the other 2 ml had been poured into a plain yellow-tip tube. The blood samples were transported directly to the MCH laboratory.

The hemoglobin (Hb), Mean Corpuscular Volume (MCV) and Mean corpuscular hemoglobin concentration (MCHC) were determined by automatic hematological analyzer model Sysmex Xn-1000. On the other hand, the yellow-tip plain tube that was not containing anticoagulant had been put into a centrifuge for separation of serum from the blood. After separation, the serum was collected and had been put into special cub in analyzer (Coulter DXC 600) for determining the iron and ferritin levels.

The WHO classification of anemia was used to characterize anemia in teenagers as Hb<11.5 g/dl. Therefore, the anemic cases were further divided into mild anemia (Hb>10 g/dl), moderate anemia (Hb ranged between 7-10 g/dl) and severe anemia <7 g/dl [20]. Iron deficiency anemia was defined as anemia with serum ferritin levels below 12 μg/L [16].

Subjects were classified as iron deficiency anemia when both hemoglobin and serum ferritin were low. Additionally, the low MCV and with abnormal small and pale red blood cells (RBCs) is microcytic anemia and considered iron deficiency anemia.

Statistical Analysis

The data was entered and analyzed using SPSS version 21.0 statistical software. Odds ratio (OR) with their 95% confidence level (CI) were calculated. Descriptive statistics of continuous variables were expressed as Mean ± Standard Deviation (± SD), $p<0.05$ was considered as statistically significant.

Ethical Consideration

Oral informed consent was obtained from the participants as well as from guardians/parents of the participated subjects besides describing the process and benefits of the study. Furthermore, confidentiality was maintained.

RESULTS

A total of 240 teenage girls participated in the current study. The mean age for them was 14.1 (± 3.4) years that ranged between 13-19 years old. The overall prevalence of anemia in the current study was 22.5% with mean Hb-value of 9.4 (± 1.36) g/dl. Among anemic cases, 3 (5.6%), 17 (31.5%) and 34 (63%) have severe, moderate and mild anemia respectively (Figure 1).

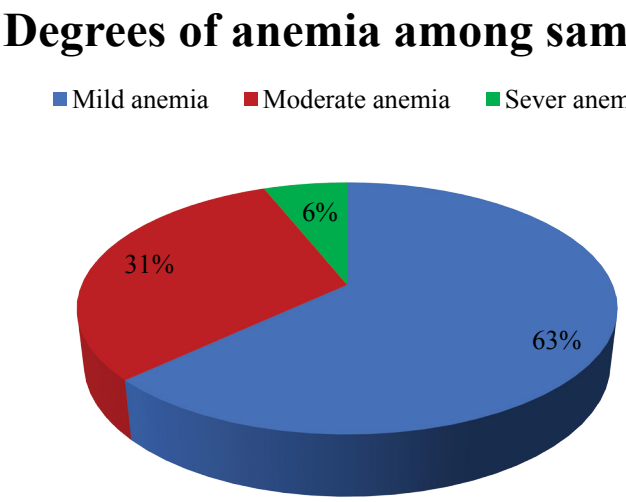

Figure 1 Displays the degrees of anemia among the sample (n=240)

Surprisingly, more than 68% (n=164) of the selected sample don't consume red meat frequently. Regarding the educational status of subjects' parents, the majority of both parents have a secondary school education, (42.9%) for fathers and (55.8%) for mothers, respectively. In terms of their families' monthly income, 98 (40.8%) have monthly income ranged between 5001-10000 Saudi Riyal. In regard to the subjects' mother's employment status, the results show that the majority of them were unemployed (59.2%). As shown in Table 1, the participants' age, family income as well as mothers' employment status were found not significantly associated with anemia among the selected sample ($p>0.05$) and (CI=1.11-2.04, 2.95-12.16 and 0.28-2.87) respectively. As displayed in Tables 1 and 2 parents' educational level, frequent intake of milk/milk products, as well as frequent drinking of soda drinks, were found to be significantly associated with anemia ($p<0.05$) and (OR=1.52, 1.06-2.16; 155, 1.07-2.25) respectively. On the other hand, frequent eating of red or white meat, frequent intake of vegetables and fruits besides frequent drinking of tea or coffee were not found to be significantly associated with anemia ($p>0.05$).

Table 1 Bivariate analysis of sociodemographic characteristics and iron deficiency anemia among the sample (n=240)

Variable		Total	Iron deficiency anemia		p-value	OR (95%CI)
		(n=240) n (%)	Yes (n=54) (22.5%)	No (n=186) (77.5%)		
Age	13-15	132 (55%)	26 (10.8%)	106 (44.2%)	0.06	1.62 (1.11- 2.04)
	16-19	108 (45%)	28 (11.7%)	80 (33.3%)		1
Family monthly income in SR	≤ 5000 SR	49 (20.4%)	13 (5.4%)	36 (15%)	0.09	1.7 (2.95-12.16)
	5001-10000 SR	98 (40.8%)	24 (10%)	74 (30.8%)		5.1 (2.82-7.61)
	≥ 10001 SR	93 (38.8%)	17 (7.1%)	76 (31.7%)		1
Father's educational level	Illiterate	19 (7.9%)	10 (4.17%)	9 (3.75%)	0.001*	1.7 (1.81-3.97)
	Primary/ intermediate	87 (36.3%)	24 (10%)	63 (26.25%)		1.88 (1.19-2.93)
	Secondary	103 (42.9%)	16 (6.67%)	87 (36.25%)		2.5 (1.58, 4.01)
	University or higher	31 (12.9%)	4 (1.67%)	27 (11.25%)		1

Mother's educational level	Illiterate	8 (3.3%)	5 (2.08%)	3 (1.25%)	0.012*	2.01 (0.79, 4.29)
	Primary/ intermediate	62 (25.8%)	26 (10.83%)	36 (15%)		2.44 (1.19-3.98)
	Secondary	134 (55.8%)	13 (5.42%)	121 (50.4%)		2.16 (1.04-5.47)
	University or higher	36 (15%)	10 (4.17%)	26 (10.83%)		1
Mother's employment status	Employee	98 (40.8%)	11 (4.58%)	87 (36.25%)	0.52	0.73 (0.28-2.87)
	None/House wife	142 (59.2%)	43 (17.92%)	99 (41.25%)		0.62 (0.43-3.58)

Table 2 Dietary factors and anemia among subjects

Type of consumed food (≥ 3 times/week)	Intake (Yes/No)	Iron deficiency anemia status		Odds Ratio (OR)	95% (CI)	p-value
		Anemic n=54 (22.5%)	Healthy n=186 (77.5%)			
Frequent eating of red meat	Yes	21 (8.75%)	55 (22.9%)	0.8	0.56-1.04	0.11
	No	33 (13.75%)	131 (54.6%)			
Frequent eating of vegetable and fruits	Yes	18 (7.5%)	119 (49.58%)	1.19	0.83-1.73	0.13
	No	36 (15%)	67 (27.92%)			
Frequent eating of white meat	Yes	34 (14.17%)	153 (63.75%)	0.72	0.47-1.12	0.2
	No	20 (8.33%)	33 (13.75%)			
Frequent drinking of milk and/milk products	Yes	36 (15%)	160 (66.67%)	1.52	1.06-2.16	0.01*
	No	18 (7.5%)	24 (10.83%)			
Frequent drinking of soda drinks	Yes	41 (17.08%)	109 (45.42%)	1.55	1.07-2.25	0.002*
	No	13 (5.42%)	77 (32.08%)			
Frequent drinking of Tea and/coffee	Yes	14 (5.83%)	68 (28.33%)	1.32	0.89-1.98	0.15
	No	40 (16.67%)	118 (49.17%)			

Table 3 shows the hematological parameters for the studied subjects, in which the mean hemoglobin value was 9.4 (± 1.36) g/dl, whereas the mean serum ferritin, as well as mean serum iron, were 6.89 (± 3.6) µg/dl and 13.7 (± 6.5) µg/dl respectively.

Table 3 Hematological parameters

Parameters	Mean	± Standard deviation
Hemoglobin (g/dL)	9.40	1.36
Mean Corpuscular Volume (MCV-fl)	68.00	9.11
Mean Corpuscular Hemoglobin Concentration (MCHC%)	19.16	3.49
Serum iron (U/dL)	13.70	6.50
Serum ferritin (µg/dl)	6.89	3.60

DISCUSSION

Iron deficiency anemia is a widespread and common nutritional disorder globally. In spite of all efforts to decrease this problem, its prevalence varies in various parts of the world. The prevalence of anemia in the current study was 22.5%, which indicates a moderate health problem. This obtained result is much lower than what is shown in numerous similar studies that were conducted internationally, nationally as well as regionally. For instance, Zahra, et al., estimated the prevalence of iron deficiency anemia (IDA) in Iran was 53.6% [21]. While Stoltzfus reported that the prevalence of IDA in Africa was 60%, Latin America (46%), Eastern Mediterranean (63%), Southeast Asia I (49%), Southeast Asia II (66%) [2]. Additionally, a high prevalence of IDA was also reported in Tanzania (79.6%), Kenya (35.3%) and Nigeria (82.6%) respectively [5,21,22].

Inversely, the prevalence of anemia in the current study is higher than concluded in some studies which reported in different countries such as that conducted in Egypt (12%), Morocco (12.2%) and in Turkey (5.4%) respectively [15,23,24].

Although the finding in the present study is in harmony with the WHO worldwide report that concluded a prevalence of 25.4% for IDA among school children globally [6]. Moreover, it goes with a study that was conducted by El-Hazmi and Warsy who reported the overall prevalence of anemia in Saudis was 24.8% [25]. And similar to findings of a study conducted in Jeddah that reported a prevalence of 23% among the studied sample [26]. Additionally, Al-Othaimeen, et al., found that the prevalence of anemia in Riyadh was 26.3% [27]. Furthermore, this result is not away from what was obtained from Jeddah by Abalkhail and Shawky who reported that 20.5% of their assessed subjects were anemic [28].

The differences in the prevalence of IDA in these regions could be due to differences in the study areas, cultural variations, sample sizes, lifestyles, socio-economic, dietary habits and other pathological or genetic factors. In the present study, a significant association was found between iron deficiency anemia and frequent intake of soda drinks and milk/milk products which contain calcium that inhibits iron absorption. This concluded result is inconsistent with what was reported by Ashry, et al., in their study in Riyadh [29].

Surprisingly, the average monthly income in the current study was not significantly associated with anemia. Although, numerous studies indicated that there is indeed a strong and significant association between family income and iron deficiency anemia. They argue that low income often correlates with limited access to a variety of food and thus results in anemia [5,30-32]. Moreover, the present study revealed that the mothers' level of education was significantly associated with anemia and is considered one of the important determinants of anemia. As lack of knowledge for good dietary practices may affect children's nutritional status negatively. In line with this finding, El-Hioui, et al., Choi, et al., Al-Zain, Djokic, et al., Jemal, et al., Osazuwa and Ehigie reported that mothers' educational level is an important determinant of anemia [11,19,33-36].

Frequent drinking of tea in the current study was not found associated significantly with anemia among subjects. On the same line, Temme and Van Hoydonck concluded that tea consumption does not influence iron status in Western countries in which people have adequate iron stores [37]. While in contrast, Zijp, et al., and Coutinho, et al., argue that tannic acid and polyphenol which were found in tea used to inhibit the absorption of iron and thus results in anemia [38,39].

CONCLUSION AND RECOMMENDATION

Iron deficiency anemia is a moderate health problem that affects teenagers. Correction of iron deficiency at this age group enhances their learning potential, increases their fitness and work capacity later. Therefore, health education to the community about balanced animal and plant food consumption are recommended strategies to reduce the burden of anemia. Moreover, health education programs and sustainable interventions should be implemented in schools to highlight the risk factors of anemia as well as to encourage the intake of diverse diets including iron-rich foods and fruits which contain vitamin C that enhances iron absorption. Further longitudinal studies with long term follow-up are needed.

Limitation of this Study

This study has some limitations, first of all, it was done based on cross-sectional data and accordingly, the cause-effect relationship was not determined. Moreover, the current study lacks detailed investigations in terms of vitamin B12 and folic acid deficiencies from anemia due to iron-deficiency. Additionally, stool tests were not done to diagnose intestinal parasitic infection that may contribute to anemia.

DECLARATIONS

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

[1] Soleimani, Nader. "Relationship between anemia, caused from the iron deficiency, and academic achievement among third-grade high school female students." *Procedia-Social and Behavioral Sciences,* Vol. 29, 2011, pp. 1877-84.

[2] Stoltzfus, Rebecca J. "Iron deficiency: global prevalence and consequences." *Food and Nutrition Bulletin,* Vol. 24, No. 4, 2003, pp. 99-103.

[3] Lee, R., and V. Herbert. "Clinical hematology: Nutritional factors in the production and function of erythrocytes." 1999, pp. 228-66.

[4] Ma, Qianyi, et al. "Bioactive dietary polyphenols inhibit heme iron absorption in a dose-dependent manner in human intestinal Caco-2 cells." *Journal of Food Science,* Vol. 76, No. 5, 2011, pp. 143-50.

[5] Onimawo, I. A., et al. "Assessment of anemia and iron status of school-age children (aged 7-12 years) in rural

communities of Abia state, Nigeria." *African Journal of Food, Agriculture, Nutrition and Development,* Vol. 10, No. 5, 2010.

[6] De Benoist, Bruno, et al. "Worldwide prevalence of anemia 1993-2005; WHO Global Database of anemia." 2008.

[7] Kumari, Rekha, et al. "Prevalence of iron deficiency and iron deficiency anemia in adolescent girls in a tertiary care hospital." *Journal of Clinical and Diagnostic Research,* Vol. 11, No. 8, 2017.

[8] Lopez, Anthony, et al. "Iron deficiency anemia." *The Lancet,* Vol. 387, No. 10021, 2016, pp. 907-16.

[9] Durrani A. Prevalence of anemia in adolescents: A challenges to the global health. Vol. 2, No. 4, 2018, pp. 24-27.

[10] World Health Organization. Regional Office for South-East Asia. 2011. http://www.who.int/iris/handle/10665/205656.

[11] Al-Zain, Bassam F. "Impact of socioeconomic conditions and parasitic infection on hemoglobin level among children in Um-Unnasser Village, Gaza Strip." *Turkish Journal of Medical Sciences,* Vol. 39, No. 1, 2009, pp. 53-58.

[12] Melwani, Veena, et al. "A study to assess the prevalence of anemia amongst adolescent girls residing in selected slum of Bhopal city." *International Journal of Community Medicine and Public Health,* Vol. 5, No. 3, 2018, pp. 1096-99.

[13] Al-Quaiz, Joharah M. "Iron deficiency anemia. A study of risk factors." *Saudi Medical Journal,* Vol. 22, No. 6, 2001, pp. 490-96.

[14] Al Hassan, Nora Nasir. "The prevalence of iron deficiency anemia in Saudi University female students." *Journal of Microscopy and Ultrastructure,* Vol. 3, No. 1, 2015, pp. 25-28.

[15] Koc, A., et al. "The frequency and etiology of anemia among children 6-16 years of age in the southeast region of Turkey." *The Turkish Journal of Pediatrics,* Vol. 42, No. 2, 2000, pp. 91-95.

[16] Camaschella, Clara. "Iron-deficiency anemia." *New England Journal of Medicine,* Vol. 372, No. 19, 2015, pp. 1832-43.

[17] Hop, Le Thi. "Programs to improve production and consumption of animal source foods and malnutrition in Vietnam." *The Journal of Nutrition,* Vol. 133, No. 11, 2003, pp. 4006-09.

[18] Stang, J, and Story, M. *Leadership, education and training program in maternal and child nutrition: Guidelines for adolescent nutrition services, Canada: Minnesota University*. http://www.epi.umn.edu/let/pubs/adol.

[19] Choi, Hyeon-Jeong, et al. "Effects of maternal education on diet, anemia, and iron deficiency in Korean school-aged children." *BMC Public Health,* Vol. 11, No. 1, 2011, p. 870.

[20] Abedini, Zahra, Maryam Mousavi Lotfi, and Fariba Parvizi. "Prevalence of iron deficiency anemia and its related factors in school-age children." *Pajoohandeh Journal,* Vol. 15, No. 5, 2010, pp. 208-12.

[21] Tatala, S. R., et al. "Risk factors for anemia in schoolchildren in Tanga Region, Tanzania." *Tanzania Journal of Health Research,* Vol. 10, No. 4, 2008.

[22] Pullan, Rachel L., et al. "Estimating the relative contribution of parasitic infections and nutrition for anemia among school-aged children in Kenya: A subnational geostatistical analysis." *BMJ Open,* Vol. 3, No. 2, 2013, p. e001936.

[23] Barduagni, P., et al. "Anaemia among school children in Qena Governorate, Upper Egypt." *East Mediterranean Health Journal*, Vol. 10, No. 6, 2004, pp. 917-19.

[24] El-Hioui, Mohamed, et al. "Iron deficiency and anemia in rural school children in a coastal area of Morocco." *Pakistani Journal of Nutrition,* Vol. 7, 2008, pp. 400-03.

[25] El-Hazmi, Mohsen Ali Faris, and Arjumand Sultan Warsy. "The pattern for common anemia among Saudi children." *Journal of Tropical Pediatrics,* Vol. 45, No. 4, 1999, pp. 221-25.

[26] Gari, Mamdooh A. "Prevalence of iron deficiency anemia among female elementary school children in Northern Jeddah, Saudi Arabia." *Journal of King Abdulaziz University-Medical Sciences,* Vol. 15, No. 1, 2008, pp. 63-75.

[27] Al-Othaimeen, Ali Karrar Osman, Sadaa Al Orf, Abdulaziz. "Prevalence of nutritional anemia among primary school girls in Riyadh City, Saudi Arabia." *International Journal of Food Sciences and Nutrition,* Vol. 50, No. 4, 1999, pp. 237-43.

[28] Abalkhail, Bahaa, and Sherine Shawky. "Prevalence of daily breakfast intake, iron deficiency anemia and awareness of being anemic among Saudi school students." *International Journal of Food Sciences and Nutrition,* Vol. 53, No. 6, 2002, pp. 519-28.

[29] Gad, Ashry, et al. "Anemia among primary school children (5-12 years) in Riyadh Region, Saudi Arabia: A community-based study." *Canadian Journal of Clinical Nutrition*, 2013.

[30] Leenstra, Tjalling, et al. "Prevalence and severity of anemia and iron deficiency: Cross-sectional studies in adolescent schoolgirls in western Kenya." *European Journal of Clinical Nutrition,* Vol. 58, No. 4, 2004, p. 681.

[31] Skalicky, Anne, et al. "Child food insecurity and iron deficiency anemia in low-income infants and toddlers in the United States." *Maternal and Child Health Journal,* Vol. 10, No. 2, 2006, p. 177.

[32] Allen, Lindsay H. "Interventions for micronutrient deficiency control in developing countries: Past, present, and future." *The Journal of Nutrition,* Vol. 133, No. 11, 2003, pp. 3875-78.

[33] El Hioui, M., et al. "Risk factors of anemia among rural school children in Kenitra, Morocco." 2008.

[34] Djokic, D., et al. "Risk factors associated with anemia among Serbian school-age children 7-14 years old: results of the first national health survey." *Hippokratia,* Vol. 14, No. 4, 2010, p. 252.

[35] Haidar, Jemal A., and Rebecca S. Pobocik. "Iron deficiency anemia is not a rare problem among women of reproductive ages in Ethiopia: a community-based cross-sectional study." *BMC Hematology,* Vol. 9, No. 1, 2009, p. 7.

[36] Osazuwa, F., and F. Ehigie. "Prevalence of anemia in preschool and school-aged children in Nigeria." *Journal of New York Science,* Vol. 2, No. 20, 2010, pp. 212-13.

[37] Temme, E. H. M., and P. G. A. Van Hoydonck. "Tea consumption and iron status." *European Journal of Clinical Nutrition,* Vol. 56, No. 5, 2002, p. 379.

[38] Zijp, Itske M., Onno Korver, and Lilian BM Tijburg. "Effect of tea and other dietary factors on iron absorption." *Critical Reviews in Food Science and Nutrition,* Vol. 40, No. 5, 2000, pp. 371-98.

[39] Coutinho, Geraldo Gaspar Paes Leme, Eny Maria Goloni-Bertollo, and Érika Cristina Pavarino Bertelli. "Iron deficiency anemia in children: A challenge for public health and for society." *Sao Paulo Medical Journal,* Vol. 123, No. 2, 2005, pp. 88-92.