*L*ibyan *M*edical *J*ournal
https://lmj.ly/index.php/ojs/index

Original article

Prevalence of Iron Deficiency Anemia Among School Students in Tripoli, Libya

Khaled Elbaruni, Eman Abdulwahed*, Mawada Elmughrabi, Samah Abozoudah

Department of Medical Laboratories Sciences, Faculty of Medical Technology, Tripoli University, Tripoli-Libya.
***Correspondence**: E.Abdulwahed@uot.edu.ly*

Citation: *Elbaruni K, Abdulwahed E, Elmughrabi M, Abozoudah S, Prevalence of iron deficiency anemia among school students in Tripoli, Libya. Libyan Med J. 2024;16(2):74-80.*

***Received**: 23-06-2024*
***Accepted**: 09-08-2024*
***Published**: 13-08 -2024*

Copyright: *© 2024 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).*

***Funding**: This research received no external funding.*

***Conflicts** of Interest: The authors declare no conflict of interest.*

Abstract

The most prevalent nutritional problem in the world is iron deficiency anemia. It is a disorder where anemia develops because there is insufficient iron present to maintain normal red cell synthesis. During childhood Iron deficiency is the most prevalent hematologic disorder, it approximately affects 48% of the children aged between 5 and 14 years in developing countries. This study aimed to determine the prevalence of iron deficiency anemia among schoolchildren in Tripoli, Libya, ages 12 to 18 years. In addition to assessing students' behavior, and also looked at parents' levels of knowledge and awareness on the importance of iron for students' health. A cross-sectional study was conducted in 7 randomly selected preparatory and secondary schools in three different regions of Tripoli City-Libya. The number of students from each school in these regions were chosen according to the consent of student's parents or their guardian. A structured questionnaire design was distributed between student's parents to measure the level of awareness, knowledge, daily practices and health profile of the participants and their families. A total of 105 students aged between (12-18) years were enrolled in this study. Blood samples were collected and were used to estimate the level of hematological parameters such as, Hemoglobin, Mean Cell Volume, Mean Cell Hemoglobin, Serum iron and total iron binding capacity. The data was analyzed using Statistical Package for the Social Sciences software, version 26. Frequencies, proportions, and rates of the given data for each variable was calculated. The overall prevalence of iron deficiency anemia was 15.2%. The rate of iron deficiency anemia in females was higher than males (21.2% vs 5.1%), and was also higher in secondary schools than the preparatory schools (22.2% vs 4.8%). Poor knowledge regarding iron-rich nutrients and their absorption, as well as improper daily healthy practices that lead to iron deficiency anemia have generally been noted. Although iron deficiency anemia occurring in all age groups with various rates, it is more prevalent in secondary school females. Correction of iron deficiency anemia at this age group improves children's ability to study, increases their level of fitness and work capacity, and critically raises girls' chances of becoming safe mothers in the future. Therefore, health education programs should be implemented in schools to highlight the risk factors of anemia and to encourage the intake of diverse diets including iron-rich foods.

Keywords: *Iron deficiency Anemia, School Students, Tripoli-Libya.*

Introduction

Anemia is one of the most common health issues in both developing and developed countries, affecting approximately 1.62 billion people globally [1]. According to the World Health Organization (WHO), anemia is a condition that characterized by a decrease in the number of red blood cells or a decrease in hemoglobin (Hb) concentration in the blood, with Hb levels of < 12g/dl in women and < 13g/dl in men [2,3]. Because hemoglobin is necessary to carry oxygen, if there is insufficient, abnormal, or inadequate red blood cells, the blood's ability to provide oxygen to the body's tissues is impaired [4].

Iron deficiency anemia is the most prevalent nutritional condition in the world and the primary cause of anemia in about 30% of the world's population [5]. It is a condition where anemia develops because there is not enough iron available to sustain healthy red blood cell

formation [6]. Iron is required for hemoglobin formation and is predominantly stored as ferritin in the liver, spleen, and bone marrow [7]. Iron deficiency occurs when dietary iron intake does not satisfy iron needs, particularly during times of life when iron requirements are high, such as during infancy and pregnancy, or iron losses exceed iron intake over time (e.g. blood loss from parasite infection, childbirth, or menstruation) [8]. Iron deficiency anemia can be so mild at first that it goes unrecognized. However, as the body's iron levels drop, the indications and symptoms worsen, including headaches, dizziness, a lack of energy and acute exhaustion, pale skin, brittle nails, a fast heartbeat, and shortness of breath [7,9]. Iron deficiency is the most common hematologic condition during childhood [6]. Data from the World Health Organization show that 48% of children in underdeveloped nations between the ages of 5 and 14 have anemia [10]. Anemia adversely affects the cognitive performance, behavioral characteristics and physical growth of infants, preschool and school-age children. In addition, anemia in adolescence causes reduced physical and mental capacity, diminished concentration in work and educational performance, and poses a serious risk to girls' future ability to become safe mothers [11].

Although there are previous studies in Libya on the prevalence of anemia [12,13,14], there were insufficient studies focused specifically on iron deficiency for the age group of 12-18 years. Therefore, our study aims to determine the prevalence of iron deficiency anemia among school students in Tripoli, Libya, as well as to assess the students' practices, level of knowledge, and awareness of parents regarding the importance of iron for their children's health. Additionally, we seek to identify the potential risk factors associated with iron deficiency anemia among school students.

Methods

Study design and setting

A cross-sectional study was conducted between the period of May to July 2022, and was approved by the Department of Medical Laboratories Sciences at the University of Tripoli. A seven randomly selected preparatory and secondary schools in three different regions of Tripoli City-Libya were enrolled in this study. The number of students from each school in these regions were chosen according to the approval of student’s parents or their guardian. A structured questionnaire design based on the previous studies was used to measure the level of awareness, knowledge, daily practices of the participants and their families [7].

Sample Collection and Laboratory Methods

Five milliliters of the blood were collected from each student by venepuncture. Two milliliters were withdrawn into a tube containing ethylenediaminetetraacetic acid (EDTA) anticoagulant and were used for complete blood count (CBC) test for the estimation of hematological parameters such as, Hemoglobin (Hb), Mean Cell Volume (MCV) and Mean Cell Hemoglobin (MCH). Other 3 ml were collected in plain tube and were allowed to clot to obtain serum which used for estimating the serum iron (SI) and Total Iron Banding capacity (TIBC). Automatic blood analyzer (sysmex xp-300) was used for CBC according to the manufacturer recommendation. Serum iron and TIBC measurements were done by using (INTEGRA 400 plus instrument).

Statistical Analysis

The database was structured in Microsoft Office Excel 2010 and analyzed using Statistical Package for the Social Sciences (SPSS) software, version 26. Frequencies, proportions, and rates of the given data for each variable was calculated.

Results

The current study enrolled about 105 students, of whom 39 (37.2%) were males, and 66 (62.8%) were females. The age groups of the students ranged between 12-18 years. From these 40% were 12-15 years old, with the rest, 60% being 16-18 years old. About 42 of the students were in preparatory stage, whereas 63 were in secondary stage. From all 105 participants, 72.4% came from families with more than five family members, with the remaining 27.6% coming from families with less than, or equal to five family members. The majority of the monthly income of the families of the participants was medium (96.2%), while both high and low incomes were found in 1.9% of the families (Table 1).

Table 1. Demographic characteristics of the study population.

Age (years)	Hemoglobin (Hb) g/dl	MCH (Pg)	MCV (FL)	Serum iron µg/dl	TIBC µg/dl
Female 12-18 y	12-16	26-32	77-91	37-145	250-450
Male 12-18 y	14-18			59-158	

The normal values of the variables used to conduct this study, and were used to measure prevalence rates, were illustrated in table (2).

Table 2. Normal values for age-matched red cell indexes and serum iron and TIBC.

Variables		No	No %
Gender	Female	66	62.8%
	Male	39	37.2%
Age (12-18) y	(12-15) y	42	40.0%
	(16-18) y	63	60.0%
Class	Preparatory	42	40.0%
	Secondary	63	60.0%
Number of family members	≤ 5 Less than or equal five	29	27.6%
	> 5 More than five	76	72.4%
Monthly income of the family	Low	2	1.9%
	Medium	101	96.2%
	High	2	1.9%

As outlined in Table (3) the overall prevalence of iron deficiency anemia in the study population were 15.2%. The prevalence of IDA in females was 21.2%, whereas the prevalence in male was 5.1%. In the preparatory group, the IDA rates were 4.8%, whereas in the secondary school age group the level of IDA was 22.2%. Females in the preparatory school were found to have no IDA deficiency, however, the prevalence of IDA between males in the same age group was 6.4%. Furthermore, IDA in secondary females was 25.4%, but the secondary males had not IDA deficiency.

Table 3. prevalence of iron deficiency anemia in general, among different gender and class groups.

Variables	**IDA%** (low Hb, low SI, high TIBC)
In general,	15.2%
Female	21.2%
Male	5.1%

Preparatory	4.8%
Secondary	22.2%
P.female*	0.0%
P.male*	6.4%
S.female*	25.4%
S.male*	0.0%

P= preparatory, S= secondary

Table (4) below displays the different variables used to assess the level of awareness among the families of students regarding IDA. Our findings revealed a lack of knowledge about iron-rich nutrients among the parents of students with IDA. Specifically, 21.7% of them were unsure if tea was a good source of iron. Additionally, 23.5% of the students with IDA had parents who believed that milk and dairy products are rich in iron, and 8.3% had parents who thought that milk does not contain iron. The prevalence of IDA was higher (30.8%) among students whose parents believed that liver does not contain iron, while 9.6% of parents believed that liver is a rich source of iron.

In this study, it was found that 13.5% of children whose parents believed that eggs were a good source of iron suffered from iron deficiency anemia. In comparison, 21.7% of children whose parents were unsure about whether eggs contain iron or not had IDA. Additionally, 14.1% of children with IDA had parents who thought that fish is rich in iron, while 28.6% believed that it was not, and 5.0% were unsure. Furthermore, 27.8% of children with IDA had parents who believed that bread is rich in iron, while 5.0% were unsure about bread's iron content.

The prevalence of iron deficiency anemia was higher among students who consumed a higher number of soft drinks (26.3%) compared to those who consumed a lower amount (7.5%). Conversely, the results showed that 12.0% and 17.5% of students with IDA consumed high and moderate amounts of natural juice and fruits, respectively. Furthermore, 28.0% of students with IDA consumed excessive amounts of chips, while 6.1% consumed chips in smaller quantities.

Table 4. Prevalence of iron deficiency anemia according to family awareness regarding diet maintaining iron levels.

Meals	Answers	No	IDA (%)
The following types of food are rich in iron:			
Tea	Yes	10	10.0%
	No	72	13.9%
	I don’t know	23	21.7%
Milk and milk products	Yes	51	23.5%
	No	36	8.3%
	I don’t know	18	5.6%
Liver	Yes	73	9.6%
	No	13	30.8%
	I don’t know	19	26.3%
Eggs	Yes	52	13.5%
	No	30	13.3%
	I don’t know	23	21.7%
Fish	Yes	64	14.1%
	No	21	28.6%
	I don’t know	20	5.0%
Bread	Yes	18	27.8%
	No	67	14.9%

	I don’t know	20	5.0%
The student’s dependence on the following foods in the diet:			
Soft drinks	High	19	26.3%
	Medium	46	17.4%
	Low	40	7.5%
Natural juice and fruits	High	25	12.0%
	Medium	63	17.5%
	Low	17	11.8%
Chips	High	25	28.0%
	Medium	47	14.9%
	Low	33	6.1%

The data presented in Table (5) shows the various variables tested to measure healthy practices among parents of IDA students. When it comes to parents' responsibilities towards their children's health, 14.1% of IDA students had parents who ensured their children had breakfast daily. On the other hand, 27.3% of IDA students did not have three meals daily. Only 11.4% of IDA students were consuming vegetables daily while 17.1% did not have them regularly. Furthermore, 13.2% of IDA students did not eat fruits regularly.

Table 5. prevalence of iron deficiency anemia related to the practices of the study population.

Practice	Answers	No	IDA (%)
Make sure that children have breakfast daily	Yes	64	14.1%
	No	41	17.1%
Children provided with three regular meal daily	Yes	61	6.6%
	No	44	27.3%
Fresh vegetables provided for children	Yes	35	11.4%
	No	70	17.1%
Fresh fruits provided for children	Yes	37	18.9%
	No	68	13.2%

Discussion

Iron deficiency anemia is the most common nutritional deficiency worldwide. It can cause reduced work capacity in adults [15] and impact motor and mental development in children and adolescents [16]. This study aimed to determine the prevalence of iron deficiency anemia among school students in Tripoli. Our findings revealed that out of a total of 105 school students, 15.2% were found to have IDA. The prevalence of IDA was 21.2% among females and 5.1% among males. This discrepancy is expected due to the rapid growth and blood iron depletion in young age groups, leading to iron deficiency anemia [17].

The prevalence of IDA in our study was slightly higher than that reported by Jbireal et al., who found an overall prevalence of 9.2% in 711 school students in Sabratha, Libya [6]. Our findings were consistent with a study by Odeh et al., who reported a general prevalence of 12.7% of IDA among 290 school students in Palestine [7].

In our study, 13.9% of IDA children had parents who believed that tea is not a rich source of iron, and only 9.6% of IDA students had parents who believed that the liver is a rich source of iron. These results were consistent with the study conducted by Odeh et al [7].

In terms of milk and milk products, it's important to note that they contain calcium, which

can inhibit iron absorption [18]. The study found that 8.3% of students whose parents were aware of this information had iron deficiency anemia, which is lower than the rate reported by Odeh et al. [7]. The results also revealed that there was a relatively similar rate of IDA in students from both groups of parents. Those who believed that eggs are a rich source of iron had a 13.5% rate of IDA in their children, while those who thought eggs were not a rich source of iron had a 13.3% rate of IDA in their children. These findings align with those reported by Odeh et al. [7].

In the present study, it was found that students who consumed high levels of soft drinks and chips as part of their diet were more likely to suffer from iron deficiency anemia. Specifically, 26.3% of students with high soft drink consumption had IDA, compared to 17.4% with moderate consumption and 7.5% with low consumption. Similarly, 28.0% of students with high chip consumption had IDA, compared to 14.9% with moderate consumption and 6.1% with low consumption. These findings are consistent with the fact that soft drinks and chips are low in iron and can inhibit iron absorption [19, 20].

In terms of other dietary practices, 17.1% of students with IDA did not have breakfast regularly, highlighting the importance of consuming a nutritious breakfast. Additionally, 11.4% of students with regular vegetable consumption had IDA, while 13.2% did not have fruits in their diet, emphasizing the role of fruits and vegetables in preventing IDA [21].

Conclusion

In summary, anemia is a preventable health issue in schoolchildren. Iron deficiency is the main cause of anemia, which can be caused by low iron intake, iron malabsorption, and iron loss leading to IDA. Although IDA can occur in all age groups, it is more prevalent in secondary school females. Addressing IDA in this age group can improve learning potential, increase fitness and work capacity, and significantly improve the chances of safe motherhood in girls in the future. Therefore, it is recommended to educate the community about balanced consumption of animal and plant-based foods as the primary strategy to reduce the rate of anemia. Additionally, health education programs and sustainable interventions should be implemented in schools to raise awareness about the risk factors of IDA and promote the intake of diverse diets, including iron-rich foods.

References

1. McLean E, Cogswell M, Egli I, Wojdyla D, de Benoist B. Worldwide prevalence of anaemia, WHO Vitamin and Mineral Nutrition Information System, 1993-2005. Public Health Nutr. 2009 Apr;12(4):444-54.
2. Patel KV. Epidemiology of anemia in older adults. Semin Hematol. 2008 Oct;45(4):210-7.
3. Basu S, Basu S, Hazarika R, Parmar V. Prevalence of anemia among school going adolescents of Chandigarh. Indian Pediatr. 2005 Jun;42(6):593-7. PMID: 15995276.
4. Milman N. Anemia--still a major health problem in many parts of the world! Ann Hematol. 2011 Apr;90(4):369-77.
5. Aliyo A, Jibril A. Anemia and Associated Factors Among Under Five Year Old Children Who Attended Bule Hora General Hospital in West Guji zone, Southern Ethiopia. J Blood Med. 2022 Jul 5;13:395-406.
6. Jbireal, J, Azab A. Prevalence of Iron Deficiency Anaemia among School Children in Sabratha, Western Libya. Archives of Hematology and Blood Diseases 2020;3(1):26.
7. Odeh, M.M.M., 2006. Prevalence of iron deficiency anemia among school children in Salfeet district (Doctoral dissertation).
8. Yip R. Prevention and control of iron deficiency: policy and strategy issues. J Nutr. 2002 Apr;132(4 Suppl):802S-5S.
9. Brunner C, Wuillemin WA. Eisenmangel und Eisenmangelanämie - Klinik und Therapie [Iron deficiency and iron deficiency anemia - symptoms and therapy]. Ther Umsch. 2010 May;67(5):219-23. German.
10. Chaparro CM, Suchdev PS. Anemia epidemiology, pathophysiology, and etiology in low- and middle-income countries. Ann N Y Acad Sci. 2019 Aug;1450(1):15-31.
11. Achouri I, Aboussaleh Y, Sbaibi R, Ahami A, El Hioui M. Prevalence of Iron Deficiency Anaemia Among School Children in Kenitra, Northwest of Morocco. Pak J Biol Sci. 2015 Apr;18(4):191-5.
12. Alawaini K, Altabeb S, Alalwe S, Alazabe M, Yaghoub W, Sarika T. Anemia among pregnant women in the northwest of Libya. GSC Biological and Pharmaceutical Sciences. 2020;12(3):150-154.
13. Abdulwahed, E., Rhoma, H. and Sultan, M., 2021. Prevalence of Anemia in A Sample of Elderly Subjects from Tripoli, Libya. AlQalam Journal of Medical and Applied Sciences, pp.238-244.

14. Mustafa, A., Elhamroush, A., Elgenaidi, A., Elwahaishi, S. and Ageel, F., Prevalence Of Iron Deficiency Anemia (Ida) Amongst Nursing Students Of Misurata University, Libya. Age, 74(45), pp.18-20.
15. Haas JD, Brownlie T 4th. Iron deficiency and reduced work capacity: a critical review of the research to determine a causal relationship. J Nutr. 2001 Feb;131(2S-2):676S-688S; discussion 688S-690S.
16. Halterman JS, Kaczorowski JM, Aligne CA, Auinger P, Szilagyi PG. Iron deficiency and cognitive achievement among school-aged children and adolescents in the United States. Pediatrics. 2001 Jun;107(6):1381-6.
17. Powers JM, Buchanan GR. Diagnosis and management of iron deficiency anemia. Hematol Oncol Clin North Am. 2014 Aug;28(4):729-45, vi-vii.
18. Abalkhail B, Shawky S. Prevalence of daily breakfast intake, iron deficiency anaemia and awareness of being anaemic among Saudi school students. Int J Food Sci Nutr. 2002 Nov;53(6):519-28.
19. Alleyne M, Horne MK, Miller JL. Individualized treatment for iron-deficiency anemia in adults. Am J Med. 2008 Nov;121(11):943-8.
20. Deivita Y, Syafruddin S, Andi Nilawati U, Aminuddin A, Burhanuddin B, Zahir Z. Overview of Anemia; risk factors and solution offering. Gac Sanit. 2021;35 Suppl 2:S235-S241.
21. Moreno-Aznar LA, Vidal Carou MDC, López Sobaler AM, Varela-Moreiras G, Moreno Villares JM. Papel del desayuno y su calidad en la salud de los niños y adolescentes en España [Role of breakfast and its quality in the health of children and adolescents in Spain]. Nutr Hosp. 2021 Apr 19;38(2):396-409. Spanish.