

# Effect of Iron Deficiency Anemia on Scholastic Achievement of Primary School Students

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**Abstract:** Iron deficiency anemia is a major health problem of morbidity among school-aged students with major consequences on physical, mental and scholastic achievement. **Aim:** assessing the effect of iron deficiency anemia on scholastic achievement of primary school students. **Research design:** Descriptive design was used. **Setting:** The study was conducted at four primary schools in New Damietta city Alkafrawy language school, Ali Ibn AbiTaleb primary school, Almostaqbal primary School, and Hassan Hussein Elzayat primary school, Dumyat Government, Egypt. **Sample:** A multi-stage random sample was used. It includes 217 students from four schools. **Tools:** Three tools, 1<sup>st</sup> tool: Consist of five parts; socio-demographic characteristics of subject's, students medical history, students dietary habits, knowledge of primary school students about iron deficiency anemia, and school record evaluation of students. 2<sup>nd</sup> Tool: Physical assessment of primary school students. 3<sup>rd</sup> Tool: An observation checklist consisted of two parts as a clinical manifestation of iron deficiency anemia and observation of students' scholastic achievement. **Results:** The result of the present study revealed that 90.8% of students suffering from Iron deficiency anemia. Iron deficiency anemia had a negative effect on their scholastic achievement as anemic students had poor scholastic achievement. **Conclusion:** The present study concluded that most of the study samples had unhealthy dietary habits, more than half of the studied samples had poor knowledge about iron deficiency anemia, and there was a positive significant relation between iron deficiency anemia and scholastic achievement. **Recommendation:** Develop an educational program to increase knowledge and improve dietary habits of students to prevent iron deficiency anemia.

**Keywords:** Iron deficiency anemia, primary school students, scholastic achievement.

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## 1. INTRODUCTION

Iron Deficiency Anemia (IDA) is a common form of nutrition deficiency. Iron Deficiency Anemia occurred when the body doesn't have sufficient iron to produce fresh red blood cells (RBCs). The body requires iron to make hemoglobin. According to WHO, iron deficiency anemia is a condition in which hemoglobin <13 g/dl in men more than age 15 years. In students, iron deficiency anemia happens when hemoglobin (Hb) level in the blood less than 11.0 g/dl for students <6 years and <12 g/dl for ≥ 6 to 14-year-old. There is no difference in hemoglobin level in students <12 years<sup>(1)</sup>.

The bone marrow considered the largest organ of production of RBCs under the control of a hormone called erythropoietin. Erythropoietin is a hormone produced by the kidney in response to reduced oxygen delivery (as in anemia and hypoxia) and increased levels of androgens. In addition to erythropoietin, the production of RBCs requires important elements mainly iron, vitamin B12, and folate. The protein inside RBCs called hemoglobin that is responsible for carrying oxygen for all body organs from the lung and removes carbon dioxide from the body, transporting it to the lungs for exhalation<sup>(2)</sup>.

Iron deficiency anemia can be a consequence of increased iron demand/loss or decreased iron level in the body due to several causes as blood loss in the body due to peptic ulcer, colon cancer results in iron deficiency anemia. Diet when a student gets too little iron or iron that is poorly absorbed (non-heme iron). Parasitic disease considers a cause of iron-deficiency anemia worldwide as parasitic worms. Other causes as Hookworm infection, malaria, inflammatory bowel disease<sup>(3)</sup>.

There are 3 phases of iron deficiency anemia as a pre-latent phase, latent phase and iron deficiency anemia phase. Most symptoms of anemia are due to the lack of oxygen in the cells. Many of the symptoms are not present with mild anemia. The most common symptoms are pallor skin, brittle or spoon-shaped nails, general fatigue, cracks at the corners of the mouth, sore or swollen tongue, cold hands and feet, difficulty concentrating, dizziness, headache, and irregular heartbeats. Iron deficiency anemia can be diagnosed through a physical exam, and blood tests as complete blood count (CBC) to detect if have lower than normal red blood cell counts, hemoglobin or hematocrit levels, or mean corpuscular volume (MCV) that would suggest anemia<sup>(4,5,6)</sup>.

Complications of iron deficiency anemia include decreased immune function as iron deficiency influences the capacity to have an adequate immune response. The role of iron for immunity is essential for immune cell proliferation, particularly lymphocytes, associated with the generation of a specific response to infection, impaired temperature regulation, lowered endurance, and increased rates of infection. Impaired cognitive functioning, memory and compromised growth and development happen because iron is very important for cognitive function and psychomotor development, heart and lung problems, restless legs syndrome<sup>(7,8)</sup>.

Iron deficiency anemia can be treated through an iron supplement, intake of iron-rich foods, and blood transfusion in a severe degree of iron deficiency anemia. Iron deficiency anemia can be prevented through primary prevention of iron deficiency anemia focused on health promotion enables students to increase control over their own health and preventing the root causes of ill health, not just focusing on treatment and cure. Nutrition is an important determinant of health in school-aged students, diet rich iron is beneficial in the prevention of iron deficiency anemia as meat, eggs, leafy green vegetables, and iron-fortified foods. A secondary level of prevention of iron deficiency anemia consists of early diagnosis and appropriate treatment. Tertiary level of prevention includes preventing of complication or disability by continuous follow up for students after treatment to monitor and manage prognosis of diseases, any complications and early treatment of related signs and symptoms and side effect of health problems for students, and regular checkup of hemoglobin level<sup>(9,10)</sup>.

The school-age period is a stage of physical, mental, social and emotional growth and development. Also, it is a stage of stress and strain, educational responsibility, and student's capacity to learn. School plays a vital role in the real structure of a community. Needs of primary school students are classified according to Maslow hierarchy of needs into physiological needs, safety needs, belongingness and love needs, esteem needs, and self-actualization needs<sup>(11)</sup>.

There is evidence of impaired motor development and scholastic achievements; psychological and behavioral effects (inattention, fatigue, insecurity) in consequence of iron deficiency anemia. The bad effect on cognitive and educational performance as iron deficiency anemia have an impact on four areas of cognitive functioning as memory, conceptualization, concentration and intellectual activities, and result in below average scores in academic performance of anemic students as compared to normal for their age<sup>(12)</sup>.

School health nurse plays a vital role in the prevention of iron deficiency anemia through the development of policies, programs, and procedures for the provision of school health services at the student level. School health nurse enhances the education process by maximizing the health and well-being of school age students. The school nurse uses the nursing process to assess, plan, implement, and evaluate care for students with iron deficiency anemia. The school nurse provides leadership to the school in implementing precautions for students to prevent iron deficiency anemia. The school nurse provides programs to staff, families, and the community about iron deficiency anemia, causes, signs and symptoms and complications of iron deficiency anemia<sup>(13,14)</sup>.

### SIGNIFICANCE OF THE STUDY

Iron deficiency anemia is a preventable cause of cognitive impairment and other negative effects on the academic potential of students, permanent loss of Intelligence Quotient(IQ), shortened attention span, and difficulty with concentration in school going students, as iron is needed continuously for brain growth in students and there is also

evidence that iron deficiency anemia impairs growth. The developmental deficits related to iron deficiency anemia can be corrected with iron treatment; however, there is evidence that some deficits are not reversible with iron treatment <sup>(15,16)</sup>.

The pediatric outpatient clinics at Al-Fayoum University Hospital, in Egypt, it was found that 64% of studied students had iron deficiency anemia (20% mild, 41.7% moderate and 2.3% severe). In Egypt, The logistic regression analysis found that students from rural areas, those from low social class and those of low maternal educational level had a higher risk for iron deficiency anemia than other students <sup>(17)</sup>.

The school health nurse plays an essential role as early detection of iron deficiency anemia. School health nurse provides long term management of students suffering from iron deficiency anemia. Also, the school health nurse provides screening and referral for them. School health nurse serves in a leadership role for health policies and programs. The school health nurse plays a vital role as a health educator in prevention and control of iron deficiency anemia through improve awareness about healthy dietary habits and provide health care about iron-rich foods are a key prevention technique for prevention and treatment of iron deficiency anemia <sup>(18)</sup>.

### **AIM OF THE STUDY**

The study aims to assess the effect of iron deficiency anemia on scholastic achievement of primary school students through:

- 1- Assessing primary school students' dietary habits.
- 2- Appraising primary school students' knowledge about iron deficiency anemia.
- 3- Evaluating primary school students' scholastic achievement.

### **Research Question**

- What are the dietary habits of primary school students?
- What is the knowledge of primary school children about iron deficiency anemia?
- What is the relation between iron deficiency anemia and scholastic achievement among primary school students?

## **2. METHODS**

### **Research design:**

The descriptive research design was used in this study.

### **Setting:**

This study was conducted at four primary schools in New Damietta city, Dumyat Government, Egypt. There are 13 schools in the city. Four schools were selected according to geographical distribution (North, South, East, and West). These schools are Alkafrawy language school, Ali Ibn AbiTaleb primary School, Almostaqbal primary school, and Hassan Hussein Elzayat primary school. Each school contains three classes in the six grades. The students' sample was class one of six grades from each school.

### **Sample:**

A multi-stage random sample was used to select governmental primary schools, four schools were chosen for this study from 13 schools. Student's number of the six grades in each school was 159 students and student's numbers of the six grades in 4 schools were 636 students, 217 students were selected from the first class of the six grades from each school. Students fulfilled the following:

### **Inclusion criteria:**

Age 11 – 13 year, both six, and selected from grade one of sex class from selected school.

### **Exclusion criteria:**

Students suffering from chronic diseases are excluded from the sample.

**Tool for data collection:** Using the following three tools

**1st Tool: An interviewer questionnaire form:** It contains 5 items as socio-demographic characteristics, student medical history, school records evaluation of students about scholastic achievement, students dietary habits that consists of 10 sub items contains right dietary habits as hand washing before and after eating, wrong dietary habits as drinking tea after eating, and drinking Nescafe, and knowledge of primary school students about iron deficiency anemia that contains 7 sub-items as meaning of iron deficiency anemia, causes, signs, diagnosis, treatment, and protection.

Dietary habits of primary school students were scored as: Right dietary habits were scored as (0) for don't know, (1) for no, (2) for yes. Wrong dietary habits were scored as (2) for don't know, (1) for no, (0) for yes. Total dietary habits were scored as: healthy dietary habits:  $\geq 60\%$ , and un-healthy dietary habits:  $< 60\%$ . Knowledge about iron deficiency anemia was scored as (1) for no or don't know, (2) for the correct and incomplete answer, and (3) for the correct and complete answer. Total knowledge score was divided into: good knowledge:  $\geq 75\%$ , fair knowledge:  $50\% - < 75\%$ , and poor knowledge:  $< 50\%$ .

**2<sup>nd</sup> tool: Student's physical assessment:** It contains 6 items such as: Student weight in kilogram, student height in centimeter, body mass index which is the result of student weight divided by square length in meters, ideal BMI ranged from 16.5 to 18.5 for students aged from 10-13 years, pulse rate, respiratory rate, and hemoglobin level in blood which is measured by a device called DiaSpect hemoglobin T system.

**3<sup>rd</sup> tool: Observational checklists of primary school students with iron deficiency anemia:** Consist of two parts as: Observation of student's clinical manifestations of iron deficiency anemia as pallor skin, brittle shaped nails, general fatigue, and observation of student's scholastic achievement which contains three items as observation of student in the class, observation of student during the sweep, and observation of student's nutritional habits in school.

**Operational design:**

**The preparatory phase:** Included reviewing of related literature and theoretical knowledge of various aspects of the study using books, articles, and magazines.

**Fieldwork:**

- The actual fieldwork started from beginning of October 2018 till the end of December 2019 for the data collection, a sample of 217 primary school student attending the study setting and the interviewed them after introducing himself.
- The aim of the study and components of the tool was explained to primary school students at the beginning of data collection.
- The investigators went to selected primary schools in New Damietta city, and collected data during the time of school, three times a week on Sunday, Tuesday, and Thursday of each week from 9 am to 1 pm, in which the investigator met every student includes in the study, written consent was taken of each student explained the purpose of the study and the component of the tool.
- Students were assured that the information collected would be recorded confidentially and it would be used only for the purpose of the study.

**4- Administrative design:**

Permission was obtained by submission of an official letter issued from Dean of Faculty of Nursing, Helwan University forwarded to the undersecretary of the Ministry of Education Damietta Governorate including the aim of the study to obtain the permission to visit each school and conduct the study. Each school manager was informed about the study, date and time of data collection. The student classes were entered by the school manager explained the purpose of the study, took written approval from them and explained the data collection form to students.

**Ethical consideration:** Ethical approval was obtained from the research ethical committee of the Faculty of Nursing, Helwan University. Official permission to conduct the study was obtained from the administrator of each school. Oral consents were obtained from students after explaining the purpose of the study. They were given an opportunity to refuse to participate in the study and they were notified that they could withdrawal at any stage of the research. Also, they were assumed that the participation in the study is entirely voluntary; anonymity, privacy, and confidentiality were assured through coding the data.

**4- Statistical design:**

The selected data were organized, tabulated and statistically analyzed using SPSS software (statistical package for the social sciences, version 23, SPSS Inc. Chicago, IL, USA). For quantitative data, the range, mean and standard deviation were calculated. For quantitative data, which describe a categorical set of data by frequency, percentage or proportion of each category, comparison between two groups and more was done using Chi-square test. For comparison between means of two groups of parametric data of independent samples, students T-test were used, for comparison between means of two groups of non-parametric data of independent samples, for comparison between more than two means of non-parametric data. Correlation between variables was evaluated using Pearson and Spearman's correlation coefficient. Significance was adopted at  $p < .01$  for interpretation of results of tests of significance.

**3. RESULT**

**Table (1):** Illustrates that 69.6% of the studied samples were in the age group 11- 12 years with  $X \pm SD 12.19 \pm 0.616$ . Regarding sex of the studied samples, it was found that 50.2% were females. Regarding residence of the studied samples, it was found that 89.4% were living in urban and 68.2% of them with 3-4 members in their family with  $X \pm SD 4.76 \pm 0.679$  and 54.4% of the studied sample were in the second arrangement. It was found that 50.7% of the income of the studied sample was sufficient and 64.5% have 3 rooms with 56.68% for crowding index  $>1 - >2$ . Regarding parents occupation, it was found that 81.6% of fathers were an employee and 43.8% of mothers were housewife.

**Figure (1):** Shows that 22.6% of the studied subjects had a previous operation, 42.4% suffering from blood hemorrhage, 58.1% don't remember or don't know if they had a medical examination, 59.9% take medication for worms; 8.3% of them had a family medical history of IDA.

**Figure (2):** Shows that 90.8% of the studied sample suffered from iron deficiency anemia, and 9.2% not suffered from iron deficiency anemia.

**Figure (3):** Shows that 71.4% of the studied subjects were eating protein, 55.3% were eating carbohydrates, 50.2% were eating vegetables, and 85.9% of them were eating fruits.

**Table (2):** Shows that there was statistical significance between iron deficiency anemia and non iron deficiency anemia groups regarding their total dietary habits with a P value equals .0001.

**Table (3):** Describe that there was statistical significance between iron deficiency anemia and non iron deficiency anemia groups regarding their nutritional habits in school with a P value equals .0001.

**Table (4):** Describes that there was statistical significance between iron deficiency anemia and non iron deficiency anemia groups regarding their total knowledge about iron deficiency anemia with a P value equals .0001.

**Table (5):** Shows that there was a statistical correlation between iron deficiency anemia and non iron deficiency anemia groups regarding their scholastic achievement, it was found that there was no statistical significance regarding student's absenteeism and their school activities. Also, there was statistical significance regarding their certificate of the 1<sup>st</sup> term with a P value equals .0001, and there was statistical significance regarding the type of school activities with a P value equals .0001.

**Table (6):** Shows that there was statistical significant between iron deficiency anemia and non iron deficiency anemia groups regarding their physical assessment with a P value equals .0001 for BMI, and with a P value equals .003 for respiratory rate. There was no statistical significance between iron deficiency anemia and non iron deficiency anemia groups and their Pulse rate with a P value equals .827.

**Table (1): Frequency Distribution of the Studied Sample Regarding Socio-demographic Characteristics (No.= 217):**

Items	No.	%
<b>Age groups (in years)</b>		
• 11- 12 years	151	69.6%
• $\geq 13$	66	30.4%
<b>Sex</b>		
• Male	108	49.8%
• Female	109	50.2%

<b>Residence</b> • Rural • Urban	23 194	10.6% 89.4%
<b>Family number</b> • 3 - 4 member • 5 – 6 member <b>X±SD 4.76± 0.679</b>	69 148	31.8% 68.2%
<b>Arrangement</b> • First • Second • Third	38 118 61	17.5% 54.4% 28.1%
<b>Income</b> • Insufficient • Sufficient • Sufficient and save	20 110 87	9.2% 50.7% 40.1%
<b>Room number</b> • 2 rooms • 3 rooms <b>X±SD 2.65± 0.478</b>	77 140	35.5% 64.5%
<b>Crowding index</b> • >1 - >2 • 2 - ≥ 3 <b>X±SD 1.85± 0.392</b>	123 94	56.68% 34.32%
<b>Father occupation</b> • Worker • Employee • Retirement • Died	29 177 9 2	13.4% 81.6% 4.1% .9%
<b>Mother occupation</b> • House wife • Employee • Worker	95 116 6	43.8% 53.5% 2.8%

Figure (1): Distribution of the Studied Subjects Regarding Their Past Medical History (No. = 217)

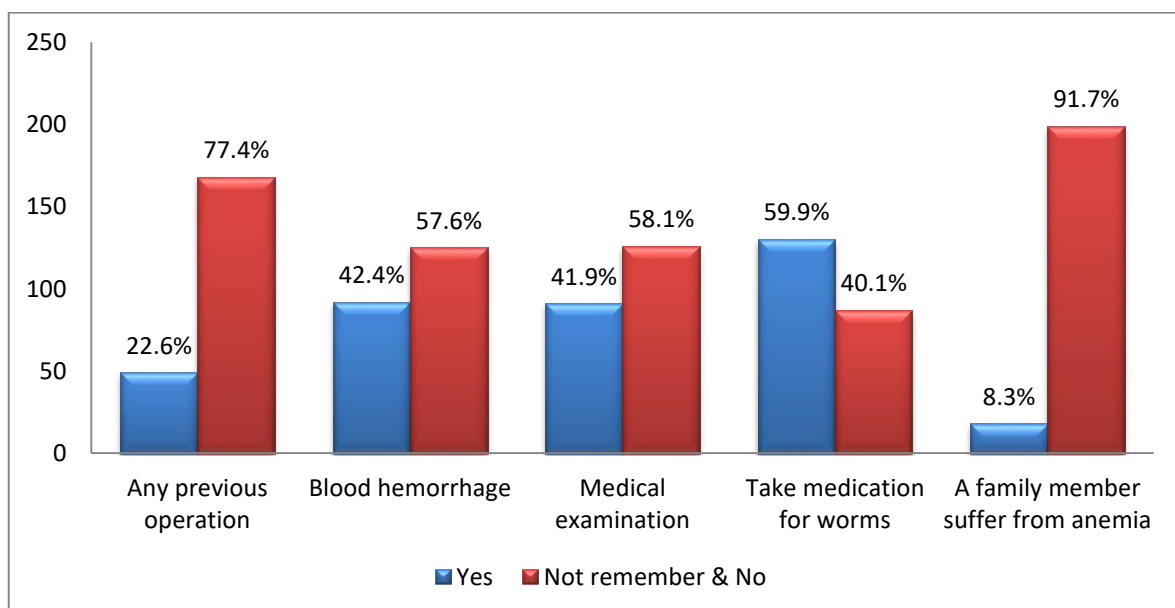


Figure (2): Distribution of IDA and non-IDA Groups of The Studied Subjects According to Hemoglobin Level

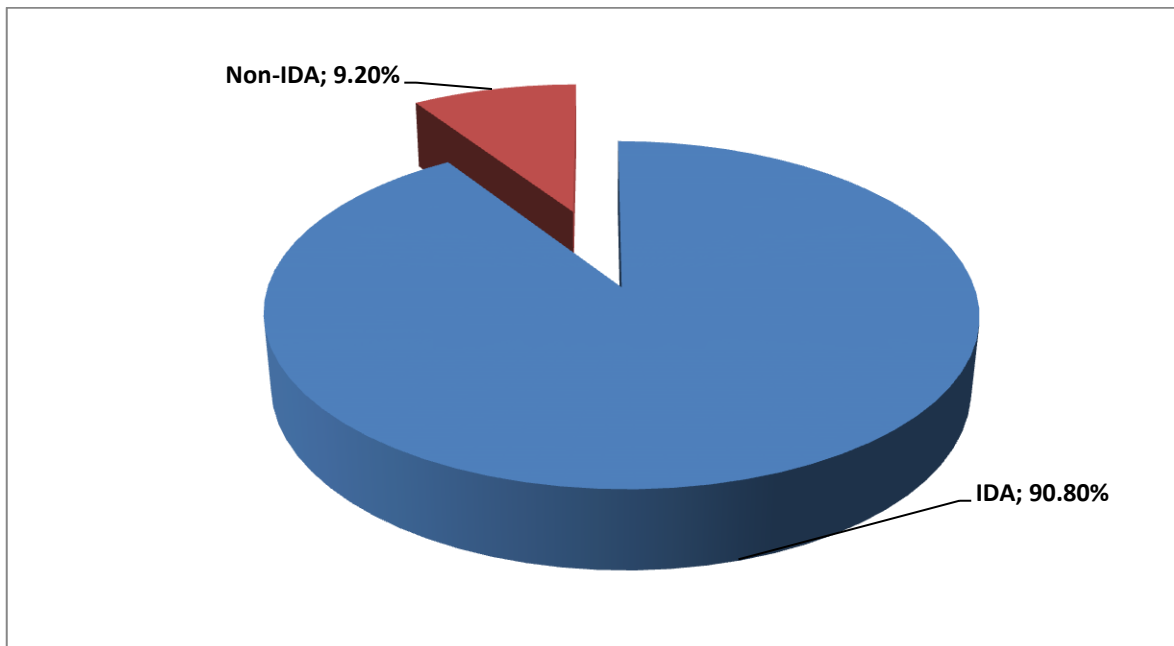


Figure (3): Distribution of the Studied Subjects Regarding their Dietary Habits about Eating Iron Rich Foods

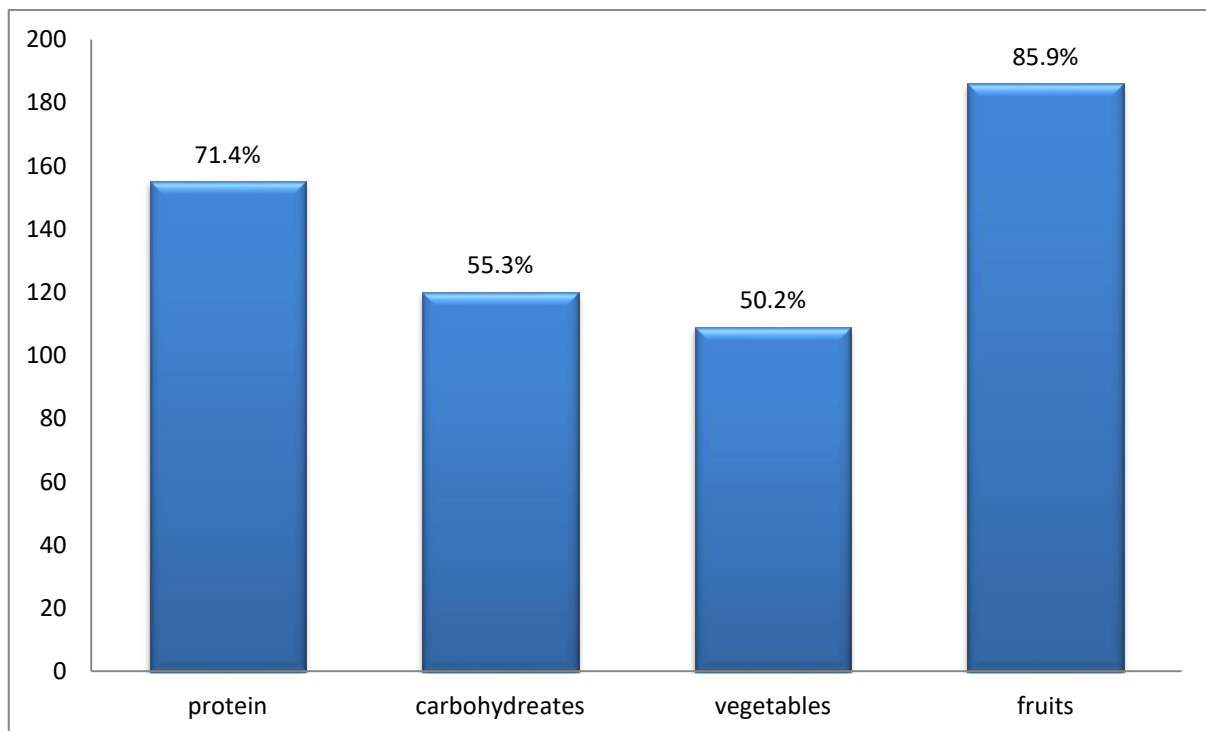


Table (2): Correlation between IDA and Non-IDA Regarding their Total Dietary Habits:

Dietary habits	IDA group N(n=197)		Non IDA group (n=20)		$\chi^2$	P value
	N	%	N	%		
Healthy dietary habits	17	8.63%	18	90%	88.87	.0001
Un-healthy dietary habits	180	91.37%	2	10%		

Table (3): Correlation between IDA and Non IDA Regarding Observation their Nutritional Habits in School:

Dietary habits	IDA group (no.=197)		Non IDA group (no.=20)		$\chi^2$	P value
	No.	%	No.	%		
Hand hygiene before eating	47	23.86%	18	90%	12.938	.0001
Eat sandwiches from home	97	49.24%	17	85%	56.14	.0001
Eat chips and soft drinks	182	92.38%	3	15%	173.19	.0001
Eat ready-made street vendors	190	96.95%	8	40%	168.29	.0001
Eat Indomie	194	98.47%	11	55%	163.36	.0001

Table (4): Correlation between IDA and Non-IDA Regarding their Total Knowledge about IDA:

Total Knowledge	IDA group (no.=197)		Non-IDA group (no.=20)		$\chi^2$	P value
	No.	%	No.	%		
Poor	122	62%	2	10%	20.112	.0001
Fair	65	33%	16	80%		
Good	10	5%	2	10%		

Table (5): Correlation between IDA and Non IDA Group Regarding Their Scholastic Achievement (No. = 217):

Scholastic Achievement	IDA group (no.=197)		Non-IDA group (no.=20)		$\chi^2$	P value
	No.	%	No.	%		
Student absenteeism					5.703	.058
• low ( $\leq 2$ day/month)	125	63.45%	18	90%		
• moderate( 3 – 5 day/month)	71	36.04%	2	10%		
• high ( $\geq 6$ day/month)	1	.51	0	0%		
Certificate of 1 <sup>st</sup> term					34.547	.0001
• Poor	18	9.1%	0	0%		
• Good	100	50.8%	2	10%		
• Very good	79	40.1%	16	80%		
• Excellent	0	0%	2	10%		
School activities					2.623	.269
• Yes	130	65.95%	16	80%		
• Some times	15	7.6%	2	10%		
• No	52	26.39%	2	10%		
Type of school activity					71.387	.0001
• Not participate	52	26.39%	2	10%		
• Football	86	43.65%	12	60%		
• Drawing	52	26.39%	3	15%		
• Playing music	7	3.55%	3	15%		



**Table (6): Correlation of IDA and Non IDA group regarding their Physical Assessment (No. = 217):**

Item	IDA group (no.=197)		Non-IDA group (no.=20)		$\chi^2$	P value
	No.	%	No.	%		
<b>BMI</b>					54.91	.0001
• Underweight < 18.5	174	88.32%	5	25%		
• Normal weight 18.5 – 24.9	23	11.86%	14	70%		
• Over-weight 25 – 29.9	0	0%	1	5%		
<b>Pulse rate</b>					.048	.827
• Normal	152	77.2%	15	75%		
• Tachycardia	45	22.8%	5	25%		
<b>Respiratory rate:</b>					9.059	.003
• Normal	98	49.75%	17	85%		
• Tachypnea	99	50.25%	3	15%		

#### 4. DISCUSSION

Iron is an essential micronutrient and major cause of anemia. Anemia is a public health problem both in developed and developing countries. Iron deficiency is the primary reason of anemia which results in iron deficiency anemia. Iron deficiency anemia is defined as a hemoglobin deficiency that results in an impaired ability of red blood cells (RBCs) to transport oxygen from the lungs to the tissues and to transport carbon dioxide from the tissues to the lungs. Iron deficiency anemia caused due to blood loss, poor dietary habits, and parasitic diseases. Iron deficiency anemia affects the physical and psychological development of primary school students as it cause poor psychomotor development and negative last long effect on central nervous system, poor intelligence quotient, poor school performance, reduced work capacity, and poor quality of life <sup>(18)</sup>.

**Regarding the demographic characteristics of primary school students**, the present study finding revealed that more than two third of the studied subjects were between 11-12 years. This is in the same direction with **Achouri et al** <sup>(19)</sup> in a published study entitled "**Prevalence of Iron Deficiency Anaemia Among School Children in Kenitra**" conducted in **Morocco** who reported that the age ranged between 6-15 years and 83.4% of the studied subjects were  $\leq$  12 years.

**Concerning sex**, the result revealed that more than half of the students were males. This agrees with **Mahroof et al** <sup>(20)</sup> in a published study entitled "**Clinical study of anemia in rural school children of Mangalore**" conducted in India mentioned that 54% of the studied subjects aged 5 to < 12 years were males.

**As regarding residence**, more than three quarters of the studied samples were live in urban area, this is disagreement with **Abdel-Rasoul et al** <sup>(21)</sup> in a published study entitled "**Epidemiology of iron-deficiency anemia among primary school children (6–11 years)**" conducted in Menoufia governorate, Egypt reported that 63.8% of the studied subjects were living in rural area and from the investigator's point of view might be due to New Damietta is an industrial city.

**According to the crowding index**, it was found that more than half for crowding index  $>1 - >2$  with a mean  $1.85 \pm 0.392$ . This is disagree with **Ibrahim et al** <sup>(22)</sup> in a published study entitled "**Nutritional program based on dietary pattern and iron deficiency anemia –related knowledge among Egyptian preparatory school girls**" conducted in El-Beheira Governorate, Egypt who founded that 57% of the crowding index was 5 persons/room and from the investigator's point of view this might due to New Damietta is a new city and most of the studied subjects had a sufficient income.

**The current study revealed that** more than half of the studied subjects were in the second arrangement of their birth order. This is inconsistent with **Singh et al** <sup>(23)</sup> in a published study entitled "**Extent of Anaemia among Preschool Children in Empowered Action Group States (EAG), India: A Challenge to Policy Makers**" conducted in India who reported that 45.6% of the birth order of the anemic child was between 4-5 arrangement in their birth order.

**Regarding income of the studied sample**, it was found that more than half were having sufficient income and from the investigator's point of view might be due to New Damietta is considered an industrial city and most of their residence are interested in working and making money. This is disagrees with **Desalegn et al** <sup>(24)</sup> in a published study entitled "**Nutritional Iron Deficiency Anemia: Magnitude and Its Predictors among School-Age Children**" conducted in **Jimma Town, Southwest Ethiopia**, they founded that 39.9% of the children's parents had a monthly high income.

**Regarding parent's occupation of the studied sample**, it was found that more than three quarters of fathers and half of mothers was an employee. This is disagreeing with **Salama et al** <sup>(27)</sup> in a published study entitled "**The Prevalence of anemia among informal primary school children**" conducted in **Rural Upper Egypt**; they showed that 58.9% of household occupations were farmers that are due to the area of the studied subject.

**As regarding past medical history of iron deficiency anemia**, more than one third had a previous operation, more than one third suffered from blood hemorrhage, more than one third had previous complaints of anemia, and nearly two-thirds took medication for worms and from the investigator's point of view might be due to increased injuries and bad dietary habits in this age. This agrees with **Alzaheb et al** <sup>(28)</sup> in a published study entitled "**The Prevalence of Iron Deficiency Anemia and its Associated Risk Factors Among a Sample of Female University Students**" conducted in **Saudi Arabia**, who reported that personal history and family history were associated with increased risk of iron deficiency anemia.

**As regarding the hemoglobin level**, more than three-quarters were suffering from iron deficiency anemia with Hb<12 mg/dl. This is in the same line with **Ncogo, et al** <sup>(29)</sup> in a published study entitled "**Prevalence of anemia and associated factors in children living in urban and rural settings**" conducted in **Bata District, Equatorial Guinea**, and they mentioned that more than three-quarters of the subjects were suffered from anemia.

In the other hand, this is disagree with **Gad, et al** <sup>(30)</sup> in a published study entitled "**Anemia among Primary School Children (5 -12 years): A Community-Based Study**" conducted in **Saudi Arabia** who reported that 22.3% suffered from anemia and from the investigator's point of view the high percentage of anemic students in the study might be due to the wrong dietary habits of primary school students.

**According to the research question: What are the dietary habits of primary school students?**

**Regarding dietary habits of students**, it was found that more than two-thirds were not washing their hands before eating, more than three quarters were washing their hands after eating, three quarters was having daily breakfast, two third were having regularly 3 meals, two third were drinking tea after eating, more than half weren't drinking Nescafe, more than three quarters were eating from street vendors, more than three quarters were eating chips, more than three quarters were eating indomie, more than three quarters were drinking cola. This is supported by **Shill et al** <sup>(31)</sup> in a published study entitled "**Prevalence of Iron-deficiency Anaemia among University Students in Noakhali Region**" conducted in **Bangladesh**, who reported that anemia was significantly more prevalent among those who were irregular in their breakfast intake than the individuals taking regular breakfast.

Also, this is in the same line with **Desalegn et al** <sup>(24)</sup> in a published study entitled "**Nutritional Iron Deficiency Anemia: Magnitude and Its Predictors among School-Age Children**" conducted in **Jimma Town, Southwest Ethiopia**, they mentioned that the majority of the studied subject had low dietary diversity score.

Also, this is in the same line with **Besarab et al** <sup>(32)</sup> in a published study "**Iron Deficiency Anemia**" who mentioned that iron deficiency and iron deficiency anemia typically result from inadequate dietary intake and from the investigator's point of view might be due to dependence on ready-made food, which doesn't rich with nutrients the body needs and drink gas drinks.

**As regarding the relation between IDA and total dietary habits**, it was found that there was statistical significance. This is supported by **Abdel-Rasoul, et al** <sup>(21)</sup> in a published study entitled "**Epidemiology of iron-deficiency anemia among primary school children (6–11 years)**" conducted in **Menoufia governorate, Egypt**, they founded that there was statistical significance between iron deficiency anemia and dietary habits.

**According to the research question: What is the knowledge of primary school children about iron deficiency anemia?**

**Concerning total knowledge of students about IDA**, there was statistical significance between iron deficiency anemia and Knowledge. This is in the same line with **Abdel-Rasoul, et al** <sup>(33)</sup> in a published study entitled "**Iron deficiency anemia among preschool children (2–6years) in a slum area: an intervention study**" conducted in **Alexandria, Egypt** who reported that there was a significant difference in pretest and posttest about knowledge of iron deficiency anemia among anemic and non-anemic students.

**According to the research question:** What is the relation between iron deficiency anemia and scholastic achievement among primary school students?

**As regarding physical assessment of the studied subjects,** it was found that there was statistical significance between iron deficiency anemia and respiratory rate. This is in the same line with **Roganović et al** <sup>(34)</sup> in a published study entitled "**Iron Deficiency Anemia in Children**" who reported that tachypnea was one of the most common manifestations associated with iron deficiency anemia.

**Concerning Physical activity of the studied subjects,** there was statistical significance between iron deficiency anemia and type of school activity especially playing football. This agrees with **Tezera et al** <sup>(18)</sup> in a published report entitled "**Prevalence of anemia among school-age children in Ethiopia: a systematic review and meta-analysis**" conducted in **Ethiopia**, they mentioned that consequences of anemia on school-age children are poor psychomotor development.

**As regarding Scholastic achievement of the studied subjects,** there was statistical significance between iron deficiency anemia and their certificates of the 1<sup>st</sup> term. This is in the same line with **Li, et al** <sup>(36)</sup> in a published report entitled "Anemia and student's educational performance in rural Central China: Prevalence, correlates and impact" conducted in **Henan province, China**, they reported that anemia status decreases student academic achievement.

Also, this is inconsistent with **Hlatswayo, et al** <sup>(37)</sup> in a published study entitled "**The effects of iron deficiency and anaemia on primary school learners' scholastic performance**" conducted in **the Winterveldt area**, they showed that there was no statistical significant between anemia and scholastic achievement but There was statistical significant between anemia and life skills and from the investigator's point of view that iron deficiency anemia affect attention and concentration that reflects on scholastic achievement of student.

## 5. CONCLUSION

**It could be concluded that:** The current study found that the majority of the studied subjects had unhealthy dietary habits, more than half of the studied sample had poor knowledge about iron deficiency anemia, and most of the anemic students of the studied sample had low physical activity and poor scholastic achievement. There were statistically significant relations between iron deficiency anemia and their dietary habits. Also, there was statistical significance between iron deficiency anemia and student's scores of a final exam. There was statistical significance between iron deficiency anemia and students achievement in class.

## 6. RECOMMENDATION

From the previous findings, the following recommendations are suggested:

- Educational programs should be given to students and schools staff about meaning, causes, symptoms, and management of iron deficiency anemia.
- We recommended applying this study to several places to confirm the results.

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