Declaration

I certify that this thesis submitted for the degree of Master is the result of my own research, except where otherwise acknowledged, and that this (or any part of the same) has not submitted for a higher degree to any other university or institution.

Signed…………….

Awad Mosa Sror

Date: 17/06/2007

Acknowledgements

Before all and above I would like to express my endless thanks to all laboratory groups in Arabic Health Center.

I sincerely thank AL-Quds University for giving me the opportunity to study the M.Sc, and help me during my work in this research.

Sincere appreciation and acknowledgment to my supervisor Dr. Hisham Darwish and to Dr. Amer Marie for their generous advise, excellent suggestions, constructive criticism, and valuable assistance.

I would like to thank Mr. Radwan Qasrawi for his help in SPSS analysis, and for his fruitful suggestion.

Finally I would like to thank every one who contributed in the progress of this work, provided help, moral support, and encouragement.

Abstract

Iron deficiency anemia has long been recognized as a common nutritional problem among Palestinian schoolchildren. Data from several sources show that the prevalence of anemia remains high among schoolchildren.

The aim of this study was to determine the status of iron deficiency anemia by assessing the hematological values (hemoglobin, MCV and iron) of schoolchildren, 8-12 years old from selected schools in the central region of the West Bank and to determine the epidemiological factors that contribute to the distribution and severity of iron deficiency among schoolchildren in this region.

Randomly cross sectional study was conducted between Feb and May 2004, to investigate the prevalence of iron deficiency anemia in schoolchildren aged, male and female, 8-12 years, residing in (Bethlehem, Elkader, Bet-sahor and Al-ezarea). The study sample consisted of 688 schoolchildren, 41% males, and 59% females. In the first part of the study, complete blood count (CBC) and iron test was performed .WHO categorization for iron deficiency anemia prevalence was used. In the second part of the study children parents filled a specially designed questionnaire, which include information about various other factors including age, class room, parent's education, socioeconomic status and eating habits .All data were analyzed using One Way ANOVA test.

The results show about 10% males and 7.5% females are suffering from iron deficiency anemia. About 8% males and 6.5 % females are suffering from iron deficiency. There was statistically significant correlation between iron deficiency anemia with the following variables, age (8-12) years ($p<0.009$ at $\alpha=0.05$), parent's education ($p<0.017$), drinking tea one hour after meal ($p<0.025$). No significant correlation was observed between iron deficiency anemia and family income, father and mother job, eating habits (type of food, number of meals, breakfast, soft drink, fresh juice) and vitamin intake.

In general, wrong eating habits and low education level contribute to increased prevalence of IDA among palestinian schoolchildren. So it's necessary to develop plans and strategies to promote dietary improvement. But to promote better iron intake and absorption in family diets, families need to learn about commonly consumed foods and meals that contain iron and those foods that enhance or inhibit its absorption.

List of abbreviations

(Hb)	Hemoglobin
(Hct)	Haematocrit
(MCHC)	Mean corpuscular hemoglobin concentration
(MCV)	Mean corpuscular volume
(IDA)	Iron deficiency anemia
(WHO)	World Health Organization
(RBC)	Red Blood Cell
(CBC)	Complete blood count
(ID)	Iron deficiency
(MA)	Master
(BA)	Bachelor

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CHAPTER ONE

INTRODUCTION

1.1 General Background

Anemia is the most widespread health problem in the world and is estimated to affect one billion individuals worldwide, half of whom are estimated from iron deficiency (WHO, 1990). In most areas of the world, iron deficiency affects primarily infants and young children, where approximately 40 percent of children are anemic (Dallman, 1987).Anemia occurs when the total volume of red blood cells and or the amount of hemoglobin in these cells is reduced below reference values, as defined by healthy populations (Glass et al., 1980).

1.2 Types of anemia

There are several different types of anemia, each with a specific cause and treatment, the classification of anemia can be based on morphologic factor the prospective approach to any individual patient, however, blood count, red cell indicates, reticulocyte count, RBC morphology and specific test can determination of the underlying disease per process. The most straightforward approach to diagnosis of anemia in both children and adults considers several broad catagores: decreased production of RBCs or blood loss, size of RBCs normal (Hoffman, Edward, Benz, Sanford, Shattil, 2005).

Macrocytic Anemia: the macrocytic anemias may be further subdivided based upon the degree to which the MCV is raised and the presence of megaloblastic production in the bone marrow. Slight increase in MCV due to the presence of retics, some instances of aplastic anemia. In all cases, the red cell precursors in the marrow are normal in morphology. Moderate increase in the MCV where MCV >105 and <110 fl, due to liver disease, marked increase in the MCV where MCV > 110 fl, due to megaloblastic anemia due to the lack of vitamin B-12 or folic acid. **Normocytic Anemia:** these are due to either an increased rate of red cell destruction or a failure in red cell production. The presence of specific poikilocytes are often diagnostic. **Microcytic Anemia**: these are associated with an inability to produce hemoglobin. Hemoglobin consists of iron inserted into the prtoporphyrin ring complex to form heme, which in turn is inserted into the globin chain. Hence these anemias are seen in iron deficiency - absence of iron ,chronic disease - iron unavailable ,thalassemia - inability to produce globin chains, sideroblastic anemia- inability to produce heme **.**(Hoffman, Edward, Benz, Sanford, Shattil, 2005).

1.3 Iron deficiency anemia (IDA)

Iron deficiency anemia is an advanced stage of iron depletion. It occurs when storage sites of iron are deficient and blood levels of iron cannot meet daily needs. Blood hemoglobin levels are below normal values with prolonged iron deficiency anemia (Hunt et al., 1994; Nissenson et al., 1999). It is common in all parts of the world including developed as well as undeveloped countries. Though iron deficiency is universal, it is more prevalent among the undeveloped countries, low standard of living ,low socio-economic condition, restricted access to food and lack of knowledge for good dietary practices and personal hygiene contribute even more to high occurrence of iron deficiency and hence anemia(Hall et al., 2001).

1.4 Causes of iron deficiency anemia

Iron deficiency anemia could result from several factors including:

Poor nutrition (type of iron consumed): iron absorption refers to the amount of dietary iron that the body obtains and uses from food. Healthy adults absorb about 10% to 15% of dietary iron, but individual absorption is influenced by several factors. Storage levels of iron have the greatest influence on iron absorption. Iron absorption increases when body stores are low. When iron stores are high, absorption decreases to help protect against toxic effects of iron overload (Bothwell et al., 1979). Iron absorption is also influenced by the type of dietary iron consumed. Absorption of heme iron from meat proteins is more efficient than non-heme iron. Absorption of heme iron ranges from 15% to 35%, and is not significantly affected by diet (Monson, 1988). In contrast, 2% to 20% of nonheme iron in plant foods such as rice, maize, black beans, soybeans and wheat is absorbed (Tapiero et al., 2001). Meat proteins and vitamin C will improve the absorption of nonheme iron(Cook, 1977). Tannins (found in tea), calcium, polyphenols, and phytates (found in legumes and whole grains) decrease the absorption of nonheme iron (Samman et al., 2001).

Body changes, increased iron requirement and increased red blood cell production is required when the body is going through changes such as growth spurts in children and adolescents, or during pregnancy and lactation (Frisancho et al., 1985). Teenage girls start to be at greatest risk of developing iron deficiency anemia because they have the greatest need for iron (Nissenson et al., 1999). Women with heavy menstrual losses can lose a significant amount of iron and are at considerable risk for iron deficiency (CDC, 1998). Adult men and post-menopausal women lose very little iron, and have a low risk of iron deficiency (Bothwell et al., 1979).

Effects of chronic diseases on body iron, were iron deficiency anemia can be associated with certain disease such as kidney failure, especially those being treated with dialysis, are at high risk for developing iron deficiency anemia. This is because their kidneys cannot create enough erythropoietin, a hormone needed to make red blood cells. Both iron and erythropoietin can be lost during kidney dialysis. Individuals who receive routine dialysis treatments usually need extra iron and synthetic erythropoietin to prevent iron deficiency. (Nissenson et al. 1999; Drueke et al., 1997).Vitamin A helps mobilize iron from its storage sites, so a deficiency of vitamin A limits the body's ability to use stored iron, this problem is seen in developing countries where vitamin A deficiency often occurs (Van et al., 1997; Kolsteren et al., 1999). Chronic malabsorption can contribute to iron depletion and deficiency by limiting dietary iron absorption or by contributing to intestinal blood loss. Most iron is absorbed in the small intestines. Gastrointestinal disorders that result in inflammation of the small intestine may result in diarrhea, poor absorption of dietary iron, and iron depletion (Annibale et al., 2001).

Blood loss**,** iron deficiency easily occurs in situations of chronic blood loss. Common causes include heavy menstrual periods, regular blood donation, chronic disorders that involve bleeding, such as peptic ulcers which is an erosion or sore in the wall of the gastrointestinal tract, the mucous membrane lining the digestive tract erodes and causes a gradual breakdown of tissue, this breakdown causes a gnawing or burning pain in the upper middle part of the belly (abdomen), Large ulcers can cause serious bleeding (Spechler et al., 2002).

1.5 Distribution of body iron

Iron is a very essential mineral for the body to stay healthy. It is essential to most life forms and to normal human physiology. In humans, iron is an essential component of proteins involved in oxygen transport. It is also essential for regulation of cell growth and differentiation (Dallman, 1986).

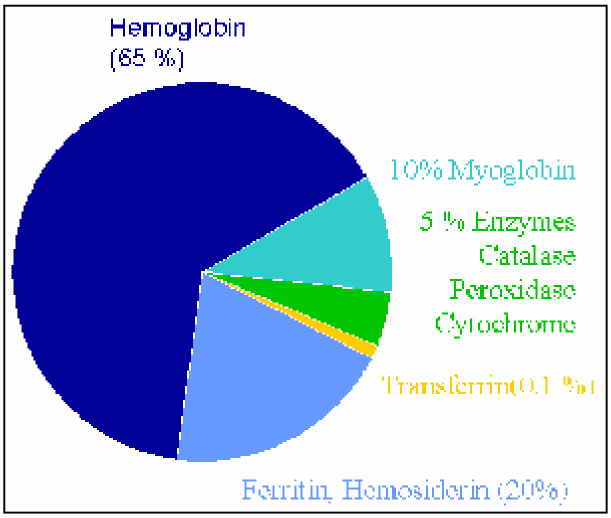


Figure 1.1-body iron Distribution

Figure (1.1) describes the body iron distribution in humans.Almost two-thirds of iron in the body is found in hemoglobin, smaller amounts of iron are found in myoglobin, a protein that helps supply oxygen to muscle, and in enzymes that assist biochemical reactions. Iron is also found in ferritin and hemosiderin that store iron for future needs (Bothwell et al., 1979).

1.6 Dietary sources of Iron

There are two forms of dietary iron: heme and nonheme. Heme iron is derived from hemoglobin, the protein in red blood cells that delivers oxygen to cells. Heme iron is found in animal foods, such as red meats, fish, and poultry. Iron in plant foods such as lentils and beans is arranged in a chemical structure called nonheme iron (Hurrell, 1997). This is the form of iron added to iron-enriched and iron-fortified foods. Heme iron is absorbed better than nonheme iron, but most dietary iron is nonheme iron (Miret et al., 2003).

Heme iron absorbed by a machinery completely different to that of inorganic iron. The process is more efficient and is independent of duodenal pH. Consequently, meats are considered excellent nutrient sources of iron. In fact, blockade of heme catabolism in the intestine by a heme oxygenase inhibitor can produce iron deficiency (Kappas et al., 1993).

A number of dietary factors influence iron absorption. Ascorbate and citrate increase iron uptake in part by acting as weak chelators to help to solubilize the metal in the duodenum. Iron is readily transferred from these compounds into the mucosal lining cells. Conversely, plant phytates and tannins inhibit iron absorption (Conrad and Umbreit, 1993). A variety of heme and nonheme sources of iron are listed in (Appendix 1, 2) in Appendices.

1.7 Iron absorption

Iron absorption occurs predominantly in the duodenum and upper jejunum (Figure 1). The physical state of iron entering the duodenum greatly influences its absorption however. At physiological pH, ferrous iron (Fe^{2+}) is rapidly oxidized to the insoluble ferric (Fe^{3+}) form. Gastric acid lowers the pH in the proximal duodenum, enhancing the solubility and uptake of ferric iron.

Ferric iron utilized a different pathway to enter cell than ferrous iron. This shown by competitive inhibition studies, the use of blocking antibodies against divalent metal transporter-1 (DMT-1) and beta3-integrin and transfection experiments using DMT-1 DNA. This indicated that ferric iron utilizes beta3-integrin and mobilferrin, Which pathway transports most nonhem iron in humans is not know. Most non-hem dietary iron is the ferric iron(Marcel, 2005).

There are other proteins, which appear to be involved in iron absorption. These are stimulators of iron transport (SFT), it is an integral membrane protein that facilitates nontransferrin-bound iron uptake. Is found on the cell surface and on intracellular recycling endosomes where it co-localizes with transferrin, SFT increase the absorption of both ferric and ferrous iron, which is postulated to be important in the transfer of iron from enterocytes into the plasma (Marcel, 2005).

Most iron delivered to nonintestinal cells is bound to transferrin. Transferrin iron is delivered into nonintestinal cells via 2 pathway, the classical transferring receptor pathway (high affinity, low capacity) and the pathway independent of the transferrin receptor (low affinity, high capacity)(Marcel,2005).otherwise, the non-saturability of transferring binding to cell cannot be explained . in the classical transferring pathway, the transferring receptor complex inter the cell within an endosome.acidification of the endosome release iron from transferring so that it can enter the cell. The apotransferrin is recycled back to plasma for reutilization. The method by which the transferring receptor-independent pathway delivers iron to the cell is not known (Marcel, 2005).nonintestinal cell also possess the mobilferrin integrin and DMT-1 pathways. There function in the absence of an iron-saturated transferring is uncertain; however, their presence in nonintestinal cell suggests they may participate in intracellular function in addition to their ability to facilitate cellular uptake of iron(Marcel, 2005).

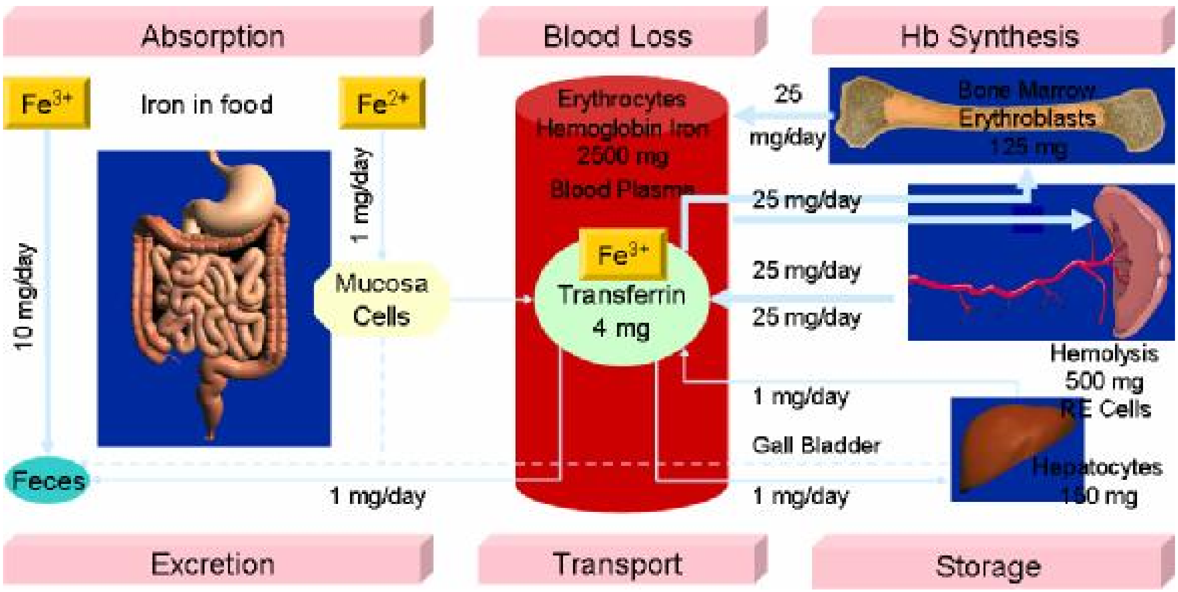


Figure 1.2 Iron metabolisms in the body

1.8 Iron requirements

About 10% of iron in a mixed diet is absorbed. The recommended iron intake is approximately 7 mg/d for term infants aged 5 to 12 months, 6 mg/d for toddlers aged 1 to 3 years and 8 mg/d for children aged 4 to 12 years (National Health and Welfare, 1990). Newborn term infants have approximately 75 mg/kg of body iron, 75% of which is in the form of hemoglobin. On average, infants almost triple their blood volume during the first year of life and will require the absorption of 0.4 to 0.6 mg daily of iron during that time to maintain adequate stores (Duncan et al., 1985).The adult males require approximately 10.0 mg/day and adult females require approximately 15.0 mg/day (Dallman, 1980).

1.9 Diagnosis of anemia and iron deficiency anemia

Iron deficiency anemia suspected

1.9.1 History and physical examination: the clinical signs and symptoms of anemia vary based on the age of the child and the etiology of the anemia. As with most other disorders in medicine, a thorough history and physical examination are important factors in evaluating the child with anemia. Patients with inherited etiologies often present in childhood. Thus, when evaluating the history of an anemic patient, one must not only review the symptoms of the patient, but also needs to pose specific questions regarding family history (Beutler et al., 2001). Signs of anemia include pallor of the skin, conjunctiva, and mucous membranes, tachycardia, orthostatic hypotension, increased heart rate. Symptoms may include fatigue, headache, dizziness and enlarged spleen. Other signs and symptoms depend on the cause for anemia, such as jaundice, dark urine in hemolytic anemia .When the diagnosis of anemia is suspected based on signs and symptoms, it can quickly be confirmed by laboratory evaluation (Hoffman et al.,1995).

1.9.2 Indicators of anemia and iron deficiency

A- Hemoglobin (Hb)

Hemoglobin has been used longer than any other iron status parameter. It provides a quantitative measure of the severity of iron deficiency once anemia has developed. Hemoglobin determination is a convenient and simple screening method and is especially useful when the prevalence of iron deficiency is high, as during pregnancy or infancy (Cook et al, 1992). The limitations of using hemoglobin as a measure of iron status are its lack of specificity (as factors such as B12 or folic acid deficiency, genetic disorders and chronic infections can limit erythropoiesis) and its relative insensitivity due to the marked overlap in values between normal and iron deficient populations (Garby et al., 1969).

B-Hematocrit

The hematocrit is the percent of red blood cells in whole blood. It is a measure of both the number and size of red blood cells. It is a commonly performed in clinical assessment used in surveys of anemia because of its simplicity and widespread availability of modern automated equipment. Hematocrit measurement is an acceptable and recommended method for anemia determination (Hoffman et al, 2005).

C-Mean corpuscular volume (MCV)

A reduction in MCV values occurs when iron deficiency becomes severe, at the same time anemia starts to develop. It is a strong indicator of iron deficiency once thalassemia and the anemia of chronic disease had been excluded. It is calculated by dividing the haematocrit by the red cell count. A cutoff value of 80 fl is accepted as the lower limit of normal MCV value in adults (Hoffman, Edward, Benz, Sanford, Shattil, 2005). Mean corpuscular hemoglobin (MCH) is a calculation of the amount of oxygen-carrying hemoglobin inside your RBCs. Since macrocytic RBCs are larger than either normal or microcytic RBCs, they would also tend to have higher MCH values.

D-Mean corpuscular hemoglobin concentration (MCHC)

MCHC is a calculated index (MCHC= Hgb/HCT), yielding a value of grams of Hgb per 100 mL of RBC. Values in the normal range (33 to 34 g/dL) indicate that cells are normochromic, whereas values lower than normal indicate the presence of hypochromia. When red blood cell loses membrane and/or water, as may be seen with congenital or acquired spherocytosis or during cellular dehydration, an increased MCHC may be present along with hyperchromia that can be appreciated on the peripheral and confirmed on the blood smear (Walters et al., 1996).

E-Red cell distribution width (RDW)

The red-cell distribution width is a relatively new red blood cell parameter, which can be used in combination with other parameters for the classification of anemia. An elevated red-cell distribution width appears to be the earliest hematological manifestation of iron deficiency. It is more sensitive than serum iron, transferrin saturation, or serum ferritin level (van Zeben et al., 1990) A low MCV together with an increased RDW is strongly suggestive of iron deficiency and when accompanied by an increased erythrocyte protoporphyrin, can be considered diagnostic (Bessman et al., 1983).

F-serum iron & serum ferritin

Serum iron is sensitive to the stage of iron deficiency, as levels decrease after body stores are fully depleted but before hemoglobin levels drop. The limitations of using serum iron include its wide diurnal variations and its lack of specificity as low levels may be found after blood loss or donation, pregnancy, chronic infections, shock (Cook et al., 1992).Ferritin is a protein found inside cells that stores iron (McPherson et al., 2007) and is a reliable and sensitive parameter for the assessment of iron stores in healthy subjects (Jacobs et al, 1972) . Ferritin levels below 12 ug/l are highly specific for iron deficiency and denote complete exhaustion of iron stores in adults (Addison et al, 1972). In children, a cut-off value of 10 ug/l has been suggested (Dallman et al, 1980). Serum ferritin levels may be elevated in case of chronic inflammation, infection, malignancy and liver disease (Lipschitz et al, 1974).

1.10 Anemia and Children

Iron deficiency remains a nutritional problem among infants and young children, which can lead to weakness, poor physical growth, increased morbidity, and delayed psychomotor development. In particular, animal studies suggest that iron deficiency early in life could inhibit the function of neurotransmitters, compromising later brain function (Horton et al, 2003).

Newborn term infants have approximately 75 mg/kg of body iron, 75% of which is in the form of hemoglobin. On average, infants almost triple their blood volume during the first year of life and will require the absorption of 0.4 to 0.6 mg daily of iron during that time to maintain adequate stores (Duncan et al., 1985). Dietary sources of Iron are affecting by the amount and the bioavailability of dietary iron. The form of the iron influences its absorption: absorption is good from ferrous sulfate (the iron source generally used in infant formulas) and elemental iron of small particle size (e.g., the electrolytic iron used in infant cereals). In general, iron absorption from foods of animal origin surpasses that from foods of plant origin. Vitamin C, meat, fish and poultry facilitate iron absorption (Fairweather, 1989). Human milk contains only 0.3 to 0.5 mg of iron. About 50% of the iron is absorbed, in contrast to a much smaller proportion from other foods. Term infants who are breast-feed exclusively for the first 6 months may not be at risk for iron depletion or for the development of iron deficiency (Duncan et al., 1985).

Although some term infants who are exclusively breast-fed may remain iron-sufficient until 9 months of age, a source of dietary iron is recommended starting at 6 months (or earlier if solid foods are introduced into the diet) to reduce the risk of iron deficiency (Siimes et al., 1984).

1.11 Anemia in the Eastern Mediterranean Region

Anemia remains a widespread public health problem with major consequences for human health as well as social and economic development(WHO 2001).According to the UNICEF report one billion people suffer from anemia and most of them have iron deficiency anemia , especially in undeveloped an developing countries, where 40-50 % of children are iron deficient (UNICEF, 1998). The information presented in Table 1.1 identifies the Prevalence of anemia in different age group from selected countries of the Eastern Mediterranean Region (WHO, 2004).

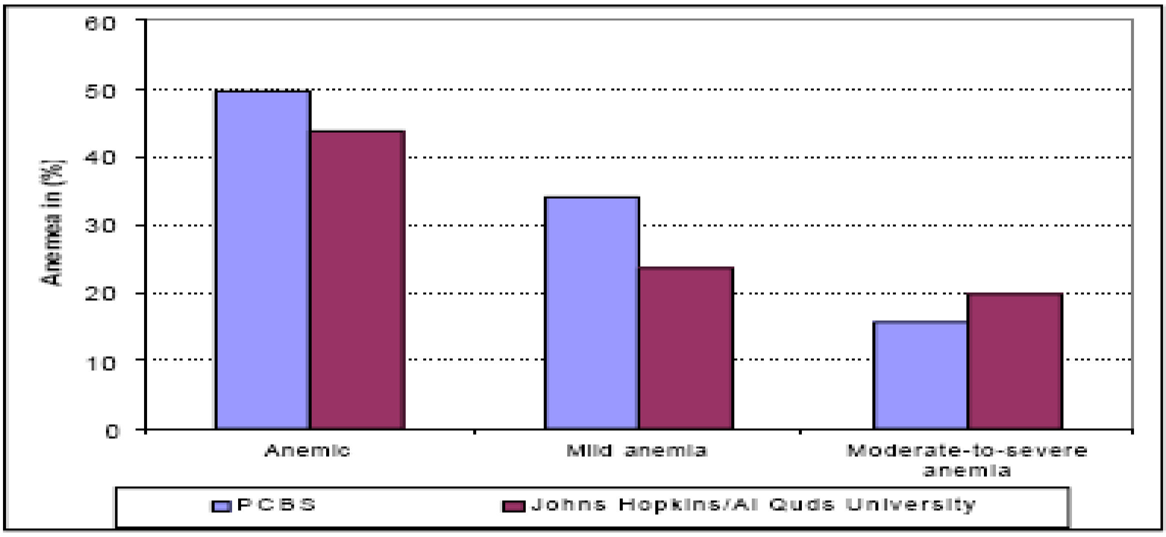
Table 1.1 Distribution of anemia in Eastern Mediterranean Region (Eastern Mediterranean Health Journal, Vol. 10, No. 6, 2004).

Prevalence (%) of anemia in different age group from selected counters of the Eastern Mediterranean Region				
country	Children 6-59 months	Children 5-14 years	Pregnant women	Women of child bearing
Bahrain	48.3	41.6	33.5	37.3
Egypt	25	-	26	11
Jordan	-	15.3	35	28
Lebanon	23		25	-
Saudi Arabia	17.2	15.9		18.3
Syria	23	-	-	40.8
Palestine	52.8	-	44.7	36.2

1.12 Iron deficiency anemia in Palestine

Iron-deficiency anemia is a common problem in Palestine. About 50% of children 6-59 months were estimated to have iron deficiency anemia (John Hopkins-Al-Quds University, 2002).

Figure 1.3 Anemia in Children and Anthropometric Measurements for Children



Source: USAID/CARE International/Johns Hopkins University/Global Management Consulting Group Al Quds University/ Rapid National Nutritional Assessment, West Bank and Gaza, August 2002.

The figures refer to children age 6-59 months. Acute malnutrition or wasting reflects inadequate nutrition in the short-term period immediately preceding the survey. The ratio of a child's weight to height (or in the case of an infant, weight for length) is the commonly used and most accurate indicator of wasting. Chronic malnutrition, or stunting, is an indicator of past growth failure, thus implying a state of longer term (weeks to months to years) under-nutrition. Chronic malnutrition may lead to serious growth and development delays. The ratio of a child's height for age is the most useful indicator for chronic malnutrition. The results also indicated that 60 % of Palestinian children face various difficulties in acquiring sufficient food including closures (60%), curfews (31%), and loss of income (56%). In addition, 61 % of families reported borrowing money to secure food, 43 %

reported using saving, and 32 % relying on food aid. Meat consumption decrease by 68% and anemia prevalence reached about 50 % (John Hopkins, AL-Quds universities 2002).

The Palestinian Ministry of health, WHO, and UNICEF conducted a comprehensive review of nutrition situation among schoolchildren in the West Bank and Gaza strip in 2005. The study showed that there is little information on the nutritional status and dietary habits of schoolchildren, and food sold at some schools have a low nutritional value, and all regulations on the quality of food available to students are not forced (WHO, 2005).

1.13 Study objectives

- To Estimate the prevalence of iron deficiency anemia iron stores status and among schoolchildren (8-12) years old in selected schools in central region of the west bank (Bethlehem, khader, Beit Sahur and Al-Izzaryya).
- To study the correlation between iron deficiency anemia with environmental and nutritional factors.

Chapter Two

Methodology

2.1 Study sample

The study target comprised of 688 primary male and female schoolchildren 8-12 years, the schoolchildren randomly chosen in order to evaluate the prevalence of iron deficiency anemia in this group. Student were identified randomly from four schools, located in (Bethlehem, Khadr, Beit-Sahur and Al-Izzaryya), in the west bank, study location are signed in red square, see figure 2.1. The distribution of the study sample in each school location is shown in Table 2.1.

Table 2.1 Distribution of schoolchildren According to school names

NO	School Institution	location	Screened students
1	Maream Al-athra (girls)	Bethlehem	153
2	Beit-Sahur(boys)	Beit Sahor	133
3	Al-sahed saed al-ass (boys)	Khadr	96
4	That Al-netageen(girls)	Khadr	145
5	Al-Izzaryya (boys)	Al-Izzaryya	53
6	Al-Izzaryya (girls)	Al-Izzaryya	108
	Total		688

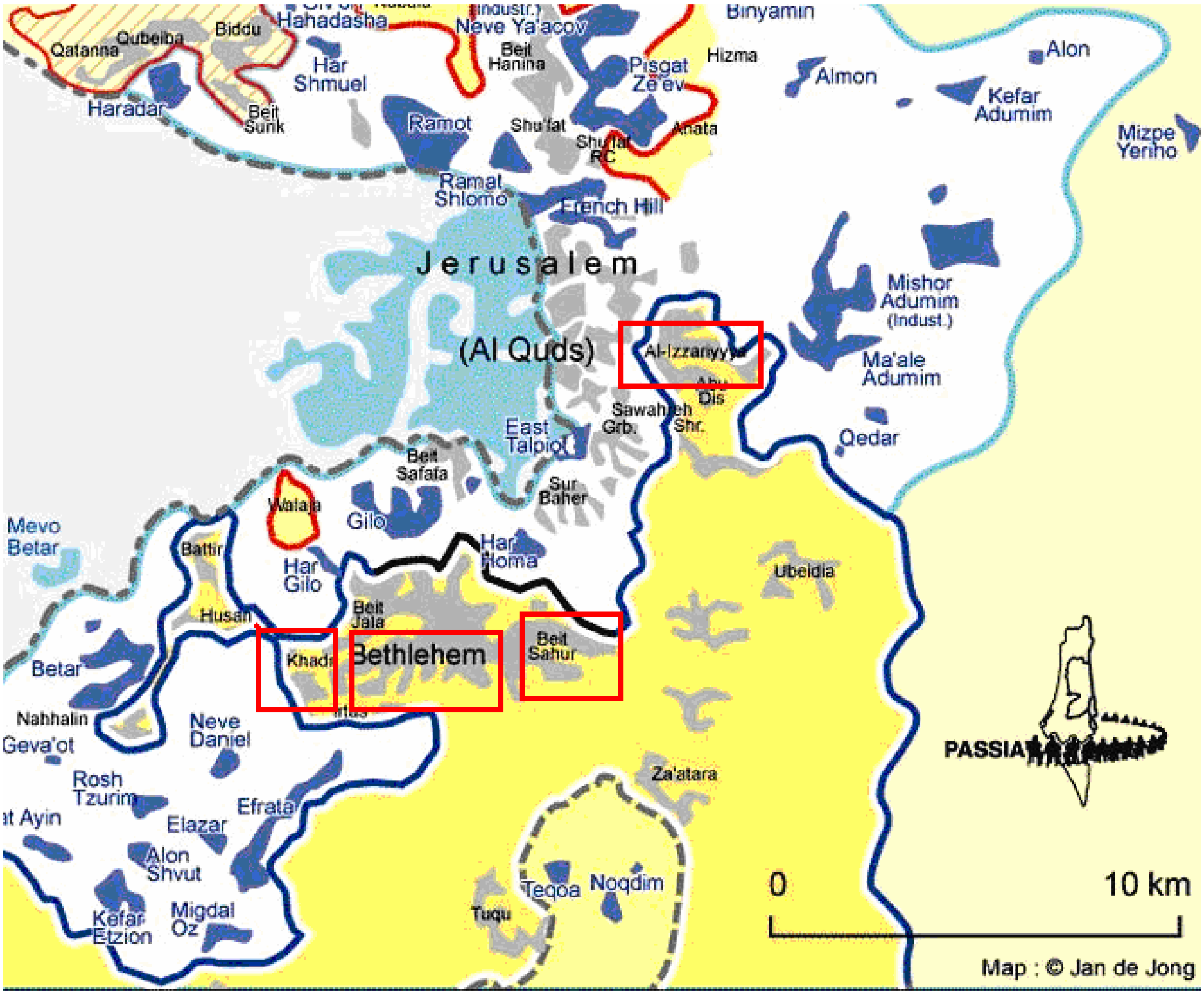


Figure 2.1 Map of study location in the West Bank.

Table 2.2 distributions of schoolchildren according to age and locality

Demographic Characteristic	**Male n**	**Male (%)**	**Female n**	Female (%)
Age group				
8-9	57	20.2	50	12.3
10	98	34.8	109	26.8
11	98	34.8	130	32.0
12	29	10.3	117	28.8
locality				
Bet Sahor	133	47.2	-	-
Khadr	96	34	145	35.7
Al-Izzaryya	53	18.8	108	26.6
Bethlehem	-	-	153	37.3

The sample distribution consisted of 282 (41 %) male students, and 406 (59 %) female students.

2.2 Tools of study

2.2.1 Blood collection

Venous blood, (3 ml) was drawn into appropriate EDTA anticoagulant tubes; blood samples were then brought to the Arab Health center (AHC) in iceboxes and tested for complete blood count (CBC) on the same day using an automated coulter T 660 analyzer. The cell counter was calibrated by BAXTER –DADE (Diff –Trol 3D).

Sample tubes were centrifuged in kubuta centrifuge for 3 minute at 3000 rpm. Plasma was separated and stored in the freezer at -20C. Plasma iron tests were performed on the collected samples, using Atomic-absorption spectroscopy (AA Analyzed 2000); The Atomic Absorption Spectrophotometer was calibrated by Iron atomic spectroscopy standard concentrate 1.000 g/l Fe No_3.

Simple screens are defined as either low hematocrit or low hemoglobin levels. Because of the abnormal thresholds for these two indices, three different parameters for this study were used as indicators for abnormal hematological values, hemoglobin level<11 g/dl, Iron <50 µg/dl and MCV <80 µm^3.WHO standards were followed in analyzing these values in the analyzed samples ,as depicted in tables 2.3, 2.4

All samples with hemoglobin < 11.0 g/dl, MCV <80 µm^3 and iron <50 µg/dl were considered as iron deficiency anemia. IDA Samples with MCV <80 µm^{3,} iron <50 µg/dl, and hemoglobin within normal value were considered iron deficiency (ID) (siberry and Iannone, 2000; Rodger, 1993).

Table 2.3 Hemoglobin cutoff for Children according to WHO criteria

Normal >11.0 g/dl
Mild anemia 10 – 10.9 g/dl
Moderate anemia 7.0 - 9.9 g/dl
Severe anemia <7.0 g/dl

Table 2.4 cutoff values for ID & IDA.

	IDA	**ID**
Hemoglobin(g/dl)	<11.0	>11.0
MCV µm^3(FL)	<80	<80
Serum iron (µg/dl)	<50 (1-9)years <70 (10-12)years	<50 (1-9)years <70 (10-12)years

MCV=mean corpuscular volume. (Siberry and Iannone, 2000; Rodger, 1993)

2.2.2 Collection of epidemiological factor

A specially designed questionnaire was filled by parents of children at household and recollected by school authority (Appendix 4).The goal of the questionnaire was to correlate and relate the status of iron deficiency anemia with other epidemiological factors by means of the following variables: Age, Sex, Location, Household income, Level of education for parents, Parent's job, Eating habits and vitamin intake.

2.2.3 Data processing and analysis

The correlation between the questionnaire results and blood parameters data were analyzed using SPSS software (SPSS Inc., 1999). One Way ANOVA Test used for correlation between iron deficiency anemia with all environmental and nutritional factors.

2.2.4 Limitations

In this study, 688 plasma EDTA samples were taken and analyzed for ferritin levels, but the results were very low due to interference between plasma EDTA ferritin and test methodology. The ferritin results had to be excluded from the study analysis.

Chapter Three

Results and Discussion

3.1 Prevalence of iron deficiency anemia

In Palestine, studies on iron deficiency anemia are very limited; Most of these studies depended on complete blood count as the major diagnostic parameters.

Table 3.1 Summary of hematological parameters for schoolchildren in the central region of the West Bank.

	Male n	Male %	Female n	Female %	TOTAL n	TOTAL %
Hg (g/dl)						
11>	**250**	**88.6**	**370**	**91**	**620**	**90**
10-11	**31**	**10.9**	**32**	**8**	**63**	**9**
7.0-9.9	**1**	**0.5**	**4**	**1**	**5**	**1**
<7.0	*	*	*	*	*	*
MCV (fl)						
>80	**156**	**56**	**269**	**67**	**425**	**62**
≤80	**126**	**44**	**137**	**33**	**263**	**38**
Hct (%)						
>35%	**228**	**81**	**317**	**78**	**545**	**62**
≤35%	**54**	**19**	**89**	**22**	**143**	**38**
RBC (10E12/L)						
>5.0	**47**	**17**	**42**	**10.3**	**89**	**13**
≤5.0	**235**	**83**	**364**	**89.7**	**599**	**87**
Plasma iron (µg/dl)						
1-50	**42**	**15**	**36**	**9**	**78**	**11**
51-70	**46**	**16**	**66**	**16**	**112**	**16**
71-160	**194**	**69**	**304**	**75**	**498**	**73**
MCH(pg)						
>27	**178**	**63**	**304**	**75**	**482**	**70**
≤27	**104**	**37**	**102**	**25**	**206**	**30**
MCHC (g/l)						
>34	**142**	**50.3**	**286**	**70.5**	**428**	**62**
≤34	**140**	**49.7**	**120**	**29.5**	**260**	**38**

* No value. Source of value (Siberry and Iannone, 2000; Rodger, 1993)

Table (3.1), shows all hematological parameters, and used in data analyses. The level of hemoglobin in the table taken according to WHO.

Table 3.2 Mean Hemoglobin and hematocrit values of children according to age.

	Females		Males	
Age	Hb g/dl	Hct (%)	Hb g/dl	Hct (%)
8-9	12.72	37.43	12.88	37.58
10	12.62	35.2	12.7	37.54
11	12.78	36.9	12.57	37.0
12	12.87	37.62	12.73	37.62
Mean	12.74	36.78	12.72	37.43

The distributions of Hb concentration and Hct between children ages 8-12 years is presented in table 3.3, mean Hb concentration was 12.73 g/dl (SD ±0.08) and Hct values mean was 37.1% (SD±0.5). Hb and Hct mean value are very close in males and females, mostly, because there is no hormonal variation effect in this age.

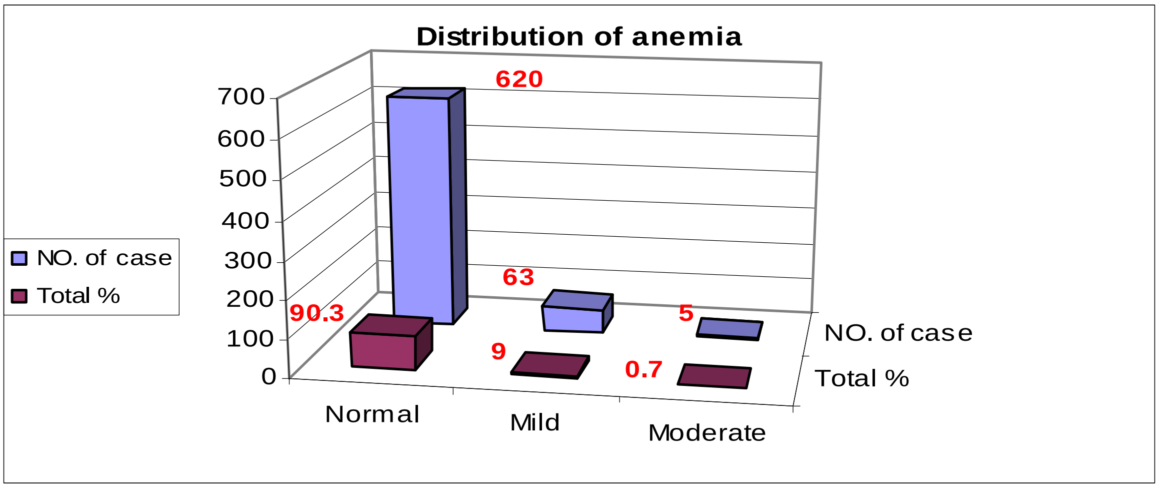


Figure 3.1 Distribution of anemia among 688 schoolchildren.

Figure (3.1), shows the anemia prevalence between primary schoolchildren. The distribution of hemoglobin in children as normal, mild, moderate or severe can be seen in Table (2.3). By that criterion, about 9.9 % of schoolchildren are suffering from anemia.

Other study focused manly on anemia among children 1-5 years between 2002-2004 in Gaza and the west Bank (WHO and MoH, 2004). The results described in figure (3.2), showed that anemia prevalence in Palestine between 2002-2004 decreased. Anemia prevalence percentage in Palestine (23%), lower than Egypt and Jordan (respectively 30% and 34%) and comparable to Lebanon (25%) (WHO and MoH, 2004). There is lack of clarity as to the changing trends in the prevalence of anemia that could be attributed to the use of different cutoff points, and age range in these studies.

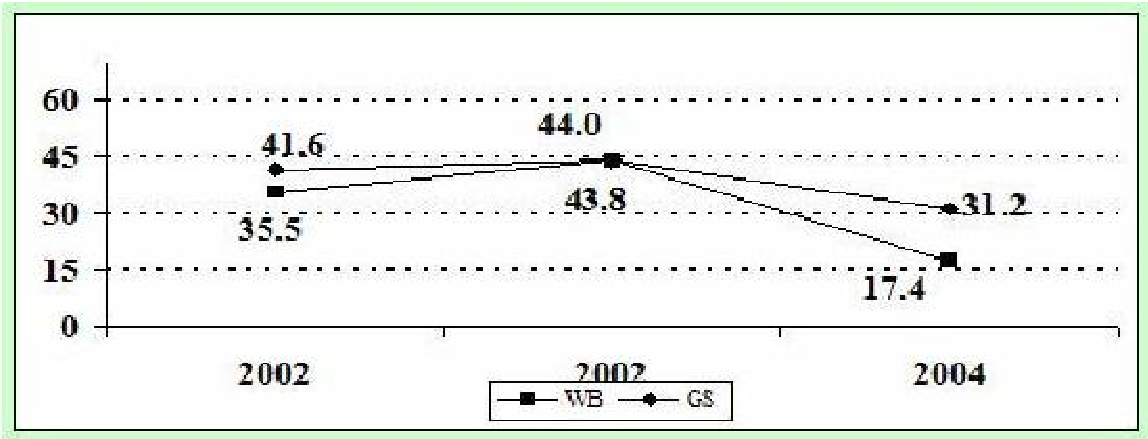


Figure 3.2 Prevalence of anemia 2002 – 2004 (WHO, MoH State of Nutrition in the West bank & Gaza, 2004)

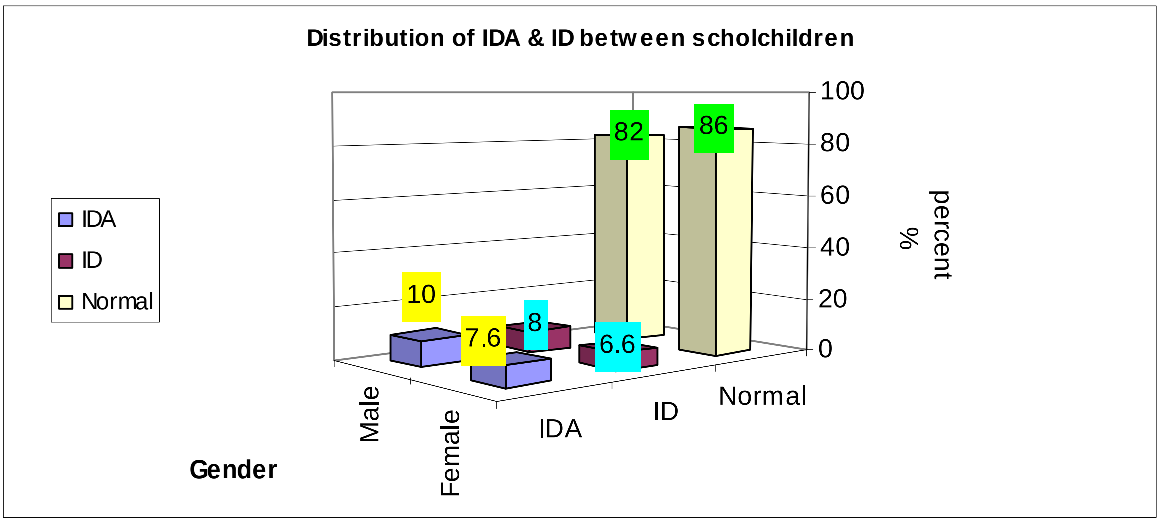


Figure 3.3 Distributions of IDA and ID between schoolchildren.

Figure (3.3), shows the prevalence of IDA and ID among our test group. Cutoff values for the IDA and ID are shown in Table (2.4). The results show about 10 % males and 7.5 % females students are suffering from iron deficiency anemia, 8 % males and 6.5% females are suffering from iron deficiency. There are several possible reasons for this increased risk of ID and IDA in males, Iron is required in highest percentage in males during peak pubertal development because of physiological changes such as rapid growth, hormonal changes, greater increase in blood volume, muscle mass and myoglobin (Dallman et al, 1980). Sex differences in food intake cannot be excluded, but our findings make this an unlikely explanation because there is no significant differences between sexes in complementary food intake, males may be born with smaller iron stores than females, despite their higher birth weight. This would be consistent with the findings of (Choi et al 2000).

Our findings with respect to the prevalence of iron deficiency anemia are less than that reported by UNRWA study in 2005, which showed that the prevalence of iron deficiency anemia in first and ninth grade school children was 14.7% in the West Bank (WHO, 2005).

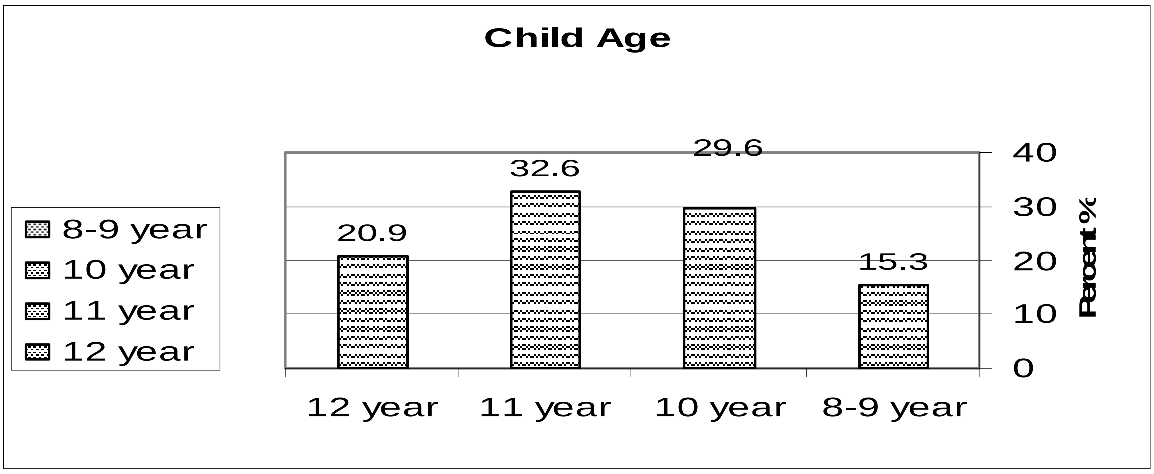


Figure 3.4 Distribution of schoolchildren according to age.

Figure (3.4), show the distribution of schoolchildren in our study according to age, were 15.3 % of schoolchildren age are between 8-9 years, 29.6 % are 10 years, 32.6 % are 11 years and 20.9 % are 12 years old.

Table3.3 ANOVA test between children age with IDA & ID.

ANOVA test(Child Age)					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9.219	2	4.61	4.741	0.009
Within Groups	666.06	685	0.972		
Total	675.279	687			

In table (3.3), describes the results of the ANOVA test used to evaluate correlation between schoolchildren age and IDA. The prevalence of Iron deficiency anemia in all studied age groups are statistically significant (***p***<0.009) at **α** = (0.05). That means children aged between 8-12 years have a strong risk acquire to be IDA.

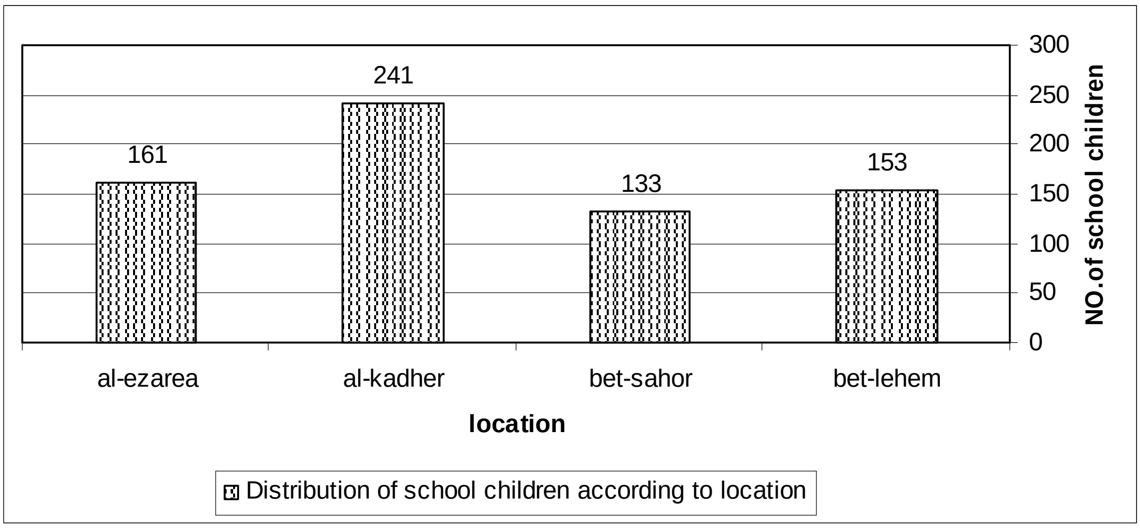


Figure 3.5 Schoolchildren distribution according to locality.

Figure (3.5), shows the distribution of schoolchildren in our study group according to place of residence. Where 153 schoolchildren live in Betlehem, 133 are live in Beit sahur , 241 in khader and 161 in Al-izzaryya

Table 3.4 Distribution of IDA & ID according to location.

locality	IDA %	ID%	Nnormal%
Bethlehem	7.1	10.3	82.6
Beit Sahour	9.6	6.6	83.8
kadher	10.1	5.7	84.2
Al-ezzaryya	6.8	6.2	87
Mean	8.4	7.2	84.4
SD	±1.45	±1.55	±1.3

Table (3.4), shows the correlation between IDA & ID according to location. were in Bethlehem IDA is 7.1% and ID is 10.3% , in Beit Sahur IDA is 9.6% and ID is 6.6 %, Khader IDA is 10.1 % and ID is 5.7 %, Al-Izzaryya IDA is 6.8 % and ID is 5.7 %.

Table 3.5 ANOVA test between IDA & ID with locality.

locality	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.180	3	.393	.432	.730
Within Groups	622.489	684	.910		
Total	623.669	687			

Table (3.5), shows the relation between iron deficiency anemia prevalence and locality. According to location (were children live), there was no statistically significant difference (***P***<0.730). This finding indicates that schoolchildren living in the study area share similar nutritional conditions and eating habits.

3.2 Effects of parent's education on distribution of IDA & ID.

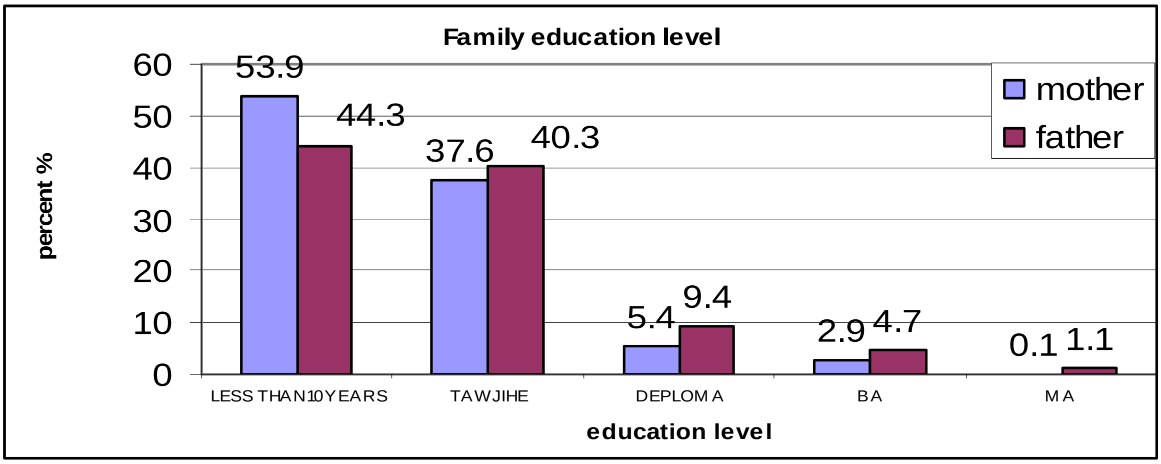


Figure 3.6 Distributions of educational level between father and mother.

Figure (3.6), describes the distribution of education level between children parents. as less than 10 years, Tawjihe (high school exam), diploma, BA or MA, clearly, large percentage 53.9 % of mother and 44.3 % of father education level was below 10 years. While only a small percentage (mothers 8.4 %, fathers 15.4 %) acquired graduate education level.

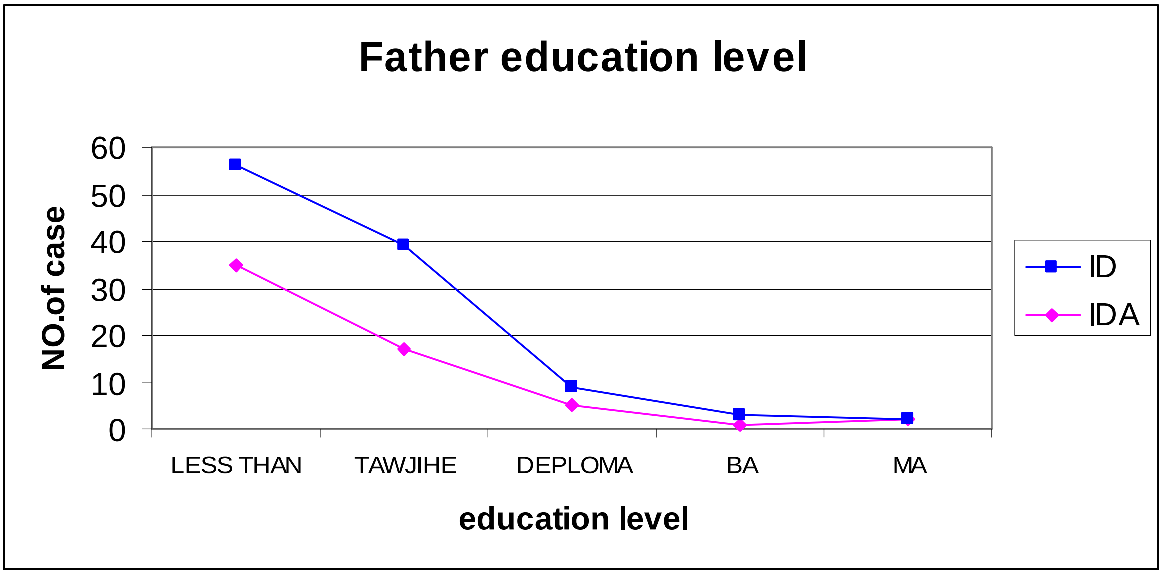


Figure 3.7 Correlations between father educations with IDA, ID.

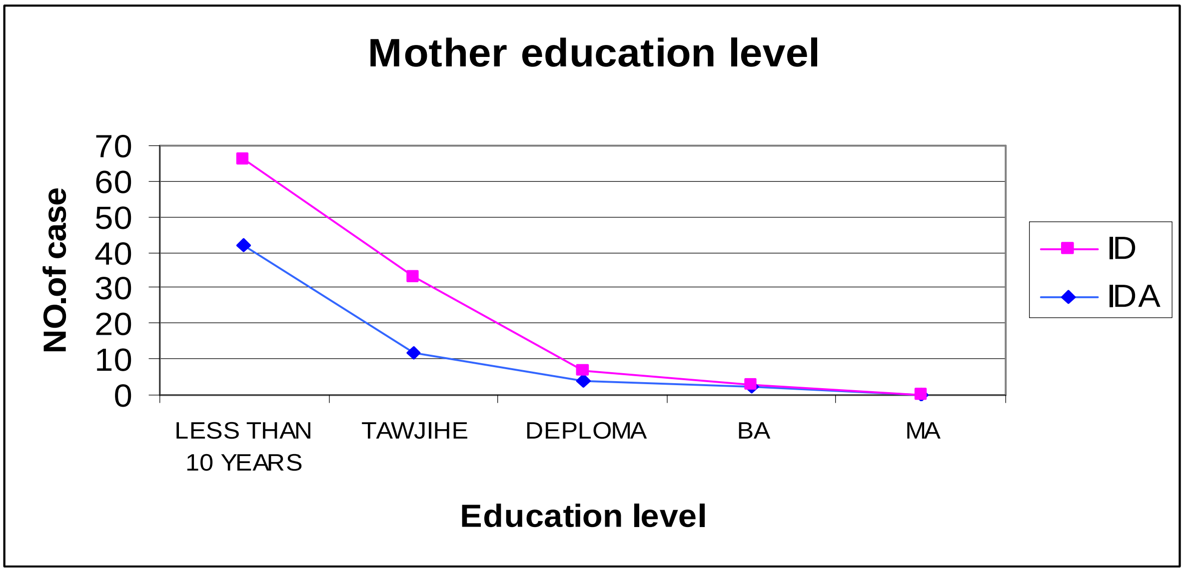


Figure 3.8 Correlations between mother educations with IDA, ID.

Figure (3.7) and (3. 8), shows the correlation of IDA & ID between fathers and mothers education level. The percentage of schoolchildren with IDA & ID and mothers education below 10 years was higher than for fathers, indicate that the education level of mothers have strongly affect the IDA & ID distribution. Where it is know that 93.3 % of mothers are housekeepers (see table 3.8).

Table 3.6 ANOVA test between IDA & ID with father education.

Father Education	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	32.792	2	16.396	2.981	.040
Within Groups	3767.718	685	5.500		
Total	3800.510	687			

Table 3.7 ANOVA test between IDA & ID with mother education.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	46.834	2	23.417	4.094	.017
Within Groups	3917.676	685	5.719		
Total	3964.510	687			

Table (3.6) and (3.7), shows the correlation between anemia of iron deficiency and parents education level. The values clearly show that there was statistically significant correlation with both, fathers (***P***<0.040) and mothers (***P***<0.017) .This strongly indicates that the level of parents education significant affect the prevalence of iron deficiency among children. This many reflect on parents knowledge about Food with high Sources of Heme and non-heme Iron and possible, the effect of iron inhibitors that can be effective .

3.3 Effect of parent's employment level on IDA & ID distribution.

Table 3.8 distribution of father and mother employment level.

Work group	**Father**		**Mother**	
	Frequency	Percentage	Frequency	Percentage
Worker	350	50.1	6	0.9
Employee	70	10	15	2.1
Teacher	22	3.1	16	2.3
Free job	81	11.6	2	0.3
Driver	62	8.9	-	
House Keeper	-	-	652	93.3
Other	114	16.3	8	1.1
TOTAL	699		699	

Table 3.9 distributions of IDA & ID with father and mother Employments.

Employment	Father (N)			Mother (N)		
	IDA	ID	Normal	IDA	ID	Normal
Worker	30	22	294	1	1	4
Employee	4	8	54	1	2	11
Teacher	1		18	2	1	12
Free job	12	6	62	*	*	2
Driver	5	5	51	*	*	*
Other	8	8	97	2		6
House-keeper	*	*	*	54	45	544

* No value, N =number of case.

Table (3.9), shows the distribution of IDA and ID according to father and mother employments. The percentage of IDA and ID in mother housekeeper is high, where about 54 cases are IDA and 45 cases are ID.

Table 3.10 ANOVA test between IDA & ID with father job.

Father job	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.339	2	.169	.043	.958
Within Groups	2723.312	685	3.976		
Total	2723.651	687			

Table 3.11 ANOVA test between IDA & ID with mother job.

Mother job	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.738	2	.369	.905	.405
Within Groups	279.488	685	.408		
Total	280.227	687			

Table (3.10) and (3.11), shows, the relation between iron deficiency anemia prevalence and type of parents work. there was no statistically significant difference with either, fathers (***P***<0.958) and mothers (***P***<0.405) employment type.

3.4 Effects of parent's income on distribution of IDA & ID.

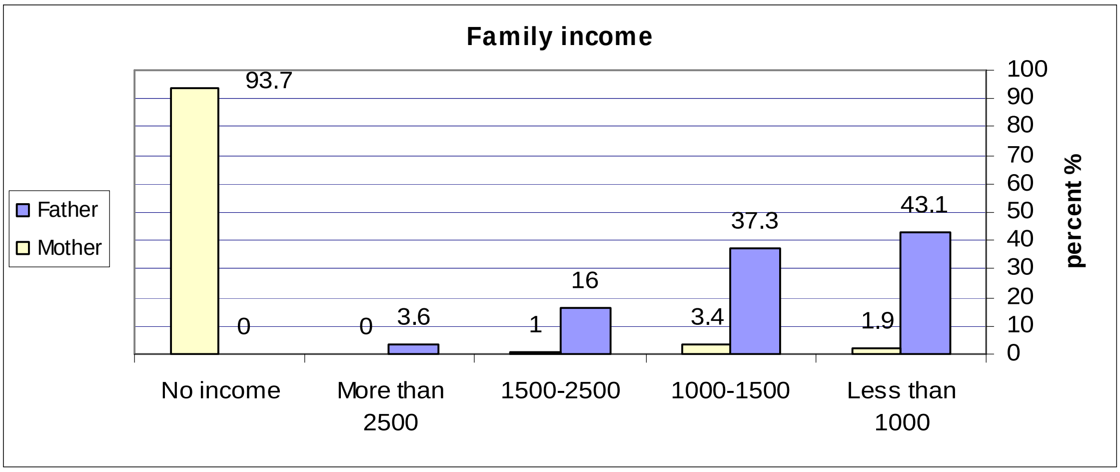


Figure 3.9 Distribution of household income.

Figure (3.9), shows total family monthly income reported in categories range from less than 1000 Sheqel, 1000-1500 Sheqel, 1500-2500 Sheqel and more than 2500 Sheqels. According of this distribution, 80.4% are reported as low incomes, 16% with middle income and 3.6% having high income; Further more 93.7% of mothers had no income. 18.6% from school children have iron deficiency anemia, which live in low income.

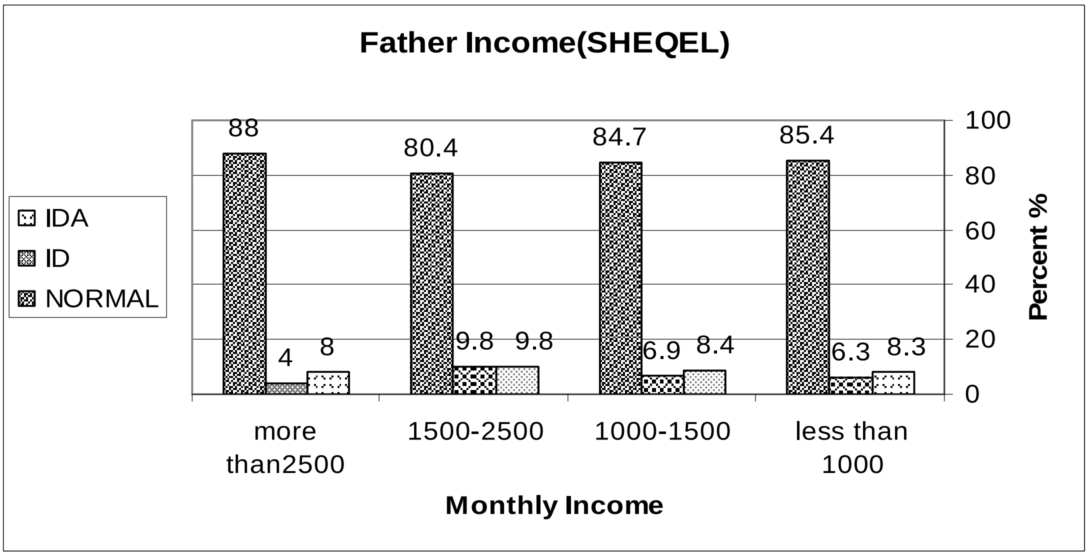


Figure 3.10 Correlations between father incomes with IDA, and ID.

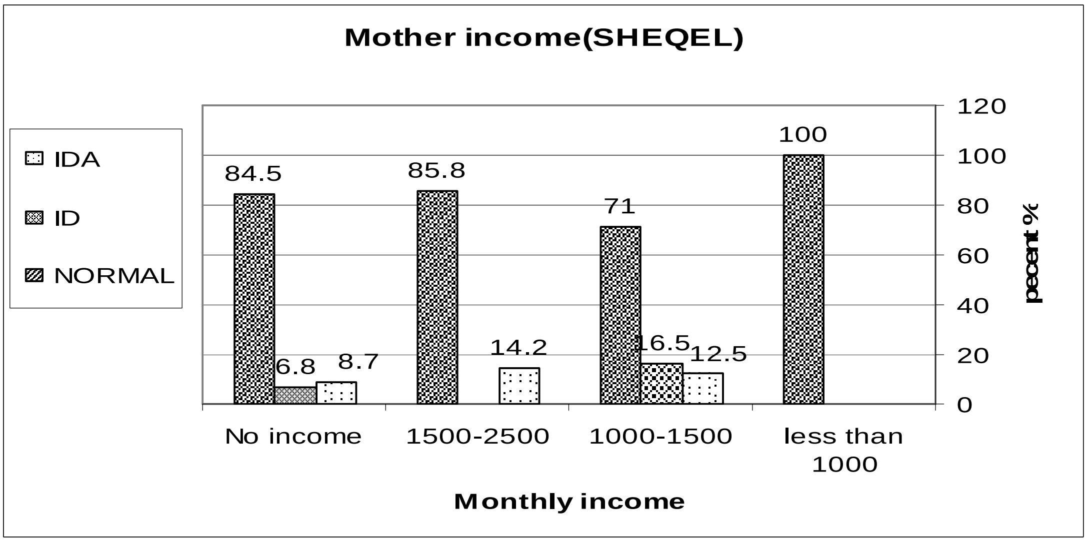


Figure 3.11 Correlations between mother incomes with IDA, ID.

In 2002, the Israeli occupation forces re-occupied West Bank cities and brought unprecedented curfews and closures. Income levels deteriorated at alarming rates and consumption indicators revealed that a growing number of Palestinians were living in conditions of poverty and hardship (Johns Hopkins, Al Quds University, 2002).

According to the World Bank, poverty increased from (44) to (60) % in 2002. UNISCO estimates that the 60 % level has already been reached, with the levels at approximately 55 % in the West Bank and 70% in the Gaza Strip and more than 56 percent of households reported having lost more than 50 % of their income (Nutrition Survey, PCBS, 2002)

Table 3.12 ANOVA test between IDA & ID with Father Income

Father Income	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.469	2	.235	.338	.713
Within Groups	475.043	685	.693		
Total	475.512	687			

Table 3.13 ANOVA test between IDA & ID with mother Income

Mother Income	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.157	2	7.860	.134	.875
Within Groups	401.899	685	.587		
Total	402.057	687			

Table (3.12) and (3.13), shows the relation of IDA with father and mother income. Interestingly, these Results show is no statistically significant difference for either fathers (***P***<0.0.713) and mothers (***P***<0.0.875) income.

3.5 Dietary screening for IDA

Next, we attempted to investigate potential correlation between prevalence of iron deficiency anemia and eating habits and food nutrition, in Table (3.14), shows the various food variables that were considered and these correlations with ID & IDA.

Table 3.14 prevalence of IDA & ID with eating habits.

Eating habits	Answers	Total(N)	ID(N)	ID (%)	IDA (N)	IDA (%)
Dose you meal take include						
Spinach	**Yes**	**274**	**18**	**2.6**	**21**	**3**
	No	**353**	**26**	**3.7**	**31**	**4.5**
	Don't know	**61**	**5**	**0.7**	**8**	**1.2**
Falafel	**Yes**	**546**	**41**	**6**	**46**	**6.6**
	No	**139**	**7**	**1**	**14**	**2**
	Don't know	**3**	**1**	**0.1**	*****	*****
Meat and beef	**Yes**	**514**	**37**	**5.3**	**42**	**6.1**
	No	**167**	**11**	**1.5**	**18**	**2.6**
	Don't know	**7**	**1**	**0.1**	*****	*****
Soft drink	**Yes**	**473**	**35**	**5**	**39**	**5.6**
	No	**209**	**14**	**2**	**21**	**3**
	Don't know	**6**	*****	*****	*****	*****
Fresh juice	**Yes**	**202**	**16**	**2.3**	**20**	**2.9**
	No	**445**	**30**	**4.3**	**37**	**5.3**
	Don't know	**31**	**3**	**0.4**	**3**	**0.4**
Seeds	**Yes**	**232**	**15**	**2.3**	**16**	**2.3**
	No	**443**	**33**	**4.7**	**43**	**6.2**
	Don't know	**13**	**1**	**0.1**	**1**	**0.1**
Bamba	**Yes**	**589**	**42**	**7.2**	**50**	**6**
	No	**97**	**7**	**1.4**	**10**	**1**
	Don't know	**2**	*****	*****	*****	*****

N=number of case, *=No value

As table (3.14), shows children who eat spinach and drink, fresh juices have both (IDA and ID) less than those that do not. This may be due to that spinach contains little amount of inorganic iron, while fresh juices enhance the absorption of iron through their acidic contents: vitamin C (ascorbic acid), and other organic acids such as (malic acid). Laboratory research has shown that some type of food (such as fresh salad, orange juice) providing 70-105mg of vitamin C in each meal which increased the absorption of iron (Hallberg, 1986). However, children who eat falafel and meat have IDA and ID more than those who do not. This may be due to the limitation in our questioner were the type of the questions were mostly is qualitative and not quantitative. This means that question asks about the frequency and quantity of such type of food would have given a much better evaluation regarding this point might consume.

Our results show the relation between IDA prevalence rates and all of the following food items are not statistically significant: spinach (p<0.401), falafel (p<0.828), meat (p<0.809), soft drink (p<0.468), fresh juice (p<0.908), seeds (P<0.274), bamba (P<0.905). For table of ANOVA test see (appendices 3).

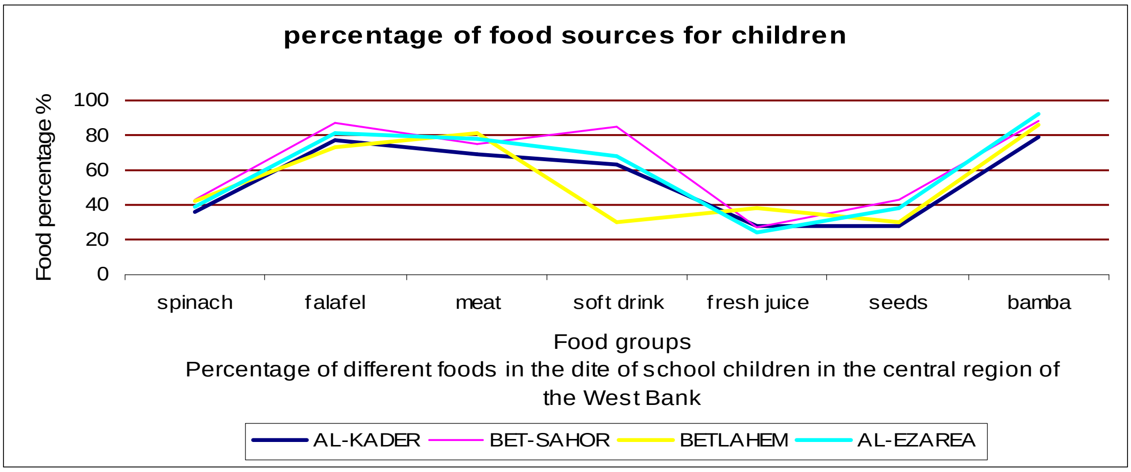


Figure 3.12 Percentages of different foods consumption in the diet of schoolchildren according to their location.

Figure (3.12), shows the type of food, consumed by schoolchildren in the different studied locations. The same percentage of food type's consumptions is noticed except in drinking soft drinks in the regions: where in Bethlehem is (low) and Beit-Sahur is (high). There is no clear explanation for this percentage difference in both regions.

Table 3.15 Correlation between eating breakfast every day with IDA**.**

	Do you take breakfast meal every day		Total
IDA category	Yes	No	
IDA	31	29	60
ID	28	21	49
Normal	314	276	590
Total	373	326	699

The habit of providing children with breakfast as one of the main factors that maintain good health and its relation to ID and IDA was also evaluated (Carroll, 1993). The results shows that 53% of our schoolchildren take daily breakfast meal and 4.4 % of them have IDA table (3.15).

Table 3.16 ANOVA test between IDA & ID with breakfast meal every day

breakfast meal every day	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.406	2	4.203	.168	.845
Within Groups	171.008	685	.250		
Total	171.092	687			

Table (3.16), shows correlation between IDA prevalence rate and breakfast meal intake. Results are not statistically significant (***P***<0.845).

Figure 3.13 Correlation between numbers of dally main meals with IDA and ID.

Figure (3.13), shows the distribution of IDA & ID with number of daily meals. Only 48.5% children take three meals, from whom 4% children have IDA. In general, male need 12 mg of iron per day, while female need 15 mg (Herbert et al., 1995).again these result, lack the quantitative evaluation of the consumed meals and nutritional value in relation to iron content.

Table 3.17 ANOVA test between IDA & ID with number of daily meals

number of daily meals	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.981	2	2.491	.067	.935
Within Groups	253.530	685	.370		
Total	253.580	687			

Table (3.17), shows the correlation between IDA prevalence rate with main meal consumption per day. Results are not statistically significant (***P***<0.935).

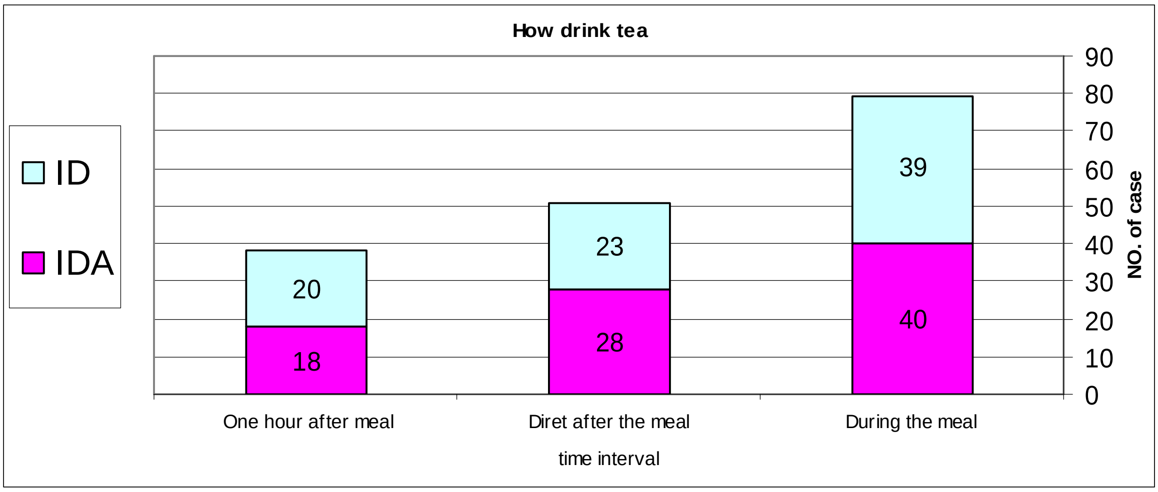


Figure 3.14 Correlations between drinking tea during, direct and after meals and IDA & ID (see appendices 4, 5, 6)**.**

Figure (3.14), shows the correlation between schoolchildren drinking tea during and after taking the meal. The percentage of IDA decreases with the time interval between meal and drinking tea. Several dietary factors inhibit iron absorption such as plant components in vegetables, tea and coffee (e.g., Tannins, polyphenols, phytates) (Samman et al., 2001). In individuals with low intakes of heme iron, low intakes of enhancing factors and/or high intakes of inhibitors, iron absorption will be at risk. Depletion of iron stores enhances iron absorption, but this effect is not adequate to compensate for the inhibition of iron absorption in such an inadequate dietary situation. (Zijp, 2000).

Table 3.18 ANOVA test between IDA & ID with drinking tea during meal

Drinking tea during meal	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.556	2	.278	1.314	0.56
Within Groups	144.954	685	.212		
Total	145.510	687			

Table 3.19 ANOVA test between IDA & ID with drinking tea direct after a meal

Drinking tea direct after a meal	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.812	2	9.058	.036	0.206
Within Groups	171.697	685	.251		
Total	171.715	687			

Table 3.20 ANOVA test between IDA & ID with drinking tea one hour after a meal

Drinking tea one hour after a meal	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.779	2	.389	1.61	0.025
Within Groups	165.452	685	.242		
Total	166.231	687			

Tables (3.18) and (3.19) show that there is no statistically significant (***P***<0.56) between IDA prevalence rate and tea drinking during meals except for drinking tea after taking the meal with one hour(***P***<0.025) (table 3.20).

Table 3.21 Symptoms for IDA or ID diagnostic

Symptoms of Anemia		
	Frequency	Percent
head aches	43	6.2
weak nails/ split	20	2.9
dizziness	32	4.6
no appetite	1	0.1
nothing	592	86.3
Total	699	100

Table (3.21), shows the distribution symptoms of anemia between schoolchildren. Headaches and dizziness was the most definite signs and symptoms were reported among the affected individuals. Table (3.22), shows the correlation between symptoms and IDA &ID, about 73.2 % do not feel anything, and in weak nails symptoms 1.2 % have IDA & ID.

Table 3.22 Correlation between symptoms and IDA & ID.

	IDA	ID	Normal
Head aches	0.6	0.4	4.7
Nothing	7.2	6	73.2
Dizziness	*	0.4	4.2
No appetite	*	*	0.1
Weak nails/ split	0.9	0.3	1.7

* No value

Table 3.23 ANOVA test between IDA and symptoms.

IDA & DA symptoms	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.612	2	1.806	3.179	.042
Within Groups	389.212	685	.568		
Total	392.824	687			

Table (3.23), shows the correlation between weak nails symptoms and IDA or ID. Results are statistically, significant (***P***<0.042).

3.6 Effects of vitamins supplement on distribution of IDA & ID

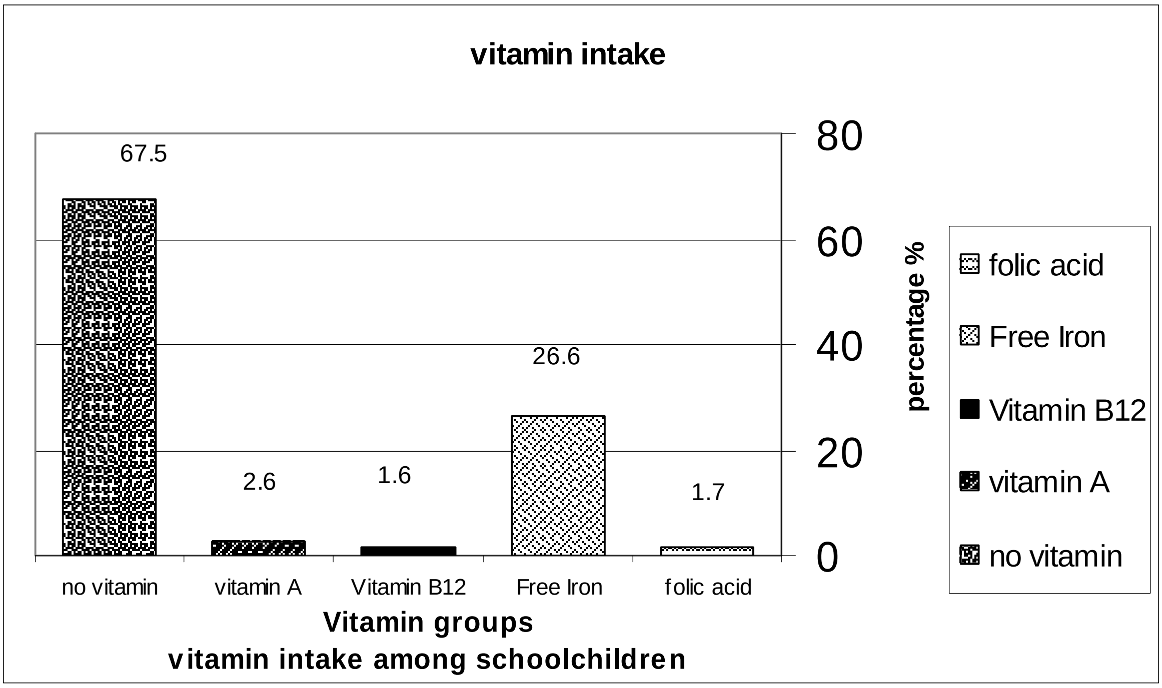


Figure 3.15 Percentages of vitamin pills intake in school

Figure (3.15), shows the distribution of vitamin intake by schoolchildren. In school/ home, about 67.5 % children don not take this vitamin pills, and only about 26.6 % students take vitamins**.** In April 2004, the Ministries of Health and Education in the Palestinian National Authority decided to make a plane strategy to prevent ID in schoolchildren. One of these strategies was to supplement schools with iron pills. Teachers were instructed to give each child in their school one iron pills per day (Palestinian Ministry of Health report. 2004). However, only 26.5 % students took these pills making this outcome of the strategy unsuccessful. The rejection –to take the pills by schoolchildren- reason was mostly due to the bad taste of these pills. Definitely finding natural product rich with iron and convenient for children would overcome this problem.

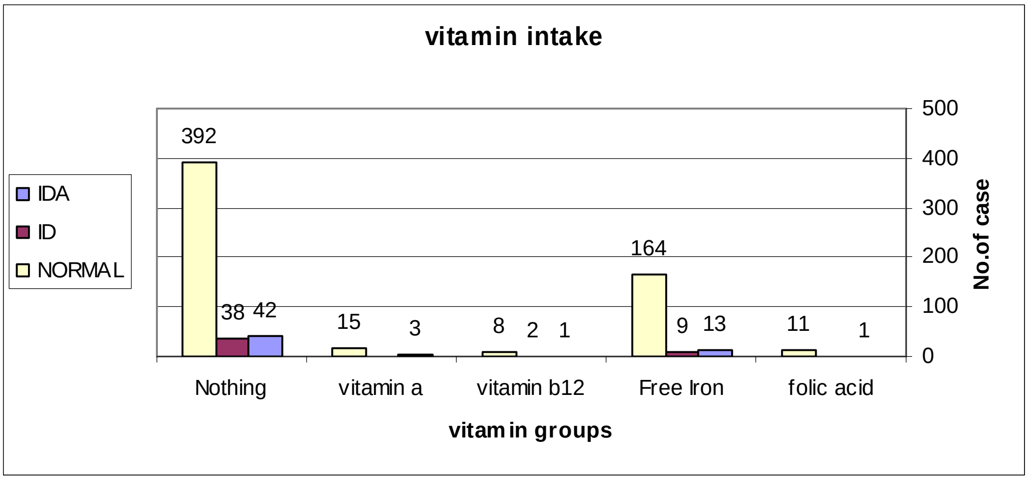


Figure 3.16 Correlation between vitamin intake and IDA and ID

Figure (3.16), shows the distribution of IDA& ID between schoolchildren, who take vitamin pills in school and home. There was no correlation between IDA and ID in children who take vitamins and those that do not. Table (3.24), shows the distribution of IDA& ID between schoolchildren who take vitamin pills. The result was statistically not significant (***P***<0.197).

Table 3.24 ANOVA test between IDA and vitamin intake

Vitamin intake	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.223	2	3.111	1.629	.197
Within Groups	1308.428	685	1.910		
Total	1314.651	687			

CONCLUSION

This study fills a gap in IDA survey in school student's ages 8-12 years, in different area localities in the central region of the West Bank, including Bethlehem, khadr, Beit Sahur and Al-Izzaryya. The study also correlates IDA and ID with different parameters. Significant results are evident with in some parameters, including age of children, parent's education level, drinking tea one hour after a meal, and anemia symptoms. However, non- significant results were detected with locality, family income, parent's works, type of food, eating habits and vitamins intake. Future work should be done on quantitative bases of schoolchildren diets and removing some of the limitations that are described our work.

RECOMMENDATIONS

According to our findings, which show a relatively high percentage of children age 8-12 years suffering from iron deficiency anemia (9.9%) therefore, more attention should be drawn to the health issue .More detailed survey studies should be implemented on regular base, with quantities evaluation, and these study should include all schoolchildren in all ages in the West Bank specially those in the growth stage, clearly deferent social and environmental condition, that determinate the more specific results from which we can draw a specific conclusion concerning iron deficiency anemia among schoolchildren in the West Bank.

The Palestinian national Authority, Ministries of Health and Education, need to develop plans and strategies to promote dietary improvement as part of their integrated strategies to prevent iron deficiency. These include iron supplementation programs that might include fortification of foodstuff; Especially designed educational program through curriculum; Other educational program targeted both for children and parents utilizing various media or channels. While nutrition educational activities alone may not affect behaviors sufficiently to solve the problem of iron deficiency, they are an essential component of any effective and sustainable program. In order to promote better iron intake and absorption in family diets need to learn what commonly consumed foods and meals contain iron and those foods that enhance or inhibit its absorption.

Monitoring of food stuffs sold an school canteens and have strict guidelines for these items.

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Appendices

Appendix 1 Food Sources of Heme Iron

Food Source	Serving Size (oz.)	Iron (mg)
Beef, liver	3.0	7.5
Beef, corned	3.0	2.5
Beef, lean ground; 10% fat	3.0	3.9
Chicken, breast w/out bone	3.0	0.9
Chicken, leg w/bone	2.0	0.7
Chicken, liver	3.0	7.3
Cod, broiled	3.0	0.8
Flounder, baked	3.0	1.2
Salmon, pink canned	3.0	0.7
Shrimp, 10 - 2 1/2 inch	1.1	0.5
Tuna, canned in water	3.5	1.0
Turkey	3.0	2.0

Appendix 2. Food Sources of Nonheme Iron

Food Source	Serving Size	Iron (mg)
Baked beans, canned	1/2 cup	2.0
Bread, white	2 slices	1.4
Bread, whole wheat	2 slices	1.7
Broccoli, cooked	1/2 cup	0.6
Broccoli, raw	1 stalk	1.1
Kidney beans	1/2 cup	3.0
Macaroni, enriched, cooked	1 cup	1.9
Peas, frozen and prepared	1/2 cup	1.3
Prune juice	1/2 cup	1.5
Rice, brown, cooked	1 cup	1.0
Rice, white enriched, cooked	1 cup	1.8
Spaghetti, enriched, cooked	1 cup	1.6
Spinach, cooked	1/2 cup	2.0

Food items and weights in the single nutrient reports are adapted from those in 2002 revision of USDA Home and Garden Bulletin No. 72, Nutritive Value of Foods.
OZ =28.35 g,

Appendix 3 ANOVA test

ANOVA test					
spinach	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.718	2	.359	.916	.401
Within Groups	268.339	685	.392		
Total	269.057	687			
Falafel					
Between Groups	6.653E-02	2	3.326	.189	.828
Within Groups	120.374	685	.176		
Total	120.440	687			
meat and beef					
Between Groups	9.135E-02	2	4.568	.212	.809
Within Groups	147.291	685	.215		
Total	147.382	687			
soft drink					
Between Groups	.111	2	5.573	.236	.790
Within Groups	161.899	685	.236		
Total	162.010	687			
seeds					
Between Groups	.388	2	.194	.760	.468
Within Groups	174.901	685	.255		
Total	175.289	687			
bamba					
Between Groups	2.616E-02	2	1.308E-02	.099	.905
Within Groups	90.147	685	.132		
Total	90.173	687			
juice during the meals					
Between Groups	4.770E-02	2	2.385E-02	.097	.908
Within Groups	168.877	685	.247		
Total	168.924	687			

Appendix 4 Correlation between drinking tea during meals & IDA.

how drink tea during the meals			
	Yes	No	Total
IDA	40	20	60
ID	39	10	49
Normal	406	184	590
Total	485	214	699

Appendix 5 Correlation between drinking tea direct after meals & IDA.

how drink tea direct after the meals			
	Yes	No	Total
IDA	28	32	60
ID	23	26	94
Normal	281	309	590
Total	332	367	699

Appendix 6 correlation between drinking tea one hour after meals & IDA.

how drink tea one hour after a meals			
	Yes	No	Total
IDA	18	42	60
ID	20	29	49
Normal	247	343	590
Total	285	414	699

Appendix 7

جامعه القدس
كليه العلوم/الدراسات العليا
بالتعاون مع مركز الصحة ألمدرسيه والإرشاد التربوي

ولي أمر الطالب:-
أرجو التكرم بتعبئة الاستمارة، مع العلم أن هذه المعلومات ستستخدم فقط من اجل البحث العلمي و ستعامل بكامل ألسريه و الخصوصية.وأرجو العلم انه لا يوجد معلومات صحيحة أو خاطئة إنما هي معلوماتكم الخاصة التي ستساعدنا على القيام بالدر اسه التي نحن بصددها والتي تهدف إلى دراسة نسبه فقر الدم في الأطفال ما بين الفئة ألعمريه (8-12) عاما في محافظه بيت لحم و ضواحي القدس والتي ستقدم استكمالا لمتطلبات الحصول على درجه الماجستير

أكمل المعلومات في الجداول الآتية :

المديرية	□ بيت لحم □ ضواحي القدس
ألمدرسه:	
جنس الطالب/ ة :	□ ذكر □ أنثى العمر ( )
الصف:	□ ثالث أساسي □ رابع أساسي □ خامس أساسي □سادس أساسي
تعليم الأب:	□ اقل من توجيهي □ توجيهي □ دبلوم □ بكالوريوس □ ماجستير
تعليم ألام :	□ اقل من توجيهي □ توجيهي □ دبلوم □ بكالوريوس □ ماجستير

اجب عن الأسئلة الآتية بوضع ☒ لاختيار الإجابة المناسبة

عمل الأب:	□ عامل □ موظف □ مدرس □ عمل حر □ سائق □ غير ذلك	الدخل الشهري اقل من 1000 شيقل 1000-1500 1500-2500 أكثر من2500
عمل الأم:	□ عامله □ موظفه □ مدرسه □عمل حر □ ربه منزل □ غير ذلك	الدخل الشهري اقل من 1000 سيقل 1000-1500 1500-2500 أكثر من 2500

الأسئلة	الخيارات

.1	هل تتناول وجبه الفطور يوميا	□نعم □ لا
.2	هل تناولت وجبه الفطور اليوم	□نعم □ لا □لا اعرف
3	ما عدد الوجبات الغذائية التي تتناولها في اليوم الواحد عادة	( )

4	هل تتناول وجبات خفيفة خلال الوجبات ألرئيسيه	□نعم □ لا
5	المشروبات والوجبات الخفيفة التي تتناولها هل تشتمل على المواد التالية	□ شبس/بمبه □ فواكه □ مشروبات غازيه □ سندوتشات/فلآفل/حمص/فول □ شاي

6	هل تحتوي وجبتك الغذائية على المواد التالية	الخيارات		
6.1	سبانخ / خس	□نعم	□لا	□لا اعرف
6.2	فلافل /حمص	□نعم	□لا	□لا اعرف
6.3	الكبد ولحوم الدجاج ، العجل ، خروف	□نعم	□لا	□لا اعرف
6.4	المشروبات ألغازيه (كولا، صودا، سفن اب ....)	□نعم	□لا	□لا اعرف
6.5	عصائر الفواكه الطبيعية	□نعم	□لا	□لا اعرف
6.6	المكسرات: لوز، جوز، فستق حلبي، بندق	□نعم	□لا	□لا اعرف
6.7	الشيبس و البمبا	□نعم	□لا	□لا اعرف

السلوكيات الغذائية

7	هل تتناول الشاي مع وجبة الطعام؟	□نعم	□لا
8	هل تتناول الشاي بعد وجبة الطعام مباشره ؟	□نعم	□لا
9	هل تتناول الشاي بعد وجبة الطعام بساعة أو أكثر	□نعم	□لا
10	عدد المرات التي تتناول فيها الشاي يوميا	( )	
11	هل تتناول العصير مع وجبه الطعام.	□نعم	□لا

12	هل تعاني من :	الخيارات		
	وجع رأس (صداع)	□كثيرا	□قليلا	□لا
	التعب والإرهاق	□كثيرا	□قليلا	□لا
	الدوار والدوخة	□كثيرا	□قليلا	□لا
	عدم وضوح الرؤيا	□كثيرا	□قليلا	□لا
	عدم القدرة على التركيز والمتابعة	□كثيرا	□قليلا	□لا
	قله الشهية	□كثيرا	□قليلا	□لا
	تقشر الأظافر و تقعرها	□كثيرا	□قليلا	□لا
13	هل تتناول الفيتامينات. إذا كانت الإجابة بنعم فما هو نوعه	□نعم	□لا	
		□ فوليك أسيد □ فيتامين ب 12	□ أقراص حديد □ فيتامين ا	

انتهت الاستمارة

ملخص

تهدف هذه الدراسة إلى تشخيص نسبه انتشار الإصابة بفقر الدم بنقص الحديد لدى طلاب المدارس الابتدائية ما بين الفئة العمرية (9-14) سنه في الضفة الغربية (بيت لحم ، بيت ساحور، الخضر و العيزرية)، ومعرفه تأثير العوامل البيئية والعادات الغذائية على انتشار فقر الدم بنقص الحديد.

تتألف العينة من 688 طالب وطالبه كعينه عشوائية من المناطق السكنية المذكورة، (41 % ذكور و 59 % إناث). في البداية تم سحب عينات دم لجميع الطلبة، ومن ثم تم توزيع استبيان بين طلاب المدارس الابتدائية. تم إجراء فحوصات مخبريه لجميع عينات البحث حيث استخدم الهموجلوبين (اللطاخات الدمويه) ، الحديد و MCV كمؤشر لفقر الدم بنقص الحديد، حيث أظهرت النتائج أن نسبه فقر الدم بنقص الحديد لدى الذكور 10 % و لدى الإناث 7.5%.

فيما يتعلق بالعوامل البيئية والعادات الغذائية فقد تبين أن مستوى التعليم لدى الوالدين يؤثر على انتشار الإصابة بفقر الدم بنقص الحديد ، وكان لذلك دلاله إحصائية حيث ($p=0.040$) أما فيما يتعلق بعادة شرب الشاي بعد الأكل بساعتين فقد تبين أنه يؤثر على انتشار الإصابة بفقر الدم بنقص الحديد، وكان لذلك دلاله إحصائية ($p=0.025$). أما بالنسبة لجميع العوامل الأخرى مثل مصدر الدخل، عمل الأب و ألام، و مكان السكن والعادات الغذائية الأخرى التي ذكرت في الاستبيان، لم تشر لأي دلاله إحصائية.

للحد من هذه المشكلة الصحية يجب أن تكون هنالك استراتيجيات مستقبليه طويلة المدى تعتمد على التثقيف الصحي للأهل ، و متابعه مستمرة من قبل وزاره الصحة و وزاره لتربيه والتعليم .