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Prevalence of Iron Deficiency Anemia Among School Children in Tobruk City, Libya

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Abstract:

Anemia continued to become a major public health problem in developing nations including Libya. Especially, school children are more vulnerable for anemia and consequences of anemia Both Iron deficiency and iron deficiency anemia have considerable adverse effect on human health. Among the different negative health concerns, including stunt development, less developed immunity, lower IQ level, no proper physical work capacity, more fatigue The present study aimed to estimate the prevalence of iron deficiency anemia (IDA) in school-going children. Our study sample was consisting of 366 school age children from (6-14) years of both genders. The blood samples were collected in EDTA (Ethylenediaminetetraacetic acid) tubes from four different health serves centers in Tobruk by trained and veteran persons. Questionnaires were utilized for the data collection, at the time of blood samples collection. Hemoglobin (Hb), hematocrit (Hct), Mean Corpuscular Volume (MCV), Mean Corpuscular hemoglobin concentration (MCHC), white blood cell and red blood cell (RBC) were determine by automatic hematological analyzer model. Results: Of the 366 screened school children 51.0% males and 48.0% females, were anemic (Hb<12 g/dl) 104 males (54.7%) and 120 females (57.9%). 25% females and 40% males were having Iron deficiency anemia (Hb<12 g/dl & serum ferritin<15 ng/ml). The percentage significant different between males and females in prevalence of IDA. The percentage of anemic children was also high (42%) in age group of 6 - 7years. Pale skin was the most common symptom of anemia. This study found that prevalence of anemia was a moderate public health problem in school children. Due to the complications of anemia for school children, preventative planning and control of anemia among school children in Libya is necessary.

Keywords: **Prevalence, Anemia, Iron-deficiency anemia, School children, Tobruk Eastern Libya**

Introduction

Anemia is a threat to public health in both industrialized and developing nations [1]. Anemia has a variety of causes [1-4]. The main cause of anemia that leads to iron-deficit anemia (IDA) is an iron deficiency. But it also coexists with parasite infection and malaria [1, 2]. Every human cell contains iron, which is a necessary micronutrient and a primary cause of anemia. Iron is involved in various metabolic processes, including the creation of energy, DNA synthesis, hemoglobin transport and storage, and electron transport [2-4].

The World Health Organization (WHO) set cut-off points for anemia, which were Hb level < 12.0 g/dL for girls and boys under the age of 15 and 13 g/dL for those over the age of 15. Hb readings between 9.0 g/dL and the cut-off lines were considered mild anemia, Hb 7.0–8.9 g/dL was considered moderate anemia, and Hb < 7.0 g/dL was considered severe anemia [5]. It is a widespread public health issue that affects both developed and emerging nations, and it has a significant impact on social and economic advancement in addition to human health [6].

Studies have shown that school-age children are more susceptible to anemia, particularly IDA, because to their rapid physical and physiological development [1, 6, 7]. According to a WHO report, anemia affects between 45.7 and 49.1% of school-age children worldwide, with a frequency of between 64.3 and 71% among school-age children in Africa [1].Poor psychomotor development, detrimental long-term consequences on the central nervous system [9], low IQ, subpar academic performance [10], decreased work capacity, and a low quality of life [3, 8] are among the effects of anemia on school-age children. Anemia can have a variety of reasons, but the most frequent ones include deficiencies in vital nutrients like iron, vitamin B12, and folic acid. Additional variables include hemolysis, worm infection, blood loss, gastrointestinal blood loss, repeated pregnancy in women, and the suppression of red corpuscle synthesis by the bone marrow [9] [10]. Microcytic anemia is caused by a lack of iron, but macrocytic anemia is caused by liver illness, folic acid, vitamin B12, and hyperthyroidism [11]. Anemia can also be caused by a few other conditions that induce blood loss, such as parasite infections, filariasis, and diarrhoea [12].

In India, anemia is still very common in women who are pregnant and in children, particularly in rural areas. It can seriously hinder a woman's ability to produce children and have long-term consequences for her neurological development. The most current official data (2019–21) show a higher prevalence than in 2015–16, which is alarming. The risk of anemia in adolescent women and their offspring is influenced by socioeconomic factors, including wealth and education, and there is also a significant variation in childhood anemia across Indian states. Anaemia is commonly thought to be caused primarily by dietary iron shortage, but new research and growing evidence from the authors' continuous literature database indicate that there may be other contributing factors, some of which have nothing to do with nutrition [13].

According to Adokorach et al. [14], 16% of people had iron deficiency anemia (boys: 13.0%; girls: 18.1%). Furthermore, the average hemoglobin (Hb) level was 13.21 g/dl, with males having a little higher level (13.46±1.55 g/dl) than girls (13.02±1.30 g/dl). Adolescent girls and boys did not exhibit a significant difference (p~0.05) in the Individual Dietary Diversity Score (IDDS), with mean individual dietary diversity measurements of 2.98±1.785 and 3.47±2.143, respectively, indicating poor dietary diversity. Adolescent females eat more fruits and vegetables than boys did across all dietary groups, with the exception of animal source foods, vitamin A-rich fruits and vegetables. According to the results using binary logistic regression, none of the study's sociodemographic variables predicted dietary diversity.

Childhood anemia is an ecological problem that does not occur alone. Its consorts are poverty, ignorance, unhealthy cooking, distributed family structure, pooreating, large family size.The aim of this study is to review evidences regarding prevalence of anemia among school-age children in Tobruk-Libya.

2. Materials and Methods

2.1. Study Population

Stratified random sampling technique covering the four health services centers of Tobruk was used. From each center number of school's children was randomly chosen (males and females from each age group). Total sample of 366 children from the selected schools aged (6-14) years constituted the subjects of the study. Distribution of samples of school children in Tobruk according to age groups, gender and were shown in table 3.1. revalence of Iron Deficiency Anemia among School Children.

2.2. Blood Samples

Blood sample collection: 5 ml was collected from each child by venipuncture and 2 ml were withdrawn into EDTA vacutainer tube for complete blood count (CBC) estimation. The other 3 ml were collected in plain tube and blood was allowed to clot and serum separated and stored at ±20°C until used for the serum iron, ferritin, and TIBC estimation.

2.3. Hematological and Biochemical Analysis

Automatic blood analyzer (Sysmex KX-21N) was used to analyze the blood samples for CBC according to the manufacture recommendation. Further investigations were done for serum iron, serum ferritin, and TIBC. Manual Kit method and automatic measurement were used by (Siemens-Dimension P and plus)

2.4. Ethical Considerations

Ethical approvals were obtained from ethical committee in Tobruk university(Number NBC:009. H.24.2). Informed consent was taken from all the participants and their families prior to their inclusion in this study.

3. Results

A total of366 school age children (6 - 14 years) with both sexes (190boys and 176girls) were interviewed and clinically examined for the presence of anemia at four healthy services in Tobruk city. After clinical examination blood samples were collected for further analysis. Of 366 were found206 patients56.2% to have laboratory evidence of anemia low Hb (Hb<12g/dl) and low MCV (104 males 54.7% and 102 females57.9%).

120 cases from these patients with iron deficiency anemia (76males40% and 44 females25%),38 cases have low serum ferritin with normal Hb, Other types of anemia group comprised86children 23.4% (36 males and 50 females). In this study the revalence of Iron Deficiency Anemia IDA among children was 32.7%, while 10.3% were iron deficient without anemia ID, and 23.4% had other types of anemias (**Figure1**).

Data in table (1) and figure (1) shown the prevalence of anemia (Hb<12g/dl) among school children in Tobruk according to geographical region and sex 56.2%, the estimated prevalence of anemia in males was 54.7%. But, the prevalence of anemia in females school children was 57.9%. The

prevalence of ferritin deficiency (serum Ferritin <15 ng/ml) among school children in Tobruk according to geographical region and sex in males was47.3%, and female38.6%. General Prevalence of iron deficiency anemia (Hb <12g/dl -serum Ferritin <15 ng/ml - TIBC<10%) among school children in Tobruk are present in table (5) and figure (5) were (32.7%) prevalence in males40% and in females were.25%. The prevalence of iron deficiency anemia among school children in Tobruk according to age group (years) in both males and females were 42.5%, 32.5%, 40.9%, and 14.7% in age groups (6-7), (8-10), (11-12), and (13-14)years , in males in males was %, 58.3%, 36.3%,38.4 and 21.1%, and in females was 26.0%, 27.7%, 44.4%, and 10% in age groups (6-7), (8-10), (11-12), and (13-14)years , respectively. There were statistically significant differences between age groups however, IDA was more frequent in children aged (6-7)years 42.5%, ID was more frequent in children aged (11-12) years 40.9%, and other types of anemia were also more frequent in children aged (6-7) 27.0%. (**Figure 3**).

Table 1: prevalence percentage of anemia, iron deficiency anemia, low serum ferritin among school children.

Prevalence percentage%			
sex	anemia	Serum ferritin low	Iron deficiency anemia
male	51	47.3	40
female	48	38.6	25

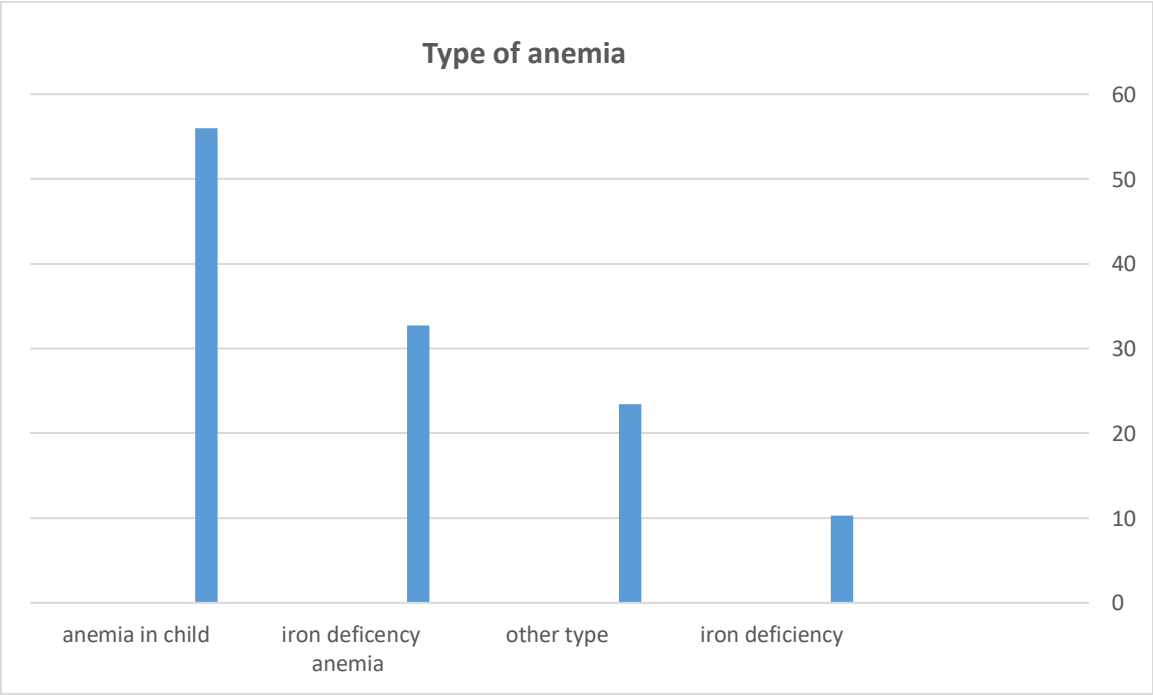

Figure 1: Distribution of anemia, ID, IDA and other types of anemia in school child

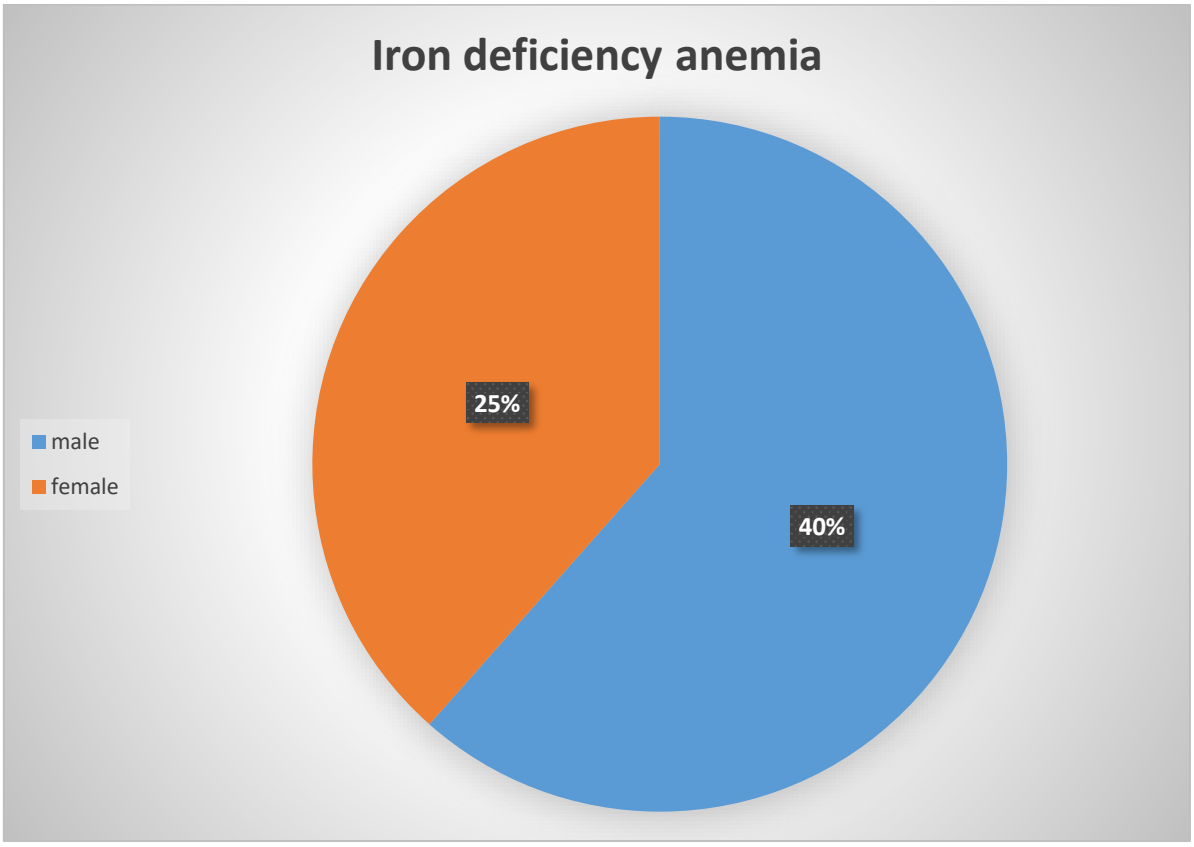

Figure 2: Distribution of IDA in children according to gender

Table2. Prevalence of Iron deficiency among school children in Tobruk according to age group and sex

Age	**Male**			**Female**		
	N	cases number	%	n	cases number	%
6-7 years	48	28	58.5	46	12	26
8-10 years	88	32	36.3	72	20	27.7
11-12years	26	10	38.4	18	8	44.4
13-14 years	28	6	21.1	40	4	10
Total	190	76	40	176	44	25

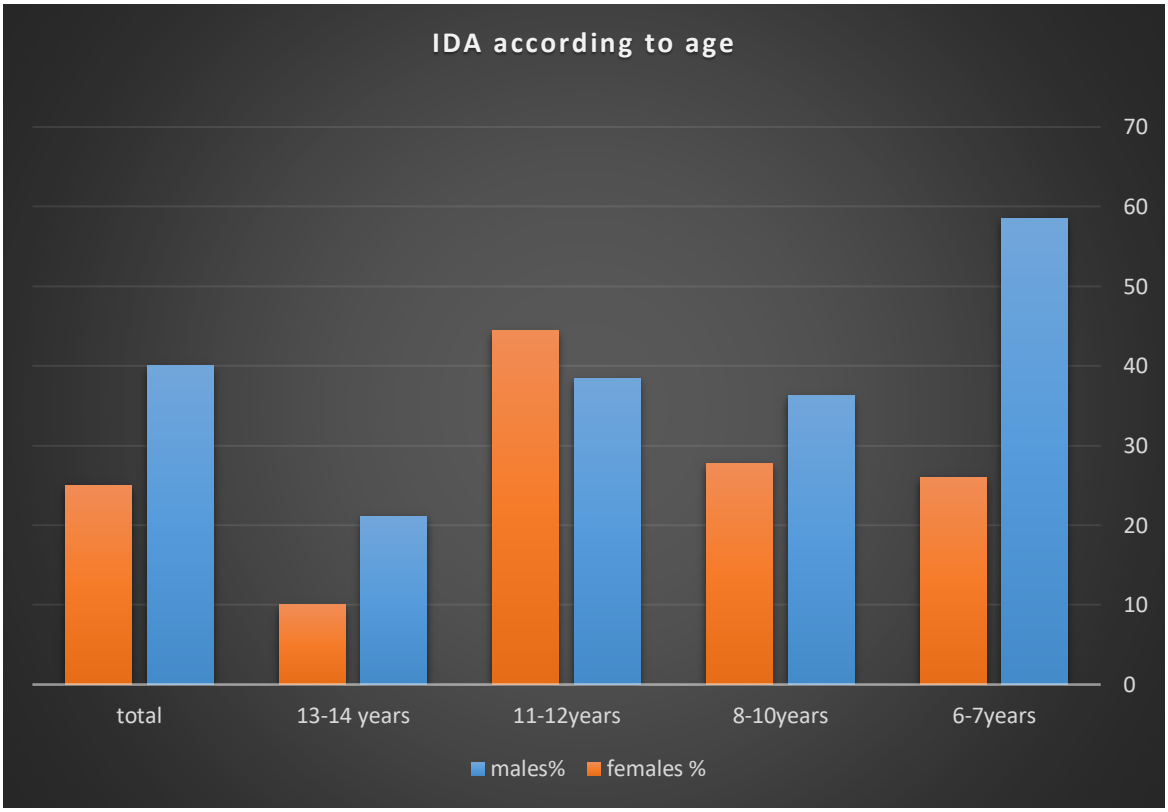

Figure 3: Distribution of IDA in children according to age. There are statistically significant differences between groups of the ages

4. DISCUSSION

Hemoglobin level measurement is an essential physiological indicator that aids in the diagnosis of anemia, polycythemia, and other disorders affecting red blood cells, as well as their severity. The World Health Organization recommends using hemoglobin cut off values for age and sex to determine the existence of anemia [15].The most prevalent dietary deficiency in the world is iron deficiency anemia (IDA). It can affect children's and teenagers' motor and mental development [16] and result in decreased work capacity in adults [17].In this study, 206 (56.2%) of the children over the age of five had anemia, and 120 (32.7%) had IDA. Conversely, 38 (10.3%) of the children had ID, and 86 (23.4%) had various forms of anemia. The prevalence of anemia in our results was higher than that performed in Egypt (12%), Morocco (12.2%), and higher than in Turkey (5.4%) respectively [16, 17, 18]. Also, El-Hioui et al., [18] reported that the overall prevalence of anemia was 12 % in 295 Schoolchildren aged between 6 and 16 years old in rural of morocco. Additionally, the results of earlier studies, which revealed that it was 24.8% of school-age children (5–15 years old) in Aligarh City, India [19], 35% in Northern Morocco [20], 36.4% among Vietnamese school-age children [21], 36.9% in a group of 250 school-age children in Leyte, Philippines [22], 37.5% of school-age children–A scenario of urban slums in India [23], 37.6% in a group of 404 school-age children (6–14 years old) in Jimma Town, Southwest Ethiopia [13], and 39.1% in a group of 271 school-age children (age range: 7–14 years old) in Asendabo Town, Southwest of Ethiopia [24].], 39.4% of 531 school-age children in Cote Divoire [25], 40.5% among the age group of 6–11 years in Jimma Town, Southwest Ethiopia [13], nonetheless, prevalence was more in line with 41.8% among schoolchildren from urban slums in India who were between the ages of 5 and 10.9 [26]. nonetheless, our prevalence was lower than the 79% prevalence among students up to the age of 12 in specific slum schools in

Bhubaneswar, Odisha, India. [5]. The variations in the research area, sample size, food consumption, and other factors could be the cause of the disparity in anemia prevalence between these locations. According to the current study, the prevalence of iron deficiency anemia was found to be 32.7% in women and 40% in men. The current study's findings are consistent with those of Aedh et al. [27], who evaluated the prevalence of iron deficiency anemia in 240 teens in Najran, Saudi Arabia, ranging in age from 13 to 19.In Najran, anemia was present in 22.5% of teenagers overall, indicating a moderate health issue. Additionally, a WHO global survey found that 25.4% of school-age children worldwide have IDA [28]. According to El-Hazmi and Warsy [29], 24.8% of Saudis suffer from anemia generally. Furthermore, it was discovered by Al-Othaimeen et al. [30] that Riyadh has a 26.3% anemia prevalence. According to Abedini et al. [31], 53.6% of Iranians were estimated to have iron deficiency anemia. Although Stoltzfus and Rebecca [32] said that IDA was more common in Southeast Asia (63%) than in Latin America (46%) and the Eastern Mediterranean (63%), Asia I (49%), Southeast Asia II (66%). Additionally, a high prevalence of IDA was also reported in Tanzania (79.6%), Kenya (35.3%) and Nigeria (82.6%) [33-34]. The most precise biochemical test that has been found to correspond with the relative total body iron reserve is serum ferritin concentration, which is therefore a prerequisite for iron insufficiency. In the current study, the prevalence of ferritin deficit was 38.6% in women and 47.4% in men. This rate is more than that of a research by El-Hioui et al. [18], which found that girls had a mean serum ferritin level of 27.9 µg/l and boys had a mean level of 26.7 µg/l. According to the findings of the study by Kokore et al. [35], schoolchildren have lower levels of ferritin and transferrin saturation coefficients, respectively, by 12.6% and 55.3%. The anemia rate in populations is over half (54%). Gender and IDA, ID, or other kinds of anemia do not statistically significantly correlate, according to Brotanek [36]. Studies was out in the Lao People's Democratic Republic in 2011 and Morocco in 2010 [37, 38] also backed up this claim. However, Tengco from the Philippines and Ekwoch from Nigeria noted that anemia is more prevalent in young boys [39, 40]. Our findings also demonstrated that the prevalence of iron deficiency anemia was higher in men than in women (40.7% and 32.7%, respectively), and that there was no statistically significant difference between the sexes in terms of anemia prevalence (54.7% and 57.9, respectively). Therefore, discrimination against girls and boys may exist. Additional cultural variables that could be involved in variations in the prevalence of iron-deficiency anemia based on sex [41].In our investigation, the relationship between age and IDA, ID, and other forms of anemia was statistically significant.Nonetheless, compared to age groups (8–10 years), IDA anemia was higher in children aged 6–7 years (42.5%) and 11–12 years (40.9%). 32.5% of children (aged 13 to 14) and 14.5% of children overall, as a child's body needs a balanced diet to support rapid growth at this age. The changes in the study areas, cultural variances, sample sizes, lifestyles, socioeconomic status, dietary habits such as frequent consumption of soda beverages and milk/milk products, and other pathological or genetic factors could all contribute to the variability in the frequency of IDA. Similar findings were reported by Kundu et al. [42], who found that children under the age of two had the highest prevalence of anemia. In a nutshell, 91.67% of the research was of excellent quality. Although there was no discernible publication bias, two outlier papers were discovered. In Bangladesh, the frequency of anemia in children and adolescents was reported to be significant.

According to Royle et al. [44] and Fouad et al [48, 50], there was no statistically significant difference between the haemoglobin concentrations in children who received adequate vitamin D (median 130.0 g/L) and those who did not (median = 128.5 g/L) ($U = 2685$, $z = 2685$, $p = 0.970$). These early findings imply that the majority of the youngsters in this cohort had appropriate levels of vitamin D and hemoglobin. There were no variations in hemoglobin concentrations based on vitamin D status, which may be explained by the fact that nearly one-third of subjects had insufficient vitamin D.

Al-Jermmy et al., [45]and Fouad et al [49] evaluates the prevalence and correlates of anemia in teenagers residing in Hodeida, a Yemeni province devastated by conflict. Examining how a nutrition education intervention affected the hemoglobin levels of teenagers who were anemic was a secondary goal. A cross-sectional study involving 400 randomly selected teenagers in Hodeida between the ages of 15 and 19 was carried out. A survey was conducted to gather information regarding clinical, lifestyle, socioeconomic, and demographic traits. Samples of stool were taken, anthropometric traits were examined, and capillary blood was drawn. The secondary goal involved randomly assigning teenagers who were anemic to two groups: one that received iron supplements plus dietary instruction, and the other that received simply iron supplements. Anemia was prevalent in 37.8% of cases. gender of the female, heavy menstruation, khat eating, headaches, exhaustion,

5. Conclusion

Hemoglobin level measurement is an essential physiological indicator that aids in the diagnosis of anemia, polycythemia, and other disorders affecting red blood cells, as well as their severity. The World Health Organization recommends using hemoglobin cut off values for age and sex to determine the existence of anemia [13].Iron deficiency anemia (IDA) is the most common dietary deficiency worldwide. It can hinder the mental and motor development of kids and teens [15] and lower an adult's ability to work [14, 15]. Furthermore, El-Hioui et al. [18] found that 295 schoolchildren in rural Morocco, ages 6 to 16, had an overall anemic rate of 12%. Additionally, the results of earlier studies, which revealed that it was 24.8% of school-age children (5–15 years old) in Aligarh City, India [19], 35% in Northern Morocco [20], 36.4% among Vietnamese school-age children [21], 36.9% in a group of 250 school-age children in Leyte, Philippines [22], 37.5% of school-age children–A scenario of urban slums in India [23], 37.6% in a group of 404 school-age children (6–14 years old) in Jimma Town, Southwest Ethiopia [13], and 39.1% in a group of 271 school-age children (age range: 7–14 years old) in Asendabo. The present study reported the prevalence iron deficiency anaemia 32.7%, in males was 40%and in females was 25%, respectively. The finding in the present study is in harmony with the results obtained by, Aedh et al., [27] assessed the prevalence of iron deficiency anemia among 240 subjects of teenagers that aged 13-19 years old in Najran, Saudi Arabia. The overall prevalence of anemia among teenagers in Najran was 22.5%, which indicates a moderate health problem. Also, WHO worldwide report that concluded a prevalence of 25.4% for IDA among school children globally [28]. El-Hazmi and Warsy, [29] reported the overall prevalence of anemia in Saudis was 24.8%.Additionally, Al-Othaimeen, et al., [30] found that the prevalence of anemia in Riyadh was 26.3%. Abedini et al., [31] estimated the prevalence of iron deficiency anemia in Iran was 53.6%. While Stoltzfus and Rebecca, [32] reported that the prevalence of IDA in Africa was 60%, Latin America (46%), Eastern Mediterranean (63%), Southeast Asia I (49%), Southeast Asia II (66%). Additionally, a high prevalence of IDA was also reported in Tanzania (79.6%), Kenya (35.3%) and Nigeria (82.6%) [33-34]. Serum ferritin concentration has been identified as the most specific biochemical test that correlates with relative total body iron store, hence is a precondition for iron deficiency. In the present study, the prevalence ferritin deficiency in males was 47.4% and in females was38.6%. This rate is higher than study in El-Hioui et al., [18] reported that the mean serum ferritin level was 26.7 µg/l in boys and 27.9 µg/l in girls. The results of Kokore et al., [35] study showed that the ferritin and the saturation coefficient of transferrin, are lowered respectively of 12.6% and 55.3% in school children. More than half of populations (54%) are anemic.

Brotanek stated that there is no statistically significant relation between gender and IDA, ID or other types of anemia [36]. This statement was also supported by studies conducted in Lao People's Democratic Republic in 2011 and Morocco in 2010 [37,38]. On the other hand, Tengco from

Philippines and Ekwoch from Nigeria, reported that anaemia is more common in male children [39,40]. Our results also proved that Iron Deficiency anemia was higher in males than females (40 % and 32.7 % respectively) and there was no statistically significant difference between females and males for prevalence of anemia (54.7% and 57.9respectively). So, there may be some discrimination between boys and girls. Other cultural factors that may contribute to sex related differences in the prevalence of iron-deficiency anemia [41]. In our study, there was statistically significant relation between age and IDA, ID and other types of anemia. However, IDA anemia was high in age groups (6 - 7 years) 42.5% and in (11 - 12years) 40.9% children as compared to age groups (8- 10years) 32.5%, (13-14years) 14.5% child because at this age the children body requires balance nutrition for rapid growth. The differences in the prevalence of IDA could be due to differences in the study areas, cultural variations, sample sizes, lifestyles, socio-economic, dietary habits like frequent intake of soda drinks and milk/milk products, and other pathologic

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