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Iron Deficiency Anemia in Primary School Children in Beni-Suef

(Prevalence and Clinical Spectrum)

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Abstract:

The aim of current study was to detect prevalence and clinical presentation of iron deficiency anemia (IDA) in primary school children in Beni-Suef and to assess their risk factors. This cross-sectional survey was conducted on randomly selected primary school children with microcytic hypochromic anemia of both genders aged from 6 years – 12 years in Beni- suef governorate. The prevalence of IDA was 26.6% among children 6-12 years of age. Socioeconomic factors (such as mother education, residence, nutritional status, parasitic infection and recurrent infection) and poor dietary habits are the main contributing factors of IDA among the children studied. It is alarming that the prevalence of IDA is high among children 6–12years of age. Screening for IDA should be directed at high-risk groups and school programs should be implemented to improve awareness of healthy food habits.

Keywords: Iron deficiency, anemia, school children, IDA.

1. Introduction:

Anemia is defined as reduction of hemoglobin (Hb) concentration and /or hematocrit below normal for age.It has a significant impact on lifelong health. It affects physical, mental, social well-being, and children development [1].

Iron deficiency anemia (IDA) is the most prevalent single nutrient deficiency in the world, is recognized by world health organization (WHO) as one of 10 greatest global health risks in existence today, affecting the lives of 2 billion people worldwide and twice as many are deficient. It affects all age groups, but it is more prevalent in pregnant women and children, especially young children from low-income families. [2].

In Egypt, previous studies have indicated that anemia is a major public health problem among children, especially school children. It affects ~30-40% of children. Iron deficiency anemia was found to be the most common cause of anemia among Egyptian infants 6 to 24 months of low socioeconomic standard affecting 43% of them. As in Qena governorate, the prevalence of IDA was 12% among children in the age group of 6-11 years [3].but in Elmenofya governorate, higher prevalence of IDA has been reported as it was 29% among school children [4].

Iron deficiency anemia rarely causes any serious or long-term complications. However, some people with IDA complained that it affects their daily life. Research has shown that IDA can affect the immune system, making the person more susceptible to illness and infection. Children with severe anemia may be at risk of developing complications that affect their heart or lungs, for example tachycardia, and heart failure [5].

Medical care starts with establishing the diagnosis and etiology for the iron deficiency (ID). In most patients, the ID should be treated with oral iron therapy, and the underlying etiology should be corrected so the deficiency does not recur. However, avoid giving iron to patients who have a microcytic iron-overloading disorder (eg, thalassemia, sideroblastic anemia). Parenteral iron therapy shouldn't be administered to patients who need to be treated with oral iron, as anaphylaxis may result [6].

Many tests are proposed for the diagnosis of ID, but the serum ferritin is currently the most efficient and cost-effective. IDA is classically a microcytic anemia, but this finding is not sensitive or specific. The red cell MCV is low with severe ID, but concurrent medical issues, such as liver disease, may blunt the decrease in red cell size. [7]. The aim of the current study was to detect prevalence and clinical spectrum of

IDA in primary school children in Beni-Suef and to assess their risk factors.

2. Patient and methods:

A cross section survey was conducted on randomly selected primary school children with microcytic hypochromic anemia of both genders aged from 6 – 12 years in Beni- suef governorate after obtaining an ethical approval from the research ethics committee of faculty of medicine at Beni-Suef University.

Medcalc ®program was used to calculate the sample size by putting the total number of primary school children in Beni-Suef governorate at a margin of error 5%, a power of study 99%, design effect 1 and expected frequency of IDA 50%, the total sample was at least 700 children that was increased to 1000 to overcome the non-response or refusal of the participants

2.1 Inclusion criteria: children aged (6-12) years.

2.2 Exclusion criteria: Other causes of anemia.

All children will be subjected to:

1- History taking to fulfill the following data:

• Clinical history was taken from children and relatives including age, onset of anemia, nutritional history, and intake of iron supply.

• History of fatigue, poor activity, exertion, dyspnea. breathlessness at rest.

• History of blood transfusion

2- Thorough physical Examination:

• Clinical examination, general, chest, cardiac, abdominal, and neurological examination

3-Lab investigations:

All patients were subjected to:

• Complete Blood Picture, Reticulocyte count.

Patients with microcytosis underwent the following:

• Serum Iron, ferritin and TIBC

Statistical analysis:

Analysis of data was performed using SPSS v. 25 (Statistical Package for Social science) for Windows. Description of quantitative variables was in the form of mean ± standard deviation (SD). Description of qualitative variables was in the form of numbers (No.) and percent (%). Data was explored for normality using kolomogrove test. T-test was used to compare between

two groups regarding the normally distributed scale variable and Mann-whitney test was used to compare groups regarding the non-normally distributed variables. Chi-squared test was used to compare groups regarding the categorical variables. The significance of the results was assessed in the form of P-value that was differentiated into: Non-significant when P-value > 0.05 and significant when P-value ≤ 0.05.Binary logistic regression analysis was done to identify the adjusted risk for different independent factors

3. Results:

Table (1) shows that about half of the studied patients were females (52 %) and the other half were males (48%), about two thirds of the studied patients had highly educated mothers (61.6%), 55.8% of them were rural inhabitants (93.8%). Mean age of the participants was 9.13±1.99 years and ranged from 6 to 12 years.

Table (2) shows that about half of the studied children were reported by mother that had a history of parasitic infection (50.2%) and 50.8% reported that they had a good nutritional status. Only 7% had history of iron intake, 16.4% had recurrent infection history and 12% had history of epistaxis. Among female children, there were 2.5% had menstruation.

7% had history of iron intake, 16.4% had recurrent infection history and 12% had history of epistaxis. Among female children, there were 2.5% had menstruation.

Table (3) shows that examination revealed that there were 17.2% were pale. The mean weight of the children was 27.5±7.3 kilogram, the mean height was 1.4±0.2 meters and the mean body mass index was 19.9±3.9. The mean systolic blood pressure was 105±12.7 mmHg, the mean diastolic blood pressure was 65±10.1 mmHg and the heart rate was 100±16 beat/minute. 4% were tachypneic, 22% were tachycardia, no cases with murmur, only 1% had splenomegaly, 47.6% had koilonychia.

Table (4) illustrates that the mean Hemoglobin, Hematocrit, MCV, MCH, MCHC, Rdw, Platelets, Serum ferritin, Serum iron, TIBC, and Reticulocytes were 11.5±1, 37.5±3.6, 81.7±6.8, 25.1±2.3, 30.6±1.4, 13.3±1.19, 265.8±66.7, 19.7±19.3, 162.8±47.1, 413.3±80.6, and 1.5±0.3 for all parameters respectively.

Table (5) illustrates that the prevalence of IDA among the studied children was 14.2% based on the low serum ferritin level (less than or equal15).

Table (6) shows that there were 266 (26.6%) of studied children with microcytosis who underwent more investigations as ferritin, it was detected that from the 266 cases with microcytosis, there were 142 cases with low ferritin level less than 15 were (53.4%).

Table (7) shows that patients with normocytosis had a significant higher hemoglobin, hematocrit, MCV, MCH and MCHC than patients with microcytosis (P-value<0.001); however, there was a significant lower serum ferritin, lower serum iron, higher TIBC, high RDW and reticulocytes in children with microcytosis and IDA than children with microcytosis without IDA.

Table (8) shows that patients with microcytosis had a significant higher prevalence of pallor, tachycardia, tachypnea, koilonychia, dyspnea, fatigue, palpitations, dizziness, irritability, and pica (P-value<0.001), but there was no significant difference between both categories regarding the bad performance in educational process.

Table (1): Socio-demographic characteristics of studied patients:

Characteristics	**Number N=1000**	**Percent (100%)**
Sex		
Female	480	48.0
Male	520	52.0
Mother education		
Low educated mother	384	38.4
Highly educated mother	616	61.6
Residence		
Urban	442	44.2
Rural	558	55.8
Age		
Mean±SD	9.13±1.993	

Categorical data is presented as number and percent Scale data is presented as mean±SD

Table (2): Distribution of history of medical importance:

History	**N=1000**	**Percent(100)**
Parasitic infection		
No	498	49.8
Yes	502	50.2
Nutrition		
Bad nutrition	492	49.2
Good nutrition	508	50.8

Iron intake	70	7.0
Recurrent infection	164	16.4
Bleeding		
Menstruation among females (no=480)	120	2.5
Epistaxis	60	12.0
Melena	0	0
Dyspnea	328	32.8
Fatigue	348	34.8
Palpitation	382	38.2
Bad performance of school	388	38.8
Dizziness	412	41.2
Irritability	214	21.4
Pica	328	32.8

Categorical data is presented as number and percent

Table (3): Signs of anemia and examination of patients under the study:

Examination	**Number N=1000**	**Percent (100%)**
Pallor	**172**	**17.2**
Weight	**27.5±7.3**	
Height	**1.4±0.2**	
BMI	**19.9±3.9**	
SBP (mmHg)	**105±12.7**	
DBP (mmHg)	**65±10.1**	
Heart rate (beat/min)	**100±16**	
Tachycardia	**220**	**22.0**
Tachypnea	**40**	**4.0**
Murmur	**0**	**0**
Splenomegaly	**10**	**1.0**
Koilonychia	**476**	**47.6**

Categorical data is presented as number and percent scale variables was presented as mean±SD

Table (4) : Laboratory investigations of patients under the study:

Labs	**Mean ±SD**	**Median**
Hemoglobin	11.5±1	11.5
Hematocrit	37.5±3.6	37.9
MCV	81.7±6.8	82.4
MCH	25.1±2.3	25.4
MCHC	30.6±1.4	30.3
Rdw	13.3±1.19	13.2
Platelets(x10^3)	265.8±66.7	259
Serum ferritin	19.7±19.3	13.9
Serum iron	162.8±47.1	177

Total IBC	413.3±80.6	444
Reticulocytes	1.5±0.3	1.5

Table (5): Prevalence of IDA regarding the level of serum ferritin:

Serum ferritin	**Number N=1000**	**Percent (100%)**
≤ 15	**142**	**14.2**
>15	**858**	**85.8**

Table (6): Microcytosis and proportion of low ferritin level among microcytic patients:

Examination	**Number N=1000**	**Percent (100%)**
Microcytosis	266	26.6
Low ferritin level (less15)	142/266	53.4

Table (7): comparison between children with normocytosis and children with microcytosis regarding their CBC parameters:

Labs	**Patients with microcytosis (n=266)**	**Patients without microcytosis (n=734)**	**P-value**
Hemoglobin Mean±SD Range (min-max) Median	10.6±0.9 8.1-12.5 10.7	11.6±0.98 8.5-14.2 11.6	<0.001 **
Hematocrit Mean±SD	35.2±3.5	37.9±3.5	<0.001 **
MCV Mean±SD	74.1±7.4	82.9±5.8	<0.001 **
MCH Mean±SD	22.4±2.3	25.5±2	<0.001 **
MCHC Mean±SD	30.2±0.9	30.7±1.4	<0.001 **
Rdw Mean±SD	13.9±1.5	13.2±1.1	<0.001 **
Platelets(x 10^3) Mean±SD	272.1±65	264.7±67	0.348
Total number of microcytosis patients	N=142	N=124	<0.001 **
Serum ferritin Mean±SD	11.2±1.9	29.4±24.9	
Serum iron	150.6±44	173.4±46.7	<0.001 **

Mean±SD	.6		
Total IBC Mean±SD	422.9±78 .3	402.2±82	0.037*
Reticulocytes Mean±SD	1.6 ±0.3	1.5±0.3	0.033*

***P-value is significant at <0.001 *P-value<0.05*

Table (8): comparison between children with normocytosis and children with microcytosis regarding their manifestations:

Complaints/symptoms /signs	**Patients without microcytosis (n=734) (%)**	**Patients with microcytosis (n=266) (%)**	**P-value**
Pallor	84 (11.4	88 (33.1)	**<0.001****
Tachypnea	16 (2.2)	24 (9)	**<0.001****
Tachycardia	148 (20.2)	72 (27.1)	**0.020***
koilonychia	300 (40.9)	176 (66.2)	**<0.001****
Dyspnea	180 (24.5)	148 (55.6)	**<0.001****
Fatigue	198 (27)	150 (56.4)	**<0.001****
Palpitations	226 (30.8)	156 (58.6)	**<0.001****
Dizziness	282 (38.4)	130 (48.9)	**<0.001****
Bad performance	278 (37.9)	110 (41.4)	0.353
Irritability	118 (16.1)	96 (36.1)	**<0.001****
Pica	202 (27.5)	126 (47.4)	**<0.001****

***P-value is significant at <0.001 *P-value<0.05*

Table (10): Multivariable binary logistic regression analysis for prediction of the risk factors for acquisition of IDA.

Independent variables	P-value	OR	95% C.I. for OR	
			Low	Uppe

			er	r
Age (years)	0.435	0.970	0.898	1.047
Urban residence	**<0.001****	**2.304**	**1.665**	**3.188**
Female sex	0.248	1.249	0.857	1.821
High educated mother	**<0.001****	**1.838**	**1.319**	**2.562**
Presence of parasitic infection	**0.039***	**1.407**	**1.017**	**1.947**
Bad nutritional status	**<0.001****	**2.406**	**1.608**	**3.600**
Blood loss	0.785	1.083	0.610	1.924
History of recurrent infection	**<0.001****	**3.230**	**2.119**	**4.925**

**P-value is significant at <0.05 **P-value is significant at <0.001 OR=odds ratio CI=confidence interval*

Table (9) shows that there was a statistically significant association of urban residence, bad nutrition, and recurrent infection and parasitic infection with the occurrence of IDA (P-value<0.001).

Table illustrates that when age, urban residence, Female sex, High educated mother, Presence of parasitic infection, Bad nutrition, Presence of bleeding (epistaxis or menstruation…..), and History of recurrent infection tested to predict the occurrence of, it was found that the highly educated mothers were found to increase the probability of occurrence of IDA more than 2.5 times compared to low educated mother.

Regarding the urban residence, bad nutrition and recurrent infections and presence of parasitic infection, it was found that they increase the probability of occurrence of IDA more than twice (OR=2.3, 2.4, 3.2 and 1.4) for all factors, respectively.

4. Discussion:

The study included 1000 children aged from 6 - 12 years with mean age 9.13±1.99 years, about half of them were females (52 %) and the other half were males (48%), about two thirds of the studied patients had highly educated mothers (61.6%), 55.8% of them were rural inhabitants (93.8%).

The current study revealed that the prevalence of IDA was 26.6%. This prevalence was almost the same as the prevalence of IDA estimated by Abdel-Rasoul et al., 2015, who conducted their study in El-Mnofya governorate [4].

Also, this result was in agreement with many studies as El-Zanaty and Way‘s study that showed that the prevalence of anemia in children was about 29.9% [8].

In addition, it was not so far from Ethiopian reports from Kersa (27.1%) (Mesfin et al., 2015) [9]. Filtu (23.66%) Gutema et al., 2014 [10], Jimma (37.6-43.7%) (Assefa et al., 2014 [11].

Also, this result was in accordance with the prevalence of IDA in rural areas of Qena governorate in Barduagni’s study. In contrast, the same study unexpectedly reported that the overall prevalence of IDA was 12%. Their low prevalence of IDA might be explained by the assumption that the dietary intake in the area is currently just sufficient to satisfy the iron needs of the majority of school-age children as he explained [12].

Moreover, the prevalence seen in this study was higher than those of studies conducted in countries such as the Siauliai region of Lithuania (10.1%) [13], Serbia (10.8%) [14].Mexico (12%) [15],and Brazil (9.3%) [16].This discrepancy might be due to the variability of risk factors across different geographic regions along with lower socioeconomic and nutritional status of school children in this study area than in the other settings.

The prevalence of anemia rates ranged between 21.1% and 82.6% have been reported for SAC and adolescents in Sub-Saharan Africa [11,17]. In countries like Ghana, poor dietary intake due to food insecurity and/or consumption of monotonous plant-based diets and infections in rural settings are key drivers of inadequate micronutrient intake and anemia [18,3].

In the current study many factors were associated with increased risk of developing IDA. In this study, IDA occurred in both sexes, with no significant differences found; this result was in coherence with two Egyptian studies [19,4]. This may be due to unhealthy food consumption in both genders.

Children from urban areas had IDA twice as much as those from rural areas (OR 2.3). This result was in harmony with a study carried out in Alexandria by Mohamed and Abo-donia [20,21].The prevalence of

anemia among children living in urban areas was greater than that among infants living in rural areas (61%). This may be attributed to the fact that urban residents consume more junk food, which is less nutritional, than rural residents as most mothers in urban communities are busy in their jobs, hence, the children have to depend on junk foods.

Also, the current study unexpectedly stated that the highly educated mother significantly increased the risk of children acquisition of IDA about two times greater than the low educated mother (OR=1.8). This result can be explained by the fact that highly educated mothers are highly employed and more dependent on junk food [22].

On the other hand, some studies concluded that the low educational level of the father and mother was found to significantly increase the risk for IDA as the study carried out by Azupogo et al., 2019 who reported that the rate of illiteracy was found to be high among the parents of anemic children. This may be attributed to the lack of knowledge of basic food requirements and awareness of food rich in iron [23].Also, low-income of families mentioned in previous studies that it increases of acquisition of IDA specially in low to middle income countries [24].Regarding the international distribution of IDA among children, the risk increased among countries with low-income countries. In Africa, it accounts for 64.6%, followed by Asia 47.7%, Latin America 39.5%, Europe 16.7% then North America3.4% [25].

The prevalence of IDA among children with a positive medical history for recurrent infections, and parasitic infestation was higher than that among children with a negative medical history for diarrhea and parasitic infestation (59.9% and 80.3%, respectively). This result is in consistent with Shubair et al [26].who stated that the diarrheal and parasitic infestations were reported in different studies in the Gaza Strip and have been shown to be associated with anemia among school-age children in Gaza. This may be because diarrhea and parasitic infestation affect absorption and may lead to loss of blood from gastrointestinal tract.

Of note, IDA was found to have a direct effect on scholastic achievement; school achievement was lower among anemic children (41.4%) despite the difference was not statistically significant, but it is still higher than non-anemic (37.9%). This result is similar to Fadila et al., in which lower

school performance is associated with anemia [27].

In terms of manifestations related to anemia, there was a significantly higher prevalence of dyspnea (39.1%), dizziness (48.9%), fatigue with any effort (56.4%), irritability (36.1%), and pica (37.6%) among children with IDA than those without IDA. This agreed with (27) studies‘ which concluded that anemic children unusually feel dizzy, easily fatigued and have fainting sensations with strange appetite to strange types of food.

The consequences of ID and anemia have been well documented; including impairment of physical and cognitive development of infants and young children [28], higher risk of morbidity and mortality for young children [29] and increased risk of low birth weight even with moderate preconception anemia on the part of women in fertile age [30]. The long-term effect of anemia is reduced cognition in the early years, which is associated with lower productivity later in life [31].

5-Conclusion and recommendations

The prevalence of microcytic hypochromic anemia was 26.6% among children 6–12 years of age. Socioeconomic factors (as mother education, residence, nutritional status, parasitic infection and recurrent infection) and poor dietary habits are the main contributing factors of IDA among the studied children. The prevalence of IDA is high among children 6–12 years of age. So, we recommend application of screening for IDA, it should be directed at high-risk groups and school programs should be implemented to improve awareness about healthy food habits. It is important to implement screening for parasitic infection, the most important cause for anemia through (blood loss, anorexia and maldigestion).

- health care provider should increase the mothers ‘knowledge about the healthy balanced diet starting from weaning till older age groups to avoid malnutrition including IDA. Moreover, mother should be treated if they suffered from symptoms of anemia.

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