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A glimpse of iron deficiency anemia and Vitamin D level among children under five years in Karbala, Iraq

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Abstract
Background: Anemia is defined by a deficiency in the number of red blood cells or their capacity of oxygen transport, which leads to inadequate supply to meet the tissue requirements. Iron deficiency (ID) is a prevalent health concern worldwide. It is characterized by a plasma ferritin level of less than 12 µg/L, which is not due to infection or inflammation. Vitamin D deficiency (VDD) is a growing public health problem associated with multiple chronic diseases such as osteoporosis, cancer, and metabolic syndrome. A study conducted in the United States showed that approximately 70% of children and adolescents were 25-hydroxyvitamin D [25 OH)D] deficient. The current study aimed to provide a glimpse of iron deficiency anemia and vitamin D level among children under five years in Karbala, Iraq.
Materials and Methods: This cross-sectional study preformed in Karbala Teaching Hospital outpatient clinic and Laboratory Department. Eighty-six patients under the age of five years with ID or IDA were included in this study.
Results: The mean age of included patients was 28±9 months and, 46 (53.5%) were male. A statistically significant association was seen between the mean age of patients in ID and IDA groups (mean age in ID was less than IDA), developmental status (better development in ID group), complementary feeding starting time (lower age in ID groups), more dietary diversity in ID group in compare with IDA, more dietary diversity in ID group and better financial status in ID group in compare with IDA group ($p<0.05$).
Conclusion: we tried to highlight the importance of ID and IDA screening in children. The IDA could have effect on developmental status of children. Dietary diversity and the sooner start of complementary feeding would be essential elements for preventing IDA. There is no correlation between vitamin D deficiency in children with ID or IDA. We encourage other researchers to provide more comprehensive research on this specific topic due to its critical importance.

Keywords: Anemia, IDA, Iron deficiency, Iraq, developmental impairment

Introduction
Anemia is defined by a deficiency in the number of red blood cells or their capacity of oxygen transport, which leads to inadequate supply to meet the tissue requirements. The etiology of this phenomenon may be multifactorial and concurrent; however, the prevailing factor is typically a deficiency in both the quantity and quality of dietary iron. Iron is a crucial dietary component which is necessary for the development during all life stages of the human [1, 2].
The iron insufficiency is a prevalent issue among young children globally, primarily attributed to their accelerated growth and high iron demands. The impact of iron on children development is of particular importance. Iron is essential element for growth and central nervous system development, particularly during the early stages of childhood.
Iron is a crucial element for various physiological processes such as growth of the brain, myelination process, function of neurotransmitters, and energy metabolism [3].
Iron deficiency (ID) is a prevalent health problem worldwide. It is characterized by a plasma ferritin level of less than 12 µg/L, which is not due to infection or inflammation and transferrin saturation (TS) of less than 16%. The impact of ID is experienced by approximately 2 billion individuals worldwide, with a particular emphasis on expectant mothers and children less than five years who reside in developing countries [4].
Iron deficiency occurs through three stages, namely iron store depletion and iron-deficient erythropoiesis, ultimately culminating in iron-deficiency anemia (IDA).
The condition known as IDA, which refers to a deficiency of micronutrients, has been observed to impact children under five years in both developed and developing countries [5, 6].

The regions with the highest incidence of IDA are South Asia and Africa. Iron deficiency anemia (IDA) prevalence among toddlers in Europe is comparatively lesser than that observed in the regions of Africa and Asia. Research has established a correlation between IDA during infancy and subsequent cognitive and behavioral deficiencies in children over the long term.

Vitamin D deficiency (VDD) is a growing public health problem associated with multiple chronic diseases such as osteoporosis, cancer, and metabolic syndrome. A study conducted in the United States showed that approximately 70% of children and adolescents were 25-hydroxyvitamin D [25 OH)D] deficient. Studies have shown that vitamin D affects bone marrow function [7]. Additionally, studies have shown that 1,25 (OH)D levels in bone marrow are hundreds of times higher than in plasma [8].

In this regard, this current study aims to provide a glimpse of iron deficiency anemia and Vitamin D level among children under five years in Karbala, Iraq.

Materials and methods

Patients and inclusion criteria

The current study preformed in cross-sectional format in Karbala Teaching Hospital outpatient clinic and Laboratory Department. Eighty-six patients under the age of five years with ID or IDA were included in this study. The medical college of Kerbala University approved the study (ethical code No. 24 on 21/9/2023). The data was collected from September 2023 until April 2024. Patients' inclusion criteria were all pediatrics less than 5 years who refereed into Karbala Teaching Hospital outpatient clinic and Laboratory Department for Iron profile check and Vitamin D3 level.

Data collection and statistical analysis

The collected data for this study include the age of patients, gender, weight, development, type of feeding, time of introducing complementary feeding, dietary diversity, history of pica, education of parents, crowding index, and financial status. All data were collected from patients file after study protocols confirmation by ethical committee of Karbala Teaching Hospital, Karbala, Iraq.

All data was analyzed using the SPSS software version 22 (IBM, SPSS). Categorical and non-parametric variables were compared using the chi-square test and Mann–Whitney U test, respectively while statistically significant different was considered as P value < 0.05.

Results

The mean age of included patients was 28±9 months and 46 (53.5%) were male. Patients with ferritin levels of less than 12 µg/L without any alteration in complete blood count (CBC) indexes, including hemoglobin (Hb), Mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) and red cell distribution width (RDW) for anemia considered as ID. IDA was defined as an alteration in CBC indexes in favor of anemia; plus, anemia general signs or symptoms and low ferritin levels.

Vitamin D levels less than 20 ng/mL considered as deficiency, 20-30 insufficient and more than 30 as sufficient. An overview of evaluated parameters and results is provided in Table 1. A significant difference was seen between the mean age of patients in ID and IDA groups (mean age in ID was less than IDA), developmental status (better development in ID group), complementary feeding starting time (lower age in ID groups), more dietary diversity in ID group in compare with IDA, more dietary diversity in ID group and better financial status in ID group in compare with IDA group (p<0.05, more information provided in Table 1).

Table 1: An over view of evaluated parameters and results in ID and IDA groups

Variables		Total	ID group	IDA group	P-Value
Included patients		86	56(65.1%)	30 (34.9%)	-
Mean age (months)		28±9	21±3.9	31.8±8.6	0.001*
Gender	Male	46 (53.5%)	28 (50%)	18 (60%)	0.3
	female	40 (46.5%)	28 (50%)	12 (40%)	
Developmental status [1]	Good	71 (82.6%)	50 (89.3%)	21 (70%)	0.02*
	Delay	15 (17.4%)	6 (10.7%)	9 (30%)	
Type of feeding	Breast only	36 (41.9%)	19 (33.9%)	17 (56.7%)	0.07
	Bottle only	14 (16.2%)	14 (25%)	-	
	Mix	36 (41.9%)	23 (41.1%)	13 (43.3%)	
Complementary feeding start time		8.8±2.1	8.13±1.6	10.13±2.4	0.001*
Dietary diversity [2]	Good	25 (29.1%)	25 (44.6%)	-	0.001*
	Poor	61 (70.9%)	31 (55.4%)	30 (100%)	
Pica	Yes	82 (95.3%)	53 (94.6%)	29 (96.7%)	0.6
	No	4 (4.7%)	3 (5.4%)	1 (3.3)	
Education of parents [3]	Educated	20 (23.3%)	20 (35.7%)	-	0.001*
	Non-educated	66 (76.7%)	36 (64.3%)	30 (100%)	
Crowded environment [4]	Yes	55 (64%)	26 (46.4%)	29 (96.7%)	0.001*
	No	31 (36%)	30 (53.6%)	1 (3.3%)	
Financial status	Poor	29 (33.7%)	8 (14.3%),	21 (70%)	0.001*
	Medium	52 (60.5%)	43 (76.8%)	9 (30%)	
	High	5 (5.8%)	5 (8.9%)	-	
Vitamin D level [5]	Deficiency	51 (59.3%)	32 (57.1%)	19 (63.3%)	0.5
	Insufficient	21 (24.4%)	15 (26.8%)	6 (20%)	
	Sufficient	14(16.3%)	9(16.1%)	5(16.7%)	

*Statistically significant differences,

1. Based on CDC's Developmental Milestones checklist
2. The poor considered as less than five food groups in 24 hours
3. Education means primary or high school education
4. Crowded environment was including a family with more than 5 members
5. Vitamin D levels less than 20 ng/mL considered as deficiency, 20-30 insufficient and more than 30 as sufficient.

Discussion

While there is excellent literature about the mechanisms by which IDA can alter neurodevelopment in children, high-quality clinical studies in this field and the therapeutic role of Iron supplementation are pretty limited (3). As we mentioned earlier A significant difference was seen between mean age of patients in ID and IDA groups (mean age in ID was less than IDA), developmental status (better development in ID group), complementary feeding starting time (lower age in ID groups), more dietary diversity in ID group in compare with IDA, more dietary diversity in ID group and better financial status in ID group in compare with IDA group ($p<0.05$, more information provided in Table 1).

The incidence of Iron Deficiency Anemia (IDA) is believed to be influenced by various factors such as low weight at birth, frequently consumption of cow's milk, inadequate intake of foods with iron sources, and poor socioeconomical status. Anemia in individuals of all ages, especially children less than of 2, may be attributed to various causes and associated factors such as inadequate sanitation, unemployment, meager wages, substandard housing, limited education, residing in rural areas, frequent consumption of cow's milk, and unfavorable health conditions [5, 9].

Another critical aspect of IDA is the suboptimal developmental status in children [10]. Frequent studies focused on this essential health concern [11]. There is limited data about the clinical outcome of the supplement Iron in children with IDA while there are a variety of studies that confirm the hematological profile improvement [11].

It needs to be mentioned that, the current study is faced with critical limitations and is just a preliminary study for evaluation of IDA and ID pediatrics population in Iraq to highlight the importance of this issue and encourage more independent researchers to study this subject in developed and developing countries. A significant limitation in the current study was about limited number of evaluated patients and differences in several ID and IDA cases. Yoon *et al* [12]. Demonstrated a high prevalence of VDD in children with IDA. However, there are also studies showing no association between vitamin D prevalence in children with iron deficiency anemia [13].

In our study, no correlation was found with the prevalence of vitamin D in iron-deficient children. Further research into the association between VDD and anemia is needed.

Meanwhile, the majority of data is confirmed with available data from literature in Iraq [14, 15], except the Vitamin D deficiency prevalence in the IDA population [16], regarding limited available studies. This conflict could be justified by considering different groups of patients and a limited number of included cases in this study.

In conclusion, we highlighted the importance of ID and IDA screening in children. The IDA could have effects on the developmental status of children. Dietary diversity and the sooner start of complementary feeding would be essential elements for preventing IDA. We encourage other researchers to provide more comprehensive research on this topic due to its critical importance.

Conflict of interest

There is no conflict of interest in this study.

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