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Prevalence of Iron Deficiency Anemia in children and its association with Dietary patterns

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Abstract: Anemia is a serious global public health problem that mostly affects children under the age of six. It strongly impacts their behavior, psychomotor development, and cognitive abilities. The immune system & its defenses are also impacted on physical development. This study is strongly contributing to assess and enroll clinical findings for iron deficiency anemia in children and assessing the association of children's iron deficiency anemia association with dietary patterns. Our study was assessed clinical outcomes of children who suffer from iron deficiency anemia. Due to that, we collected medical records of children from Baghdad, Iraq hospitals during follow-up, ranging from March 2024 to March 2025. Our study conducted a comparative for 106 samples, where the first group shows 56 children with iron deficiency anemia and second group includes 50 children without iron deficiency anemia.

Furthermore, we enrolled clinical data of children in both groups, including hematological profiles and dietary patterns. Also, we determined the extend of association between iron deficiency anemia and dietary patterns. Based on collected clinical data, we noted a low in hemoglobin, serum ferritin, and serum iron in a group of children with iron deficiency anemia in comparison with children without iron deficiency anemia [(9.1 ± 0.8 g/dL), (8.5 ± 3.2 ng/mL), and (28.5 ± 10.1 µg/dL). Also, we defined the risk factors of children with iron deficiency anemia including excessive cow's milk, rare/never consumption of meat, and rare/never consumption of Vitamin C-rich foods. According to the association between iron deficiency anemia in children and dietary patterns, we found that tea consumption with meals and lack of iron-fortified formula had a significantly impact on iron deficiency anemia. Our study shows that poor eating habits had highly impact in children with iron deficiency anemia, where it public health initiatives and parent education should place a strong emphasis on the value for a balanced diet, iron supplements, and minimizing cow's milk consumption in early life.

Key words: IRON DEFICIENCY ANEMIA; DIETARY PATTERNS; RISK FACTORS; AND HEMATOLOGICAL PARAMETERS.

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Introduction

Children anemia is one of the major problems of nutritional deficiency in the world and is associated with high infant and maternal morbidity and mortality, and with the negative impact on the emotional, cognitive, and motor development of children under 36 months. 90% of anemia in the world is due to iron deficiency [1, 2, 3, 4]. Iron deficiency anemia is the final stage of iron deficiency and it occurs during the critical period (less than two years) without early intervention, it can cause irreversible damage, preventing the child from achieving adequate neurological development. [5]

This public health problem is associated with low birth weight and increased susceptibility to infections, with the most vulnerable population being children under 5 years of age, due to their accelerated growth and increased iron requirement [6, 7, 8]. Anemia, like chronic malnutrition, is another impact variable of the nutritional food system and is determined through a biochemical assessment, which measures the amount of blood hemoglobin (Hb) in g/dL and, based on standardized cut-off points, classifies its severity [9, 10]. The concentrations of Hb in children from 6 to 59 months of age, to diagnose anemia at sea level, in g/dL, are: greater than 11 without anemia, 10.9 to 10.0 mild anemia, 9.9 to 7.0 moderate anemia, and values less than 7 severe or severe anemia. [11]

Regarding the classification of anemia as a public health problem, if the prevalence is less than 5.0%, there is no public health problem; from 5.0 to 19.9%, mild public health problem; from 20.0 to 39.9%, moderate public health problem; more than 40.0%, serious public health problem [12, 13]. Globally, 47.4% of children under the age of five have some level of anemia, being the most critical problem in low and medium-sized economic countries, and among its determinants are reported low economic condition, low maternal educational level, poor access to primary health care, inadequate sanitary conditions, widespread consumption of iron-deficient foods, maternal anemia, and maternal vegetarianism. [14]

Patients & Methods

A 12-month cross-sectional study was performed in hospitals in Baghdad, Iraq, between March 2024 and March 2025. Children around between the ages of one and twelve who visited the pediatric inpatient department at hospitals in Baghdad, Iraq, participated in the study. One hundred six children were gathered and divided into two groups. Fifty-six youngsters with a recent diagnosis for iron deficiency anemia (IDA) made up the IDA group. Fifty age-matched children who were proven to have normal iron status and who came in for routine checkups or minor illnesses constituted the control (Non-IDA) group. The investigation excluded children with acute serious illnesses, congenital anomalies, chronic systemic diseases, and those who had received iron supplements or transfusions of blood in the previous three months.

A mix of laboratory tests, a comprehensive physical examination, and a structured interview were employed to obtain data. The parents were questioned in order to gather information regarding the mother's schooling, socioeconomic situation, and demographic traits (age, sex). Dietary habits have been examined via a pre-validated food consumption questionnaire (FFQ). The most common milk sources (breast milk, cow's milk, and iron-fortified formula), the frequency of consuming various food categories (meat, vitamin C-rich vegetables and fruits, eggs, nuts, fast food, snacks, and candies), the frequency of breakfasts, the consumption of tea, and the degree of physical activity were each recorded in this questionnaire. Using approved methods, anthropometric data such as height and weight were obtained, and BMI was estimated.

After an overnight fast, venous blood samples (about 5 ml) were gathered from each participant. An automated hematology analyzer was employed to determine the levels of hemoglobin (Hb), the mean corpuscular volume (MCV), as well as the mean corpuscular hemoglobin (MCH) in the complete blood count (CBC). Standard spectrophotometric along with chemiluminescence approaches were utilized in measuring the measurements of blood iron, serum ferritin, and total iron-binding capacity (TIBC), respectively. Serum 25-hydroxyvitamin D quantities were measured to determine vitamin D status. A hemoglobin level less than the age-specific cut-off (<11 g/dL in children under 5 years, <11.5 g/dL for children aged 5-11 years) combined with at least two other abnormal iron parameters—serum ferritin <12 ng/mL, serum iron under forty µg/dL, MCV <70 fL, as well as transferrin saturation <16%—was weighed iron deficiency anemia, according to the World Health Organization's (WHO) criteria for children.

SPSS version 26.0 was implemented for all statistical analyses. For continuous variables, descriptive statistics were displayed as the mean and the standard deviation (SD); for categorical variables, data was expressed as frequencies and percentages. Multivariate logistic regression modeling was used to identify independent risk variables for IDA. To compute (aOR) via 95% confidence intervals, the model included all factors that were considered clinically relevant or had a p-value below 0.05 during the univariate analysis. For all analyses, a p-value of 0.05 or lower was deemed statistically significant.

Results

Table 1: Basics demographic features and clinical data of patients who participated in our study.

ameters	A Group (n=56)	n-IDA Group (n=50)
e groups (years), n (%)		
3	(32.1%)	(24.0%)
6	(39.3%)	(32.0%)
9	(19.6%)	(30.0%)
- 12	3.9%)	14.0%)
, n (%)		
le	(42.9%)	(52.0%)
nale	(57.1%)	(48.0%)
II Parameters, [Mean ± SD]		
ight (kg), Mean ± SD	3 ± 4.1	9 ± 5.2
ght (cm), Mean ± SD	.5 ± 18.3	6.8 ± 19.5

II (kg/m²), Mean ± SD	9 ± 1.8	4 ± 1.6
in symptoms, n (%)		
lor	(85.7%)	10.0%)
igue/Lethargy	(92.9%)	(20.0%)
a	(26.8%)	2.0%)
or Appetite	(71.4%)	(24.0%)
quent Infections	(50.0%)	18.0%)
ucation of mother, n (%)		
mary or below	(35.7%)	16.0%)
ddle school	(32.1%)	(24.0%)
ior high school	(21.4%)	(30.0%)
ior college or above	10.7%)	(30.0%)

Table 2:- Distribution of hematological data in children recorded in hospitals.

matological Parameter	A Group (n=56)	n-IDA Group (n=50)
moglobin (g/dL)	± 0.8	5 ± 0.9
um Ferritin (ng/mL)	± 3.2	2 ± 10.1
CV (fL)	4 ± 5.6	1 ± 4.3
CH (pg)	1 ± 2.5	3 ± 1.9
um Iron (µg/dL)	5 ± 10.1	4 ± 20.5
BC (µg/dL)	0.2 ± 45.8	0.6 ± 35.2

Table 3:- Categorizing dietary patterns distributed in children for both groups.

tary Pattern / Factor	A Group (n=56)	n-IDA Group (n=50)
dominant Milk Source		
astfed >12 months	(17.9%)	16.0%)
w's Milk	(62.5%)	(30.0%)
n-Fortified Formula	(19.6%)	(54.0%)
at Consumption		
ly/Every other day	14.3%)	(50.0%)
times per week	(35.7%)	(36.0%)
ely/Never	(50.0%)	14.0%)
. C Rich Food Consumption		
ly	(17.9%)	(44.0%)
times per week	(32.1%)	(40.0%)
ely/Never	(50.0%)	16.0%)
amin D Status		
ficient (>30 ng/mL)	3.9%)	(36.0%)
ufficient (20–30 ng/mL)	(26.8%)	(40.0%)
ficient (<20 ng/mL)	(64.3%)	(24.0%)
a Consumption with Meals		
s	(39.3%)	10.0%)
	(60.7%)	(90.0%)
cessive Cow's Milk (>500ml/day)		
s	(67.9%)	(24.0%)
	(32.1%)	(76.0%)
derate-to-high physical activity		
times/week	(71.4%)	(50.0%)
times/week	(28.6%)	(50.0%)
dtime, n (%)		
0 p.m.	(32.1%)	(60.0%)
0 p.m.	(67.9%)	(40.0%)
lnutrition, n (%)		
s	(57.1%)	16.0%)
	(42.9%)	(84.0%)
owth retardation, n (%)		
s	(35.7%)	10.0%)
	(64.3%)	(90.0%)
eakfast habits, n (%)		
3 times a week	(44.6%)	16.0%)
5 times a week	(35.7%)	(24.0%)
me a day and more	(19.6%)	(60.0%)

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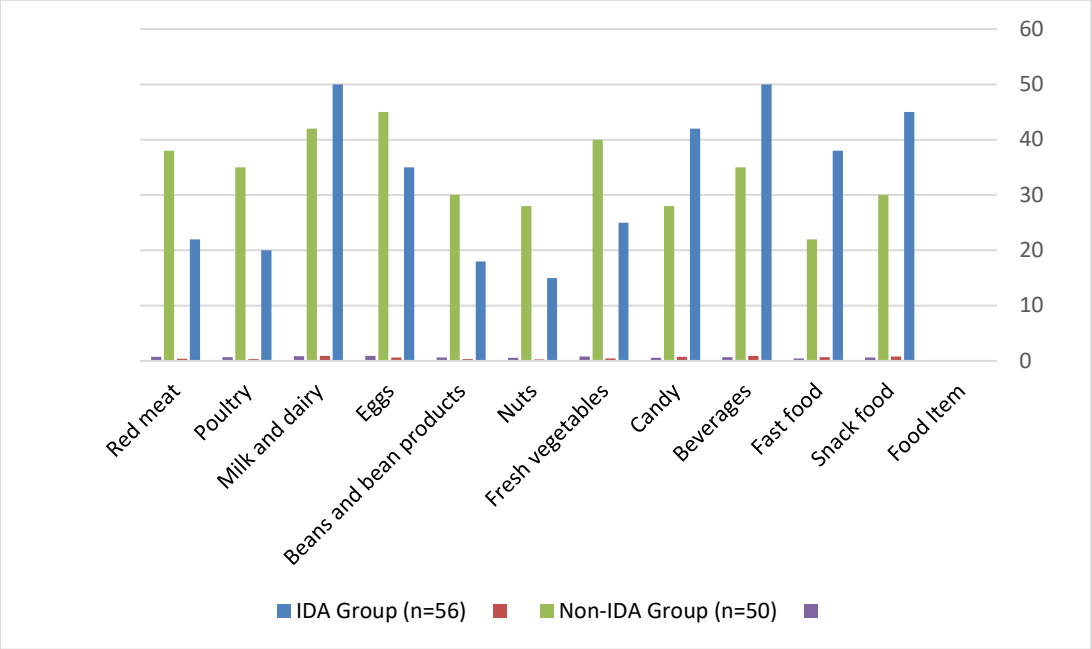

Figure 1: Determining daily food intake for children in both groups.

Table 4:- Performing a multivariate logistic regression analysis related to risk factors for children who suffer from iron deficiency anemia.

k Factor	justed Odds Ratio (aOR)	% Confidence Interval	alue
ely/Never consumes meat	5	5 - 13.45	02
w Birth Weight (<2.5 kg)	0	0 - 8.52	20
emic Mother	2	5 - 9.90	04
essive Cow's Milk Intake	0	5 - 12.70	001
Iron Fortified Milk	5	5 - 8.20	05
Consumption with Meals	5	0 - 12.30	10
ely/Never consumes Vit. C foods	0	5 - 11.20	03
amin D Deficiency (<20 ng/mL)	0	8 - 8.76	05
e Group (4 - 6 years)	0	2 - 4.40	30
nale Sex	5	5 - 2.85	90

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Table 5:- Chi-square test using in assess the association between dietary patterns & patients with iron deficiency anemia.

tary Pattern	**Value**	**alue**
dominant Milk Source (Cow's Milk vs. Fortified/Breast)	82	001
at Consumption (Rarely/Never vs. Regular)	45	001
. C Rich Food Consumption (Rarely/Never vs. Regular)	33	001
ı Consumption with Meals (Yes vs. No)	56	001
cessive Cow's Milk (>500ml/day) (Yes vs. No)	45	001
akfast Habits (Irregular vs. Regular)	12	001

Discussion

The WHO catalogues iron deficiency anemia as a public health problem of epidemic proportions. Iron deficiency or iron deficiency is the most frequent and widespread nutritional disorder worldwide [15, 16, 17]. This is the only deficiency disease that, in addition to affecting the health of children and women in developing countries, also affects industrialized countries with great impact [17]. Currently, 2000 million people suffer from anemia, this is more than 33% of the world's population. Iron deficiency in children affects intellectual and psychomotor development, decreases resistance to infections, and slows growth. This deficiency affects cognitive development in all age groups, but its effects in the first years of life are irreversible [18].

Iron is fundamental for normal brain development, mainly during fetal and early postnatal life, which are the most critical and sensitive periods of brain development. Abnormally low serum iron levels in pediatric patients aged 0 to 5 years are capable of causing growth deficits, bone disorders, impaired immune response [19], heart problems, and cognitive disorders. There are several factors that increase iron deficiency in childhood. Premature birth, low birth weight, multiple pregnancy, cow's milk-based diet, and low-iron diet are described [20]. Anemia is a condition in which there are not enough red blood cells or insufficient amounts of hemoglobin, that is the ability of the blood to transport oxygen to the tissues of the body decreases, when a person has an insufficient amount of red blood cells, they are abnormal or do not contain enough hemoglobin, this can cause symptoms such as exhaustion, weakness, dizziness and breathing difficulties. [21, 22]

In our study, the prevalence of children with iron deficiency anemia was 52.83%, while 47.17% without this pathology, where these results have a high coincidence with the a study published in Argentine [23] which obtained 52% and 48% respectively, in their study, in which it is presumed that the most frequent cause of suffering from this pathology could be a consequence of inequality in public health for the rural area, where it is also pointing out that anemia and malnutrition affect people from vulnerable Argentine.

Age in children represents an important risk factor for anemia, since this is due to the high need for iron in this age range, derived from accelerated growth and development this combined with insufficient intake of this mineral [24]. Based on our study, it is found that the percentage is 32.1% corresponding to patients aged 1 - 3 years and 39.3% in patients aged 4 - 6 years for patients with iron deficiency anemia while it is found that the percentage is 24.0% corresponding to patients aged 1 - 3 years and 32.0% in patients aged 4 - 6 years for patients with iron deficiency anemia, the results are remarkably consistent with the analysis which conducted in Brazil [25], obtained 47.3% in children aged ≤ 6 years.

Our study found a high prevalence of growth retardation, which caused to gradual maturation that lead into increasing of iron loss during menstruation [26]. Additionally, the study discovered a negative correlation among ID and longer sleep duration, which was in line with results from a study conducted in the US that connected ID with poor sleep quality [26]. We enrolled that the growth retardation into children with anemia had 35.7%.

Moreover, higher BMI and less breakfast were all associated with the higher rate of transferrin over-standard, which leads to loss of iron in children. Obesity was associated with higher levels of inflammation, which would affect the iron levels in the body. We found that children with iron deficiency anemia group have 9.1 ± 0.8 Hemoglobin (g/dL), Serum Ferritin (ng/mL) 8.5 ± 3.2, 28.5 ± 10.1 Serum Iron (μg/dL). Also, we found that five dietary patterns intake have snack food 80.40%, Candy 75.00%, Milk and dairy 89.30%, Fast food 67.90%, while fast food and snake got 60.00%, 44.00% in children without anemia. [27] Recent evidence that vitamin D has a role of hematopoiesis while iron metabolism, and deficits in both contribute to the pathophysiology of anemia, supports our finding that vitamin D insufficiency was an independently IDA risk factor.

Meat and offal patterns were the only ones shown to be connected to TRF, according to the multivariate study of the relationship among dietary patterns and TRF. Children with a greater preference in meat and offal were less likely to have TRF over-standard. Both showed that a meat pattern was linked to a decreased

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incidence of ID, which was in line with the impact on dietary patterns on SF [28, 29]. Additionally, it suggested that the pattern of meat and offal had the most impact on the body's iron levels, which was consistent with other studies showing that meat were an excellent suppliers of iron. [30]

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Conclusion

Iraq's high childhood anemia rate remains to be an important issue. Based on the study, different dietary patterns offer various impacts on children's anemia. For example, while cereal, tuber, and snack, and fast food patterns are risk factors for ID, fruit and vegetable patterns and meat patterns are protective factors. For boys and younger children, the impact of nutrition upon the body's level of iron is more significant. The findings of this study may encourage the development of preventative and control strategies for iron deficiency as well as iron deficiency anemia in adolescents.

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