

## **HEALTH OUTCOMES FOR IRAQI CHILDREN WITH ANEMIA**

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### **Abstract**

**Background:** Anemia is a widespread condition affecting nearly half of all children under the age of five worldwide. **Objective:** This study aims to analyze and assess the health outcomes associated with anemia in Iraqi children. **Patients and methods:** A prospective study was conducted using clinical data collected from different hospitals in Iraq, including 87 children under the age of thirteen with anemia. The study period was from April 16th, 2022, to August 25th, 2023. This study aimed to establish goals for the outcomes of children with anemia, using patient data to compare changes in blood hemoglobin levels and red blood cell count percentages over the short and long term, according to CHR. VAS was also relied on to assess the long-term health physical and mental quality of life of paediatric anemia patients. **Results:** The clinical data shows that there were 20 cases of parasitic worm infection, 27 cases of malaria infection, and 17 cases of intestinal protozoa infection. This study aimed at determining the severity of anemia, which was classified as mild in 12 cases, moderate in 30 cases, and severe in 45 cases. In terms of nutrition, the study identified normal levels in 70 patients; 13 patients were overweight, and 4 cases exhibited signs of malnutrition.

Additionally, 22 patients who were anemic took iron supplements. Over the two-year follow-up period, the study found a decrease in hemoglobin levels in patients. However, the data demonstrated a significant reduction in the long term. This investigation scrutinised the quality-of-life outcomes of patients, uncovering high health risk scores in relation to cognitive development, treatment burden, growth, and physical development. **Conclusion:** Anemia is a risk factor for physical and health growth, which leads to negative consequences on the quality of life of children in the long term.

**Key words:** Anemia; CHR; Changes in Hemoglobin and % hypochromic erythrocytes; Children.

**Introduction.** Anemia is a disorder in which the number of erythrocytes is insufficient to meet the body's needs. Iron deficiency is the most common cause of anemia, but it can be caused by other nutritional deficiencies, parasitosis, and other diseases that affect the synthesis of hemoglobin. [1]

The hemoglobin concentration alone cannot be used to diagnose iron deficiency. However, the prevalence of anemia is an important indicator, so the hemoglobin concentration can provide information about the intensity of iron deficiency. [2]

Iron deficiency is defined as a condition in which signs of a compromised supply of iron to the tissues were observed [3]. When individual hemoglobin levels are below two standard deviations (- 2DE) from the mean hemoglobin distribution in a population of the same sex and age living at the same altitude, iron deficiency anemia is considered to be present. [4]

Iron deficiency negatively affects the cognitive performance, behavior, and physical growth of infants, preschoolers, and school-age children. [5]

In a study done in France, children who had moderate anemia during childhood achieved lower intelligence scores upon entering school than children who did not have anemia. This finding was corroborated even by controlling for a broad set of socioeconomic factors. [6]

The results of a study done in the United States in children under three years of age support the idea that iron deficiency anemia and iron deficiency without anemia during infancy and childhood can have detrimental effects on neurological development. Therefore, they recommend addressing the problem using methods for early detection. [7]

In a study conducted in Poland, significant differences were found in school performance between children who had anemia and those who did not have it at one year of age. They conclude that the negative effects on development associated with iron deficiency anemia at the age of one year may persist at ten years of age and be expressed in the school environment. [8]

Likewise, its association with poverty has been corroborated by research carried out in America based on the evaluation data in the years 2010, 2012, and 2013. In these studies, it was found that the proportion of children with anemia doubles in the regions of the country with the worst indicators of social exclusion. [9]

It is considered that it is precisely the group of children between 6 and 23 months of age that has the greatest risk and vulnerability, according to evidence from multiple countries, given the inadequate intake of micronutrients due to limitations in the variety and quantity of available foods. [10]

However, it is not only under conditions of poverty that this health problem occurs. A study conducted with healthy infants in Norway, a country with high human and economic development, reveals that there is mild iron deficiency anemia among them, so they conclude that prevention and early treatment should be a priority for health services. [11,12]

The most common practice in the evaluation of whether or not it is iron deficiency anemia consists in monitoring the response of hemoglobin and hematocrit levels after 1 or 2 months of oral iron supplementation. An increase of 10 g/L of hemoglobin or 3% in hematocrit is indicative of iron deficiency. [13,14]

The limitation of hemoglobin or haematocrit measurements is that the levels change only when the iron deficiency is already severe. That is why, when sufficient resources are available, it is necessary to include more sensitive and specific individual evaluation tests such as serum ferritin, transferrin saturation, and others. [15]

With regard to the age of starting screening, it is assumed that most children are at low risk before six months of age because their iron stores are adequate, so the earliest age to start the assessment of iron status is usually between 6 and 9 months. [16]

In this regard, the American Association of Pediatrics (AAP) recommends that universal screening for anemia should be performed with the determination of hemoglobin concentration at approximately one year of age. [17]

The Pan American Health Organization (PAHO), in this regard, proposes that the countries of the region collect the information required to determine the magnitude and severity of the problem [18]. To do this, he points out that rapid evaluation studies should be carried out to provide the minimum amount of information necessary for the maintenance of the programs to be implemented instead of resorting to sophisticated or expensive research projects [19]. The variations in the prevalence of iron deficiency worldwide, the availability of laboratories for testing, and the appearance of other factors that cause anemia require that the related indicators be adjusted to the environmental circumstances [20].

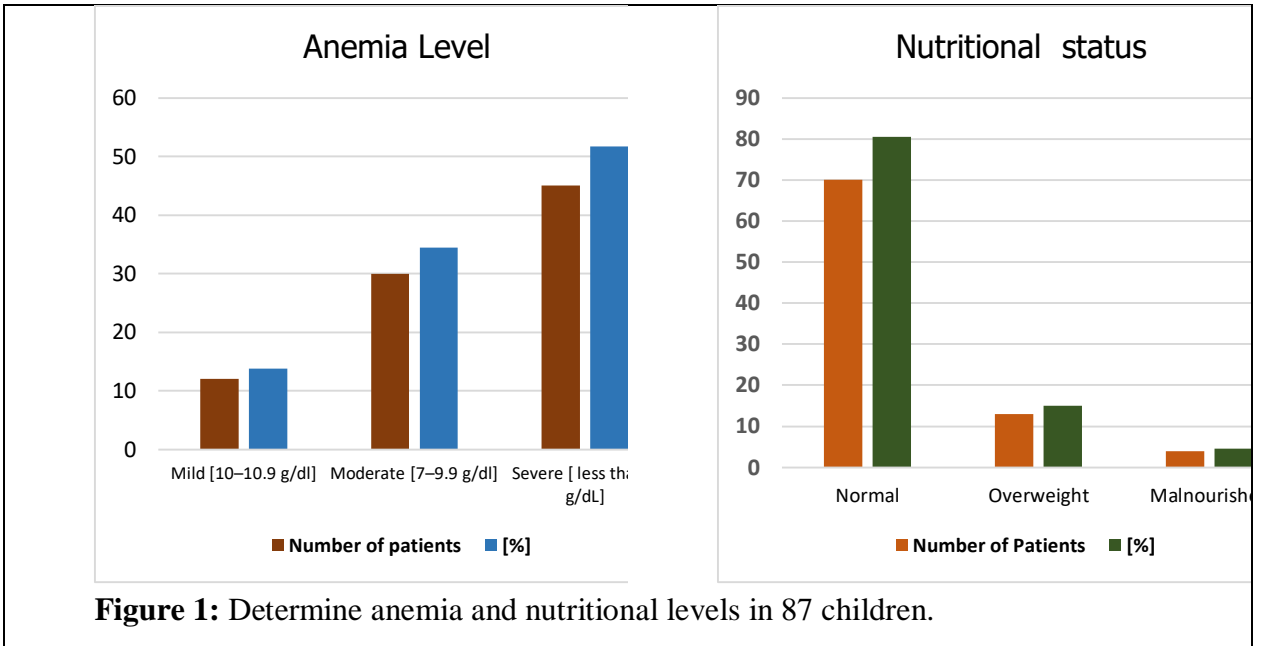
### **Patients and methods**

A prospective study of clinical data collected from different hospitals in Iraq was presented on 87 children under the age of thirteen with anemia, and this period included from April 16th, 2022, to August 25th, 2023. This study took samples from patients and recorded the characteristics prevalent in the patient's data, which included age, gender, symptoms, body mass index rate, the mother's marital status, the income and education level of the parents, and the diseases causing the patients. Moreover, the study examined the level of hemoglobin in the blood and determined the level of anemia in children by taking 3 ml of the child's venous blood and allocated it to Mild [10–10.9 g/dl], Moderate [7–9.9 g/dl], Severe [ less than seven g/dL]. Relying on the data of pediatric patients, this study completely covered all the data specified regarding the level of nutrition given to children, as it was classified into three types: normal, overweight, and malnourished. Also, this questionnaire recorded the nutritional practices followed by the children by the parents in terms of meals, the type of food products used, and the nutritional program followed. Also, all operations the children had previously undergone, blood transfusions, blood loss, iron supplement intake, and other chronic diseases were included. This study contributed to defining current and future goals for the outcomes of children with anemia by conducting a comparison covering patient data related to changes in the level of hemoglobin in the blood and hypochromic red blood cells % in the short and long term by CHr. CHr is an effective tool that works to diagnose anemia resulting from iron deficiency by measuring iron metabolism by taking a blood sample and conducting a blood test, as the hemoglobin level is considered normal if the CHr rate is between (24.5 - 31.8), and if it is less than 24, it is an indicator on iron deficiency. We also relied on the VAS to conduct a test to assess the long-term health and physical and mental quality of life for pediatric patients with anemia. It was built in light of the patient's current results, as the VAS scale was organized into grades ranging between (0 - 10) and 0 represents the best while 10 represents the worst. This study also performed multivariate logistic regression analysis associated with risk factors for children with anemia. This study was desiged and analysed of results' study by SPSS.

### **Results**

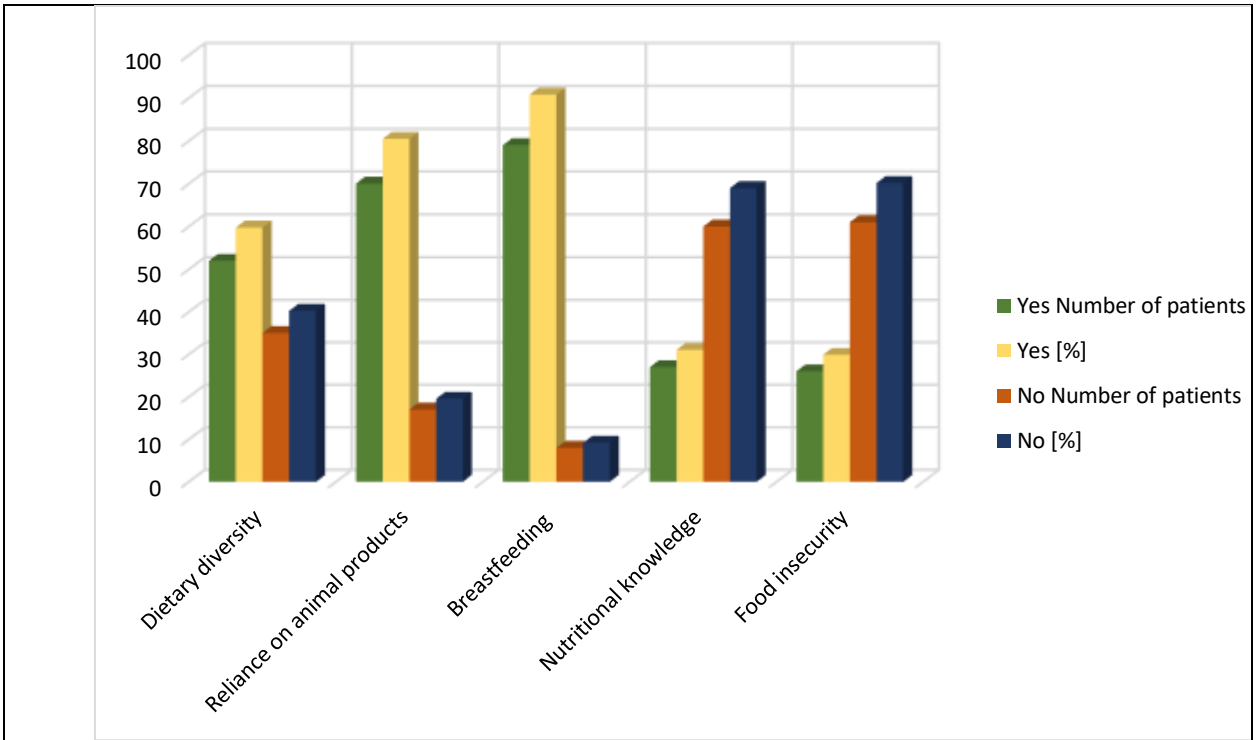
<b>Table 1:</b> Baseline demographic characteristics related to children's patients.
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<b>Characteristics</b>	<b>Number of patients [87]</b>	<b>Percentage [%]</b>
<b><i>Age (years)</i></b>		
< 1	40	45.98%
2-4	15	17.24%
5-7	20	22.99%
8-10	12	13.79%
<b><i>Gender</i></b>		
Male	53	60.92%
Female	34	39.08%
<b><i>Symptoms</i></b>		
Pale skin	30	34.48%
Fatigue	20	22.99%
Increase heartbeat	18	20.69%
Swollen tongue	10	11.49%
Enlarged spleen	9	10.34%
<b><i>BMI (Kg/m<sup>2</sup>)</i></b>		
Healthy weight	30	34.48%
Overweight	45	51.72%
Obese	12	13.79%
<b><i>Marital status of the mother</i></b>		
Married	52	59.77%
Divorced	20	22.99%
Widow	15	17.24%
<b><i>Education level of parents</i></b>		
Primary school	12	13.79%
Secondary School	30	34.48%
College	45	51.72%
<b><i>Monthly Income of parents</i></b>		
300 \$	10	11.49%
700 \$	46	52.87%
1000 \$	31	35.63%
<b><i>Helminthic infection</i></b>		
Yes	20	22.99%
No	65	74.71%
<b><i>Malaria infection</i></b>		
Yes	27	31.03%
No	60	68.97%
<b><i>Intestinal protozoa infection</i></b>		
Yes	17	19.54%
No	70	80.46%

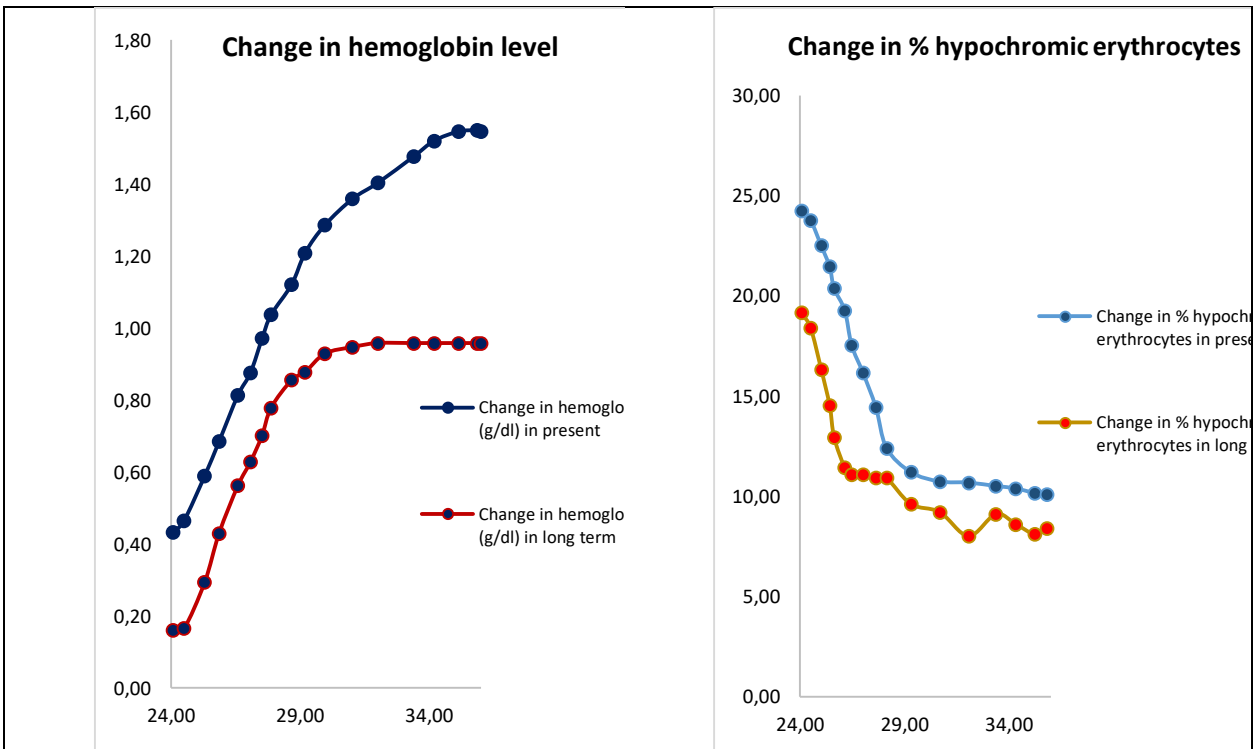


**Table 2:** Secondary outcomes.

	Number of patients [87]	Percentage [%]
<b>Severe blood loss</b>		
Yes	9	10.34%
No	78	89.66%
<b>Blood transfusion</b>		
Yes	4	4.60%
No	83	95.40%
<b>Iron supplements intake</b>		
Yes	22	25.29%
No	65	74.71%
<b>Previous history of surgical procedure</b>		
Yes	5	5.75%
No	82	94.25%
<b>Chronic diseases</b>		
Yes	2	2.30%
No	85	97.70%



**Figure 2:** Identification of nutritional practice findings in patients with anaemia.



**Figure 3:** Hemoglobin and % hypochromic erythrocytes outcomes of children with anemia in the short-term and long-term.

**Table 3:** Assessment of quality of life for children with anemia in the long term by VAS scale.

Variables	Quality of life
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Physical Health	7.2 ± 0.8
Cognitive Development	8.1 ± 0.63
Activities Practice	6.5 ± 1.05
Physical growth and development	7.4 ± 0.21
Treatment Burden	8.7 ± 0.31

**Table 4:** Multivariable logistic regression analysis of risk factors associated with children with anaemia.

Variables	COR (95 % CI)	P-value
Age	1.47 [0.21 – 4.6]	0.23
Male	1.03 [0.24 -4.1]	0.182
Monthly Income of parents	0.84 [0.11-3.5]	0.21
Diversity practice	1.72 [0.30-8.9]	0.68
Breastfeeding	0.4 [0.02-6.7]	0.023
Nutritional knowledge	1.21 [0.23-5.31]	0.47
Helminthic infection	5.62 [0.80-20.6]	0.12
Malaria infection	6.5 [1.05-15.66]	0.37
Intestinal protozoa infection	1.28 [1.10-8.3]	0.115

### Discussion

This study recorded pathological data and found that children younger than one year had a higher infection rate of 45.98% compared to other ages. Males had 53 cases and females 34 cases with symptoms, which is estimated to be pale skin in 30 patients, which was considered the most common symptom in patients with poverty. Blood with 45 weight gain, the diseases causing anemia were considered the most dangerous for children, as clinical data were recorded that parasitic worm infection was 20 patients, malaria infection was 27 patients, and intestinal protozoa infection was 17 patients. This study determined the level of severity of anemia. Mild was 12 cases, moderate was 30 cases, and severe was 45 cases. Regarding the level of nutrition, the results of the study showed rates of nutritional level, as it discovered normal in 70 patients, overweight in 13 patients, and malnutrition in 4 cases, while the percentage of anemic child patients who took iron supplements was 22 patients with a previous history of surgical operations was set at 5 cases.

Regarding diet, this study found that the rate of breastfed children was 79 patients, the rate of eating animal products was 70 patients, while the rate of children with dietary diversity was 52 patients. This study determined the evaluation of short-term and long-term health outcomes. This study showed that patients had a decrease in hemoglobin levels during the follow-up period, which lasted two years, but the results of the data showed a significant decrease in the long term.

This study evaluated patients' quality of life outcomes where cognitive development, treatment burden, growth, and physical development were observed to be high in their health risk scores.

According to previous studies, anemia is a risk factor that negatively affects healthy living, which causes a source of concern for the general quality of life in the long term [21,22]. Another studies have confirmed that helminth infections, intestinal protozoa infections, and malaria infections are widely associated with anemia among children under the age of ten [23]. Also, an American study indicates that children with malaria are more likely to develop severe anemia compared to children who have helminth infections. [24]

Another study showed that a lack of nutrition affects the rates of low hemoglobin in the blood, which is caused by iron deficiency [25]. This study concluded that not eating iron-rich foods causes a low level of hemoglobin, which is caused by anemia. [26]

### **Conclusion**

These results of the study found that age greatly affects anemia, as it was found that half of the pediatric patients suffered from severe anemia. The results of this study showed that malnutrition and vitamin deficiency negatively affect the lack of sufficient iron in the production of hemoglobin, which helps in the rate of oxygen in the blood. This study reported that risk factors such as intestinal protozoa infection, helminth infection, and helminth infection cause are negatively associated with an increased incidence of anemia in children. This study indicated that anemia affects the child's physical and healthy growth and development, which greatly affects the quality of life of children in the long term.

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