



The Prevalence of Anemia and Associated Factors Among Children under 5 Years in Zakho City, Kurdistan Region, Iraq: A Cross-sectional Study

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ABSTRACT

Background: Anaemia is a lower concentration of haemoglobin and red blood cells. Nearly 1.62 billion individuals worldwide suffer from anaemia, of which approximately 47% are preschool-aged children. Anaemia due to iron deficiency can be prevented by breast-feeding, taking formula with iron, avoiding cow's milk till the child reaches the age of one year, and including iron-rich foods in the diet.

Objectives: The primary aim of this study was to determine the prevalence of anaemia and associated factors in children under the age of five who were admitted to Zakho General Hospital.

Methods: A cross-sectional study was conducted from August 2022 to February 2023 among children under 5 years in Zakho city. 1404 children were recruited in this study, and the ages ranged from six months to five years. A spectrophotometric method is typically used to assess anaemia by measuring the haemoglobin (Hb) concentration.

Results: The children that participated in this study were 1404, ages 6 months to 60 months (23.01 ± 14.77). Age and anaemia were significantly correlated (p -value < 0.01), with a higher prevalence of anaemia in younger age groups. In children aged 6 months to less than 24 months, the history of breast-feeding was significantly correlated with anaemia; 164 (59%) of the 278 children with a history of breast-feeding had anaemia (p -value < 0.0001). Anaemia and meat consumption were significantly correlated (p -value = 0.007). The frequency of egg intake, the size of the family, and the level of the mother's education had no effect on anaemia.

Conclusion: Among children under the age of five, particularly those under two, anaemia is disturbingly widespread, according to our study. As a result, enhanced nutritional therapy and a robust public health education campaign may assist in reducing the prevalence of this hematologic health concern. Additionally, it was shown that a history of breast-feeding and a limited meat diet are the two most significant risk factors for anaemia.

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Keywords: Anaemia, Children, Prevalence, Zakho City, Kurdistan, Iraq.

1. Introduction

A lower concentration of haemoglobin and red blood cells are indicators of anaemia compared to healthy individuals of similar gender, age, race, and physiological condition without considering what caused the deficiency^[1,2]. It is a global public health problem that impacts all communities at all income levels and has serious adverse health effects on individuals' well-being as well as the socioeconomic growth of those countries^[3].

Nearly 1.62 billion individuals worldwide suffer from anaemia, of which approximately 47% are preschool-aged children. South-East Asia and Africa have the most incredible prevalence rates^[4,5]. Failure of hematopoietic nutrient concentration to meet demands will cause nutritional anaemia^[6]. A lack of B12 vitamins, folate, and iron, as well as deficits in other minerals like copper and zinc, contribute significantly to anaemia^[7]. Globally, folic acid and vitamin B12 are far less frequent, and iron deficiency is the leading cause of nutritional anaemia^[8].

Other risk factors for childhood anaemia include poor education, poverty, digestive and absorption problems, intestinal helminth

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infections, and genetic abnormalities^[9]. Anaemia has the most significant impact on children because their body development is still in progress, especially the brain, the fastest-developing organ in young and infants. The permanent brain damage might result from the consequences of iron inadequacy that are shown in the first six months of life^[8]. It also can result in low oxygenation of the brain tissues, which can affect motor and intellectual development as well as growth^[10,11].

Anaemic individuals, significantly children, have decreased immunity against infections, reduced appetite, and an inability to maintain body temperature in severe anaemia may also be seen^[8]. Depending on the type, underlying cause, severity, and any underlying medical issues, anaemia's signs and symptoms might vary^[12]. Pale skin, physical growth problems, light-headedness and dizziness, weakness, and cold hands and feet are the most common signs and symptoms^[13]. Pica is another nonhematologic effect of anaemia in general, especially iron deficiency anaemia. Iron deficiency has been associated with impaired neurocognitive function in infancy. It has also been connected to later, maybe irreversible, cognitive deficits. Some studies indicate an increased risk of seizures, strokes, and breath-holding episodes in children^[14].

Initially, the evaluation of anaemia should be through history taking since signs and symptoms of mild anaemia may be absent. Information about (birth weight, diet, breast-feeding, prematurity, chronic diseases, family history, and ethnicity) should be asked. A complete blood count is used as a diagnostic test. Additionally, microcytic, normocytic, and macrocytic anaemia are distinguished by MCV (mean corpuscular volume)^[15].

The inherited types of anaemia cannot be prevented. However, anaemia due to iron deficiency can be prevented by breast-feeding, taking formula with iron, avoiding cow's milk till the

child reaches the age of one year, and including iron-rich foods in the diet, such as egg yolks, raisins, and all sorts of meat^[16]. Few statistics are available on the prevalence of anaemia in children under the age of five in the Kurdistan Region of Iraq. As a result, the primary goal of this study was to determine the prevalence of anaemia and associated factors in children under the age of five who were admitted to Zakho General Hospital.

2. Materials and Methods

2.1 Selection of subjects

A cross-sectional study was conducted in Zakho General Hospital in the Iraqi city of Zakho, Kurdistan. The study was carried out between August 2022 to February 2023. The children who took part in this study, a total of 1404, ranged in age from six months to five years old.

2.2 Patient information

Parents of the children were directly questioned using a questionnaire that asked about their sociodemographics (age, sex, location of residence, occupation, and educational attainment of the mother), family characteristics (number of children, order of children in the family), as well as dietary history, children's immunization data and health background.

2.3 The criteria of the study sample:

2.3.1 Inclusion criteria

Any children between the ages of 6 and 60 months.

2.3.2 Exclusion criteria

Children younger than 6 months or older than 60 months.

2.4 Definition of variable

Table 1: The WHO classification of infant breast-feeding practices ^[17].

	Requires that the infant receive	Allows the infant to receive
Exclusive breast-feeding (EBF)	Breast milk (including milk expressed or from a wet nurse).	Oral Rehydration Solution, drops, syrups (vitamins, minerals, medicines).
Predominant breast-feeding (PBF)	Breast milk (including milk expressed or from a wet nurse) is the predominant source of nourishment.	Certain liquids (water and water-based drinks, fruit juice), ritual fluids, and ORS drops or syrups (vitamins, minerals, medicines).
Mixed feeding (MF)	Breast milk (including milk expressed or from a wet nurse) and solid or semi-solid foods.	Anything else: any food or liquid, including non-human milk and formula or human milk in a bottle.
Bottle-feeding	Any liquid (including breast milk) or semi-solid food from a bottle with a nipple/teat.	Anything else: any food or liquid, including non-human milk and formula.

Definition of vaccination

Up-to-date vaccination is a proportion of vaccinated children at pre-defined ages^[18].

Complete vaccination was described as having received all doses for each of 4 vaccines: polio (4 doses administered at Birth, 6, 10, and 14 weeks), measles (administered at 9 months), Bacillus Calmette-Guérin (BCG) against tuberculosis

(administered at Birth), and DTwPHibHep (DTP) against diphtheria, tetanus, pertussis, influenza, and hepatitis B (3 doses administered at 6, 10, and 14 weeks^[19].

2.5 Sample collection

Four millilitres of peripheral venous blood were drawn from each patient using the appropriate sterile venipuncture technique

putting on a K2 ethylenediaminetetraacetic acid (EDTA) tube (BD Vacutainer, Franklin Lakes, NJ).

The K2-EDTA tubes are well mixed by inverting 10 times (or by putting on a rotator mixer).

2.6 Laboratory procedures

Haemoglobin levels were used to determine the presence of anaemia measured using a fully automated blood analyzer (Medonic M-series- Sweden) instrument at the hospital clinical laboratory. From (5-60 months) of age, 11g/dl and above is considered the average haemoglobin level, according to WHO guidelines^[20].

2.7 Ethical Approval

The study proposal was approved by the ethics committee of the College of Medicine / University of Zakho in the Kurdistan Region of Iraq. Before collecting samples, parents of children were approached for permission to participate in the study, and all participants signed an informed written agreement.

2.8 Statistical Analysis

was performed using SPSS vs.25 application. Frequencies and percentages were used to describe descriptive statistics of the participants. The association between basic-demographic characteristics variables and anemia was studied using Chi-

Square or Fisher's exact test. Statistical significance was defined as a p-value of 0.05 or less.

3. Results

The children in this study were 1404, ages 6 to 60 months (23.01 ± 14.77). The demographic characteristics of the total children are summarized in Table 2. Children were placed into three age groups: those aged 6-24 months, those aged 25-42 months, and those aged 43-60 months, accounting for 922 (65.7%), 282 (20.1%), and 200 (14.2%) total children. According to children's gender, 656 (46.7%) females and 748 (53.3%) males were among the investigated children. The study identified that anaemia was more common in females than males; of the total of 748 males, 305 (40.8%) were anaemic, while 295 (45.1%) females 656 had anaemia.

In terms of religion, 1213 (86.4%) of the children were Muslims, while 171 (12.2%) were Yazidis, and 20 (1.4%) were Christians. Regarding the children's ethnicity, Kurds made up the majority of 1320 (94%) of the ethnic group, while Arabs made up 80 (5.7%).

Regular breast milk was given to 178 children aged 6 to 24 months (30.2%). The study discovered that 206 (14.67%) of the 1404 children aged six to sixty months had chronic illnesses, while 1109 (79%) had received up-to-date vaccines.

Table 2: Sociodemographic information as well as additional medical and health factors

Variable	Category	N=1404	100%
Age	6 - 24 months	922	65.7%
	25-42 months	282	20.1%
	43-60 months	200	14.2%
Sex	Male	748	53.3 %
	Female	656	46.7 %
Religion	Muslim	1213	86.4%
	Yazidi	171	12.2%
	Christian	20	1.4%
Ethnicity	Kurd	1320	94 %
	Arab	80	5.7%
	Others	4	0.3 %
Prevalence of breast-feeding among children	Children 6 - <24 months	178	30.2%
Up-to-date vaccination	6 months -5 years	1109	79%
Chronic diseases	6 months -5 years	206	14.67%

Anaemia's frequency in society according to the age of the studied population is shown in Table 3. Anaemia affected 436 (47.3%) of the total (922) children aged 6 months to 24 months, 102 (36.2%) of the 282 children were between the ages of 25 and 42 months, and 63 (31.5%) of the 200 children fell between the ages of 43 and 60 months. Anaemia was seen in 42.8% of children aged 6 months to 5 years. The frequency of anaemia differs significantly between children's ages when analyzed using the Chi-square test (χ^2 -test) (p-values < 0.001).

Table 3: The incidence of anaemia by age groups.

Age group	Anaemic children	Non-anaemic children	Total	p-values < 0.001
6-24 months	436 (47.3%)	486 (52.7%)	922 (100%)	
25-42 months	102 (36.2%)	180 (63.8%)	282 (100%)	
43-60 months	63 (31.5%)	137 (68.5%)	200 (100%)	
Total	601 (42.8%)	803 (57.2%)	1404 (100%)	

* Chi-square test results are used to calculate the p-value.

The relationship between breast-feeding history and anaemia in children aged 6 months to 2 years was also explored. It was shown that 164 (59%) of the 278 breast-fed children aged 6 to 24 months were anaemic, whereas 114 (41%) were not. Of the total 637 children, 269 (42.23%) were anaemic and not breast-fed, while 368 (57.77%) were not anaemic and not breast-fed (Table 4). Using the Chi-square test (χ^2 -test), the differences between the breast-feeding history with anaemia in children aged between 6 months to 24 months were statistically significant (p-value < 0.0001), indicating that the history of breast-feeding can be a risk factor for anaemia.

Table 4: Distribution of infants aged 6 to 24 months based on previous breast-feeding experiences with anaemia.

Anaemia	Breast-feeding History	No Breast-feeding History	Total	p-values 0.0001
Yes	164(59%)	269 (42.23%)	433(47.32%)	
No	114(41%)	368 (57.77%)	482 (52.68%)	
Total	278(100%)	637 (100%)	915(100%)	

* Chi-square test results are used to calculate the p-value.

Our findings showed a statistically significant distinction (p-value= 0.007) between the intake of meats with an increased anaemia risk, as shown in Table 5. It was found that 200 (38.17%) of the 524 cases who consumed meats three or more times per week were anaemic. Of the 880 cases, 401 (45.57%) of those who ate meats less than three times per week were anaemic.

Table 5: Anaemia prevalence and times when meat is consumed.

Anaemia	Eating meats ≥ 3 times /week	Eating meats < 3 times/week	Total	p-values 0.007
Yes	200 (38.17 %)	401 (45.57%)	601 (42.81%)	
No	324 (61.83%)	479 (54.43 %)	803 (57.19%)	
Total	524 (100%)	880 (100%)	1404(100%)	

* Chi-square test results are used to calculate the p-value.

On the other hand, it was found that out of 582 cases who consumed eggs three or more times per week, 236 (40.5%) were anaemic. Additionally, of 822 cases who consumed eggs 3 times per week, 365 (44.4%) were anaemic. Our results revealed no statistically significant difference. (p-value = 0.150) association between the intake of eggs per week with an increased anaemia risk, as shown in Table 6.

Table 6: Distribution of anaemia and the frequency of egg consumption.

Anaemia	Eating eggs 3 and more times/per week	Eating eggs < 3 times/per week	Total	p-values 0.150
Yes	236 (40.5%)	365 (44.4%)	601 (42.81%)	
No	346 (59.4%)	457 (55.6%)	803(57.19%)	
Total	582 (100%)	822 (100%)	1404 (100%)	

* Chi-square test results are used to calculate the p-value.

According to the research, 135 (43.5%) of the children of 310 women with low levels of education were anemic, while 157 (41.9%) of the children of 375 mothers with a primary school education were anemic. 188 (40%) of the 470 children of secondary-educated mothers were anaemic. Additionally, 121 (48.6%) of the 249 children raised by college-educated and higher-educated mothers were anaemic. Our results revealed that the association between the mother's level of education and risk of anaemia, as seen in Table 7, was statistically insignificant ($P=0.163$).

Table 7: Anaemia prevalence based on their mother's educational degree.

Mother's Level of Education	Anaemic child No. and %	Not anaemic child No. and %	Total	p-value 0.163
Illiterate	135 (43.5 %)	175 (56.5 %)	310 (100%)	
Primary school level	157 (41.9%)	218 (58.1 %)	375 (100%)	
Secondary school level	188 (40%)	282 (60%)	470 (100%)	
College level	121(48.6 %)	128 (51.4 %)	249 (100%)	
Total	601 (42.85%)	803 (57.2 %)	1404 (100%)	

* Chi-square test results are used to calculate the p-value.

The study found that the frequency of anaemia was highest in households with just one child. Anaemia was present in 138 (47.5%) 290 families with only one child. The frequency of anaemia was 156 (40.8%) out of 382 households with two children. Additionally, there were 307 (41.9%) anaemic families out of 732 families with three or more children (Table 8). Our findings showed no variations between anaemia and the number of children in the family ($P=0.171$).

Table 8: Anaemia prevalence concerning the number of children in the family.

Anaemia	One child	Two children	Three and more Children	Total	p-value 0.171
Yes	138 (47.6 %)	156 (40.8 %)	307 (41.9 %)	601 (42.8%)	
No	152 (52.4 %)	226 (59.2 %)	425 (58.1 %)	803 (57.2%)	
Total	290 (100 %)	382 (100 %)	732 (100 %)	1404 (100%)	

* Chi-square test results are used to calculate the p-value.

4. Discussion

Anaemia is a worldwide health issue affecting young children, especially in developing countries; therefore, measuring the

haemoglobin level provides evidence of a child's anaemic status. Consequently, this study aimed to assess the prevalence of childhood anaemia in Zakho City, Kurdistan Region, Iraq, as well as its associated factors in children under the age of five.

In this study, the hemoglobin level was measured in 1404 children who attend Zakho General Hospital. It was discovered that 42.8% of toddlers aged 5 to 60 months had anaemia, which is comparable to earlier studies conducted in Iraq as Al-Hamadan^[21] and Lozoff B et al.^[22] in which prevalence was (42%), (34.9%), respectively, close to S. Arabia's 37.2% anaemia prevalence KA Madani and others^[23] The WHO prevalence of anaemia (29–60%) in a study conducted in the eastern Mediterranean region by Bagchi K et al.^[24]

Furthermore, according to our findings, girls are more likely than boys to suffer from anaemia.

This study contradicts the studies done by Hameed 2007^[25] and S. Muwakkit et al. 2008.^[26] According to this research, 57% of anaemia patients were males compared to 45.1% of females, which may be related to males consuming more milk and food than females.

Current studies revealed that more infants and toddlers aged 6 to 24 months had anaemia, and this agrees with F Cetinkaya et al. 2005.^[27] C Sandoval et al 2002^[28], both studies concluded that most anaemic children were between the ages of 13 and 24 months, which contradicted Abdul Zahra's 2010^[29] and Abdulhussein et al.2021^[30], finding that most anaemic children were between the ages of 6 -12 months /6 - 11 months respectively. This might be due to high iron demands associated with rapid growth rate and erythropoiesis,

Regarding children in each household, 47.6% of anaemic cases occurred in households with just one child, as opposed to 41.9% of children in households with three children. This contradicts Al-Zabedi's 2014^[31] that a higher prevalence of anaemia was found in larger family sizes. Family size may affect children's nutrition status because of some of the behaviours in the family, but the result shows a non-significant relationship.

Regarding the mother's educational level, it seemed to have an impact on the percentage of anaemic children, in which 60 % of the mothers had secondary school degrees, as opposed to F Cetinkaya et al. 2005^[27], in which 81% of females had only completed elementary school, and also contradict Al-Zabedi 2014^[31], which found that children of mothers with low educational level (< 6 years of formal education) were four times more likely to develop anaemia than children of mothers with higher educational levels.

According to our study, children who were breast-fed had a higher percentage of anaemia than those who were not breast-fed, with 164 (59%) out of the total 278 breast-fed children having anaemia, as opposed to 269 (42.23%) out of the total 637 non-breastfed children. This finding was in agreement with Hameed's 2007 findings^[25]. Breast milk's lower iron content than artificial milk could account for the lower percentage of anaemic children (42.23%) who were not breast-fed.

Regarding egg consumption, children who ate less than three eggs per week had a higher percentage of anaemia (44.4%). This is related to eggs' iron content, and this study agrees with another study done by Psirropoulou et al.^[32] While 36% of children who were anaemic ate eggs rarely.

Furthermore, in this study, we found that a more significant percentage (45.57%) of anaemia was present in children who ingested meat less often than three times per week., which can be attributed to the higher hem iron and B12 content^[33]. This is consistent with Psirropoulou et al.^[32], who discovered that anaemic children ingested meat at a lower rate (46.7%) than other children.

The limitations of this study are the cross-sectional nature of the study design; it does not reveal causal links between independent variables and anaemia. Despite the limitations, we have determined the magnitude of anaemia and identified essential factors associated with anaemia among children aged 6–60 months in Zakho City, Kurdistan region, Iraq.

Conclusions

According to our research, anaemia is alarmingly common in children under the age of five, particularly those under the age of two. As a result, enhanced nutritional therapy and a robust public health education campaign may assist in reducing the prevalence of this hematologic health concern. Additionally, it was shown that a history of breast-feeding and a limited meat diet are the two most significant risk factors for anaemia.

Conflict of interests

None

Authors contribution

The authors contributed equally to this work, from the implementation and design of the research to the analysis of the results and to the writing of the manuscript.

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