

Prevalence of Iron Deficiency Anemia among Different Age Groups in Duhok City, Kurdistan region, Iraq

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ABSTRACT

Iron deficiency anemia is a prevalent public health concern affecting various age groups worldwide. This study aimed to determine the prevalence of iron deficiency anemia among different age groups in Duhok City, Kurdistan region, Iraq. A cross-sectional study was conducted, including 323 participants diagnosed with anemia from three hospitals in Duhok city. Data were collected from October 2022 to March 2023 and analyzed between April and May 2023. Hemoglobin, hematocrit, mean corpuscular volume, mean corpuscular hemoglobin, iron, and ferritin levels were assessed, with gender-specific normal ranges considered. The results showed a higher prevalence of anemia among females (70.9%) compared to males (29.1%). The majority of patients exhibited abnormal levels of hemoglobin, hematocrit, iron, and ferritin, indicating iron deficiency anemia. A positive correlation was found between hemoglobin and iron levels, while a weak correlation was observed between hemoglobin and ferritin concentrations. This study highlights the high prevalence of iron deficiency anemia in Duhok City, and emphasizes the need for public health interventions and further research to identify contributing factors and implement effective strategies for reducing the burden of anemia in the region.

KEY WORDS: Anemia, Iron deficiency, Iraq, Ferritin, Hemoglobin.

1. INTRODUCTION

Iron deficiency anemia (IDA) is a pervasive public health issue that disproportionately affects populations in developing countries (World Health Organization, 2021). Iraq country, is no exception to this global challenge, as it faces unique social, economic, and infrastructural barriers that contribute to the high prevalence of IDA (Albaroodi, 2021). This study aims to explore the prevalence of iron deficiency anemia among various age groups in Duhok, Iraq, and identify potential risk factors and interventions that could mitigate this pressing health concern.

Iron deficiency anemia is characterized by insufficient levels of hemoglobin due to a lack of adequate iron intake, absorption, or utilization (Camaschella, 2015). It has been associated with various adverse health outcomes, including impaired cognitive development in children, decreased work productivity in adults, and increased risk of maternal and infant mortality (WHO, 2021). In Iraq, the prevalence of IDA has been on the rise, largely due to inadequate dietary intake, poor iron absorption, and other factors such as parasitic infections (Albaroodi, 2021).

The burden of IDA in Kurdistan region is particularly concerning, as it has been affected by years of conflict, political instability, and socioeconomic challenges that have resulted in limited access to healthcare services and resources (Ibrahim et al., 2020). Moreover, studies on the prevalence of IDA in Duhok have been scarce, necessitating a comprehensive investigation into the extent of the problem and the identification of vulnerable age groups.

The present study seeks to address this knowledge gap by examining the prevalence of IDA among different age, and gender groups in Duhok, Iraq. The findings will not only shed light on the current epidemiological landscape of IDA in the Kurdistan region but also help inform targeted public health interventions to improve the iron status and overall health outcomes of affected populations (Lopez et al., 2016). By understanding the age-specific prevalence of IDA, healthcare providers and policymakers can develop and implement more effective strategies to combat this debilitating condition and its associated consequences.

2. LITERATURE REVIEW

Iron deficiency anemia (IDA) is a substantial public health issue worldwide, disproportionately affecting developing countries (WHO, 2021). Numerous recent studies have investigated the prevalence of IDA in various populations, risk factors, and consequences to better understand the problem's scope and inform interventions.

In a comprehensive study by Albaroodi et al., the prevalence of IDA in Iraq was found to be increasing due to factors such as inadequate dietary intake, poor iron absorption, and parasitic infections (Albaroodi, 2021). The authors emphasized the importance of addressing the growing burden of IDA on the healthcare system and the overall well-being of affected populations. Similarly, a study by Lopez et al. underscored the necessity of targeted public health interventions for improving iron status and mitigating the consequences of IDA (Lopez et al., 2016).

Kassebaum et al. conducted a global analysis of anemia and found that IDA was the leading cause of anemia-related disability-adjusted life years (DALYs) across all age groups (Kassebaum et al., 2014). This study highlights the significant global burden of IDA and the need for more effective interventions to address the issue. Another study by Stevens et al. estimated the worldwide prevalence of anemia and its association with iron deficiency, emphasizing the considerable regional variations in anemia prevalence and the role of iron deficiency as the primary contributor (Stevens et al., 2013).

Several studies have specifically focused on the age-specific prevalence of IDA. For instance, Ibrahim et al. reported a higher prevalence of IDA among children, adolescents, and women of reproductive age in low-resource settings (Ibrahim et al., 2020). The study stressed the importance of identifying vulnerable age groups and tailoring interventions accordingly. Camaschella further explored the adverse health outcomes of IDA, such as impaired cognitive development in children, decreased work productivity in adults, and increased maternal and infant mortality risks (Camaschella, 2015).

Recent research has also examined the impact of IDA on populations affected by conflict and political instability. A study by Lopes et al. identified limited access to healthcare services and resources as a contributing factor to the high prevalence of IDA (Lopes et al., 2022). The authors called for a comprehensive investigation into the epidemiological landscape of IDA in the region and the development of effective strategies to address the issue.

Rakanita et al. emphasized the importance of understanding the role of dietary habits and food fortification in addressing iron deficiency anemia in developing countries (Rakanita et al., 2020). They suggested that incorporating iron-rich foods and promoting the use of fortified foods could help reduce the prevalence of IDA in vulnerable populations.

The existing literature underscores the importance of understanding the prevalence of IDA among different age groups, particularly in regions like Duhok, Iraq, where access to healthcare and resources is limited. By investigating the age-specific prevalence of IDA in Duhok, this study aims to contribute to the existing knowledge base and inform targeted public health interventions to improve the iron status and overall health outcomes of affected populations (Lopez et al., 2016).

3. MATERIALS AND METHOD

3.1 Equipment

To ensure the accuracy of the study results, a complete blood count (CBC) machine was utilized for hematology analyses (Rao et al., 2008). This machine employs hydrodynamically focused impedance measurement, flow cytometry (using a semiconductor laser), and the SLS-hemoglobin method. The device is designed to count and size red blood cells (RBC) and platelets (PLT) by leveraging hydrodynamic impedance counting techniques. Concurrently, the hematocrit (HCT) value is calculated using the RBC pulse height detection method. Cytometry is a crucial analytical tool for examining the physiological and chemical characteristics of cells and other biological particles, while flow cytometry specifically analyzes these cells and particles as they traverse through minuscule flow cells.

Additionally, iron ferritin levels were assessed using the COBAS 6800 analyzer. This advanced diagnostic instrument offers a high degree of precision and reliability, enabling accurate and comprehensive analysis of iron deficiency anemia prevalence among the studied age groups in Duhok, Iraq.

3.2 Study Design

The study encompasses 323 samples obtained from patients diagnosed with anemia. The data collection process involves a random selection of patients from various age groups. Data is gathered from three hospitals in Duhok city, specifically Vajeen, Vin, and Azadi, during the period between October 1, 2022, and March 30, 2023. Following the completion of data collection, the analysis process is taken place from April to May 2023, with the aim of identifying significant differences and trends in the collected data. The analysis focuses on identifying significant differences between iron and ferritin levels, and blood parameters such as hemoglobin (Hb), hematocrit (Hct), packed cell volume (PCV), mean corpuscular hemoglobin (MCH), and mean corpuscular volume (MCV) in relation to the patients' ages.

3.3 Blood Sampling

Blood tests are conducted to measure iron and ferritin levels, as well as complete blood count (CBC) tests to assess blood parameters such as hemoglobin (Hb), hematocrit (Hct), mean corpuscular volume (MCV), and mean corpuscular hemoglobin (MCH) in the participating patients.

Criteria

The study focuses on data from patients with anemia across various age groups. However, to ensure the accuracy and specificity of the results, certain patient populations are excluded from the study. These exclusions encompass individuals with liver diseases, kidney diseases, those who are pregnant or breastfeeding, as well as patients with other gastrointestinal disorders, cancer, and heart failure. By excluding these patient populations, the study aims to provide a more precise assessment of the prevalence of iron deficiency anemia in the target demographic in Duhok, Iraq.

4. RESULTS AND DISCUSSION

4.1 Results

The study included 94 male participants (29.1%) and 229 female participants (70.9%), the gender distribution exhibited a mean of 1.74 and a standard deviation of 0.687, suggesting a numerical representation for gender categorization. whose ages ranged between 1- 73 years. With a mean \pm SD (27.17 \pm 22.753) for male, and mean \pm SD (31.24 \pm 17.367) for a female. The mean of Hemoglobin (Hb) level of total participant was found to be 11.9907 g/dL, with a standard deviation of 1.91251, while the mean of Hematocrit percentage of all participant was 36.1888%, with a standard deviation of 5.46922, The Mean Corpuscular Volume (MCV) had a mean value of 79.4839 fL and a standard deviation of 9.12908, the Mean Corpuscular Hemoglobin (MCH) level was on average 26.1876 pg, with a standard deviation of 3.50459, The mean of iron in study population concentration in the serum was 64.0402 μ g/dL, with a standard deviation of 37.24147, furthermore Serum ferritin levels averaged 83.5718 ng/mL, with a notably high standard deviation of 115.81234.

Hemoglobin levels were analyzed separately for males and females due to different normal ranges. Among female participants, 81 had normal Hb levels (11.5 - 15.5 g/dL), 3 had abnormally high Hb levels (>15.5 g/dL), and 145 had abnormally low Hb levels (<11.5 g/dL). Among male participants, 37 had normal Hb levels (13 - 17 g/dL), 1 had an abnormally high Hb level (>17 g/dL), and 56 had abnormally low Hb levels (<13 g/dL).

Moreover, Hematocrit levels were analyzed for males and females. Among female participants, 117 had normal PCV/HCT levels (36 - 46%), 3 had abnormally high levels (>46%), and 109 had abnormally low levels (<36%). Among male participants, 53 had normal PCV/HCT levels (36 - 46%), 8 had abnormally high levels (>46%), and 33 had abnormally low levels (<36%).

Mean corpuscular volume levels were analyzed for males and females. Among female participants, 137 had normal MCV levels (80-100 fL), 1 had abnormally high levels (>100 fL), and 91 had abnormally low levels (<80 fL). Among male participants, 45 had normal MCV levels (80-100 fL), 1 had an abnormally high level (>100 fL), and 48 had abnormally low levels (<80 fL).

Furthermore, mean corpuscular hemoglobin levels were analyzed for males and females. Among female participants, 123 had normal MCH levels (27-32 pg/cell), 2 had abnormally high levels (>32 pg/cell), and 104 had abnormally low levels (<27 pg/cell). Among male participants, 43 had normal

MCH levels (27-32 pg/cell), 1 had an abnormally high level (>32 pg/cell), and 50 had abnormally low levels (<27 pg/cell).

Iron levels were analyzed separately for males and females. Among female participants, 181 had normal iron levels (50 - 150 µg/dL), none had abnormally high levels (>150 µg/dL), and 48 had abnormally low levels (<50 µg/dL). Among male participants, 71 had normal iron levels (50 - 175 µg/dL), 1 had an abnormally high level (>175 µg/dL), and 22 had abnormally low levels (<50 µg/dL).

Ferritin levels were analyzed separately for males and females. Among female participants, 136 had normal ferritin levels (15 - 150 ng/mL), 26 had abnormally high levels (>150 ng/mL), and 66 had abnormally low levels (<15 ng/mL). Among male participants, 76 had normal ferritin levels (15 - 400 ng/mL), 6 had abnormally high levels (>400 ng/mL), and 12 had abnormally low levels (<15 ng/mL).

4.2 Discussion

This study highlights a significant prevalence of Iron Deficiency Anemia (IDA) in Duhok City, Kurdistan Region. The findings echo global concerns regarding IDA, a condition affecting diverse populations across various geographical locations. Comparative analysis with similar studies reveals a shared pattern of higher IDA prevalence among females, though the rates vary by region due to differences in dietary habits, access to healthcare, and socio-economic factors. For instance, a study conducted in India reported an IDA prevalence rate of approximately 50% among women of reproductive age, which was attributed to poor dietary iron intake and socioeconomic factors (Gupta & Gupta, 2019). Similarly, research in Sub-Saharan Africa identified a high IDA prevalence, with rates exceeding 60% in some communities, largely due to parasitic infections and inadequate healthcare infrastructure (Adams et al., 2020). These studies, like this paper, highlight gender disparities and the influence of socio-economic and environmental factors on IDA prevalence.

Hemoglobin (Hb) Levels

The results indicate that among female participants, 63.3% had abnormal low Hb levels, 1.0 % had abnormally high levels, and 36.1% had normally Hb levels (Fig.1). In contrast, among male participants, 39% had normal Hb levels, 1% had abnormally high levels, and 60% had abnormally low levels. The high prevalence of anemia observed in this study, particularly among female participants, aligns with global patterns identified in the literature. can be attributed to several factors, especially considering that 50% of these females were children and adolescents. Studies such as that conducted by Miller et al. (2013) in Southeast Asia found a similarly high incidence of anemia among females, attributing it largely to menstrual blood loss and inadequate dietary iron intake, especially among adolescents and women of reproductive age. This is further corroborated by research from Lopez et al. (2016), which highlighted rapid growth phases during childhood and adolescence as periods of increased iron demand not always met by dietary intake due to socio-economic and cultural factors.

Furthermore, the World Health Organization's report on anemia underscores the multifaceted causes of this condition, highlighting the critical role of nutrition education and the enhancement of food quality in combating anemia globally (WHO, 2021). The consistency of these findings with our observations in Duhok City suggests that while the prevalence of anemia is influenced by local socio-economic conditions and dietary habits, the underlying physiological and nutritional mechanisms are universally applicable.

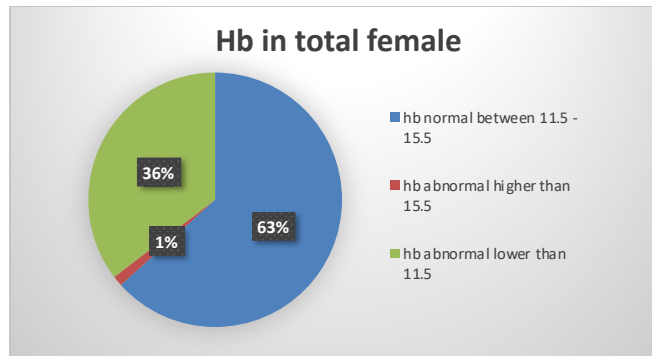


Fig.1. Hb levels among female participants

Hematocrit (PCV/HCT) Levels

For hematocrit levels, 51.1% of female participants had normal PCV/HCT levels, 1.3% had abnormally high levels, and 47.6% had abnormally low levels. Among male participants, 56% had normal PCV/HCT levels, 9% had abnormally high levels, and 35% had abnormally low levels (Fig.2). These results are consistent with the hemoglobin findings, indicating a high prevalence of anemia among the study population, especially among females.

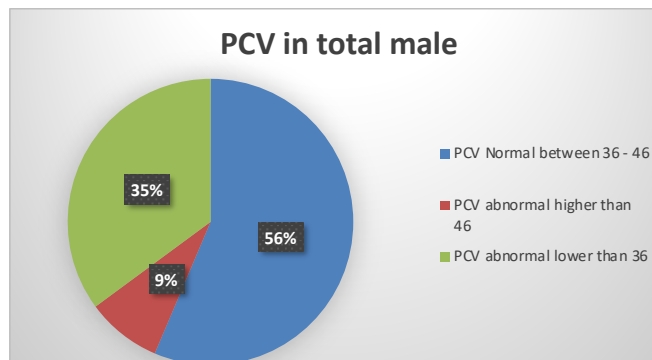


Fig.2. Hematocrit levels among male participants

Iron Levels

Regarding iron levels, 79.0% of female participants had normal iron levels, and 21.0% had abnormally low levels. In male participants, 76.0% had normal iron levels, 1% had abnormally high levels, and 23% had abnormally low levels. These findings suggest that iron deficiency might be a significant contributor to anemia in both male and female populations. It's important to consider the bioavailability of iron in the diet and the impact of other micronutrient deficiencies, such as vitamin B12 and folate, which are crucial for effective iron utilization in hemoglobin synthesis (Rahman et al. 2020). Moreover, the impact of chronic infections and inflammation on iron metabolism, altering its bioavailability and utilization, is well documented in the work of Weiss and Goodnough (2005), emphasizing the multifactorial nature of anemia beyond simple nutritional deficiencies.

Ferritin Levels

In terms of ferritin levels, 59.6% of female participants had normal levels, 28.9% had abnormally high levels, and 11.4% had abnormally low levels (Fig.3). Among male participants, 81.0% had normal ferritin levels, 13.1% had abnormally high levels, and 6.0% had abnormally low levels. The higher proportion of abnormally high ferritin levels might indicate the presence of other factors contributing to anemia, such as inflammation or other underlying conditions (Clark, 2008). This finding is corroborated by Thurnham et al. (2010), who discussed ferritin as an acute phase reactant that can be elevated in the context of inflammation or infection, independent of iron stores.

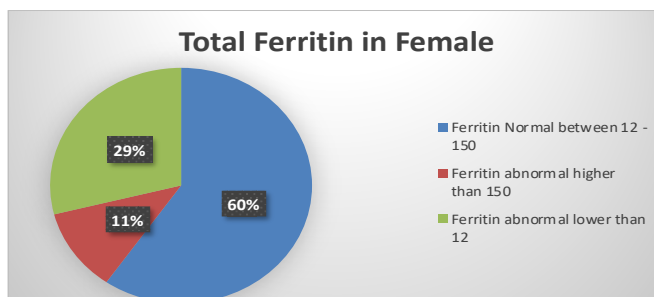


Fig.3. ferritin levels among female participants

Correlations and IDA Parameters by Gender

Correlations between serum hemoglobin, iron, and ferritin concentrations indicate a positive correlation between Hb and iron levels, as well as between iron and ferritin levels. This suggests that iron deficiency may play a significant role in the development of anemia in the studied population.

Correlation	Hb	IRON	Serum Ferritin
Hb	1		
IRON	0.49942767	1	
Serum Ferritin	0.01276135	0.18728864	1

The comparison of IDA parameters between male and female participants highlights the differences in means and standard deviations for Hb, MCV, MCH, HCT, iron, and ferritin levels. These results further emphasize the importance of considering gender-specific reference ranges when interpreting laboratory findings.

5. CONCLUSION

This study demonstrates a high prevalence of iron deficiency anemia among different age groups in Duhok, Iraq, particularly in the male population. The findings underscore the importance of implementing appropriate screening, diagnosis, and treatment strategies to address the public health implications of anemia in this region. Future research should explore potential factors contributing to the high prevalence of anemia, such as nutritional deficiencies, genetic predispositions, and the presence of other underlying health conditions. Public health interventions, such as iron supplementation programs and educational campaigns, should be

considered to improve the overall health status of the population in Duhok, Iraq. Moreover, further studies are needed to assess the effectiveness of these interventions and determine the most appropriate strategies for reducing the burden of iron deficiency anemia in the region.

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