

Impact of Pediculosis on Iron Deficiency and Anemia: A Public Health Perspective

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Abstract

Pediculosis capitis (head lice infestation) is a common parasite in children and is associated with a number of health risks, including some anaemias. The focus of this study was to determine the relationship between pediculosis capitis (head lice infestation) and anaemia in children in Babylon Province, Hilla City, Iraq. Fifty (50) whole blood samples were tested from children with pediculosis detected by eyeglasses and compared to blood samples from 10 healthy controls. Samples were obtained using standard venipuncture and analysed by complete blood count (CBC). No children under 4 or over 12 years of age were studied. The cohort consisted of children aged 4 -12 years, with 86% being female children and 14% male children. Findings reported that 22% of female patients were anaemic and the mean haemoglobin levels were below the normal reference range, 12.5–13.5 g/dL. Four percent of male children were anaemic. All children in the control group were reported to have normal haemoglobin levels. This study showed that pediculosis (head lice infestation) and anaemia were associated, especially in girls between 4 – 12 years of age. Further studies are warranted to clarify the aetiology and identify preventive and treatment implications necessary for children.

Keywords: *Pediculosis Capitis; Head Lice Infestation; Anemia; Pediatric Health; Parasitic Infections.*

1. Introduction

Anemia, a significant global health problem, affects a large part of the world's population but is especially prevalent in children, women of reproductive age, and the elderly, with iron deficiency being an important reason for its development [1]. The World Health Organization estimates that anemia affects nearly a Quarter of the world population, and disproportionately, preschool-aged children are most affected [2]. Iron deficiency anemia can produce numerous adverse health outcomes, such as impaired cognitive and motor development in children, increased maternal morbidity and mortality, and limited physical work capacity in adults [3]. The causes of anemia are multifactorial, including nutritional deficiencies, genetic disorders, infectious disease, chronic disease, socio-economic factors, environmental contaminants, autoimmune diseases, or malabsorption of nutrients [4]. It is well-known that nutritional iron deficiency is a major cause of the development of anemia [1], but less appreciated causes, especially in resource-limited settings, can play an important role, such as chronic parasitism disease [5],[6]. Specifically, ectoparasitism such as pediculosis (lice infestation) has been suggested as a potential cause of iron-deficiency anemia in certain populations [7]. Iron deficiency is the most common nutrient deficiency worldwide and is especially common in infants, preschool children, and adolescents [8], [9]. In 2016, the World Health Organization indicated that over 40% of children and pregnant women suffered from anemia [10].

Pediculosis, a parasitic infestation of the skin caused by lice, is a health issue affecting millions of people globally, especially children in developing countries. Individuals who are infested with lice can suffer from chronic blood loss, leading to deficiencies in iron and even potentially into iron-deficiency anemia, especially when considering individuals with heavy or prolonged infestations. The burden of anemia is significant in developing countries where dietary deficiencies, iron deficiency, high rates of parasitic infections, and poor sanitation co-exist with anemia [11]. Anemia contributed to 58.6 million years lived with disability globally in 2019 [12]. Anemia can be due to many reasons outside of dietary deficiency, and worldwide, the top three most common causes of anemia were found to be dietary iron deficiency, Vitamin A deficiency, and Beta-thalassemia trait [12]. If we extend this even further, we can see that there are around 190 million cases of anemia in Sub-Saharan African countries, so this is a huge problem [13]. Furthermore, anemia without any treatment can cause various health outcomes in adults, such as fatigue, reduced productivity at work, and heart failure. In children, anemia can affect cognitive and motor development, but also adults and children's contributions to child and maternal mortality [13]. Overall, the relationship between pediculosis, iron deficiency, and anemia warrants further investigation, especially with the current public health framework to control and treat these health issues in at-risk populations.

2. Materials and methods

2.1. Research region

The study was conducted in Babylon province, Hilla City, Iraq.

2.2. Samples collection

Whole blood samples were collected from 50 children diagnosed with pediculosis capitis and 10 healthy controls using standard venipuncture. The samples were placed in EDTA tubes and immediately subjected to complete blood count (CBC) analysis.

2.3. Study group & control group

The study group included 50 children aged 4 to 12 years, of whom 86% (n = 43) were female and 14% (n = 7) were male, as shown in Figure 1. The control group consisted of 20 healthy children, including 80% females (n = 16) and 20% males (n = 4), as shown in Figure 2.

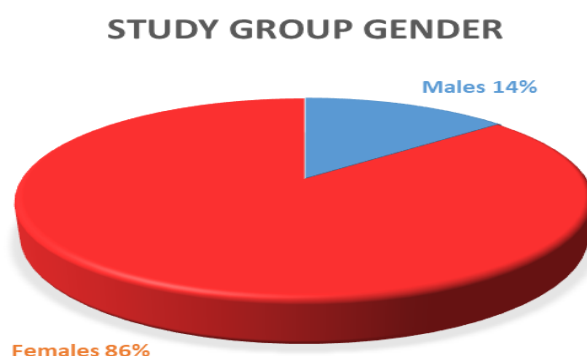


Fig. 1: Study Group Gender.

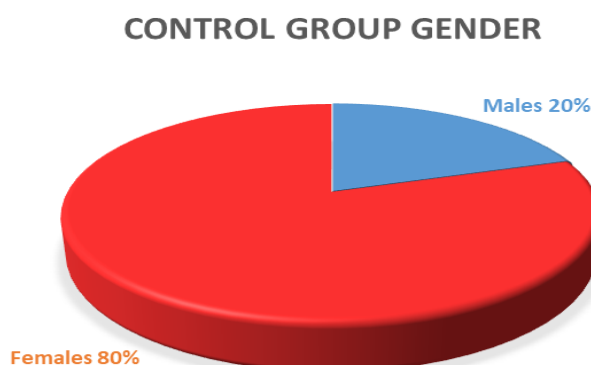


Fig. 2: Control Group Gender.

2.3. Statistics

Data analysis was conducted using IBM SPSS Statistics (version 26) and Microsoft Excel. Independent samples t-tests were used to compare hemoglobin levels between groups. A p-value of less than 0.05 was considered statistically significant.

2.4. Equipment and materials

A Sysmex XN-350 fully automated hematology analyzer was used to perform the CBC tests. This device provides 6-part differential analysis and supports single-sample evaluation in open mode.

3. Results and discussion

The sample consisted of 50 children, aged from 4 to 12 years, of whom 86% (n = 43) were female, while 14% (n = 7) were male. The control group consisted of 20 children aged from 4 to 12 years, of whom 80% (n = 16) were female, while 20% (n = 4) were male. Based on the data collected, 22% (n = 11) of the sample female had a mean hemoglobin (9.31 g/dL) indicative of anemia as their values were below the pediatric normal range of 12.5 to 13.5 g/dL (Figure 4). While 44% (n = 22) of the females had normal hemoglobin (Figure 5). Among the males, 4% (n = 2) of the sample were anemic, and had a mean hemoglobin (10.3g/dL) shown in Figure 6, while 10% (n = 5) had normal values, Figure 7. In the control group, all children had normal hemoglobin values, indicating no signs of anemia.

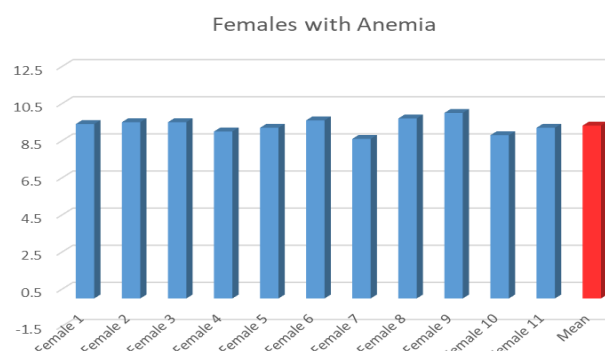


Fig. 4: Hemoglobin Levels in Female Patients with Anemia Due to Pediculosis. Normal Reference Range: 12.5–13.5 G/Dl.

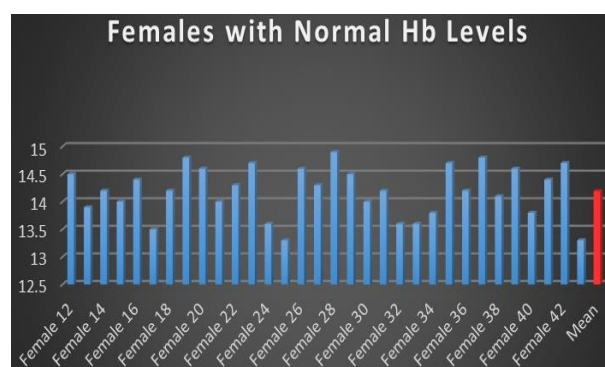


Fig. 5: Hemoglobin Levels in Female Patients with Pediculosis but Normal Hemoglobin. Normal Reference Range: 12.5–13.5 G/Dl.

3.1. Pediculosis capitis and its hematological impact

Pediculosis capitis, caused by *Pediculus humanus capitis*, is one of the most common ectoparasitic infestations and occurs predominantly in children, especially in underdeveloped areas where poor hygiene and person-to-person transmission are present. The outcomes from this study demonstrated a significant relationship between head lice infestation and anemia, particularly among females, with 22% demonstrating a hemoglobin reading less than the normal valid value (9.31 g/dL). This supports previous studies suggesting that chronic infestations of lice can produce blood dyscrasias, particularly iron-deficiency anemia (10).

3.2. Gender disparities in anemia prevalence

A robust difference was established in anemia rates between the sexes, with 22 percent of females and 4 percent of males diagnosed. The present findings conform with studies that suggest that young girls may be more likely to develop anemia, owing to physiological differences, diet, and encountering lice (11). Chronic pediculosis capitis can lead to anemia by several biological mechanisms. Each adult louse can feed several times a day on human blood, and a chronic condition can lead to thousands of lice being present. As noted by (11), the average blood loss per louse is 0.5 mg each day. In severe instances, the total blood loss may exceed 1–2 mL each day, while chronic cases of kids with pediculosis capitis are at greater risk for long-term chronic iron depletion, particularly if they eat a diet that does not exceed their age requirements for dietary iron.

Iron depletion occurs because lice feeding creates a localized inflammatory response. The repeated puncture of the scalp creates opportunities for micro hemorrhages and potentially stimulates the release of systemic levels of cytokines (for example, IL-6, TNF- α), which change iron metabolism and sequester iron in storage sites while limiting its availability for erythropoiesis. The inflammatory-driven iron deficiency transformation of iron metabolism - co-occurring with direct blood loss - adds to the iron-deficiency burden.

The scratching behavior caused by pruritus may also cause secondary skin damage and minor bleeding, further compounding iron loss. Together, these factors explain how chronic lice infestation can progressively lead to iron-deficiency anemia, particularly in children with repeated or untreated infestations.

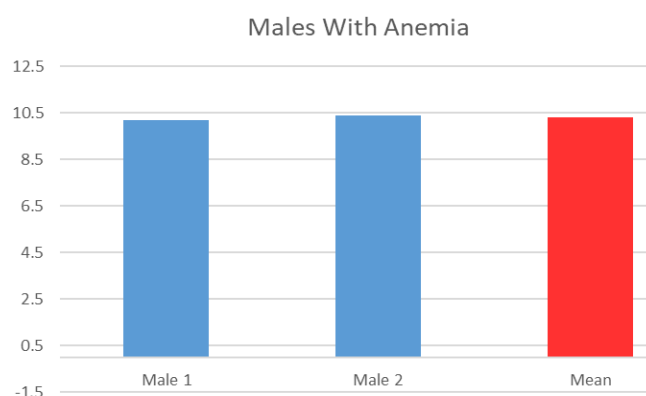


Fig. 6: Demonstrating Hb Results of Males with Anemia Caused by Pediculosis Infestation, Normal Reference Range of Hb Level (12.5-13.5 G/Dl).

3.3. The role of hygiene and socioeconomic conditions

Head lice infestation often correlates with socioeconomic status and hygiene practices. Studies have shown that pediculosis is not confined to low-income populations but is widely distributed among different social groups, indicating that transmission dynamics and lack of preventive education play a crucial role (12). This study's findings align with prior epidemiological research supporting routine screenings and hygiene interventions as effective control measures.

3.4. Implications for public health and preventive strategies

Given the relationship between pediculosis capitis and the prevalence of anemia, public health strategies should prioritize early detection and management via routine head lice screenings, improved sanitation, and health education programs in both schools and communities. Interventions such as school-wide awareness campaigns have been shown to reduce rates of infestation to improve hematological health outcomes. (13) Future research should also be devoted to exploring biomarkers of iron metabolism, longitudinal studies to track anemia in children with recurrent head lice infestation, and the biological plausibility of parasitic exposure effects on immune systems. Understanding these mechanisms will facilitate improved treatment approaches while reducing the overall load of establishing health risks for persistent pediculosis capitis.

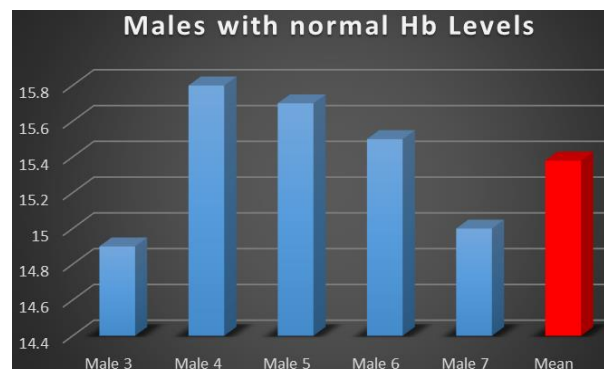


Fig. 7: Demonstrating Hb Results of Males with Pediculosis Having Normal Hb Levels Normal Reference Range of Hb Level (12.5-13.5 G/Dl).

Pediculosis (e.g., *Pediculus humanus capitis* and *Pediculus humanus corporis*) is a parasitic infestation caused by lice and is increasingly being recognized as a potential risk factor for iron deficiency anemia (IDA) due to the blood-feeding habits of lice. Pediculosis is commonly termed as a benign condition to describe the risks of infestation; however, in rarer and more clinical instances, severe occurrences of pediculosis can lead to high losses of blood which can be a precursor of IDA, especially for some groups of people such as children or people who are pre-disposed to iron deficiency anemia (14) (1) (15) (16). The amount of blood loss is often negligible per individual louse; however, the blood loss can accumulate through heavy infestation of lice. Numerous studies have documented cases of lice infestation in children, leading to an increase in blood losses and raising the blood loss to sufficient levels to cause anemia (17) (18) (19). The increase in the loss of blood is likely to occur in environments lacking hygiene and overcrowding, which have a higher probability of present lice infestations (17). The public health implications of this possible connection are significant because IDA is already a big problem worldwide and already affects over 1.62 billion globally, and in lower socioeconomic areas and among children and women. (20). (21). Other potential connections of IDA may be demonstrated by exploring its epidemiology or hypotheses; however, without a systemic approach to induce lice management and iron supplementation for at-risk populations, there could potentially be a link, if not exclusion of other causes of IDA.(20) (21). Addressing pediculosis as a contributing factor to IDA involves not only treating the infestation with topical agents like permethrin and oral medications like ivermectin but also ensuring adequate iron intake through dietary improvements and supplementation (14). (16) This multifaceted approach is crucial for mitigating the impact of pediculosis on iron deficiency and anemia, thereby improving overall health outcomes in affected populations.

Table (1) summarizes hemoglobin values and anemia distribution across study and control cohorts. Anemia was detected in 26% of the total study group, with a higher percentage observed among males. All individuals in the control group maintained normal hemoglobin levels. The results reinforce the association between pediculosis infestation and lower hemoglobin concentration, especially among females, who formed the majority of the study sample

Table 1: Hemoglobin Levels and Anemia Status Among Study and Control Groups

Group	Sample Size	Mean Hb (g/dL)	Anemic Cases (n)	Anemic Cases (%)	Normal Hb Cases (n)	Normal Hb Cases (%)
Females (Study)	43	9.31	11	25.6%	22	51.2%
Males (Study)	7	10.3	2	28.6%	5	71.4%
Total (Study)	50	—	13	26%	27	54%
Control	20	13.1	0	0%	20	100%

Table (2) presents standard hemoglobin reference ranges stratified by age and gender. Pediatric hemoglobin values increase with age and are generally higher in males during and after puberty due to hormonal influences. For children aged 4–12, the normal range typically lies between 11.5 and 14.5 g/dL. These ranges provide a baseline for identifying anemia, which was defined in this study as any hemoglobin value falling below the age- and sex-adjusted thresholds. Using these criteria ensures more accurate classification of anemia cases in the pediatric population under investigation.

Table 2: Normal Hemoglobin Reference Ranges by Age and Gender

Age Group	Normal Hb Range (g/dL)
1–5 years	11.0–13.5
5–11 years	11.5–14.5
12–14 years (girls)	12.0–15.0

12–14 years (boys)	12.5–15.5
15–18 years (girls)	12.0–15.5
15–18 years (boys)	13.0–16.0

4. Conclusion

The results showed a significant link between Pediculosis and anemia in the sample with 50 subjects aged 4 to 12 years old. The subjects in the sample completed an interview targeted at addressing various behavioral, attitudinal, and societal predictors of adolescent health. Only a few subjects in the case group (anemia and Pediculosis) were male (14%), with 86% female. The case groups and control group included the same test(s), so the whole did differ from the original outcomes sample. Altogether these main findings present strong evidence for a link between Pediculosis and anemia. This association is particularly strong among females in the 4-12 years age group, signaling the need for further consideration into the mechanisms responsible for this curious relationship.

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