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Article

Physiological and Hormonal Changes Caused by Lice in Infected Individuals

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Abstract: The results of the present study demonstrated a clear effect of head lice infestation on both hemoglobin (Hb) levels and adrenaline hormone concentrations among infected individuals. A gradual decline in hemoglobin levels was observed with increasing severity of infestation. The mean Hb level in the control group was 14.4 g/dL, which decreased to 12.7 g/dL in mild infestation cases, 12.1 g/dL in moderate infestation cases, and reached 11.3 g/dL in severe infestation cases. These findings suggest that chronic and severe infestation may contribute to relative anemia due to continuous blood loss and the physiological stress associated with persistent itching and inflammation. Conversely, adrenaline levels showed a significant progressive increase with infestation severity. The mean adrenaline concentration in the control group was 70.0 pg/mL, increasing to 77.1 pg/mL in mild infestation, 102.1 pg/mL in moderate infestation, and 157.4 pg/mL in severe infestation. This elevation likely reflects the body's stress response to continuous irritation, discomfort, and physiological disturbances caused by head lice infestation. Statistical analysis further revealed a strong negative correlation between infestation severity and hemoglobin levels ($r = -0.94$), indicating that increased infestation severity is associated with decreased Hb levels. In contrast, a strong positive correlation was found between infestation severity and adrenaline levels ($r = 0.97$), suggesting that worsening infestation is accompanied by an enhanced hormonal stress response. All observed differences were statistically significant at $P < 0.05$.

Keywords: Head Lice, Hemoglobin, Adrenaline, Physiological Changes, Hormonal Changes, Anemia

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1. Introduction

Pediculosis capitis (head lice infestation) is considered one of the most common parasitic conditions affecting children, particularly those of school age. It represents a significant public health concern due to its physical, psychological, and social consequences on affected individuals and their families. In addition, it may lead to social stigma, bullying, sleep disturbances, and reduced academic performance among schoolchildren. Conventional topical pediculicides with neurotoxic effects, such as malathion, permethrin, phenothrin, and carbaryl, have shown increasing treatment failure in recent years because of the emergence of resistance among lice populations [1].

Head lice, scientifically known as Pediculus humanus capitis, are small wingless ectoparasitic insects that feed exclusively on human blood and inhabit the scalp. Adult lice measure approximately 2–4 mm in length and possess six legs adapted for grasping hair shafts. Transmission occurs primarily through direct head-to-head contact, especially among children [2].

Lice have parasitized humans for thousands of years, and their species differ according to their site of infestation on the host body. The three major sucking lice species affecting humans are head lice (Pediculus humanus capitis), body lice (Pediculus humanus corporis), and pubic lice (Pthirus pubis). Body lice are recognized as vectors of several bacterial diseases, including epidemic typhus, trench fever, and relapsing fever. Head lice infestations are more prevalent among schoolchildren, whereas body lice infestations are commonly associated with crowded environments such as refugee camps and homeless shelters [3].

Diagnosis of head lice infestation is usually confirmed by the detection of live lice on the scalp or hair. Most eggs hatch within 7 days, although some may require up to 13 days, and empty nits may remain attached to hair shafts for several weeks after hatching (4). Despite advances in public health and hygiene, pediculosis capitis continues to be a persistent health problem, particularly in low-resource communities, where it negatively affects the health and educational achievement of school-aged children [4].

Although many infected individuals experience only mild symptoms, pruritus remains the most common clinical manifestation due to hypersensitivity reactions caused by lice saliva during feeding. Persistent scratching may lead to secondary bacterial skin infections and enlargement of lymph nodes. Furthermore, infestation can result in psychological distress, social embarrassment, impaired concentration, and sleep disturbances, particularly among children [5]. Head lice feed on human blood by piercing the scalp skin and injecting saliva, which causes irritation and chronic blood loss. In severe and prolonged infestations, this blood loss may contribute to iron deficiency anemia. Previous studies have indicated that an adult female louse feeds three to five times daily and can ingest approximately 0.01579 mL of blood per meal. Consequently, heavy infestations may result in a blood loss of approximately 20.8 mL per month. Although such blood loss may not significantly affect healthy and well-nourished individuals during short-term infestations, chronic infestation may eventually lead to clinically significant anemia [6].

2. Materials and Methods

Collection of Study Samples The present study included 100 individuals randomly selected from Baqubah City. Preliminary data were collected through manual examination of the scalp to confirm infestation with head lice (Pediculus humanus capitis). The examination revealed that 30 individuals were infested, whereas 70 individuals were non-infested and considered as the control group. Hemoglobin (Hb) levels were measured in all participants to evaluate the effect of head lice infestation on anemia. Statistical analysis of the obtained data was performed using the Statistical Package for the Social Sciences (SPSS). Analysis of Variance (ANOVA), correlation coefficient analysis, and prevalence rate calculations were applied with the assistance of computer-based statistical programs. Measurement of Adrenaline Hormone Level Blood adrenaline (epinephrine) levels were measured using a specialized American diagnostic kit (EPI/Epinephrine/Blood Kit) to assess the physiological and psychological stress associated with head lice infestation. Venous blood samples (5 mL) were collected from both infested and non-infested individuals using sterile disposable syringes. The blood samples were transferred into tubes containing anticoagulant and centrifuged at 5000 rpm for 10 minutes to separate the serum from blood cells. The separated serum was then transferred into sterile Eppendorf tubes (1.5 mL) and stored at −20°C until further immunological analysis for adrenaline determination.

3. Results

It Effect of Head Lice Infestation on Hemoglobin and Adrenaline Levels The results of the present study demonstrated significant physiological alterations among individuals infested with head lice compared with the control group. These alterations

were characterized by a reduction in hemoglobin (Hb) levels and an elevation in adrenaline hormone levels, with the severity of changes increasing according to the degree of infestation. The decrease in hemoglobin concentration may be attributed to chronic blood loss caused by repeated feeding activity of head lice on the host's blood, which may gradually contribute to the development of anemia, particularly in moderate and severe infestations. In contrast, the elevated adrenaline levels observed in infested individuals may be associated with continuous itching, sleep disturbances, discomfort, and psychological stress caused by infestation. These factors can stimulate the sympathetic nervous system, resulting in increased secretion of adrenaline hormone. Furthermore, statistical analysis revealed significant differences among the studied groups, indicating a potential correlation between the severity of head lice infestation and both decreased hemoglobin levels and elevated adrenaline concentrations.

The statistical analysis was performed using IBM SPSS Statistics software to evaluate the effect of head lice infestation on hemoglobin (Hb) and adrenaline levels among the study groups.

Severity of infestation	Hb (g/dL) Mean ± SD	Adrenaline (pg/mL) Mean ± SD	Correlation coefficient (r)	P-value
Control	14.4 ± 0.5	70.0 ± 4.2	—	—
Mild infection	12.7 ± 0.6	77.1 ± 5.1	-0.94 (Hb)	$P < 0.05$
Moderate infection	12.1 ± 0.7	102.1 ± 6.4	0.97 (Adrenaline)	$P < 0.05$
Severe infection	11.3 ± 0.9	157.4 ± 8.3	-0.91 (Hb vs Adrenaline)	$P < 0.05$

Interpretation: The statistical analysis showed significant differences among the study groups in both hemoglobin and adrenaline levels ($P < 0.05$). A strong negative correlation was observed between infestation severity and Hb level, while a strong positive correlation was found between infestation severity and adrenaline level.

4. Discussion

1. Hemoglobin Level (Hb)

The results demonstrated a gradual decline in hemoglobin (Hb) levels among individuals infested with head lice compared with the control group. The mean Hb concentration in the control group was 14.4 g/dL, whereas it decreased to 12.7 g/dL in mild infestations and further declined to 12.1 g/dL in moderate infestations. The lowest Hb value was recorded in severe infestation cases, reaching 11.3 g/dL. This progressive reduction indicates an inverse relationship between the severity of head lice infestation and hemoglobin concentration, suggesting that persistent infestation may contribute to varying degrees of anemia, particularly in chronic and severe cases. This may be explained by the fact that head lice feed directly on the host's blood, resulting in continuous minor blood loss. In addition, indirect effects such as sleep disturbances, loss of appetite, physiological stress caused by persistent itching, and associated skin inflammation may further contribute to reduced hemoglobin levels. The findings of the current study are consistent with several previous studies that reported an association between ectoparasitic infestations and decreased hemoglobin levels, particularly among children and immunocompromised individuals. Study [7] reported that head lice infestation may lead to severe iron-deficiency anemia caused by chronic blood loss, and although such complications are relatively rare, they may become life-threatening in severe cases. Similarly, study [8] demonstrated that head lice survive by consuming blood

meals from human hosts, which results in continuous blood loss and may subsequently cause anemia, especially in severe or chronic infestations. Furthermore, the present findings agree with study [9], which suggested that blood-feeding behavior of head lice may contribute to iron-deficiency anemia and confirmed the existence of a positive association between infestation intensity and anemia severity.

2. Adrenaline Hormone Leve

The results also revealed a gradual increase in adrenaline hormone levels among individuals infested with head lice compared with the control group. The mean adrenaline level in the control group was 70 pg/mL, increasing to 77.1 pg/mL in mild infestations and 102.1 pg/mL in moderate infestations. The highest level was observed in severe infestation cases, reaching 157.4 pg/mL. This elevation may be attributed to increased activation of the sympathetic nervous system as a result of chronic stress associated with lice infestation. Persistent itching, sleep disturbances, and psychological discomfort stimulate the adrenal glands to release greater amounts of adrenaline as part of the body's stress response. Social anxiety and emotional exhaustion related to infestation may also contribute to elevated hormone levels, particularly in severe and chronic cases. The present findings are in agreement with study [10], which indicated that elevated adrenaline secretion in response to anxiety and fear may increase heart rate and cardiovascular stress, potentially leading to severe complications. In addition, obligate human ectoparasites such as head lice and human scabies mites are known to induce significant clinical manifestations and remain important subjects in medical research. Recent investigations have highlighted the immunological mechanisms underlying host responses to these parasites [11]. Increasing evidence also suggests a potential role of ectoparasitic infestations in the pathogenesis of iron-deficiency anemia, eosinophilia, and elevated immunoglobulin E (IgE) levels [12]-[15].

Relationship Between Infestation Severity and Physiological Variables The results demonstrated:

An inverse relationship between infestation severity and hemoglobin level.

A direct relationship between infestation severity and adrenaline level. As the severity of head lice infestation increased, Hb levels significantly decreased while adrenaline levels markedly increased. These findings indicate that head lice infestation is not merely a superficial dermatological problem, but may also induce significant physiological and hormonal alterations in the human body.

5. Conclusion

This study demonstrated that head lice (*Pediculus humanus capitis*) infestation is associated with significant physiological changes, including decreased hemoglobin levels and increased adrenaline concentrations. The severity of infestation showed a strong negative correlation with hemoglobin levels and a positive correlation with adrenaline levels. These findings suggest that chronic and severe head lice infestation may contribute to anemia and physiological stress, highlighting the importance of early detection, effective treatment, and preventive measures to minimize its health impact.

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