

Effect of Head Lice (*Pediculus humanus capitis*) on Some Haematological Variables Among Female Students in Al-Hajjaj Primary Schools

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ABSTRACT: Head lice (*Pediculus humanus capitis*) is the most widespread external parasite worldwide, especially in developing countries, the present study involved a visual examination of 3006 female students from December 3, 2023, to May 10, 2024, across six primary schools (Hoor Al-Ain, Al-Baraa, Al-Irada Al-Iraqiya, Al-Saad, Palestine, Asmara) in the Al-Hajjaj district of Salah Al-Din Governorate, to investigate head lice prevalence. According to the findings of the current study, the overall infection rate of *Pediculus humanus capitis* was 25.91% throughout all of the schools that were utilized in the research. 797 female students out of the total number of female students who were examined were found to be contaminated. Infection cases appeared in different age groups. The highest infection rate was in the age group 9-10 years at a rate of 31.10%, while the age group 6-7 years recorded the lowest infection rate of 18.69%.

The back of the head exhibited the highest lice infection rate at 43.64%, while the middle of the head recorded the lowest rate at 12.62%. The infection rate in the head region was 23.37%, but in the frontal area, it was 14.99%. The long hair category exhibited the greatest infection rate at 30.93%, followed by the very long hair category at 23.24%, while the short hair category recorded the lowest rate at 20.28%. The results of present study shown no significant differences were observed in lymphocytes when compared to the control group. Conversely, significant differences were noted in HGB, HCT, MCV, MCH, and MCHC at a probability level of $P > 0.01$ relative to the control group.

Keywords: Head lice, Female, Hemoglobin Concentration. (Hb%).



1. INTRODUCTION

Human lice, comprising *Pediculus humanus capitis*, *Pediculus humanus corporis*, and *Phthirus pubis*, are significant medicinal arthropods in human existence. These arthropods induce medical conditions known as pediculosis, which can occasionally result in severe diseases with mortality(1). Head lice *Pediculus humanus capitis* is the most widespread external parasite worldwide, especially in developing countries, causing health problems(2). According to estimates, an adult *Pediculus humanus capitis* measures between two and three millimeters in length. This parasite feeds on the blood that is present in the blood vessels that stretch in the scalp, which causes itching in this region (3). During its life span of three to four weeks, an adult *Pediculus humanus capitis* is capable of laying approximately three hundred eggs, each measuring 0.3×0.8 mm in size (3). For thousands of years, lice have been and still are common as a parasitic skin disease (1). More than 530 species have been described, each of which parasitizes one or more mammalian host species (4), there

are three different important types of lice that infect humans: head lice (*Pediculus humanus capitis*), usually found in the hair at the back of the neck and the back of the ears (4) body lice (*Pediculus humanus humanus*), sometimes called *Pediculus humanus corporis*, which parasitizes the body and lays its eggs (nits) on clothing; and pubic lice (*Phthirus pubis*), which parasitizes the pubic area of the body and is completely different from head and body lice, as it belongs to the Phthiridae family, while the other two species belong to the Pediculidae family (5) Head lice, *Pediculus humanus capitis*, are small, flat, compact, wingless, dorsoventrally squamous insects. Head lice are obligatory ectoparasites, and live on the host for three to four weeks if the person is left untreated(6), lice infestation causes itching that can lead to severe irritation. Lice also cause many symptoms, including sloughing and scratching of the scalp, itching, discomfort, and secondary bacterial infections, in addition to social and economic problems for many families (7). These symptoms appear as an allergic reaction to the saliva and fecal matter that the insect secretes into the blood vessels when feeding on the host's blood (2). Contemporary human society still suffers from this parasite despite the tremendous progress in the contents of social life, and the rates of infection vary between societies depending on their composition and diversity in different parts of the world(7). Given the importance of this topic and the clear increase in its prevalence among students and its lack of continuous treatment, the aim of the study was to demonstrate the extent of head lice infestation among female primary school students in Al-Hajjaj district, and to know the effect of head lice on blood parameters through examining the complete blood count (CBC).

2.MATERIALS AND METHODS

2.1 Location and Period of the study

This study was conducted in Al-Hajjaj district in Salah Al-Din Governorate during the period from December 3, 2023 to May 10, 2024. Head lice infestations were investigated among primary school girls aged 6-12 years in Al-Hajjaj district. 3006 students were examined and a direct external visual examination of the students' heads was conducted. The scalp was examined with special attention to the nape and behind the ears. The examination was done with the naked eye and a magnifying lens was used when necessary. The infection was diagnosed when the full insect or one of its stages (egg, nymph) was present. The study included 6 schools affiliated with Al-Hajjaj district, namely (Hoor Al-Ain, Al-Baraa, Al-Iraqiya Will, Al-Saad, Palestine, Asmara). The samples were collected as shown in Table (1).

Table (1) Shows the names of the schools included in the study.

School name	Number of students
Houri al-Ayn	539
Al-Baraa	448
Al-Iraqiya Will	495
Al-Saad	513
Palestine	528
Asmara	483
Total	3006

2.2 Collection of Blood Samples

Blood samples were collected by withdrawing 5 ml of venous blood using a tourniquet with a 5 ml medical syringe, and the blood was divided into two parts: 1.5 ml of blood in laboratory tubes containing EDTA to perform the CBC test.

2.3 Haematological and biochemical analyses of blood samples

All physiological blood tests were performed, and the complete blood count (CBC) test is called the Saw Lab device (Swedish company) for the required physiological blood characteristics including Total White Blood Cells Count (WBCs), Hemoglobin Concentration. (Hb%), and Differential Leucocytes Count (DLC), which is represented by lymphocytes.

2.4 Statistical analysis

Data were obtained on the number of people infected with lice and summarized as a percentage of the total number, the people from whom blood samples were taken. Microsoft Excel was used as the database the study.

3. RESULTS AND DISCUSSION

3.1 Prevalence of head lice among primary school girls

After conducting a visual examination on 3006 female students from 6 primary schools in Al-Hajjaj district included in the study for the period from December 3, 2023 to May 10, 2024, it was found that the number of infections was 779 cases. Asmara School recorded the highest infection rate of (28.66%) and Palestine School recorded the lowest infection rate of (18.91%), while the rest of the schools had similar infection rates as shown in Table (2).

Table (2): Shows the difference in infection rates in the schools under study

School Name	Number of Samples Tested	Number of Infected Samples	Percentage (%)
Houri al-Ayn	609	172	28.24
Al-Baraa	491	118	24.03
Al-Iraqiya Will	449	126	28.06
Al-Saad	556	146	26.25
Palestine	423	80	18.91
Asmara	478	137	28.66
Total	3006	779	25.91

The results of the current study showed an infection rate of (25.91%) among primary school girls in Al-Hajjaj district. These results differ from what was recorded by (8) regarding a study that she conducted in which she investigated the epidemiology of the disease among primary school children in Baghdad Governorate, as the infection rate reached 13.5%. It is also close to what was recorded by (9) for a study that he conducted on six primary schools in Kirkuk city, and he obtained an infection rate of 20%. The results of the study also agreed with what was recorded by a study conducted by (10) on 15 schools in Erbil city, Kurdistan Region, Iraq of varying economic and social levels in the governorate. The study showed an infection rate of 24.08%, and also agreed with a study conducted by (11) on 22 primary schools, as the results of this study showed an infection rate of 25.5%.

The results of this study differ from what was mentioned by (12) about a study he conducted in 3 schools in Sulaimani Governorate, Kurdistan Region of Iraq, where the total infection rate was 14.52%. These results also differ from results

conducted by (7) for a study he conducted on the spread of head lice infection among males and females living in IDP camps in Samarra city, where it reached a rate of 14% of the total number of infected people. The variation in infection rates between the schools included in our current study is attributed to several reasons: including differences in the social and economic level of students, lack of awareness among parents of prevention methods, methods of cleaning and getting rid of lice when infected, overcrowding in the number of students in one class, and sharing one seat with more than one student due to the lack of sufficient school seats. All of these reasons have a significant impact on the spread of lice among students.

3.2 Prevalence of infection by age group

The results of the current study of primary school girls showed that the highest infection rate was recorded in the 9-year-old age group, at (31.44%), and the lowest infection rate was in the 6-year-old age group, at (16.45%), as shown in Table (3).

Table (3): Shows the prevalence of head lice infection rates according to age groups

Age group (years)	Number of Samples Tested	Number of Infected Samples	Incidence percentage (%)
6-7	476	89	18.69
7-8	500	122	24.4
8-9	514	149	28.98
9-10	434	135	31.10
10-11	549	159	28.96
11-12	533	125	23.45
the total	3006	799	25.91

The results of our current study differ from the results of the study of Suleiman and Maghar (2014), as the infection rate in the age group 8-9 years in a study conducted on primary school students in Kirkuk city was 10.9%, and differ from what El Magribi (2015) reached, the highest infection rate in the age group 6-9 years in a study conducted on some primary schools in the Egyptian city of Assiut, as the rate was 12.9%. It differs from what was reached by (13) in a study conducted in Kirkuk city, and the highest infection rate was in the age group 6-12 years, at a rate of (15.11%). The results of this study are consistent with a study conducted by (10) on 22 primary schools in Erbil, and the results show a high infection rate for the age of 9 years, as the infection rate reached 30.3%, and the results of the same study differ from the results of our current study, as the infection rate for the age of 6 years reached (25.5%).

3.3 Prevalence of infection by head region

The results of the current study of primary school students under study showed that the nape category recorded the highest infection rate, reaching (43.64%), while the central region had the lowest infection rate, reaching (12.62%), as in Table (4).

Table (4): Shows the incidence of head lice according to the area of the head

Injury area	Number of Samples Tested	Number of Infected Samples	Percentage (%)
Frontal region	527	79	14.99
Central region	689	87	12.62
Neck of the head	960	419	43.64
Diffuse	830	194	23.37
Total	3006	779	25.91

From the results we have reached above, it is clear that lice prefer to stay in the back of the head area more than any other area, as the conditions are suitable for survival and reproduction, and that the back of the head area includes the area behind the ears and the bottom of the neck, and these areas are preferred by lice because they are warm and shady, which helps head lice to survive(14).

3.4 Prevalence of infection according to hair length

The results of the current study showed a variation in the infection rate according to hair length, as the results showed that the highest infection rate was for the long hair category at (30.93%), while the lowest infection rate was (20.28%) for the short hair category, as in Table (5).

Table (5): Shows the incidence of head lice according to hair length

Hair length	Number of Samples Tested	Number of Infected Samples	Percentage (%)
Short	759	154	20.28
Long	1335	413	30.93
Very Long	912	212	23.24
Total	3006	799	25.91

Based on the relationship between infection and hair length in the spread of infection, our current study showed that very long hair has a higher infection rate than short hair, which is similar from a study conducted by (9), as the results showed that those with long hair had an infection rate of 15.02% and those with short hair had an infection rate of 13.99%, and it is consistent with a study conducted by (15), as the results showed that long hair recorded the highest infection rate of 33.2%, while short hair recorded the lowest infection rate of 19.5%. These percentages are very close to the results of our current study. The difference in the rates of head lice infection between different hair lengths, whether the infection rate in long hair is higher than the infection rate in short hair or vice versa, in addition to the closeness of these percentages, the reason may be due to several factors: some of which depend on the customs of society. For example, many societies prefer that girls' hair be long, and this, in their opinion, increases the beauty of the female. This increases the rate of infection, and also makes the spread of infection easier, as long hair sometimes touches people next to the infected person, and this also helps in the spread of lice.

3.5 Hematological Variables

The results of the CBC examination of the current study of female students infected with head lice showed no significant difference in the level of Lymphocytes compared to the control group, as the levels of infected women reached

32.60±13.5% compared to the control group 103/ul3 34.33±9.76, while the HGB levels of the infected patients reached 10.80±1.75 g/dL compared with the control group levels of 11.72±1.14 g/dL. The results of the statistical analysis showed significant differences at a significant level of $P \leq 0.01$ compared to the control group, and in Hematocrit the percentage of infected levels reached 34.24±4.73% compared to the control group levels of 37.40±3.81%, and the results of the statistical analysis showed differences at a significant level of $P \leq 0.01$ compared to the control group, while MCV the percentage of infected levels reached 80.68±9.68 fL compared to the control group levels of 85.97±4.41 fL. The results of the statistical analysis showed that there were differences at a significance level of $P \leq 0.01$ compared to the control group. As for MCH, the percentage of infected levels was 25.39±3.66 pg compared to the control group levels 28.55±2.11 pg. The results of the statistical analysis showed that there were differences at a significance level of $P \leq 0.01$ compared to the control group. In MCHC, the **percentage** of infected levels was 31.23±2.39 g/dL compared to the control group levels of 32.85±1.45 g/dL. The results of the statistical analysis showed differences at a significance level of $P \leq 0.01$ compared to the control group, Table (6).

Table (6): Shows the levels of L Y M P H, H G B, H C T, MCV, MCH, and MCHC in those infected with head lice

Group	L Y M P H %	H G B g/dL	H C T %	MCV fL	MCH pg	MCHC g/dL
Infected group	32.60 13.5±	10.80 1.57±	34.24 4.73±	80.68 9.68±	25.39 3.66±	31.23 2.39±
Control group	34.33 9.76±	11.72 1.14±	37.40 3.81±	85.97 4.41±	28.55 2.11±	32.85 1.45±
T-test value	-0.97	4.32	4.62	4.92	-7.10	5.44
P-Value	Ns 0.335	** 0.01	** 0.01	** 0.01	** 0.01	** 0.01

The results of the current study indicated that there are no statistically significant differences in the number of lymphocytes between female students infected with head lice, and the results of this study are consistent with other studies (9), and (16). This may be due to the fact that head lice do not affect the number of these cells. Or to the physiological condition of the infected student and the body's ability to increase the rate of production of these cells, or the reason may be due to the fact that the severity of head lice infection for the people under study may be low. The hemoglobin concentration in the blood of female students infected with head lice was measured and compared with those not infected as a control sample. The results show significant differences in hemoglobin concentration at a significance level of $P \leq 0.01$. The results of the current study differ from the results of a study conducted by (17), which indicated that there was a slight decrease in hemoglobin concentration in people with head lice compared to the control group and they stated that this decrease may not lead to anemia in people with head lice. The HCT ratio was measured in the blood of female students with head lice and compared with those without infection as a control sample. The results showed differences at a significance level of $P \leq 0.01$. These results indicate the effect of head lice on the blood of infected women and are considered a cause of anemia in addition to the effect on hemoglobin (18). The results of the MCH, MCHC and MCV tests also indicated the presence of differences at a significance level of $P \leq 0.01$, which proves that head lice have an effect on the blood of infected women. Infection with large numbers and for a long period can lead to anemia.

4. CONCLUSION

The results of the current study indicate that the highest incidence of *Pediculus humanus capitis* was in the 9-year age group and the lowest incidence was in the 6-year age group. The study also showed that the most common place for head lice is in all areas of the head and the least common place is the frontal area. The study revealed that hair length is related to the spread of head lice, as the long hair category recorded the highest infection rate. A decrease in the concentrations of HGB, HCT, MCV, MCH, and MCHC was observed in positive samples and an increase in the concentration of white blood cells in positive samples. The study also showed no effect on red blood cells and lymphocytes in positive samples.

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