Study of the prevalence of head lice infestation among school students and its effect on some blood tests, and a statement of the effect of five types of treatment on eliminating lice in Salah Al-Din Governorate

Rania Ghasan Abd

Department of Biology, College of Education for Woman, Tikrit University, Tikrit, Saladin Governorate, Iraq

Correspondence Author: Rania Ghasan Abd

Received 22 Feb 2023; Accepted 4 April 2023; Published 17 April 2023

Abstract

The research was conducted in the city of Tikrit from the beginning of October 2022 until the end of May 2023. Head lice was searched among students in primary schools. Samples were taken from the students, and the scalp was examined to detect the presence of head lice infection. The study was conducted on the spread of lice in various areas of the city, and to find out the effect of (age, gender, hair texture, hair length) on the increase or decrease in the rate of infection. The results of the research showed a total head lice infection of 22.2%, after conducting the examination. On 1000 school students of varying ages (6-12) years, the number of head lice infections reached 220 cases, with a rate of 98.1% in females and 1.8% in males. The visual examination method was the method used to confirm infection and detect eggs (nits), nymphs, and adult lice. Lice and nits were found in the scalp area, around and behind the ear, as well as on the back of the head. For the purpose of confirming the examination and determining the presence of the infestation or not, plastic combs with fine teeth and combs with fine iron teeth were used to separate the lice eggs (nits) from the hair shafts. The infestation appeared in all age groups and reached the highest percentage among the age group (6 - 7) years. It was 38.9%, followed by (8-9) years with a rate of 31.5%, and (9-10) years with a rate of 22.5%, while the age group (10-11) reached 9%, and finally the age (11-12) years with the lowest infection rate. 4.5%.

The highest infection rate was recorded among females with long, thick hair, 42.1%, while those with short hair reached 4.1%. The highest overall infection rate was recorded in women with long, curly hair, 25.4%, and the lowest in women with long, curly hair, 9.7%. It was noted that there were differences in the results of the hemoglobin examination and the volume of compressed blood cells in females infected with head lice, compared to the control group and the non-infected students. Also, no difference was recorded in the white blood cell count compared to the control group. There is a clear relationship in infected people who carry the blood type O^+, with lice infection the incidence was high among those with the blood group O^+. The extent of the effect of five types of lotions used to treat lice, which were used on children infected with lice, was demonstrated, and the total percentage of lice killed was determined.

Keywords: student's primary schools, blood samples, *Pediculus humanus* and *Phthirus pubis*

Introduction

There are more than 3,000 species of lice. Only two species are preferred by humans as hosts: *Pediculus humanus* and *Phthirus pubis*. *P. humanus* includes two phenotypic forms: *Pediculus humanus capitis*, the head lice, and Pediculus humanus corporis, the body lice (Light *et al*., 2008) [25]. There are three different types of lice that infect humans: head lice, body lice, and pubic lice (Amin and Ameen, 2018) [8]. The human head lice (*Pediculus humanus* Var *capitis*) is a wingless external parasite that feeds on human blood and lives parasitically during its entire life cycle on the human scalp (Madke and Khopkar, 2012) [26]. It infects millions of people in various age groups, especially children in All over the world (Doroodgar *et al*., 2011) [16] and in developing countries, especially crowded places with low economies and poor health. Akhter *et al*., 2010) [1]. Human head lice (*Pediculus humanus capitis*) lives on the human scalp, clinging to the shaft part of the hair. It feeds on human blood and spends all stages of the life cycle as nits, nymphs, and adults (Meister and Ochsendorf, 2016) [28]. Head lice is more widespread in developing countries, especially crowded places in low-income communities and poor countries. (Akhter *et al*., 2010) [1]. The human head lice, *Pediculus humanus capitis*, lives on the human scalp, clinging to the hair shaft, feeding on blood. It completes all stages of its life cycle, the egg and the nits, which are called nits, nymphs, and adults (Meister and Ochsendorf, 2016) [28]. Head lice do not have wings to fly or jump. Instead, they are transmitted from the infected person to the rest through direct contact from the head of the lice-infected person to the head of the other person, and sometimes indirectly through sharing hair combs, clothes, towels, and blankets. (Devore *et al*., 2015) [15] Head lice is not considered a source of transmission of pathogens, but the parasite's saliva and fecal antigen cause strong itching and sensitivity in the scalp area of the head (Wooltorton, 2003) [36]. At the site of the bite, secondary bacterial infections occur, which are more common and complex, especially in very severe cases of infection. Head lice anemia in infected persons (Guss *et al*., 2011) [19]. An outbreak of lice is called pediculosis, and it is considered one of the pathological characteristics. It is highly contagious and is easily transmitted from one person to another through contact with the head area. Infection with the three types of lice infects humans, except for body lice, which

represents a vector of pathogens to humans. Epidemic typhus is transmitted through body lice and relapsing fever. fever and trench fever are diseases caused by Rickettsia prowazekii, Borrelia recurrentis, and Bartonella Quintana, respectively. (Clarck, 2022) [13].

Materials and methods

The research was conducted to reveal the spread of lice among primary school students in different areas in terms of social and economic level in the city of Tikrit in the period from October 2022 to May 2023. The study samples included 1,000 male and female students. A direct external examination of the scalp was conducted for students whose ages ranged from (6-12) years. A questionnaire form was filled out containing information about each student, such as age, gender, hair type and nature. The area around and behind the ears, as well as the back of the head, was examined. Her examination was carried out with the naked eye and the use of a magnifying glass when necessary, and the infestation was diagnosed when the adult insect or one of its stages, an egg or a nit, was present, and a nymph. The female hair was divided into two groups: short hair and long hair, and according to the texture of the students' hair, it was divided into straight hair when the hair was straight and curly hair when the hair was straight. There is a distortion in it, and the comparison between the above indicators was studied according to percentages.

1. Collect blood samples

100 blood samples were taken from infected students and 25 samples from non-infected students as control samples. Their ages ranged from 6 to 12 years. The samples were collected from students from primary schools. Blood samples were obtained from a 3 ml vein from each student and placed in a special test tube containing EDTA, an anticoagulant used for counting white blood cells, measuring hemoglobin concentration, measuring the size of compressed blood cells, and blood type.

2. Measurement of blood variables

a) Estimating hemoglobin concentration

The measurement was done according to the Drabkin method, where 20 microns of blood containing the anticoagulant EDTA are added to about 5 ml of Drabkin solution and mixed well. Then the sample is placed at room temperature for 15 minutes to ensure that the hemoglobin turns brown. The sample is then measured in a photometer. spectrophotometer the sample is then measured at a wavelength of 540 nm (John, 2001) [21].

b) Measuring the volume of compressed blood cells (PCV)

The ratio of packed blood cells to the blood volume was calculated using the capillary tube method using a centrifugation haematocrit device. We place the blood sample to be examined in the capillary tube and close one end of the tube with wax. We measure the blood volume with the tube. After that, we centrifuge the tube. Central for a quarter of an hour at a speed of 3000 revolutions per minute, and the percentage was extracted using a haematocrit reader measuring ruler equipped with the device. The results were expressed in percentage (Ashraf, 2006) [9].

c) Determining blood type

ABO blood types were determined according to (Lewis *et al*., 2001) [24] and it includes the glass slide method. We take three drops of blood on the slide so that they are spaced apart, we add Anti A to one of the drops and we add Anti B to the second drop. On the third drop of Anti D, we mix the drops well, one at a time, using a clean wooden stick. We notice that there is no agglutination in the drops, and then the species is determined after two minutes of stirring.

d) Total white blood cell count

A counting chamber is used, and a special dilution solution for counting white blood cells is called Turkeys solution. This solution works to decompose red blood cells, preserve white blood cells, and clarify their nuclei. We withdraw 380 microliters of Turkeys solution using a pipette, then add 20 microliters of the blood to be tested with an inhibitor added to it. EDTA coagulation, then shake the mixture well and leave it for (2-3) minutes until all the red cells dissolve and the white cells stain and the nuclei appear clear. Prepare a counting slide called a haemocytometer, clean it well and place a glass cover on it according to (Ashraf, 2006) [9].

Results

The prevalence of infection among primary school students was 22.2%, and there was an increase in the infection rate among females, reaching 43.2%, more than males, 0.8%.

Table 1: Total infection rate by gender in primary schools

Percentage of infection	Number of infected people	Number of people examined	Gender
% 43.2	216	500	Females
% 0.8	4	500	Males
100%	220	1000	Total number

The highest infection rate was 38.6% in children aged (6-7) years. It was observed in children aged (11-12) years with the lowest rate of infection with the parasite, 4.5%. A large variation in infection was recorded according to age groups in the schools in which the parasite was inspected.

Table 2: Total infection rate by age group in primary schools

Percentage of infection	Number of infected people	Number of people examined	Age groups
38.6	85	200	Age 6-7
31.5	63	200	Age 8-9
22.5	45	200	Age 9-10
9	18	200	Age 10-11
4.5	9	200	Age 11-12
100	220	1000	The grand total

It was noted that the highest infection rate among females was

among those with long, thick hair at a rate of 42.1%, followed by a lower rate among those with long, flowing hair, 25.4%, and the lowest rate among those with short hair, at 4.1%.

Table 3: Total infection rate according to the nature and texture of hair in primary schools

Percentage %	Total number of affected females	Nature and texture of hair
42.1%	91	Long hair dense
25.4%	55	Long hair combed
18.5%	40	Light hair long
9.7%	21	Long hair curly
4.1%	9	Short
100	216	The grand total

There is a clear relationship between the number of family members and the rate of total infection with head lice. The highest infection rate was for students in families whose family members ranged from five or more, at a rate of 79.5%. As for students in families with less than five members, the infection rate was less than 20.4. % and it was consistent with what was found by (Al-Abady, 2009) [3]. The reason may be that the infection increases with the increase in the number of family members. Family crowding provides suitable opportunities for the head to be transmitted from one infected person to another within the same family, especially through the use of some common tools such as the comb and sleeping in one bed.

Table 4: Total infection rate according to the number of family members in primary schools

Infection rate	Number of infected people	Number of people examined	Number of family members
79.5	175	500	Five individuals and more
20.4	45	500	Less than five individuals
100%	220	1000	Grand total

Blood tests

Measurement of hemoglobin and the volume of compressed blood cell Hemoglobin tests for those infected with head lice compared with control samples showed high differences, and the results of the study were consistent with Al-Samarrai and Kadir (2000) [7]. which indicates that head lice infestation causes a decrease in hemoglobin concentration, and the total hemoglobin rate reached 10.887 g/dl and a decrease in the size of blood cells. blood pressure in the blood of infected people, reaching 37.30%, as blood is the only food for head lice, as it feeds in successive periods, more than five times a day, and each feeding takes a few minutes (Daniel, 2005) [14].

Table 5: Hemoglobin percentage, erythrocyte sedimentation rate, and total white blood cell counts in those infected with head lice compared to controls

Arithmetic rate				
W.B.C. count 10^9/L	% P.C.V.	Hb(g/dl)	Number	Totals
6532	40.11	12.111	25	Control
7400	37.30	10.887	75	Infected

The table showed that there were no clear differences in the total white blood cell count between the infected and control samples, as the arithmetic average for infections was 7400 white blood cells, while the arithmetic average for non-infections was 6532. These results indicated that head lice infestation does not affect the immunity of the infected person. The results of blood group tests in students infected with head lice showed that there were 39 cases of infection with blood type O+, at a rate of 52%, for 75 infected people, 20 infected with blood group A, at a rate of 26.6%, 11 infected with blood group AB, at a rate of 14.6%, and five infected with blood group B, at a rate of 6.6 %.

Table 6: Percentage of total head lice infestation according to blood type

Percentage %	Total Number	Totals
52%	39	Blood type O
26.6%	20	Blood type A
14.6%	11	Blood type AB
6.6%	5	Blood type B
100	75	Total

The increase in the number of infected people carrying the O blood group explains the preference of the lice to feed on the O blood group, which is similar in that to the Anopheles mosquito, which prefers the O blood group (Shira *et al*., 2004) [33]. where it was found that mosquitoes prefer the O blood group, and found a relationship between the malaria parasite and blood type Ashraf (2006) [9]. Five types of lotion available in pharmacies used to kill head lice were also used after testing them on students and the extent of their effect. The highest percentage of killing lice was Nyda lotion at a rate of 59%, followed by Kwell-p at a rate of 27.7, then Stop lice lotion at a rate of 11.3%. The lowest percentage of killing lice in TIC-TAC shampoo was 1.3%, followed by Blue Magic at 0.4%. The reason for the high percentage of killing lice using Nyda shampoo may be due to the fact that this preparation is a silicone oil preparation that is in liquid form and works to suffocate the lice and dry them out and thus works to block Holes in the cover of the eggs, which leads to the death of the lice embryos. The process can be repeated after (7-10) days to eliminate the nymphs emerging from the eggs that are not affected by the treatment. (Heukellbach *et al*., 2008) [20] mentioned that the sticky substance in the Dimeticone product affects the respiratory openings of the system. The respiratory system of the lice stages, in addition to its effect on the respiratory openings in the gill cover of the eggs, works to prevent the efficiency of air exchange. Richling and Bockele (2008) [31] indicated that the product Dimeticone does not have any side effects when used and is highly effective. (Burgess and Burgess, 2011) [11] stated that Nyda preparation has superior properties, as it enters and spreads quickly into the trachea and its branches, filling even the smallest branches, preventing oxygen from reaching the lice, leading to suffocation and death of the lice. As for Kwell-p shampoo, the killing rate was 75%. This is due to it containing Lindane, which is highly neurotoxic and works to kill lice. It is an

organic chloride that affects the human central nervous system. However, the World Food and Drug Organization recommended the safety of the product, but it must be It is used with extreme caution, especially in young children, and it is prohibited for infants and pregnant women. As for TIC-TAC (Permethrin 1%) shampoo and blue magic, the reason for the low rate of killing lice in it may be due to the occurrence of resistance in the lice as a result of the widespread use of these two products.

Table (7): Percentage of total lice killing according to type of lotion

Percentage %	Total killing of lice	The Name of the shampoo
59%	130	Shampoo Nyda
27.7%	61	Kwell-p shampoo
11.3%	25	Stop lice shampoo
1.3%	3	TIC-TAC shampoo
0.4%	1	Blue magic shampoo
100	220	Grand total

Discussion

In the current study, five primary schools in the city of Tikrit were investigated to determine the prevalence of head lice, genus P. humanus capitis, among primary school students. The total number of students who were examined for the purpose of diagnosing head lice infestation was 1,000 children, and the total infection rate was 22.2%. Lice is classified, according to the National Pediculosis Federation, as a pandemic in the United States of America, when the rate of infection level is higher than 5% (Rassami and Soonmera, 2012) [30], and it was estimated An estimated 6-12 million children aged 3-11 years are infected with head lice each year in the USA (CDC, 2015) [12]. The rate of lice infestation in Iraq during recent years is close to the results of the research, as (Mahmud *et al*., 2011) [27] examined children from primary schools, their ages ranged between (6-12) years in the city of Baghdad, with a total infection rate of 13.5%, and in the city of Mosul, students were examined. In primary schools, the total infection rate was 33.2% (Al-Abaddy, 2008) [2]. In Najaf and Erbil, the total infection rate was between 14.52% and 14%, which is close to the results of the current study (Khidhir *et al*., 2017; Salih *et al*., 2017) [22, 32]. In the Arab Republic of Egypt, the level of infection in children in primary schools reached 33% by microscopic examination (El-Sayed *et al*., 2017) [17]. In Iran, the rate of head lice infection among primary school children reached (0.47-67.3) % (Soleimani-Ahmadi *et al*., 2017) [34]. The levels of head lice infestation in the current study were high in females and there were large differences when compared to males. This is consistent with most researchers in Iraq and the world (Al-Marjan and Kamil, 2014) [6]. The main reason for the high level of infestation in females is that females have long, thick hair that is groomed. A good place for the parasite to climb without feeling it. The highest infestation rate was among groups of children aged (6-7) years compared to older groups (8-9) years, (10-11) years. These rates are consistent with numerous studies by researchers who recorded the same rates among younger children who are more susceptible to infection with lice. The head of those who are older (Khidhir *et al*., 2017) [22]. The reason for infection in younger children is their lack of knowledge of the rules of hygiene and their inability to clean their hair at the time of swimming, touching and playing among young children in the classrooms at school and according to the social lifestyle. The age group most vulnerable to head lice infection is children between (5-13) year (Baghdadi *et al.*, 2021; Clarck, 2022) [10, 13]. In the current research, the spread of head lice varies greatly from one school to another and depends mainly on the difference in economic and social level between people, cultural differences among parents, advice on personal hygiene, and the application of control plans for different regions (Toloza *et al*., 2009) [35]. There is a direct relationship. Between lice infestation and the number of students in the same class as a result of overcrowding in the number of students in one class and the short distance between students, which leads to a large physical contact between students and this helps to increase the level of infestation (Gharsan *et al*., 2016) [18], the spread of lice on the head was a health problem. It is associated with students of low socioeconomic status, but now head lice is observed among students of all social and economic levels, and head lice also causes a state of anxiety among students (Lacarrubba *et al*., 2019) [23]. The reason for the difference in the rate of infection between schools is due to the difference in the level of personal and general health, and the decline of some research on areas with high rates of infection that are characterized by being poor areas in terms of health and economics and with high population density, where crowding increases and personal hygiene, including the number of showers, decreases. As well as the difficulty of controlling infection in children Al-Affas, N.H. (1993) [4] and this variation in the total infection rates between schools in this research is expected due to the variation in the level of students in the social and economic level, especially after the increase in population following the changes that the region witnessed as a result of the displacement of families. The results of the research also showed a higher rate of lice in females compared to males, which is identical. According to what was found by Al-Samarrai and Kadir (2000) [7] who recorded an infection rate of 21.24% in females and 10.14% in males, that males adopting complete hair shaving (Al-Abady, 2009) [3] and not mixing males with females while playing in schools and sitting in seats separate from females led to As long as they are not infested with lice, the difference in head lice infestation between the sexes has no physiological basis, but rather depends on the difference in hairstyle. Long hair and dreadlocks are a predominant characteristic among older girls, and the small number of times hair is cut in females helps the infestation to remain and perpetuate. Al-Kubiassy and Abdul Karim (2003) [5], with regard to hair density, the highest infestation rate appeared in long, thick hair at 42.1%, while it reached 4.1% in women with short hair. The reason for these results may be attributed to the fact that head lice infestation increases with increasing hair density, which is considered a safe haven for lice to hide.

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