

Original article

Comparative efficacy of topical dimethicone and permethrin for the treatment of head lice infestation in students

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Background: Despite improved living conditions, individual health and health indicators in human societies, head lice infestation continues to be a major health problem. Therefore, studying the efficacy of drugs and identifying treatment - resistant cases in the prevention and elimination of this disease is of particular importance.

Objective: The study aimed to determine the efficacy of dimethicone and permethrin in infected pupils in elementary schools for girls.

Methods: This study was conducted on primary schoolgirls infected with head lice in Doroud County, Lorestan-Iran. The eighty infected girls were detected and randomized into two groups receiving any of the treatments listed. By the end of second week, the efficacy of the drugs was determined.

Results: The efficacy of dimethicone and permethrin after treatment were 82.6% and 54.7%, respectively, for removing head lice at the end of two weeks. In other words, the efficacy of dimethicone was 27.9% higher than permethrin. The Chi-square test at the end of the first week, there were no significant differences between the treatment groups ($P = 0.065$). The outcomes of dimethicone treatment at the end of the second week ($P = 0.025$) and generally at the end of two weeks ($P = 0.006$) were more effective than permethrin.

Conclusion: The results of this study suggest that dimethicone is useful in the treatment of head lice compared to permethrin.

Keywords: Dimethicone, head lice, *Pediculus capitis*, permethrin.

Among the arthropod-pests of medical importance or arthropod associated diseases ^(1 - 13), *Pediculus*

capitis (De Geer) (Anoplura: Pediculidae) is mentioned as one of the most important human obligatory ectoparasites that generally infest the human hair and scalp. *Pediculus capitis* (head lice) is a global parasitic disease that can be considered a public health threat that occurs in different parts of the world, mainly affecting school-aged children with a maximum incidence of under 15 years, including Iran. Today, as in the past, head lice infestation remains a major health issue ⁽¹⁴⁾ despite improvements in living conditions, individual health and health indicators in human

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societies. All stages of *P. capitis* are associated with human hosts for their lifetime. The nymphs and adult insects nourish only human blood without having wings and jumping ability. These insects are mostly spread by physical contact. (15 - 18) Topical medications are the first choice for managing head lice. In the first line of head lice treatment, topical medications such as dimethicone and permethrin are used. Resistance to topical medicines, particularly pyrethroids, is a growing concern around the world, and certain genetic mutations have been introduced to justify it. (19) Dimethicone 4% lotion is a recent new product development in treatment of head louse infestation. Dimethicone [polydimethylsiloxane, $(\text{CH}_3)_3\text{SiO}[\text{SiO}(\text{CH}_3)_2]_n\text{Si}(\text{CH}_3)_3$] is a silicon-based polymer used as a lubricant and conditioning agent. The mode of action of the product was to kill the insects by physical mechanisms rather than by neurotoxicity. However, the dimethicone mode of action has been unclear. Other investigators have loosely referred to the mode of action of different molecular weight products, as well as straightforward occlusive creams, as “asphyxiation” or “suffocation” but without clear biological evidence in support of their claims. In Iran, head lice infestation is emerging as a health problem due to the increasing villager migration to the cities, marginalization, and the creation of satellite cities with minimal health and welfare facilities. The prevalence rate of head lice infestation in primary school students was reported at 7.4%, with 1.6% for boys and 8.8% for girls. (20) Therefore, studying the efficacy of drugs and identifying treatment-resistant cases in the prevention and elimination of this disease is of particular importance. This study was conducted to determine the efficacy of dimethicone and permethrin in infected pupils in elementary schools for girls in Doroud County, Lorestan-Iran.

Materials and methods

Detection of infected students

This cross-sectional and interventional study was conducted on infected primary school girls in Doroud County, Lorestan-Iran. The necessary permits were obtained from the Doroud County Education Office and the Health and Medical Network Office prior to field work. To explain the study objectives, a coordination and justification meeting was held with school administrators, health educators and other stakeholders. Then, in agreement with the school administrators and health educators, we went to

primary schools to identify the infected students on certain days and according to the previous agreement. The county was divided into five geographical areas, including the west, east, north, south and center. In each area, a few girls' schools were randomly selected and a sampling was conducted. It was estimated that there were 896 students needed in accordance with the below formula used to estimate sample size. Additional required information was gathered from student files or questions and included on the checklist. While meeting the students, ethical principles were observed.

How to estimate sample size

The sample size was estimated in accordance with the formula used to estimate the ratio and prevalence of infected cases in previous studies. Based on consideration of 95.0% confidence level and accuracy, “ $Z_{1-\alpha/2} = 1.96$ ” and “ $d = 0.05$ ”. In past studies, “ P ” was “0.8”, therefore “ q ” would be “0.2”. By putting the numbers into the following formula, the sample size was estimated at 682 students. To complete the study in five schools, it was expanded to 896 students.

To estimate the sample size to compare the effect of two topical medications, the Devore CD, *et al.* method (21) was used using the following formula. The number of students in each group was established as “6” and for greater certainty, “40 students” were considered for each drug.

$$n = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2 * [P_1(1-P_1) + P_2(1-P_2)]}{(P_1 - P_2)^2}$$

Where “ $\alpha = 0.05$ ”, “ $\beta = 0.2$ ”, “ $P_1 = 100\%$ ” and “ $P_2 = 45.0\%$ ”.

Treatment

The eighty infected girls were detected and randomized into two groups receiving any of the treatments listed. The amount of permethrin 1% shampoo and dimethicone 4.0% lotion was 60 ml. Affected students and their parents learned proper drug-use skills. If failure occurs at the end of the first week, treatment is continued for an extra week. By the end of week two, the efficacy of the drugs was determined. The Chi-square test was used to compare the drug efficacy. $P < 0.05$ was considered statistically significant.

Table 1. The efficacy of dimethicone and permethrin for the treatment of head lice infestation in girl students.

Treatment groups	Infected students	Improved		Unimproved	
Dimethicone	Individuals	Individuals	%	Individuals	%
At the end of the first week	40	34	85.0	6	15.0
At the end of the second week	6	4	66.7	2	33.3
At the end of two weeks	46	38	82.6	8	17.4
Permethrin					
At the end of the first week	40	27	67.5	13	32.5
At the end of the second week	13	2	15.4	11	84.6
At the end of two weeks	53	29	54.7	24	45.3

Results

Table 1 illustrates the efficacy of the treatment groups. The efficacy of dimethicone and permethrin after treatment were 82.6 and 54.7%, respectively, for removing head lice at the end of two weeks. In other words, the efficacy of dimethicone was 27.9% higher than permethrin (Table 1). At the end of the first week, there were no significant differences between the treatment groups ($P = 0.065$). The outcomes of dimethicone treatment at the end of the second week ($P = 0.025$) and generally at the end of two weeks ($P = 0.006$) were more effective than permethrin.

Discussion

Pediculus capitis is mentioned as one of the most important human obligatory ectoparasites among arthropod-pests of medical importance, such as ticks, mosquitoes and cockroaches or arthropod-associated diseases like leishmaniosis, myiasis and scabies.⁽²²⁻³³⁾ In recent decades, there has been a significant increase in head lice infestations around the world. One of the reasons is drug resistance to consumed drugs.^(34, 35) The efficacy of permethrin was 27.9% lower than that of dimethicone. In other words, for treatment failure, permethrin was found to be 27.9% greater than dimethicone. For students who continued treatment with permethrin for 14 days, the recovery rate (15.4%) was not the same as the non-recovery rate (84.6%) in the second week, and this issue can emphasize the development of drug resistance to permethrin (Table 1). In a study conducted by Rafinejad J, *et al.* treatment failure for permethrin was 20.5% among female students, after seven days⁽³⁶⁾, which is less than the present study.

However, in a study conducted by Soleimani-Ahmadi, treatment failure for permethrin was 49.0% among female students after seven days and diminished to 21.0% after 14 days.⁽³⁷⁾ Treatment outcomes during the first week did not reveal any significant differences between treatment groups. Dimethicone treatment within the second week and generally for two weeks was more effective at removing head lice than permethrin. Zahirnia A, *et al.* reported that the rate of treatment for permethrin was 88.0%.⁽³⁸⁾ In a study conducted by Izri A, *et al.*, the lice killing effect of dimethicone was determined to be 83.2%.⁽³⁹⁾ However, in another study conducted by Ihde ES, *et al.* the results showed that the efficacy of dimethicone and permethrin were 80.7% and 45.3%, respectively, after 14 days.⁽⁴⁰⁾ Tashakori G, *et al.* reported the rate of treatment with permethrin 45.3% after four weeks.⁽⁴¹⁾ One reason for diminishing the therapeutic effect of permethrin is the resistance of *P. capitis* to permethrin in comparison to dimethicone. It appears that the intensity of resistance of *P. capitis* to permethrin has progressively increased over the past decade. The dimethicone mechanism is oil-based, which physically kills the insects by blocking the breathing holes *P. capitis*. Consequently, there is less potential for resistance to dimethicone.⁽²⁰⁾ The difference between dimethicone and permethrin treatment was clearly observed by Burgess IF, *et al.* who suggested the removal of permethrin from the treatment of head lice.⁽⁴²⁾ The results of this study like one conducted by Kalari H, *et al.* confirm the usefulness of dimethicone for the treatment of head lice compared to permethrin.⁽⁴³⁾

Conclusion

The results of this study suggest that dimethicone is useful in the treatment of head lice compared to permethrin.

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Conflicts of interest statement

Each of the authors has completed an ICMJE disclosure form. None of the authors declare any potential or actual relationship, activity, or interest related to the content of this article.

Data sharing statement

The present review is based on the references cited. Further details, opinions, and interpretation are available from the corresponding authors on reasonable request.

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