

Evaluation of the Role of Epidemiological Factors in Head Lice Infestation among Elementary School Female Students and Comparison of the Effectiveness of 1% Permethrin Shampoo with Dimethicone Lotion and Home Remedies

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Abstract--- Introduction: Despite the progress of societies in different levels of health, head lice infestation is still an important health problem in poor and developing countries. Therefore, the aim of the present study was to investigate the role of epidemiological factors in head lice infestation among primary school girls and to compare the effectiveness of permethrin shampoo 1% with dimethicone lotion and home remedies.

Materials and Methods: This cross-sectional (descriptive-analytical) study was performed on female students of elementary schools in Nahavand, Hamadan, Iran. First, demographic information for each student was collected based on the students' files or questions from them and, if necessary, questions from the students' parents and then recorded in the relevant checklist. Infested students were then randomly divided into five treatment groups and treated. Infested students and their parents were given the necessary training on how to use the drug properly. After 17 days, the effectiveness of the treatment methods was evaluated. The data of this study were analyzed by SPSS software version 24 and using Chi-square test.

Results: A total of 499 people were included in the study, of which only 89 students (17.83%) had pediculosis. The results showed a significant difference between the prevalence in terms of variables of father's education, mother's education, maternal employment, previous history of disease, assistance of family members in health affairs, and hair condition, hair type and hair length ($P < 0.05$), but in terms of basic variables of education, father employment, number of household members, number of baths per week and use of personal comb and brush, this difference was not statistically significant ($P > 0.05$). Also, the effectiveness of permethrin shampoo, dimethicone lotion, home treatment, dimethicone lotion/home treatment and permethrin shampoo/home treatment were 66.67%, 80%, 53.34%, 100% and 86.67%, respectively, which were statistically significant ($P < 0.05$).

Conclusion: Dimethicone lotion combined with home treatment is recommended as the first method in treating cases of head lice by observing the instructions for use and educating parents and school health officials.

Keywords: Head Louse, Pediculosis, Permethrin, Dimethicone.

I. Introduction

Lice are tiny, wingless, bloodthirsty insects that can infest the human body (head, body and pubic area). Medically important lice are divided into three categories: head, body and pubic lice (1). Lice transmit diseases such as epidemic typhus, recurrent epidemic fever and ditch fever (2). Head lice (*CapitishumanusPediculus*) belong to the arthropod Phylum, the Insecta class, the order Anoplora, and the Pediculidaefamily. Both males and females are bloodthirsty and are considered mammalian forced ectoparasites. It is mainly transmitted through direct contact. Head lice infestation causes feelings of inferiority, psychological irritation, depression, insomnia, academic failure,

loss of social status, secondary infections, hair loss, and allergies (3). Among the methods to prevent head lice are personal hygiene, regular bathing and avoiding the use of other people's personal belongings (4).

The rate of head lice infestation in different regions of Iran varies from 0.9 to 20.5% (5). Many treatments for head lice have been investigated around the world. Although head lice infestations are less common today due to improved living standards, head lice infestations have been reported in varying proportions in almost all parts of the world (6). Head lice and their Nits need special conditions of temperature and humidity to survive, therefore, the best place for lice grow is not only on the hair and scalp, especially in the areas behind the ears and back of the head, but also is on all the scalp, benefits and other parts, e.g., hairy parts in conditions of severe infestation.

It is usually possible to transmit the infestation through direct contact with the sick person and sharing a mask, headband, hat, comb, scarf, undergarment, towel, sheet, pillow and even a mobile phone, but the most common way of transmission is through head-to-head contact (7).

The risk of head lice is associated with many factors, but is relatively high in areas with high population density, poor economic status, lack of personal hygiene, lack of access to baths and lack of health facilities (8).

Head lice are found world-wide, but are often found in temperate regions. The resulting harassment is comparable to the problems caused by colic in the tropics of the world (9). In Iran, unfortunately, pediculosis is emerging due to population growth in areas prone to pollution, increasing rural-urban migration, increasing marginalization and the creation of satellite cities without coordination with relevant organizations, with minimal health and welfare facilities, among others infectious diseases in some areas (10). Head lice infestation is highly prevalent in females and is more common in elementary school students than in other grades. It is also slightly higher in rural areas than in urban areas. Factors related to its prevalence include race, level of education and occupation of parents, household population, type and length of hair, use of shared combs and personal belongings, shared bed, frequency of bathing, socio-economic status (11). Therefore, the aim of the present study was to investigate the role of epidemiological factors of head lice among female elementary school students and to compare the effectiveness of 1% permethrin shampoo with dimethicone lotion and home remedies.

II. Materials and Methods

This cross-sectional and interventional study was performed on all female elementary school students in Nahavand, Hamadan-Iran.

Sample Size

The sample size was based on the formula for estimating the ratio and prevalence of infection in previous studies (12). Considering the 95% confidence level, $z = 1.96$ and accuracy $d = 0.05$. In previous studies, P was 0.8, so q would be 0.2. By placing the numbers in the following formula, the sample size was estimated to be 245 people. The total number of female students was 499. Therefore, all students were examined for better estimation.

$$n = \frac{(Z)^2 (pq)}{(d)^2} \\ \frac{(1.96)^2 \times 0.2 \times 0.8}{(0.05)^2} = \frac{3.84 \times 0.2 \times 0.8}{0.0025} = 245$$

Procedure

First, Nahavand city was divided into 5 geographical regions including west, east, north, south and center and the number of primary schools for girls in each region was calculated along with the population of students. The number of female primary school students was 499, so all students were counted in a numerical manner by a research team along with a disease prevention and control expert.

Diagnosis of infection was based on the standards contained in the school lice control manual and the latest pediculosis treatment guidelines published by the Deputy Minister of Health of the Ministry of Health and Medical Education (77). The students' hair (especially in the areas behind the ears and above the neck) was examined individually by the researchers in the presence of sufficient light, observing the principle of confidentiality, for about 4 minutes for each student. After identifying infected students, the information required in the study includes head lice infestation status, student's educational background, parents' education and employment status, number of household members, number of baths per week, having a personal brush and comb, previous history of illness, parental assistance in the personal health of students and the condition and type of hair were collected based on the students' files or questions from them or questions from the students' parents and then recorded in the relevant checklist.

Finally, the total number of infested students was 89, of which 85 students were selected and randomly divided into 5 groups of 17 people. Then, in each area, one of the treatment methods (permethrin shampoo, dimethicone lotion, home treatment, permethrin shampoo/home treatment, dimethicone lotion/ home treatment) was used for treatment.

Necessary training for the correct use of medicine (first time and repeated one week later) and post-treatment care including washing students' personal belongings (shoulders, brushes, masks, scarves, shawls, hats, pillows, sheets) in boiling water and sweeping the whole house, preferably with a vacuum cleaner, was given completely to the infected students and their parents after using the treatment methods. Finally, the effectiveness of the methods was evaluated after 17 days.

The permethrin shampoo used in this study was a 1% solution of 60 ml made by Gilaranco Pharmaceutical Company. Students should have a sufficient amount of shampoo (for long hair: full shampoo, medium hair: 3/4 of shampoo and short hair: half of Shampoo was applied to wet hair so that all the hair and scalp were well impregnated with the shampoo and kept in the same condition for 10 minutes, then the hair was washed with plenty of water and rinsed. After that, they should refrain from washing their hair for 2 days, but the shampoo effect remains on the head and hair for up to a week.

The second drug used in this study was 4% dimethicone lotion in the amount of 60 ml made by Sami Daroo Company. The method of application was that you should first apply the lotion on dry hair from the hair roots to ensure that the scalp is covered with the lotion. The hair should then be allowed to dry naturally and the lotion left on for at least 8 hours or overnight. Finally, the head and hair should be washed with ordinary water and shampoo, and then the lice carcasses and lice eggs should be removed from the hair with a fine-toothed comb. The home method consisted of using ordinary shampoo and using white vinegar in equal proportions of vinegar and water, which sprayed some mixture of water and vinegar to the ends of the hair, especially around the ears and behind the head, after washing the head. After half an hour, Nits were removed by the parents every three days for two weeks.

Data Analysis

The data of this study were analyzed by SPSS software version 24 using descriptive statistics (frequency and frequency percentage) and inferential statistics (Chi-square test). Significance level was considered less than 0.05.

Ethical Considerations

Prior to the patients' participation in the study, their parents were adequately explained about the optionality of participating in the study. Informed consent was obtained from the parents of the participants in the study. It should be noted that no additional costs were imposed on patients in the course of this study. Also, the information in the checklists was considered confidential and the results were published only in groups. Helsinki Ethical Principles were observed. The study was approved by the Ethics Committee of Iran University of Medical Sciences, IR.UMSHA.REC.1399.555.

III. Results

A total of 499 people were included in the study. The frequency of head lice infestation among students by grade level is shown in Table 1. First grade students had the highest infestation (20.77%) and second and sixth grade students had the lowest infestation (16.66%). However, as can be seen, the results of chi-square test did not show a significant difference between the rate of lice infestation and students' educational level (P = 0.098).

Table 1: Frequency of Head Lice Infestation by Educational Level

Grade	infestation	No infestation	Statistical x ²	P-value
	Frequency	Frequency		
First	16 (20.77%)	61 (79.23%)	0.703	0.98
Second	13 (16.66%)	65 (83.33%)		
Third	17 (18.68%)	74 (81.32%)		
Fourth	15 (17.24%)	72 (82.76%)		
Fifth	16 (17.02%)	78 (82.98%)		
Sixth	12 (16.66%)	60 (83.34%)		

The prevalence of head lice infestation among students in terms of parental education is shown in Table 2. Students with fathers (26.13%) and mothers (28.71%) with primary education had the highest infestation and students with fathers (11.81%) and mothers with higher education (5.62%) had the least infestation. As can be seen, the results of chi-square test showed a significant difference between the rate of lice infestation and education in parents (P <0.05).

Table 2: Frequency of Head Lice Infestation by Parental Education

Father's education	infestation	No infestation	Statistical x ²	P-value
	Frequency	Frequency		
Primary	23 (26.13%)	65 (73.87%)	11.32	0.01
Middle school	32 (22.53%)	110 (77.47%)		
Diploma	21 (13.2%)	138 (86.8%)		
Above the diploma	13 (11.81%)	97 (88.19%)		

Mother education				
Primary	29 (28.71%)	68 (71.29%)	27.99	<0.001
Middle school	26 (22.6%)	89 (77.4%)		
Diploma	25 (19.68%)	102 (80.32%)		
Above the diploma	9 (5.62%)	151 (94.38%)		

The frequency of head lice infestation among students was assessed according to the occupational status of the parents. Five of the students with unemployed fathers were infested (31.25%), followed by 68 (18.47%) with self-employed fathers and 16 (13.91%) with government-employed fathers. Furthermore, 11 (68.75%) with unemployed fathers had no infestation, followed by 300 (81.53%) with self-employed fathers and 99 (86.09%) with fathers working in government organizations.

In addition, 73 (18.25%) with housewives' mothers were infested with head lice, followed by 16 (16.16%) with working mothers. Moreover, 327 patients (81.75%) with housewives' mothers had no lice infestation, followed by 83 patients (83.84%) with working mothers. As can be seen, the results of chi-square test did not show a significant difference between the rate of lice infection and the job status of the father ($\chi^2 = 3.28$, $P = 0.19$), but this difference was significant in the job status of mothers ($P = 0.014$, $\chi^2 = 5.99$).

The frequency of head lice infestation among students in terms of the number of households is shown in Figure 1. Among the students with 3 household members, 28 were infested and 182 (86.67%) were uninfested. Among those with 4 households, 44 were infested and 161 (78.54%) were uninfested. Of those with a family of five or more, 17 were infested and 67 (79.77%) were uninfested. As can be seen, the results of chi-square test did not show a significant difference between the rate of lice infestation and the number of household members ($P = 0.08$).

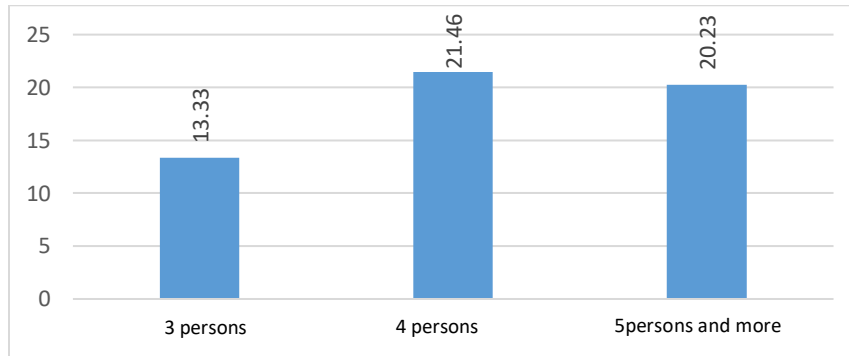


Figure 1: Frequency of Head Lice Infestation by Number of Household Members

The frequency of head lice infestation among students in terms of the number of baths per week is shown in Table 3. Students with bathing once a week had the highest infestation (25%) and students with bathing three times and more had the lowest infestation (16.77%). However, the results of chi-square test did not show a significant difference between the rate of lice infestation and the number of baths per week ($P = 0.42$).

Table 2: Frequency of Head Lice Infestation by Number of Baths per Week

Take a shower several times a week	infestation	No infestation	Statistical χ^2	P-value
	Frequency	Frequency		
once	11 (25%)	33 (75%)	1.71	0.42
Twice	51 (17.34%)	243 (82.66%)		
Three times and more	27 (16.77%)	134 (83.23%)		

The prevalence of head lice infestation among students in terms of comb and brush use showed that 32 patients (15.38%) were infested and 176 patients (84.62%) were uninfested. Of those who did not use a personal comb and brush, 57 (19.58%) were infested and 234 (80.42%) were uninfested. The results of chi-square test did not show a significant difference between the rate of lice infestation and the use of personal combs and brushes ($P = 0.23$).

In Table 3, the frequency of head lice infestation among students was examined according to the study variables. The results demonstrated that the previous incidence of head lice ($P = 0.046$), health ($P = 0.001$), hair condition ($P = 0.001$), hair type ($P = 0.002$), hair length ($P = 0.035$) had significant relationship with infestation.

Table 3: Frequency of Primary Head Lice Infestation According to the Studied Variables

	infestation	No infestation	Statistical χ^2	P-value
	Frequency	Frequency		
Previous history of infected				
No	23 (15.86%)	122 (84.14%)	0.54	0.046

Yes	66 (18.64%)	288 (81.36%)		
Assisting family members in doing health care				
Yes	35 (10.54%)	297 (89.46%)	36.01	<0.001
No	54 (32.33%)	113 (67.67%)		
Hair condition				
Curly	59 (29.94%)	138 (70.06%)	32.59	<0.001
Straight	30 (9.93%)	272 (90.07%)		
Hair type				
Normal	41 (16.87%)	202 (83.13%)	12.34	0.002
Dry	13 (10.31%)	113 (89.69%)		
Fat	35 (26.92%)	95 (73.08%)		
Hair length				
Short	17 (12.68%)	117 (87.32%)	6.68	0.035
Medium	45 (17.37%)	214 (82.63%)		
Tall	27 (25.47%)	79 (74.53%)		

Table 4 shows the effectiveness of different treatments after 17 days of treatment. The effectiveness of permethrin shampoo was found to be 20% less than permethrin shampoo/home treatment. The results of chi-square test did not demonstrate significant differences between these two treatments ($P = 0.39$). The effectiveness of dimethicone lotion was 20% less than dimethicone lotion with home treatment, but the results of chi-square test did not show a significant difference between the two treatments ($P = 0.22$). The results of chi-square test also revealed a significant difference between treatment methods and treatment of patients ($P < 0.05$).

Table 4: Comparison of the Effectiveness of the Type of Treatment

Treatment methods	17 days after treatment		Statistical χ^2	P-value
	No Improved	Improved		
	Frequency	Frequency		
Permethrin shampoo (15 people)	5 (33.33%)	10 (66.67%)	11.15	0.02
Dimethicone lotion (15 people)	3 (20%)	12 (80%)		
Home treatment (15 people)	7 (46.66%)	8 (53.34%)		
Dimethicone lotion with home treatment (15 people)	0 (0%)	15 (100%)		
Permethrin shampoo with home treatment (15 people)	2 (13.33%)	13 (86.67%)		
Permethrin shampoo with home treatment (15 people)	2 (13.33%)	13 (86.67%)	1.72	0.39
Dimethicone lotion with home treatment (15 people)	0 (0%)	15 (100%)	1.48	0.22

Table 5 shows the effectiveness of permethrin shampoo and dimethicone lotion with home treatment. The effectiveness of home treatment was 13.33% less than permethrin shampoo and the effectiveness of home treatment was also found to be 26.66% less than dimethicone lotion, but the results of chi-square test showed no significant difference between these two treatments with home treatment ($P > 0.05$).

Table 5: Comparison of the Effectiveness of Permethrin Shampoo and Dimethicone Lotion with Home Treatment of Head Lice

Treatment methods	17 days after treatment		Statistical χ^2	P-value
	No improved	Improved		
	Frequency	Frequency		
Permethrin shampoo (15 people)	5 (33.33%)	10 (66.67%)	0.56	0.46
Home treatment (15 people)	7 (46.66%)	8 (53.34%)		
Dimethicone lotion (15 people)	3 (20%)	12 (80%)	2.4	0.12
Home treatment (15 people)	7 (46.66%)	8 (53.34%)		

IV. Discussion

Head lice infestation is still an important issue in poor and developing societies, despite the progress and pervasiveness of health practices in the community. Although the prevalence of this disease has decreased significantly compared to previous decades, even low percentages of pollution, which in the past was considered a success in controlling this infestation, are now considered a public health problem (13). Therefore, the aim of the present study was to investigate the role of epidemiological factors in head lice infestation among primary school girls and to compare the effectiveness of 1% permethrin shampoo with dimethicone lotion and home remedies.

The prevalence of head lice infestation in the present study was 17.83%, which is higher than the study conducted by Zahiria et al. in Hamedan (13.5%), (14). Similar studies conducted in different parts of the country

on the prevalence of head lice in elementary school students, where its prevalence rate has been reported from Amlash(9.2%) (15), Tonekabon (19.9%) (16), Jahrom (6.8%) (17).

In a systematic review and meta-analysis in Iran by Moosazadeh et al. (18), the prevalence of head lice in the female student population was estimated at 8.8%, which is lower than the present study. Epidemiological studies have estimated the prevalence of head lice in Asia at 0.7 to 59%. According to the definitions and criteria of the National Pediatric Association of the United States, a condition in which at least 5% of the children in a population have head lice is referred to as an epidemic (19). Considering the present study, Qahvand city is seriously facing this problem. The prevalence of infestation in this study (17.83%) is higher compared to other similar studies among female students, such as studies in Mashhad (13.6%) and Qom (13.28%) (21, 20). One of the reasons for the high prevalence in this study could be the emergence of new suburban areas and the lack of estimated community need for health education. In marginalized areas, poor health care, and less public health education and training, lead to lower health and more pollution. Another reason for the high prevalence of head lice among students could be due to the negligence of school health educators on routine training and disease prevention methods in infested students. Also, it may be possible to explain the difference in sample size and time of field studies as the reasons for the differences between the mentioned studies and the results of this study.

In the present study, the prevalence of lice infection did not differ significantly at different ages. Although the rate of infection was somewhat lower among higher grade students, but according to the chi-square test, no significant difference was observed between the prevalence of pediculosis and students' grade. Motevali Haghi et al. (22), and Nazari (23) have pointed to similar results. However, in the study of Haidarpour et al. (2019) and Moradi (2012), this difference was statistically significant, which contradicts the results of this study (16, 24).

One of the reasons for the lower prevalence of infection in higher grades can be the difference in students' awareness in different grades and its increase in proportion to increasing age and observation of cases of infestation among friends and relatives of students. At this age, for example, we see the onset of independent behaviors in personal hygiene and bathing in children, and they may not yet have sufficient skills and abilities in these areas. Of course, educational level is not the only effective criterion in infestation, and it cannot be concluded that the prevalence percentage always decreases with increasing age of primary school students (21, 25). There was also a significant relationship between infection in students and parents' education. Increasing the level of education of parents leads to increasing the level of family health literacy and thus providing appropriate solutions to solve health problems. This finding is consistent with the results of trustee studies (22).

Despite the decrease in cases of infection at older ages, the father's education is always an important and significant variable and this finding adds to the importance of this issue (6). Unlike some studies (11, 15,), students' mother's education did not show a statistically significant effect. One reason for observing this result could be the lower number of mothers with university education or lower level of education than the father of students, which has been reported similarly in other studies (18).

Mothers' education and awareness can be as important as fathers' education. In the present study, all students benefited from parental assistance in maintaining personal hygiene, and this support was probably often provided by their fathers. In the study of Tarkhasi et al., Mother's education, unlike father's education, did not show a statistically significant relationship (25). Of course, this argument cannot be generalized to all cases, as Doroudgar et al in a study reported the father's education as ineffective factor and the mother's education as effective in head lice infestation (26).

In the present study, no significant difference was observed between the two variables of head lice infection and the number of household members. But with the increase of household members, the prevalence of infestation increased. It is obvious that the increase in the number of family members, the amount of contact with each other and the possibility of using shared equipment has increased and sometimes less attention is paid to the health of the family due to financial deficiencies, leading to easy transmission of infection.

In different studies, the highest prevalence has been reported in children living in large families (27, 22). In another study on the role of family population in head lice infection, the number of family members is a factor influencing the distribution of lice among school children. In this study, the highest prevalence was reported from children living in large families. This is probably due to the fact that children from large families are more exposed to contact and also large families may pay less attention to hair hygiene (7).

Based on the results of the present study, there was no significant relationship between the frequency of lice infestation and the use of shared equipment and personal hygiene, but the rate of infestation was higher among students using shared equipment.

Since close contact is the main way of transmitting head lice, it seems that the game girls, moving scarves during sports hours, putting scarves, hats and clothes on top of school clothes and using combs, headbands and other common accessories can spread head lice.

In fact, using personal items and maintaining good personal hygiene can significantly reduce head lice infestation. These results are consistent with the findings of the Motevali Haghi and Yazdani (22, 28). It is noteworthy that a significant relationship was found between the history of infestation and current infestation in the present study. These results are consistent with the findings of studies conducted by other researchers (27).

There was no significant relationship between the number of baths per week and the rate of lice infestation, but this rate was lower in students who took more baths per week, which is consistent with the results of studies by Haghi and Yazdani (22, 28). In the present study, there was a significant relationship between the two variables of lice infestation and hair condition, so that the prevalence was higher among students with curly hair. In the study conducted by Rafinejad, a significant relationship was observed between hair condition and type of infestation, which contradicts the results of this study (15). But other studies point out that the frequency of infestation is higher in curly hair, and difficulty combing is the most important cause of this phenomenon (18).

Also in a study conducted in Asadabad by Nazari showed a significant difference in lice infestation between students with curly hair (5.5%) and students with straight hair (1.9%) (23), which is consistent with the results of this study. In this study, the rate of infection in students with oily hair was higher than other students, which is consistent with a study conducted by Tashakori et al in 2018 (29). There was a significant relationship between infestation in students and parents' jobs.

Employee parents had children with less infestation than other occupations. The reason for this can be considered in the high level of education, culture, relative economic and social level of the family, which can be effective in the rapid follow-up and treatment of infestation. Poverty and education both seem to be involved in infestation in some way, the results of this study are consistent with the results of Motevali Haghi and Rafinejad (22, 15). Regarding the effectiveness of the type of treatment, the results showed that the most effective was related to dimethicone lotion/home treatment (100%), followed by permethrin shampoo/home treatment (86.67%), dimethicone lotion (80%), permethrin shampoo (66.67%) and home treatment (53.34%). The results of chi-square test also showed a significant difference between treatment methods and treatment of patients. In a study by Tashakouri et al., the rate of treatment with permethrin shampoo after four weeks was 45.3%, while the use of vinegar was 45.1% effective (30). In a study conducted by Izri in 2010, the lice killing effect of dimethicone lotion was determined to be 83.2% (31).

In another study conducted by Erin Speiser Ihde in 2015, the results showed that the effectiveness of dimethicone lotion and permethrin shampoo were 80.7% and 45.3%, respectively, after 14 days of treatment (32). However, Zahirnia, reported that the rate of treatment for permethrin was 88% (14). One of the reasons for the decrease in the therapeutic effect of permethrin shampoo is the resistance of *Pediculus humanus capitis* to permethrin compared to dimethicone.

V. Conclusion

The results showed that Dimethicone lotion /home treatment was more effective in treating pediculosis. This treatment method is recommended as the first method in treating cases of head lice by observing the instructions for use and educating parents and school health officials. Infestation depends on several factors, including a decrease in the level of literacy in families, an increase in the family dimension, a decrease in the number of baths per week, and the use of a personal comb and brush. Therefore, in order to reduce the burden of the disease and its consequences, it is necessary to carry out health and medical interventions, as well as necessary training for the residents of this city.

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