

Impact of a Health Educational Interventional Program on Reducing the Head Lice Infestation Among Pupils in an Elementary School of a Sub-Tropical Region

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Abstract

Background: Pediculosis is an important social challenge that can be caused by human head louse, *Pediculus humanus capitis*. This infestation is cosmopolitan, especially in countries with low hygiene and sanitation. Regular health education classes for students and their parents are required to reducing this infestation in schools and families. This study aimed to evaluate the impact of a health education intervention program on reducing of head lice among pupils of an elementary school.

Methods: In a pre-post study, a total of 594 pupils, a girl elementary school, were screened for pediculosis (2017-2018). The prevalence of pediculosis estimated before and after two month interventional education program. Visual inspection was applied for initial diagnosis of infection. The suspected cases were confirmed by wood lamp examination and *potassium hydroxide (KOH)* microscopic wet-mount examination. An elementary school in the same area was selected as the control group, with no interference. The prevalence of contamination by the same method was obtained in the study group.

Results: At the beginning of study, pre-intervention prevalence of pediculosis among pupils was 8.4% (49/594). The mean age in all pupils was 9.86 ± 1.83 years old and the most infestation was showed in fourth-grade students with 10 years old. Analysis of statistics demonstrated a significance difference between having infestation and the number of members in the families. Post-intervention phase led to a decreased prevalence of pediculosis in pupils to 3% (8/594) (p -value < 0.05) and significant increase of parental knowledge on prevention program of pediculosis (p -value < 0.001),

Conclusion: The prevalence of pediculosis was significantly reduced following the interventions in the school. The applied interventions may be implemented in other residual centers to get rid of this important infestation.

Introduction

Head lice infestation is an important social challenge, which can be developed by *Pediculus humanus capitis* as a human head louse. This infestation is cosmopolitan, especially in countries with low hygiene and sanitation¹. These obligate ectoparasites of human have been well-known antiquity and are associated with some life-threatening diseases including epidemic typhus, relapsing fever, and trench fever². As a rapid spreading infestation, pediculosis is considered the most common contagious disease among school children afterward common cold virus³. Spreading of lice is more commonly due to direct contact with the hair of infested people. However, other uncommon routes such as contact with clothing and inanimate objects and personal belongings of infested persons are reported throughout the world⁴. Living in more crowded places including schools, orphanages, and other residual centers increase the risk of infestation. Subsequently, infested people in the mentioned centers spread lice between their families as well as societies⁵. However, parents' education level, family financial status and geographical location of the schools have been found to have no association with the spreading of head lice⁶. On the other hand, head lice infestation has been more reported in females than males⁷. Untreated pediculosis can

result in itching, hives, repeated wounding of head and body skin, mental health (nightmares), and allergy in infested individuals^{3,8}. These mentioned symptoms are more common in chronically infected patients, and it is due to toxicity of the insect saliva⁹. Head lice outbreaks and its obvious symptoms are more occurred in children and pre-school pupils and lead to a negative attitude by their classmates and friends¹⁰. Due to the potential spreading of pediculosis from infested people to society and their families, treatment and follow up of head lice infestations should be more emphasized in each region¹¹. For some people, the pediculosis management and treatment is expensive and laborious. Thus, it should be considered as a community-based approach to cover families, schools, health care professionals and the governments^{12,13}.

Previous studies in Iran demonstrated a considerable prevalence of head lice infestation in all provinces or geographic regions¹⁴⁻²¹. This infestation is increased significantly over time in both girls and boys, and it was varied from 1.72% in 2014–2015 to 3.42% in 2017–2018^{22,23}. Effective communication between parents and school health instructors about head lice can has an essential role in the control of pediculosis. Regular health education classes for students and their parents are required to reducing this infestation in schools and families^{24,25}. Despite the efforts of health authorities in Iran, the incidence of head lice infestation is increased in school children under the age of fifteen, particularly in female elementary school pupils^{20,23}. Moreover, the incidence of pediculosis is increased in Mashhad metropolis, the capital of Khorasan-Razavi Province. Due to being a hospitable city and a destination for religious tourism, this city has been a major endemic focus of pediculosis in Iran²⁶.

This study aimed to evaluate the effectiveness of parental knowledge and attitude on reducing of head lice among pupils in elementary schools in northeastern Iran. For this goal, a training-oriented process has been designed for increasing the awareness of teachers, pupils, and parents to prevention and control approaches of pediculosis in Mashhad city, northeastern Iran.

Materials And Methods

Study area

In a pre-post study, a total of 594 pupils, a girl elementary school, were screened for pediculosis (2017–2018). The prevalence of pediculosis estimated before and after two months in an interventional education program for both students and their parents in Mashhad city, the capital of Khorasan-Razavi Province. In a developed form, demographic data, weight, height, hair length, body mass index (BMI), parents' education and occupations, and the number of family members were recorded. Moreover, the frequency of infestation were measured for each pupil two times. This study was approved by the Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran, according to the Ethics Committee code of IR.MUMS.fm.REC.1398.347.

Sampling and detection

The school was randomly selected from a socio-economic medium area of Mashhad city. To estimate prevalence, the sample size was determined according to the expected prevalence of pediculosis (12.5%), which already was obtained in our pilot study and using Cochran's formula (prevalence rate), considering error of 5%, test power of 80% and relative error of $p/4$, the minimum predictable sample size was determined about 880 cases. Which, one third was considered to the control group, and two thirds to the intervention group. The visual inspection was applied for initial diagnosis of pediculosis infection by the school's competent public health consultant. Followed by, the suspected cases were confirmed by wood lamp and direct microscopic examination. The wood lamp examination determined the existence of lice eggs (nits) in greenish-yellow fluorescents that attached to the base of the infested hair shaft. During the direct microscopy examination, hair samples were trimmed with scissors, and were clarified with a drop of 10 % potassium hydroxide (KOH) on a microscopic slide, covered with a sterile coverslip (with a maximum magnification of 100× and 400×).

All elementary school students who are periodically visited by the hair regarded as inclusion criteria and unwillingness to participate in the program and not consuming permethrin shampoo in the month before sampling were considered as sampling exclusion criteria in the study. Detected infestations in the pupils were categorized into past, recent and present infestation cases. Detecting of dead eggs and/or nits more and less than 1 cm from the scalp is categorized in past and recent infestation, respectively. The existence of lice and/or eggs was considered as a present infestation. The light infestation was considered in cases with less than 5 lice and a few eggs. Numerous lice and eggs was considered as heavy infestation, and the existence of lice, eggs and numerous lice eggs and nits was detected as heavy long-standing infestation²⁷. An elementary school in the same area with 311 pupils was selected as the control group, without any interference. The prevalence of contamination by the same method was obtained in the study group.

Fifty parents who participated in the training sessions voluntarily, participated in the survey and asked for nine questions in a standard questionnaire, whose validity and reliability had already been confirmed by the health belief model (HBM)²⁸. The subjects were the aspects of recognizing the a developed questionnaire (according to Dehghani *et al.* study, 2018)²⁸, with eight questions about diagnostic, epidemiology, treatment and preventions aspects were filled by parents before and after training, to evaluate their general knowledge and measure the effectiveness of learning.

Interventions

In two steps, the interventions were applied in eradication of infestation due to case detection, and training-oriented prevention program. These implementation steps were applied with considering to ethical standards about infested cases and their families. The detected cases were referred to health centers for completing the treatment courses. Simultaneously, the transmission, prevention, and control of these ectoparasites were completely explained to their parents and students in a two months program by specialists as well. Moreover, the holding justification meetings were done for school managers and teachers to provide solutions and recommendations to manage this infestation. The educational content

of these part-time sessions were focused more particularly for classes with a high load of head lice infestation. For easy detecting of lice and their eggs and nits, related photos were showed to pupils and their parents using group discussion. Preventive healthcare strategies were described as personal hygiene including hair combing, ironing their cloths, covering the coat and jacket in nylon bags prior to placing in classroom hanger, swimming pools, mosques, hotels and even relatives' house. Moreover, for more effective learning, some brochures and educational pamphlets about pediculosis were distributed among pupils and their parents.

Statistical analysis

All data were statistically analyzed using SPSS software (version 20.0, SPSS, Inc., Chicago, IL, USA). Relative frequencies were determined and data were expressed as mean \pm standard deviation (SD). Shapiro-Wilk test was used to check the normality of quantitative variables. Mann Whitney U test was used to test the null hypothesis, and the Chi-square test was used to compare the relations and means. McNemar's test was also applied to investigate the prevalence rate before and after the intervention. A p-value of less than 0.05 was considered as statistically significant.

Results

Before interventions

At the beginning of study in autumn, the overall prevalence of pediculosis among the pupils was 8.4% (49/594). The mean age in all pupils was 9.86 ± 1.83 years old and the most infestation was showed in fourth-grade students with 10 years old (Table 1). The descriptive statistics for age, height, weight, body mass index (BMI), number of family members, and frequency of infestation in before and after course are shown in Table 2. There was no statistically significant difference between having head lice and age, weight, height, and BMI of pupils. The education level and occupation of the pupil's parents are characterized in Table 3. The number of family member's average among studied pupils was 4.30 ± 0.93 , and the infestation frequency's average in four examinations was 1.08 ± 0.84 . The analysis of statistics demonstrated a significance difference between having infestation and the number of family members. Moreover, the families with larger populations had more head lice infestation. The findings demonstrated a more infestation in long hairs (62%) pupils, but without any statistically significance difference. The severity of infestation in 55% of the infested cases was light with a low number of 1–5 nits. Heavy infestations were observed in almost all grades. Figure 1 shows an instance of the presence a nit attached to the hair shaft of infected pupil in a direct microscopic examination (wet mount).

Table 1

Infected and non-infected cases among study group according to their different educational grade.

School grade (age)	Negative cases	Positive cases (< 6 years)	Positive cases (6–10 years)	Positive cases (> 10 years)	Total
Pre-school (6)	59	2	0	2	63
Grade 1 (7)	85	4	1	2	92
Grade 2 (8)	90	4	2	2	98
Grade 3 (9)	101	5	4	2	112
Grade 4 (10)	103	8	3	1	115
Grade 5 (11)	107	4	1	2	114
Total	545	27	11	11	594

Table 2

Different characteristics of pupils, before interventions for head lice infestation

Characteristic	Non-infected (Mean \pm SD)	Infected (Mean \pm SD)	Total (Mean \pm SD)	p-value
Age	9.68 \pm 1.94	10.4 \pm 1.7	9.86 \pm 1.93	0.44
Weight	36.07 \pm 12.51	34.24 \pm 12.86	35.17 \pm 12.65	0.44
Height	138.97 \pm 12.91	137.02 \pm 13.87	138.02 \pm 13.36	0.55
BMI	18.26 \pm 4.27	17.65 \pm 3.78	17.96 \pm 4.03	0.51
Number of family members	4.06 \pm 0.78	4.56 \pm 1.01	4.30 \pm 0.93	0.003
Frequency of infestation in four time hair examination	0.00 \pm 0.00	1.72 \pm 0.93	1.08 \pm 0.84	$<$ 0.001

Table 3
Occupation and education level of parents of studied pupils for head lice infestation

		Non-infested (SD)	Infested (SD)	Total (SD)	p- value
Father's education	Less than high school diploma	26 (50%)	15 (30%)	41 (40.2%)	0.04
	High school diploma	19 (36.5%)	19 (38%)	38 (37.3%)	
	University degree	7 (13.5%)	16 (32%)	23 (22.5%)	
	Total	52	50	102	
Mother's education	Less than high school diploma	17 (32.7%)	12 (24%)	29 (28.4%)	0.50
	High school diploma	28 (53.8%)	28 (56%)	56 (54.9%)	
	University degree	7 (13.5%)	10 (20%)	17 (16.75)	
	Total	52	50	102	
Father's occupation	Self-employed	40 (76.9%)	37 (74%)	77 (75.5%)	0.93
	Retired/Unemployed	3 (5.8%)	3 (6%)	6 (5.9%)	
	Employee	9 (17.3%)	10 (20%)	19 (18.6)	
	Total	52	50	102	
Mother's occupation	Self-employed	1 (1.9%)	4 (3.08%)	5 (4.9%)	0.44
	Housewife	46 (88.5%)	41 (82%)	87 (85.3%)	
	Employee	5 (9.6%)	5 (10%)	10 (9.8%)	
	Total	52	50	102	

After interventions

The interventions lead to decreasing of prevalence of pediculosis in pupils from 8.4% (49/594) in the first of fall to 3% (8/594) in end of spring. These decreasing was occurred with a statistically significance difference (p-value < 0.05). Moreover, according to the data extracted from the questionnaires, 97% of the parents believed that the training courses were useful and effective in the raising of awareness about pediculosis. The prevalence of pediculosis in control school showed the rates of infestation 9%, 12%, and 11% in autumn, winter, and spring, respectively. Education was able to elevate attitude of parents on 8

different designed questions in the field of diagnosis, epidemiology, treatment and prevention of pediculosis significantly. Table 4 shows the results of interventions about head lice infestation among the parents of pupils.

Table 4

The results of interventions about head lice infestation among the parents of pupils, before and after interventions

Variables	Scope	Before Intervention	After Intervention			p-value
			No	Yes	Total	
Checking your child hair for infestation in home	Diagnosis	No	6 (12%)	26 (52%)	32 (64%)	< 0.001
		Yes	2 (4%)	16 (32%)	18 (36%)	
		Total	8 (16%)	42 (84%)	50	
Understand transition routes of pediculosis	Epidemiology	No	3 (6%)	40 (80%)	43 (86%)	< 0.001
		Yes	2 (4%)	5 (10%)	7 (14%)	
		Total	5 (10%)	45 (90%)	50	
Using personal accessory	Prevention	No	6 (12%)	38 (76%)	44 (88%)	< 0.001
		Yes	4 (8%)	2 (4%)	6 (12%)	
		Total	10 (20%)	40 (80%)	50	
Ironing yours and your child's clothes regularly	Prevention	No	6 (12%)	26 (52%)	32 (64%)	< 0.001
		Yes	4 (8%)	14 (28%)	18 (36%)	
		Total	10 (20%)	40 (80%)	50	
Understand treatment of pediculosis	Treatment	No	1 (2%)	26 (52%)	27 (54%)	< 0.001
		Yes	2 (4%)	21 (42%)	23 (46%)	
		Total	3 (6%)	47 (94%)	50	
Participate in educational programs at school about pediculosis prevention	Prevention	No	2 (4%)	45 (90%)	47 (94%)	< 0.001
		Yes	1 (2%)	2 (4%)	3 (6%)	

		Total	3 (6%)	47 (94%)	50	
Use the bath weekly	Prevention	No	3 (6%)	30 (60%)	33 (66%)	< 0.001
		Yes	2 (4%)	15 (30%)	17 (34%)	
		Total	5 (10%)	45 (90%)	50	
Use the common blanket and cloth	Prevention	No	3 (6%)	20 (40%)	23 (46%)	0.036
		Yes	8 (16%)	19 (38%)	27 (54%)	
		Total	11 (22%)	39 (78%)	50	

Discussion

Despite global improvements in the hygiene and sanitation of societies, pediculosis is reported from both developed and developing countries. This is considered as a growing neglected infestation in many regions of the world, especially developing countries. Pediculosis can be occurred in schools and other residual centers of rural and urban areas (5). The high prevalence (8.4%) of pediculosis in recent study is in line with the previous studies in Iran, which demonstrated prevalence from 1.6–67% in different provinces^{17,19,31}. No statistically significant difference between pediculosis and age, weight, height, and BMI of pupils. There were also no relationship between the variables in previous studies in Iran and other countries^{22,32}. However, this study showed that all pupils in schools are at risk of head lice infestation. On the other hands, it was shown that the number of individuals in the families is an effective factor on more infestation. This finding agree with the previous study in Iran with an association between mentioned variable³¹. In the line with other studies in Iran, despite more infestation in long hair pupils (62%), no statistical difference was indicated in the current study^{31,32}. Heavy and light pediculosis was demonstrated in all infested pupils in every age group. Although, the occupation and education level of parents have been showed no effect on the frequency of pediculosis²⁰. According to the study results, it seems any increasing in the education level of the family members, can lead to serious changes in the attitude, viewpoint and behavior of all family members about pediculosis. However, its reasons has been not explained exactly, and needs additional clarification on the specific reasons in various studies. High prevalence of pediculosis in Mashhad elementary schools could be a reflection of the family's lifestyle changes in recent years. This problem might be related to increasing use of music player devices and using tools such as earphones and headphones, which are usually shared between family's members. Moreover, other urban civilization phenomenon such as the subway, which has been more popular, can be effective as a crowded and closed place in the formation of uncontrolled outbreaks. Furthermore, the use of schools to welcome local rural pilgrims in recent years on various occasions has let to temporarily

accommodate large human populations in the metropolis of Mashhad. This event could be considered as a potential in creating an epidemic at the schools, particularly in winter that must be considered.

Interventions in the infested pupils and programming for the training of parents and pupils as well as teachers have critical role in the control of pediculosis in each society^{33,34}. Improvement of parent's awareness, knowledge, and perception about head lice, timely preventive health actions, and interruption of the parasite lifecycle could lead to decrease of this infestation in the present study. For example, before intervention in our study, more than 86% of parents have no knowledge about transmission routes of pediculosis. While, after the intervention, the ratio has changed significantly. Our findings are in line with studies of²⁸ and³⁵ that previously measured the level of parental learning in health education programs for pediculosis. Despite this significant decrease in the prevalence rate, the eradication was not achieved, which seems to be due to the short duration of intervention and control. Therefore, it is suggested to approve and implement some long-term 5-year plans for future projects. For example, Frankowski *et al.* could achieve a considerable success in this field, during a 6-year plan¹¹. Furthermore, from confounding factors in this study can be pointed to fungal diseases in such children age group that mimic as pediculosis. Therefore, it should be distinguished specifically from superficial fungal diseases such as trichomycosis, tinea capitis, white piedra, black piedra and dandruff caused by *Malassezia*²⁹. Interestingly in the current study we faced with several misdiagnosed cases how later rule out for pediculosis. Choosing the right treatment requires a prior accurate diagnosis (clinical and laboratory), because of the possibility of drug interactions and side effects. However, some physicians do empirical treatment regardless of patient referral to the laboratory for definitive diagnosis. In some cases, these infections may also be simultaneously³⁰. Hence, in such cases it requires the collaboration of an entomologist/parasitologist with other specialists such as a mycologist and dermatologist.

And finally, some of the important results that we achieved in this study include: first, creating a sense of responsibility in pupils to convey and share useful about prevention of infestation among their families, relatives and classmates. Second, the parent-teacher association (PTA) and its role to solve the school problems through scientific and research methods have been regarded. Third, use of the educational potentials using families, which led not to impose financial burden on families have been noticed, country health services, and school management. Forth, to reduce of anxiety around the stressful situation for the parents and teachers, those were in daily contact with the infested pupils.

One of the notable points in this regard, there have not been ever conducted such studies on female elementary school students in this area. So, the findings of this study could increase our knowledge from the epidemiological aspects of disease, and could change the authorities' attitude and focus from expensive case therapy toward cheap group training

There are some limitations in our study that deserve mention: the collected data was a self-report by mothers and students files, thus recall bias is warranted. Also, we performed the studied in one urban area of Iran, thus our findings may have limited generalizability to other regions and cultures.

Conclusion

This study provided the evidence-based effective interventions for reducing head lice infestation in the elementary schools. Current study showed a successful practical approach, step by step with emphasis on process-oriented teaching to reduce pediculosis infestation using contribution of teachers, students and families as the core target groups for interventions. We recommend to develop such prevention programs. However, further studies are required to understand the effectiveness of these interventions in the control of pediculosis in other regions, due to the different geographical, cultural and climatic alternations.

Abbreviations

KOH: potassium hydroxide; HBM: the health belief model; SD: standard deviation; BMI: *body mass index*

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran, according to the Ethics Committee code of IR.MUMS.fm.REC.1398.347. All participants provided with written informed consents. All research activities were carried out in accordance with relevant regulations of children guardian.

Consent for publication

Not applicable.

Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors have no conflicts of interest.

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Authors' contributions

MN contributed to the design, implementation, and writing of the manuscript. MAG, BRHF and JJ contributed to critically refining the article. EM and ME were involved in conducting the study. HZ (Correspondence) contributed to the data analyses. All authors read and approved the final manuscript.

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Figures



Figure 1

Laboratory identification of nit on the base of hair strand (KOH 10%), followed by direct microscopic examination (400x magnification)