

## Original Article

# Pediculosis and Factors Affecting Its Prevalence among Schoolchildren in Amol City, Northern Iran

Zohreh Gholami, \*Mohammad Saaid Dayer, Amrollah Azarm

Department of Parasitology and Medical Entomology, Faculty of Medical Sciences, Tarbiat Modares University, Tehran, Iran

\*Corresponding author: Dr Mohammad Saaid Dayer, E-mail: dayer@modares.ac.ir

(Received 14 Jan 2023; accepted 20 Feb 2024)

### Abstract

**Background:** Head louse infestation, pediculosis, is a serious health problem worldwide. Infected children usually suffer from itching, allergies, and secondary infections besides psychological disorders such as depression and lack of self-confidence leading to school failure. This study aimed to investigate the status of pediculosis and its determinant factors among schoolchildren in Amol City, Northern Iran.

**Methods:** This study included 228 schools frequented by about 20017 students. Pediculosis was determined by careful examination of students' hair on the scalp, back of the neck, and around the ears. The diagnosis was based on observation of live adults, nymphs, and nits. A questionnaire was used to record the personal and demographic characteristics of participants.

**Results:** This study revealed that the prevalence of pediculosis among schoolchildren during all schooling seasons (autumn, winter, and spring) correlated with sex: the prevalence being higher among girls than boys ( $p=0.00$ ). In addition, the highest rates of pediculosis occurred during the autumn season ( $p=0.00$ ). The public schools accommodated higher numbers of louse-infected students than the private ones ( $p=0.00$ ). While head louse occurred at higher frequencies in long hair over the schooling year, dandruff had anti-lice effects ( $p=0.00$ ) during cold seasons, autumn, and winter. Socioeconomic status and educational level of parents played determinant roles in head louse prevalence ( $p=0.00$ ). Schoolchildren coming from socioeconomically well-situated families had lower rates of head louse infestation.

**Conclusion:** Our results showed that head pediculosis was a serious health problem among schoolchildren in Amol city and its prevalence and severity tended to be multifactorial.

**Keywords:** Pediculosis; *Pediculus capitis*; Schoolchildren; Mazandaran; Iran

## Introduction

*Pediculus capitis* (Anoplura: Pediculidae) is an obligate ectoparasitic insect with incomplete metamorphosis that spends its developmental stages on the human scalp (1). The infestation of humans by lice is commonly called pediculosis (2). By feeding on human blood, the insect causes considerable health and socioeconomic burden worldwide, although its role as a disease vector has not been proven yet (3). Head louse can move from infected to uninfected person through direct or indirect contact such as using shared personal items including head coverings, combs, hairbrushes, etc. Hair

length, color, and type are among the most important factors affecting the rate of pediculosis (4). Common symptoms of pediculosis include bites, itching, allergies, and secondary infections such as dermatitis and jaundice. Pediculosis in children results in social ills such as insomnia, depression, lack of self-confidence, loss of social status, and even school failure. In many cases, infected people develop secondary infections associated with hair loss, allergies, and other complications due to frequent itching (5). Head louse is the most common type of human louse, especially infecting school

age groups of 11 to 13 years old at prevalence rates varying between 5 to 40% (6). As an illness, pediculosis comes second after the common cold among schoolchildren worldwide with infection rates ranging between 5% in Europe and 33% in South America (7, 8). In Iran, head louse infestation is a common health problem, although, the prevalence of pediculosis varies in different regions from 0.9 to 20.5% (9-12). Studies have shown that public centers such as barracks, dormitories, educational centers, and communities are the most infected locations in Iran (1). Schools are the main focus for spreading pediculosis among students and play key roles in its transmission among schoolchildren (2). In different parts of the world, several intervention strategies have been used to control head louse infestations (3). The strategies generally fall into two categories: physical control such as hair shaving, combing, washing, and ironing, and chemical control, such as the use of pesticides (3-5). Permethrin and Lindane are the two effective insecticides used against head louse in different parts of the world, especially in developing countries (6-8). This study aimed to investigate the pediculosis prevalence and the factors underlying its severity in primary schools of Amol City in Mazandaran Province.

## Materials and Methods

### Study area

Amol City is the center of Amol City in Mazandaran Province. Amol City is geographically located in the center of Mazandaran Province, at 36° 28 '11.2" north and 52° 21' 06.7" east. The city has a temperate and humid climate (Fig. 1).

### Demographic information and Head louse detection

The number of primary schools in Amol City is 228 accommodating more than 20017 students from both sexes. All students were examined for head louse infestation during this

epidemiological study. Demographic and epidemiological information of each student, including her/his name, surname, sex, hair size, hair type, monthly visits to hair salons, number of baths per week, number of family members, parents' occupation and education level and type of school as well as meeting with a health instructor in the school. A questionnaire was completed per participant by interviewing the student, her/his health instructor, or referring to health records. Examination of head louse infestation for each student was performed during three schooling seasons using standard methods. First, the student was exposed to light for 5 minutes. For louse detection, hair on the scalp, back of the neck, and around the ears was carefully examined. Students with specific symptoms of pediculosis and suspicious cases were also examined for head lice infestation with a hand-held lens or a comb. Pediculosis was considered positive based on observation of live adults, nymphs, and nits (13).

### Data analysis

In this study, the Chi-square test was performed using SPSS 21, and the correlation between the prevalence of head louse and determinant factors was calculated using Excel software 2013.

## Results

The number of primary schools in Amol County was 228 schools (81 urban and 147 rural). The total number of students frequenting the schools was 31031 individuals (20017 city dwellers and 11014 villagers). The number of girls and boys students in primary schools in Amol City was 10514 (52.53%) and 9503 (47.47%), respectively.

### Relationship between sex and pediculosis

The results showed the dependence of seasonal pediculosis on sex. The total average prevalence rate of pediculosis among school-

children for both sexes was 2.16% (Table 1). However, the prevalence of pediculosis among girls in autumn, winter, and spring were 4.7%, 2.5%, and 2.0% respectively ( $p= 0.00$ ), while the seasonal prevalence rates among boys were 1.9%, 1.2%, and 1.0% respectively ( $p= 0.00$ ). The results showed that during the three seasons, the rates of head louse infestation were always higher among girls than boys ( $p= 0.00$ ).

#### **Relationship between age and pediculosis**

The results demonstrated a meaningful relationship between students' age and seasonal pediculosis rates among schoolchildren aged between 7 to 12 years old ( $p= 0.00$ ). The results showed the prevalence rates among students in autumn were 0.07% (15), 0.14% (30), 0.19% (40), 0.39% (80), 0.74% (150) and 16.73% (335) for groups aged 7, 8, 9, 10, 11 and 12 years old respectively. In winter, however, the prevalence rates were 0.02% (5), 0.09% (19), 0.12% (25), 0.27% (55), 0.46% (93), and 0.82% (165) whereas in spring were 0.03% (8), 0.05% (12), 0.10% (22), 0.27% (55), 0.42% (85) and 0.53% (107) for the same ages respectively. During the three sampling seasons, the severity of infestation positively correlated with the age of students. The differences between age-specific severity of head louse infestation were statistically significant ( $P= 0.00$ ). However, the results showed that pediculosis rates decreased from autumn to spring at all ages (Fig. 2) (Table 1).

#### **Relationship between type of school and pediculosis**

Our data showed that head louse infestation was lower in public schools than in private schools. The highest infestation rates in both types of schools occurred in autumn. There were 2.7% and 5.7% infestations for public and private schools respectively. The number of infested cases decreased in winter and spring compared to autumn. The difference between the prevalence rates of head louse in public and private schools was statistically significant at  $P= 0.01$  (Table 1).

#### **Relationship between family size and pediculosis**

The results of this study indicated that larger families had higher rates of pediculosis than smaller families. The highest rates of prevalence were observed in autumn in families with 6 children (29.07%). During the same season, the average prevalence rates of pediculosis among students born to families with 2, 3, 4, 5, 6, and 7 children were 0.0%, 0.7%, 1.5%, 6.2%, 8.4%, and 4.2% respectively. The difference between prevalence rates of pediculosis in small families (2, 3, and 4 children) and large families (5, 6, and 7 children) was statistically significant at  $P= 0.000$  (Fig. 3) (Table 1).

#### **Relationship between Father's occupation and pediculosis**

The results showed that the highest infestation rates in both private and public schools during the sampling seasons were among parental orphan students. Among other students, the highest prevalence rates of pediculosis were among those whose fathers were jobless. The prevalence rates among these students in autumn, winter, and spring were 7.0%, 6.1%, and 2.7% respectively. In autumn, students whose fathers had freelance jobs came in second place with and prevalence rate equal to 2.9% (Table 1).

#### **Relationship between Father's education level and pediculosis**

The data analysis showed that the highest prevalence rates of seasonal head louse infestation in both private and public schools occurred among students whose fathers were illiterate ( $p= 0.00$ ). However, those students whose fathers have degrees higher than diplomas suffer less from pediculosis. In winter and spring, the severity of infestation was at the lowest levels except for paternal orphan students who were infested more during the winter season than in other seasons ( $p= 0.01$ ) (Table 1).

### **Relationship between Mother's occupation and pediculosis**

The results showed that the highest prevalence rate was observed in autumn at a rate of 9.5% among students whose mothers had freelance jobs ( $p= 0.00$ ). In winter, however, the highest prevalence rates were found amongst students whose mothers were homemakers ( $p= 0.01$ ). In addition, the lowest level of infestation was observed in winter among students whose mothers had administrative jobs (0.8%) ( $p= 0.02$ ) (Table 1).

### **Relationship between Mother's education level and pediculosis**

The statistical analysis indicated that the level of mothers' education is significantly effective in the prevalence rate of pediculosis ( $P= 0.00$ ). Except for paternal orphans, the highest prevalence rates of pediculosis in both private and public schools belonged to students whose mothers' education levels were diploma or less (4.86%). However, the lowest rates (1.26%) were observed for students whose mothers' education levels were higher than diplomas. The orphan students had the highest prevalence rates of pediculosis (Table 1).

### **Relationship between the number of combing per day and pediculosis**

Data analysis showed that in the studied seasons, the highest prevalence rates of infestation (5.7%) occurred in autumn among students who did not comb their hair daily. The results showed that combing at least once a day can significantly reduce the rate of infestation ( $p= 0.00$ ) (1.3%). Although the repetition of daily combing was expected to further reduce the louse infestation, a slight increase was observed with combing twice or twice per day (Table 1).

### **Relationship between the number of bathing per week and pediculosis**

The statistical analyses showed a significant

direct relationship between the prevalence of pediculosis and the weekly frequency of bathing ( $p= 0.01$ ) (Table 1). In autumn, the highest level of prevalence rates of pediculosis (7.0%) belonged to students who bathed once a week, while those who bathed twice a week had the lowest rates of infestation, particularly in winter.

### **Relationship between hair type, color, and style and pediculosis**

The statistical analysis showed no meaningful relationships ( $p= 0.01$ ) between hair type (straight or curly), hair color (light or dark), and hairstyle (arranged and unorganized) with head louse prevalence rates during the study seasons. However, hair length was effective in head louse infestation ( $p= 0.00$ ). The results showed that the average prevalence rates of pediculosis were 1.3% for short, 2.5% for long, and 3.5% for medium-sized hair (Table 1).

### **Relationship between dandruff and pediculosis**

The results showed that head louse infestation was lower in students involved with dandruff in comparison with those with no dandruff in the two cold seasons (autumn and winter). The average prevalence rates of head louse infestation in the two seasons were 1.2% and 3.5% for students with and without dandruff respectively. This difference was significant at the level of 1%. However, as the weather got warmer in the spring season, the infestation in students with dandruff and without dandruff was the same at 1.4% (Table 1).

### **Relationship between previous history of pediculosis and pediculosis**

Our results indicated that the average prevalence rate in the three seasons for students with a history of infection was 2.7%, while for those without a history of infection was 1.7% and statically was/was not significant ( $p= 0.00$ ) (Table 1).

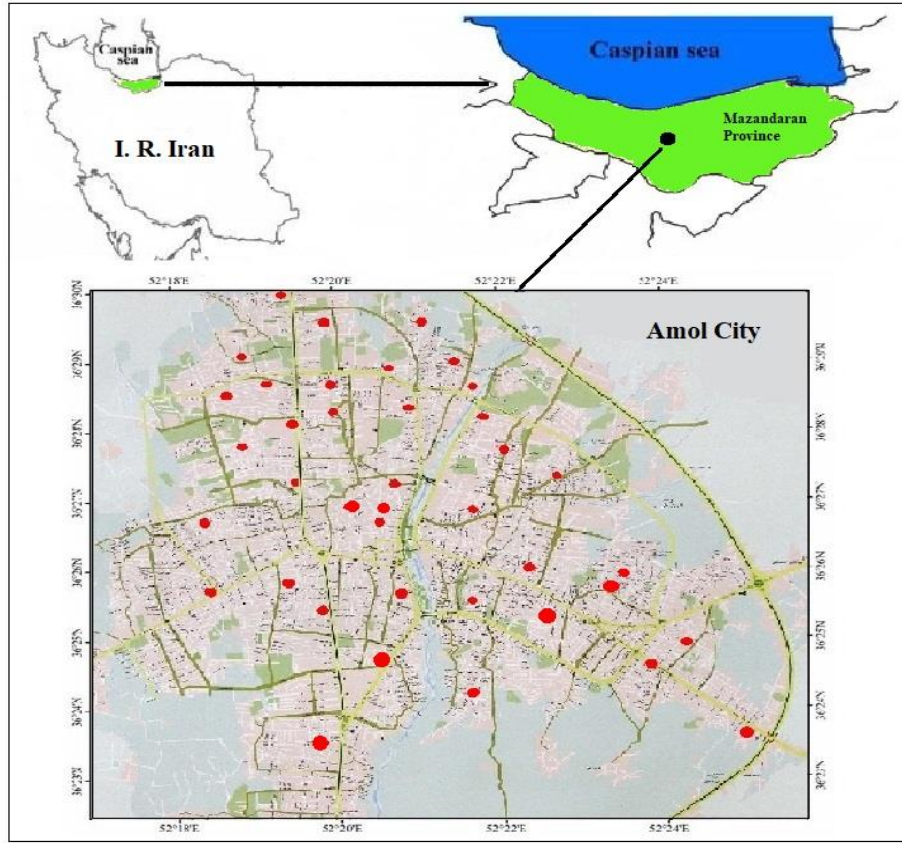
**Table 1.** Relationship between demographic characteristics (n= 20017) and pediculosis infestation in primary schools in Amol City, Mazandaran Province, in 2017

Variable	Subgroup	Season											pediculosis frequency	
		Autumn (650)					Winter (362)			Spring (289)			Total	% (T)
		N	%	P	%	%(T)	P	%	%(T)	P	%(289)	%(T)		
<b>Gender</b>	Boys	10514	52.5	200	30.8	0.99	126	34.80	0.62	102	35.29	0.5	428	2.13
	Girls	9503	47.5	450	69.2	2.2	236	65.2	1.2	187	64.7	0.9	873	4.18
<b>Age</b>	7	3735	18.6	15	2.3	0.0	5	1.3	0.0	8	2.7	0.0	28	0.1
	8	2980	14.8	30	4.6	0.1	19	5.2	0.0	12	4.1	0.0	61	0.3
	9	2240	11.1	40	6.1	0.1	25	6.9	0.1	22	7.6	0.1	87	0.4
	10	2740	13.6	80	12.3	0.3	55	15.1	0.2	55	19.0	0.2	190	0.9
	11	3337	16.6	150	23.0	0.7	93	25.6	0.4	85	29.4	0.4	328	1.6
	12	4985	24.9	335	51.5	16.7	165	45.5	0.8	107	37.0	0.5	607	3.0
<b>Type of School</b>	public	16487	82.3	450	69.2	2.24	267	73.7	1.3	220	76.1	1.0	937	4.6
	Private	3530	17.6	200	30.7	0.9	95	26.2	0.4	69	23.8	0.3	364	1.8
<b>Family size</b>	2 persons	50	0.2	0	0	0	1	0.2	0.0	1	0.3	0.0	2	0.0
	3 persons	1360	6.7	10	1.5	0.0	8	2.2	0.0	5	1.7	0.0	23	0.1
	4 persons	9777	48.8	142	21.8	0.70	45	12.4	0.2	40	13.8	0.1	227	1.1
	5 persons	2496	1.2	155	23.8	0.7	55	15.1	0.2	22	7.6	0.1	232	1.1
	6 persons	1836	9.1	154	23.6	0.7	100	27.6	0.4	85	29.4	0.4	339	1.6
	7 persons≥	4498	22.4	189	29.0	0.9	153	42.2	0.7	136	47.0	0.8	478	2.3
<b>Father's job</b>	Absent	61	0.3	21	32.3	0.1	18	4.9	0.0	19	6.5	0.0	58	0.2
	Unem- ployed	4108	20.5	288	44.3	1.4	250	69.0	1.2	112	38.7	0.5	650	3.2
	Freelance	8328	41.6	239	36.7	1.1	72	19.8	0.3	82	28.3	0.4	393	1.9
	Employed	7520	37.5	102	15.6	0.5	22	6.0	0.1	76	26.2	0.3	200	0.9
<b>Father's educa- tion level</b>	Absent	61	0.3	21	3.2	0.1	18	4.9	0.0	19	6.5	0.0	58	0.2
	Illiterate	4576	22.8	256	39.3	1.2	119	32.8	0.5	89	30.7	0.4	464	2.3
	Diploma<	7810	39.0	333	51.2	1.6	189	52.2	0.9	135	46.7	0.6	657	3.2
	Diploma≥	7570	37.8	40	6.1	0.1	36	9.9	0.1	46	15.9	0.2	122	0.6
<b>Mother's job</b>	Absent	40	0.1	8	1.2	0.0	16	4.4	0.0	12	4.1	0.0	36	0.1
	House- wives	11847	59.1	438	67.3	2.1	263	72.6	1.3	115	39.7	0.5	816	4.0
	Freelance	4615	23.0	103	15.8	0.5	54	14.9	0.2	79	27.3	0.3	236	1.1
	Employed	3515	17.5	101	15.5	0.5	29	8.0	0.1	83	28.7	0.4	213	1.0

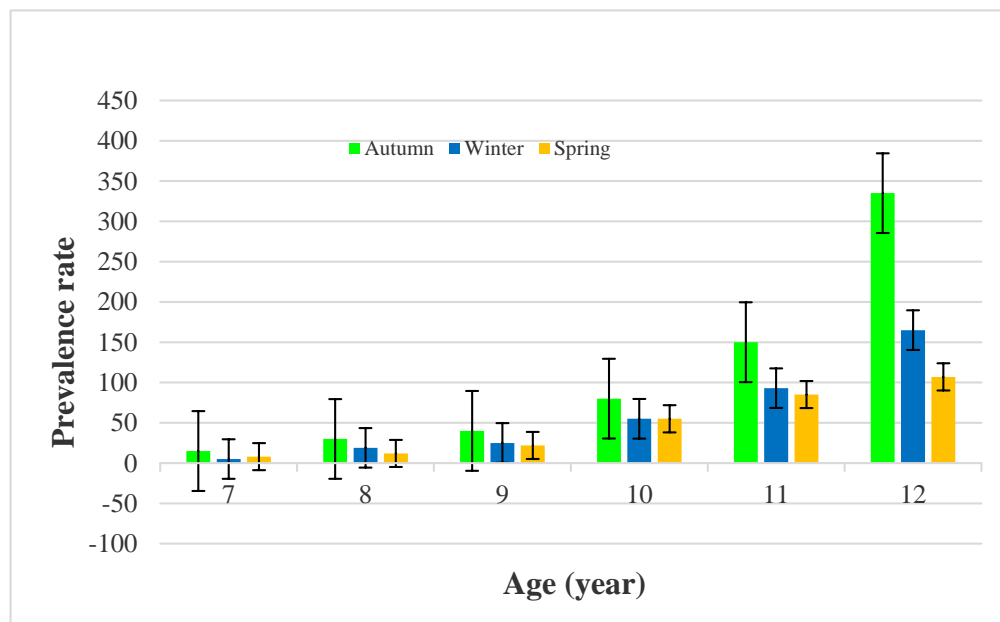
Table 1. Continued ...

<b>Mother's education level</b>	Absent	40	0.1	8	1.2	0.0	16	4.4	0.0	12	4.1	0.0	36	0.1
	Illiterate	10892	54.4	242	37.2	1.2	136	37.5	0.6	96	33.2	0.4	474	2.3
	Diploma<	4155	20.7	320	49.2	1.5	152	41.9	0.7	133	46.0	0.6	605	3.0
	Diploma≥	4930	24.6	80	1.2	0.3	58	16.0	0.2	48	16.6	0.2	186	0.9
<b>Combing per day</b>	Never	6962	34.7	395	60.7	1.9	226	62.4	1.1	162	56.0	0.8	783	3.1
	Once	5939	28.1	79	12.1	0.3	61	16.8	0.3	45	15.5	0.2	185	0.9
	Twice	3802	18.9	120	18.4	0.5	45	12.4	0.2	50	17.3	0.2	215	1.0
	Three≥	3314	16.5	56	8.6	0.2	30	8.2	0.1	32	11.0	0.1	118	0.5
<b>Bathing per week</b>	Once <	1514	7.5	33	5.0	0.1	55	15.1	0.2	9	3.1	0.0	97	0.4
	Once	4646	23.2	326	50.1	1.6	285	78.7	1.4	150	51.9	0.7	761	3.8
	twice	13875	69.3	291	44.7	1.4	22	6.0	0.1	130	44.9	0.6	443	2.2
<b>Hair type</b>	Straight	11632	58.1	356	54.7	1.7	250	69.0	1.2	201	69.5	1.0	807	4.0
	Curly	8385	41.8	294	45.2	1.4	112	30.9	0.5	88	30.4	0.4	494	4.7
<b>hair size</b>	Short	11647	58.1	297	45.6	1.4	58	16.0	0.2	101	34.9	0.5	456	2.2
	Medium	7134	35.6	319	49.0	1.5	276	76.2	1.3	156	53.9	0.7	751	3.7
	Tall	1236	6.1	34	5.2	0.1	28	7.7	0.1	32	11.0	0.1	94	0.4
<b>Hair color</b>	Black	13766	68.7	420	64.6	2.0	276	76.2	1.3	218	75.4	1.0	914	4.5
	Brown	4554	22.7	165	25.3	0.8	55	15.1	0.2	51	17.6	0.2	271	1.3
	Blonde	1697	8.4	65	10	0.3	31	8.5	0.1	20	6.9	0.0	116	0.5
<b>Previous infection</b>	yes	7310	36.5	288	44.3	1.4	192	53.0	0.9	186	64.3	0.9	666	3.3
	No	12707	63.4	362	55.6	1.8	170	46.9	0.8	103	35.6	0.5	635	3.1

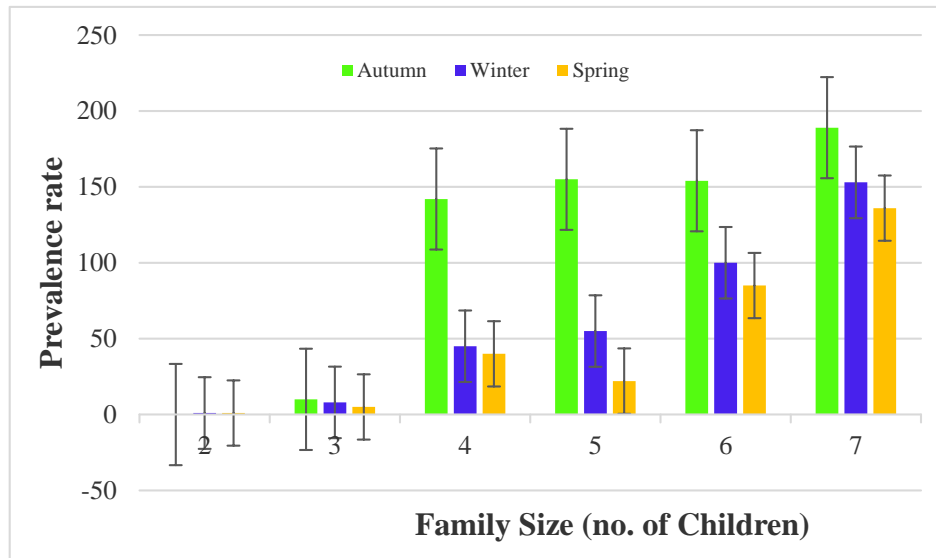
Guide: N; Number of Children's P; Infected with pediculosis T; Total number of students



**Fig. 1.** Location of primary schools (Red points) in Amol City (Black point), Mazandaran Province (Green area), North of Iran



**Fig. 2.** Relationship between students' age and seasonal pediculosis in primary schools, Amol City, in 2017. Bars indicate mean and SD



**Fig. 3.** Prevalence rate of pediculosis in different family sizes (no. of Children) and seasons in primary schools, Amol City in 2017. Bars indicate mean and SD

## Discussion

The prevalence of pediculosis has been reported to be growing worldwide since the mid-1960s reaching up to 80% in some countries (9). However, based on epidemiological studies, the average prevalence rate of pediculosis in schools in different countries was stated to be 16%. These rates were 15% in France, 28.3% in Turkey, 33.7% in Australia, and 37.2% in Korea (10-12, 14). In the present study, the average prevalence of pediculosis among primary schools in Amol City was estimated at 6.6%. In the study of Moosazadeh et al. prevalence of head louse among Iranian primary school children was assessed respectively as 1.6, 8.8, and 7.4% for boys, girls, and all the students (1). In the study by Motavalli-Haghi et al. (15) on pediculosis in Mazandaran Province, this rate was obtained to be 1.4%. Saghafipour et al. (16) reported the rate to be 13.28% in Qom, whereas Abadi et al. (17) found a 1.7% infestation rate in Yazd. A recent study at the national level on the prevalence *P. humanus capitis* among urban students in Iran showed an upward trend of pediculosis from 1.7% to 3.42% from 2014 to

2018 with a significantly higher prevalence in girls than boys ( $P < 0.05$ ) and in autumn (2.42 times higher) than spring (18). Based on our results, the prevalence of head louse infestation in schoolchildren correlated with sex, so the rate was higher in girls than in boys, during the schooling seasons (autumn, winter, and spring). Tashakori et al. (19) reported the same result. This may be attributed to behavioral and lifestyle differences between girls and boys as the formers tend to have closer contact and more hair mass. In addition, the girls use a head covering such as a scarf, which may serve as a vehicle to spread the infection among family members. However, Al Bashtawy et al. (20) believe that head covering by girls can reduce head-to-head contact and reduce head louse transmission. Contrary to the results of some researchers who have reported a decrease in infestation rates with older ages (21), this study found that the prevalence rates of louse infestation increase in older groups of schoolchildren. This was consistent with the results of the Al-Shawa study (22). This could be due to the dependence of younger students on their



mothers for washing and combing of hair. At older ages, however, personal health and bathing are left to the students themselves who may not yet have the capacity to perform proper personal hygiene. In this study, there was a significant relationship between father occupation and head louse infestation; so most students with head louse infestation had jobless fathers. According to Meister et al. (23), busy and low-income families are more prone to louse infestation. The results of this study showed a significant relationship between the prevalence rate of pediculosis and the level of education of the father. Our findings were consistent with previous studies (24, 25). In this study, most infested students had their mothers as freelancers. The highest rates of infestation were observed among students whose mothers hold diplomas or lower degrees, whereas the lowest rates of infestation belonged to those whose mothers hold diplomas or higher degrees. The illiterate mothers tend to be homemakers who care more for their children's hygiene. The results of this study, as in previous studies, showed that the higher level of parents' education was an effective factor in reducing louse infestation (1, 26). Data analysis showed that there is a significant relationship between the rates of head louse infestation and the family size. The highest rates of infestation were observed among larger families. The reason behind this can be increased contacts because of crowding and increased possibility of using common personal tools such as combs and head covering. As a result, the head louse infestation would occur rapidly between the family members (27). The prevalence of pediculosis as a common health problem has a direct relationship with the factors of sex and father's occupation and has an inverse relationship with the sample size (28). Our results showed that the prevalence of head louse among schoolchildren in Amol City was 16.2% in the educational season, which is lower than the average reported in many parts of the country or abroad, but more care and control measures should be taken to prevent possible epidemics.

## Conclusion

Head louse is one of the most important human ectoparasites and one of the most important health problems in human societies. The prevalence of pediculosis in the schoolchildren of Amol City was dependent on sex, season, age, type of school, parent occupation and education level, family size, bathing frequency per week, combing frequency per day, and hair length. In general, the average prevalence of pediculosis in Amol City was lower than in other parts of the country. However, to prevent aggravated situations, control measures, and regular monitoring should be undertaken by local authorities.

## Acknowledgements

This work was part of an MSc thesis carried out in the Department of Parasitology and Medical Entomology of Tarbiat Modares University (Code Number: 3957). The financial support of Tarbiat Modares University is therefore acknowledged. The authors would like to thank Dr Z Telmadarraiy for her advisory assistance and Mrs F Baghkhanian for her cooperation.

## Ethical considerations

The protocols conducted in this study followed the guidelines of the institutional ethical committee (Tarbiat Modares University). The protocols were approved by the TMU ethical committee under registry TMU-3957.

## Conflict of interest statement

The authors declare there is no conflict of interests.

## References

1. Moosazadeh M, Afshari M, Keianian H,

- Nezammahalleh A, Enayati AA (2015) Prevalence of head lice infestation and its associated factors among primary school students in Iran: a systematic review and meta-analysis. *Osong Public Health Res Perspect.* 6(6): 346–356.
2. Zahirnia A, Aminpoor M, Nasirian H (2021) The impact and trend of factors affecting the prevalence of head lice (*Pediculus capitis*) infestation in primary school students. *Chula Med J.* 65(4): 359–368.
  3. Ghofleh Maramazi H, Sharififard M, Jahani-fard E, Maraghi E, Mahmoodi Sourestani M, Saki Malehi A, Rasaei S (2019) *Pediculosis humanus capitis* prevalence as a health problem in girl's elementary schools, southwest of Iran (2017 – 2018). *J Res Health Sci.* 19(2): e00446.
  4. Bush SE, Rock AN, Jones SL, Malenke JR, Clayton DH (2011) Efficacy of the Louse-Buster, a new medical device for treating head lice (Anoplura: Pediculidae). *J Med Entomol.* 48(1): 67–72.
  5. Bekri G, Shaghaghi A (2022) Prevalence of *Pediculus humanus capitis* and associated risk factors among elementary school-aged girls in Paveh, West Iran. *J Infect Dev Ctries.* 16(9): 1506–1511.
  6. Kassiri H, Fahdani AE, Cheraghian B (2021) Comparative efficacy of permethrin 1%, lindane 1%, and dimeticone 4% for the treatment of head louse infestation in Iran. *Environ Sci Pollut Res Int.* 28(3): 3506–3514.
  7. Canyon DV, Speare R (2007) A comparison of botanical and synthetic substances commonly used to prevent head lice (*Pediculus humanus* var. *capitis*) infestation. *Int J Dermatol.* 46(4): 422–426.
  8. Mac-Mary S, Messikh R, Jeudy A, Lihoreau T, Sainthillier JM, Gabard B, Schneider C, Auderset P, Humbert P (2012) Assessment of the efficacy and safety of a new treatment for head lice. *ISRN Dermatol.* 2012: 460467.
  9. Martínez de Murguía Fernández L, Puig Algora G, Bajona Roig M, Bacchini G (2021) Effectiveness and tolerability of a squalane and dimethicone-based treatment for head lice. *Parasitol Res.* 120(5): 1883–1890.
  10. Candy K, Nicolas P, Andriantsoanirina V, Izri A, Durand R (2018) In vitro efficacy of five essential oils against *Pediculus humanus capitis*. *Parasitol Res.* 117(2): 603–609.
  11. Oh JM, Lee IY, Lee WJ, Seo M, Park SA, Lee SH, Seo JH, Yong TS, Park SJ, Shin MH, Pai KS, Yu JR, Sim S (2010) Prevalence of *Pediculosis capitis* among Korean children. *Parasitol Res.* 107(6): 1415–1419.
  12. Feldmeier H (2012) *Pediculosis capitis*: new insights into epidemiology, diagnosis and treatment. *Eur J Clin Microbiol Infect Dis.* 31(9): 2105–2110.
  13. Boukan A, Mohebi L, Rashti R, Boukan A, Oshaghi MA (2021) *Pediculosis capitis*; the importance of accurate differentiation of nits and hair casts. *Int J Trop Insect Sci.* 1: 647–650.
  14. Özkan Ö, Hamzaoglu O, Yavuz M (2015) The prevalence and management of *Pediculosis capitis* in Turkey: a systematic review. *Turkiye Parazitoloj Derg.* 39(2): 135–146.
  15. Motevalli-Haghi SF, Rafinejad J, Hosseini M, Yazdani-Charati J, Parsi B (2014) Prevalence pediculosis and associated risk factors in primary-school children of Mazandaran Province, Iran, 2012–2013. *Journal of Mazandaran University of Medical Sciences.* 23(110): 82–91.
  16. Saghafipour A, Zahraei-Ramazani A, Vatan-doust H, Mozaffari E, Rezaei F, KaramiJooshin M (2018) Prevalence and risk factors associated with head louse (*Pediculus humanus capitis*) among primary school girls in Qom Province, Central Iran. *Int J Pediatr.* 6(4): 7553–7562.
  17. Abadi MS, Moghadasi Amiri M, Falah Mehrjordi S, Aghaei A, Zarehshahi F, Alizadeh S (2018) *Pediculosis capitis* and its relat-

- ed factors among girl primary school students of Meybod, Yazd Province, in 2015–2016. *J Health*. 8(5): 552–560.
18. Ziaoddini A, Riahi R, Heidari-Beni M, Ziaoddini H, Zamani S (2019) National and provincial prevalence of *Pediculus humanus capitis* among urban students in Iran from 2014–2018. *J Res Health Sci*. 19(4): e00459.
  19. Tashakori G, Dayer MS, Mashayekhi-Goyonlo V (2018) Comparative efficacy of three control protocols of head lice (*Pediculus humanus capitis*) infesting school-children in Mashhad City, Iran. *Int J Pediatr*. 6(6): 7803–7814.
  20. Al Bashtawy M, Hasna F (2012) *Pediculus capitis* among primary-school children in Mafraq Governorate, Jordan. *East Mediterr Health J*. 18(1): 43–48.
  21. Zayyid MM, Saadah RS, Adil A, Rohela M, Jamaiah I (2010) Prevalence of scabies and head lice among children in a welfare home in Pulau Pinang, Malaysia. *Trop Biomed*. 27(3): 442–446.
  22. Al-Shawa RM (2015) *Pediculus capitis*, infestation according to sex and social factors in Gaza Governorate. *IUG J Nat Stud*. 16(1): 17–21.
  23. Meister L, Ochsendorf F (2016) Head lice: epidemiology, biology, diagnosis, and treatment. *Dtsch Arztebl Int*. 113(45): 763–772.
  24. Jahnke C, Bauer E, Feldmeier H (2008) *Pediculosis capita* in childhood: epidemiological and socio-medical results from screening of school beginners. *Gesundheitswesen*. 70(11): 667–673.
  25. Nunes SC, Moroni RB, Mendes J, Justiniano SC, Moroni FT (2015) Head lice in hair samples from youths, adults and the elderly in manaus, amazonas state, brazil. *Rev Inst Med Trop Sao Paulo*. 57(3): 239–244.
  26. Moshki M, Zamani-Alavijeh F, Mojadam M (2019) Correction: efficacy of peer education for adopting preventive behaviors against head lice infestation in female elementary school students: a randomised controlled trial. *PloS One*. 14(2): e0212625.
  27. Kassiri H, Kasiri A, Kasiri N, Moeininejad F (2015) Epidemiology and morbidity of head Lice infestation in Khorram-shahr County, Iran (2006–2009). *J Health Sci Surveillance Sys*. 3(2): 83–87.
  28. Akbari M, Sheikhi S, Rafinejad J, Akbari MR, Pakzad I, Abdi F, Pakzad R, Aivazi AA (2022) Prevalence of pediculosis among primary school-aged students in Iran: an updated comprehensive systematic review and meta-analysis. *J Med Entomol*. 59(6): 1861–1879.