



# Head lice prevalence and associated factors in primary schools in Karun County, Khuzestan Province, Iran

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## General Note



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## ABSTRACT

Head lice infection is one of the most common diseases of all ages and has a global spread. The disease is more common in areas with high population density and lack of public health. Population growth and poor health are factors that exacerbate this infestation. It is transmitted through two main mechanisms; direct contact from one host to another, or through objects, of course,

the main way of transmission is through head-to-head contact. Studies of children around the world show that the prevalence of head lice infection is less than 10%, sometimes as high as 40% or more. According to the World Health Organization, Iran is one of the most infested regions in the world. Due to the fact that the prevalence of pediculosis capitals in primary schools in the county of Karun (southwestern Iran) has not been studied so far and due to the health importance of this disease, the need for this study was felt. For this purpose, a study was conducted to determine the rate of head lice infection in primary school pupils in this county and the factors influencing it in 2017. In this descriptive-analytical study, 751 male and female pupils were examined. Pupils were selected by a stratified cluster random sampling. Using the questionnaire, information about pupils' personal and family characteristics and other related information were completed. The hair on the head, back of the neck, and around the students' ears was examined to find out nits or live lice. Analysis was done by Chi-square I tests using SPSS software, version 18. A P- value of less than 0.05 was considered to be significant. At the time of the study, 217 pupils (28.9%) were infested with head lice. The prevalence of infestation in girls (37.6%) was significantly higher than in boys (20.3%). The rate of nit infestation was 61.3%, and in 38.7% of cases both live lice and nits were found. In this study, 37.2% of pupils reported itching in the head and statistically, there was a significant relationship between Pediculosis capitis and itching in the head. Furthermore, this significant relationship was observed between head lice infestation and each of these factors: gender, pupil grade in all schools, grade in all-girls schools, father's educational level and occupation, family size, connection to piped water, presence of a hygienic bathroom at home, number of showers per week, co-sleeping, awareness of head lice infestation, presence of a health educator at school, infestation in the family, previous history of infestation, access to healthcare services, appearance of pupils with respect to hygiene, use of a shared comb, frequency of combing per day, use of a shared towel or of a shared scarf, type, length, density and color of hair, dandruff and head itching. The relatively high prevalence of head lice among students in Karun County requires inter-population cooperation between the Department of Education and health service centers. It seems necessary to teach health education to students in various fields of health, especially personal hygiene in order to physically fight the spread of this infestation.

**Keywords:** Head Lice, Primary schools, prevalence, epidemiology, risk factors, Iran

## 1. INTRODUCTION

Public health and hygiene are so important that no community can progress without them. Infestation with ectoparasites remains a health issue despite improvements in health quality and progress in medical sciences. Based on the reports by medical organizations, lice infestation has not been sufficiently controlled in different countries despite large sums of money that have been spent for this purpose (Rafie et al., 2009). Lice are wingless arthropods that infest head, body and pubic hairs and feed on human blood. They have white, oval-shaped eggs (nits). A head louse (*Pediculus capitis*) glues its nits to hair shafts about 1-1.5 mm above the scalp. The nits hatch after 10 days (Habif, 2006). Head lice infestation is highly contagious, specifically by close physical contact. It is also transmitted by sharing clothing, hats, combs, brushes, scarves, chairs and cell phones. Head lice are more common among children, specifically girls. Infestation is typically diagnosed in schools by school teachers or health educators. This infestation can be asymptomatic or cause itching in the area behind the ears or the back of the neck. Secondary fungal and bacterial infections caused by scratching the scalp can induce impetigo and adenopathy. Depression, psychological irritations, academic failure, insomnia, and loss of social status are its other side effects (Zabihi et al., 2005).

Although body lice infestations are less common in recent years owing to improved standards of living, especially in wealthy communities, head lice are reported almost worldwide. Despite the global spread of head lice, these infestations are often found in temperate regions and are as troublesome as mosquitoes are in tropical regions (Mimouni et al., 2002). Hundreds of millions of head lice infestation cases have been reported globally in recent decades, and the infestation has become very prevalent. Head lice infestations affect more than 12 million Americans annually. In Belgium, they affect 8.9% of children aged 2-12 years (Willems et al., 2005; Akisu et al., 2005; Rupes et al., 2006). Their reported prevalence among children is 16.6% in Izmir, Turkey (Farzinnia et al., 2003) and doubled in the Czech Republic and Slovakia in 2005. The prevalence of live head lice among individuals aged 6-15 years was 14.1% in this country (Rupes et al., 2006). There are also reports of head lice infestations in different parts of Iran. In the all-girls boarding schools of Ardabil Province (northwestern Iran), 28.5% of the pupils had head lice (Adalatkhah et al., 2003). A study showed that 12.27% of the pupils in Bandar Abbas City (southern Iran) had head lice (Soleimani Zadeh & Sharifi Sarasiabi, 2002). In Sanandaj (western Iran), 19.7% of the primary school pupils suffered from head lice infestations (Davari & Yaghmaei, 2005).

This study investigated prevalence of head lice infestation and its associated factors among the primary school pupils of Karun County (southwestern Iran) in 2017 and finally have been proposed to the health authorities' appropriate programs and strategies for controlling this dilemma.

## 2. SUBJECTS AND METHODS

This research is a primary school-based cross-sectional-descriptive study and the study population was all primary school pupils in Karun County. Sample size determination and sampling technique The sample size was determined by using a single population proportion formula with assumptions;  $p=2\%$ , 95% confidence level ( $Z_{\alpha/2}$ ) and margin of error ( $d$ )=0.01

$$n = \frac{(z_{\alpha/2})^2 p(1-p)}{d^2} = \frac{(1.96)^2 0.02(1-0.02)}{0.01^2} = 751$$

Totally 751 pupils in the first to sixth grades in males' and females' primary schools were selected via multistage, systematic, cluster, random sampling in the rural and urban regions of Karun county, Khuzestan Province. The data was collected by interview and observation for head lice infestations. Each person was interviewed individually. In this study, all selected pupils in terms of head lice infestation (nit, nymph and adult) were examined by trained and experienced people under the supervision of researchers. By directly observing the head and neck of the pupils and the presence of lice and their eggs on the hair of the head, it is considered as infestation of the individual. Mainly because head lice escape from light and heat, they lay eggs mostly behind the ears and behind the neck of patients. A hand-held magnifying glass was used to further diagnose infestation.

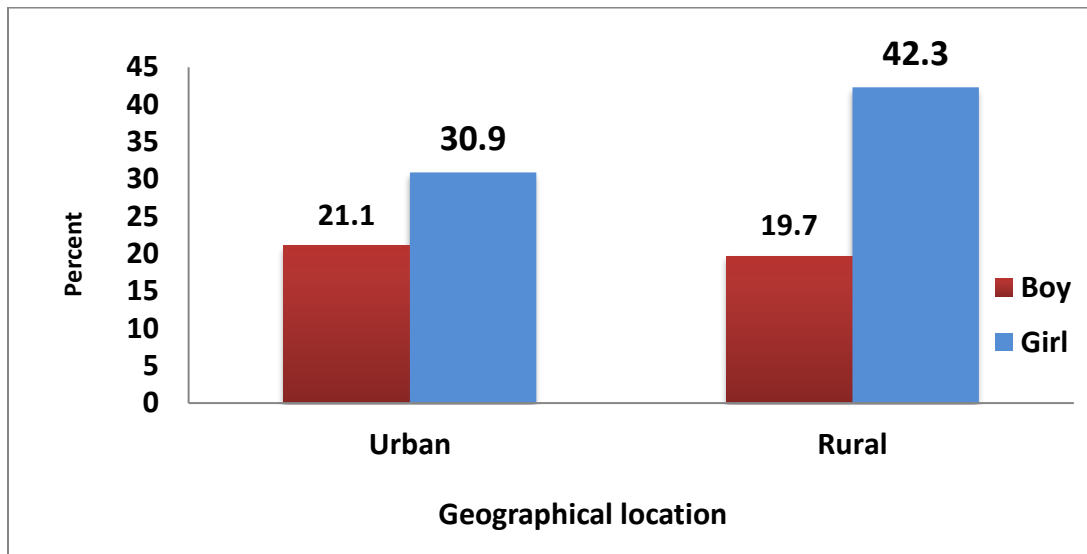
The questionnaire was filled out by face to face interview. The questionnaire recorded the following information: school grade, gender, geographical location, school Type, number of family members, parents' jobs, parents' literacy, length of hair, type of hair, number of comb uses per day, use a common comb, use a shared towel, use a shared scarf, the sharing of personal items, sleeping in shared bedroom, knowledge of head lice, hair density, hair color, past lice infestations, infestation in the family, access to health services, presence of one of the life stages of lice, infestation severity, frequency of hair washing per week, bathroom at home, access to tap water, presence or absence of dandruff, having itching on the head, and presence of a school health educator. For the data analysis, a Chi-square test (SPSS software, version 18) was used, and a P value of less than 0.05 was considered to be significant.

### Ethics Statement

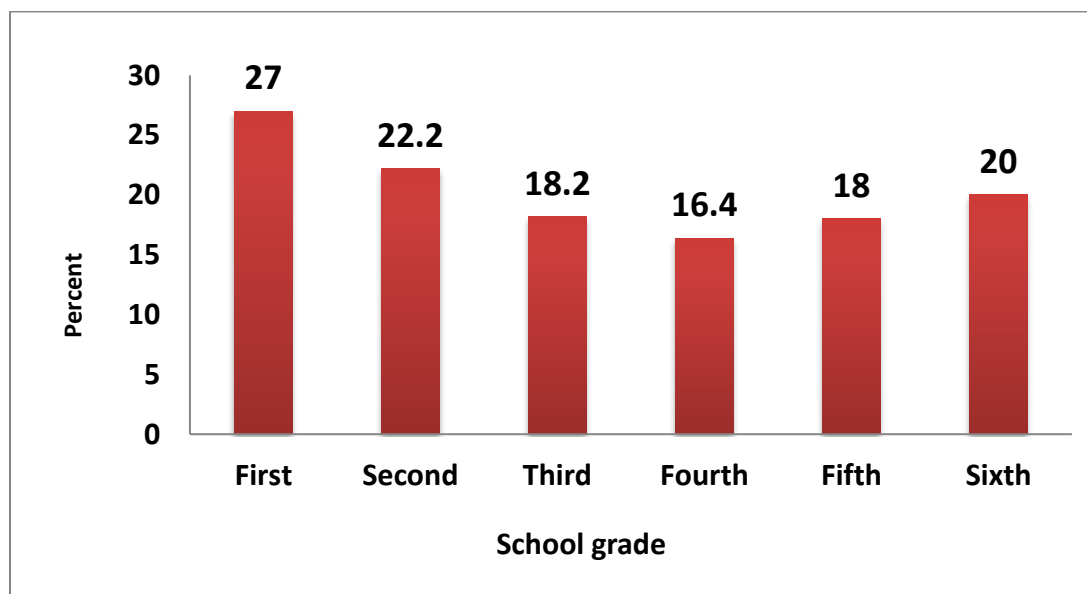
The study was approved by the Committee of Ethics in Research, Ahvaz Jundishapur University of Medical Sciences and registered as IR.AJUMS.REC.1394.435. This project was done in accordance with the ethical principles and the national norms and standard for conducting medical research in Iran. No photographs or names of cases are found in the paper. The confidentiality of the records of patients was assured. Participation was fully voluntary and written- signed informed consent (after getting the data and after a verbal description of the objectives and the method of the research) was got from all the parents of eligible children under study. Confidentiality of the data had been retained at whole levels of the research. The aim of the research was described to the study cases, to school officials and parents of the primary school pupils and assent was gotten from them. Health education was given for school officials, teachers and pupils after information collection is finished.

## 3. RESULTS

In this study, 751 primary school pupils were screened and 217 of whom (28.9%) were infested with head lice. The prevalence of head lice infestation was 20.3% among the boys and 37.6% among the girls. The prevalence rates of head lice infestation in rural and urban pupils were 31.1% and 25.9%, respectively. Abundant distribution of head lice infestation in female and male primary school students has been shown separately in urban and rural areas in figure 1. In boys' schools, the percentages of infested cases with head lice in the first to sixth grades have been shown in figure 2. The percentages among the first to sixth grades all-girls schools have been shown in figure 3. The between-grade differences in prevalence in all-boys schools were not statistically significant ( $p < 0.725$ ,  $df = 5$ ,  $X^2 = 2.838$ ) whereas they were significant in all-girls schools ( $p < 0.001$ ,  $df = 5$ ,  $X^2 = 24.249$ ). Rates of head lice infestation were higher among students whose mothers had not finished high school (31.6%) or were illiterate (29.7%). Similarly, the highest rates of infestation were observed in pupils whose fathers not finished high school (35.3%) or were illiterate (29.8%).



**Figure 1** Abundant distribution of head lice infestation in female and male primary school students in urban and rural areas of Karun County, southwestern Iran.



**Figure 2** Frequent distribution of head lice infestation according to different educational grades in boy's primary schools in Karun County, southwestern Iran.

Parents' occupations were another of the studied variables. The results showed that the highest rates of infestation were observed among students whose mothers were freelancers (33.3%) or whose fathers were unemployed (36.4%). Moreover, the highest rates of infestation were observed in families with six members (40.6%) and with eight or more members (38%). Approximately 61.3% of the patients were hosts only to nits and 38.7% of them had both nits and live lice. In total, 17.5% of the cases exhibited severe infestation. Table 1 shows the prevalence of head lice infestation by such variables as geographic area, gender, type of school, school grade, parents' educational levels and occupations and family size. Table 2 shows the prevalence of head lice infestation by personal hygiene-related variables such as house connection to piped water, hygienic bathroom at home, number of showers per week, use shared sleeping items, sleeping in a shared bedroom, access to healthcare services, observance of personal hygiene of pupils, use of a shared comb, frequency of daily combing, use of a shared towel or scarf, pupils' awareness of head lice infestation and presence of a health educator at school. Table 2 also shows the infestation rates by color, length, density and type of hair as well as presence of dandruff and itchy scalp.

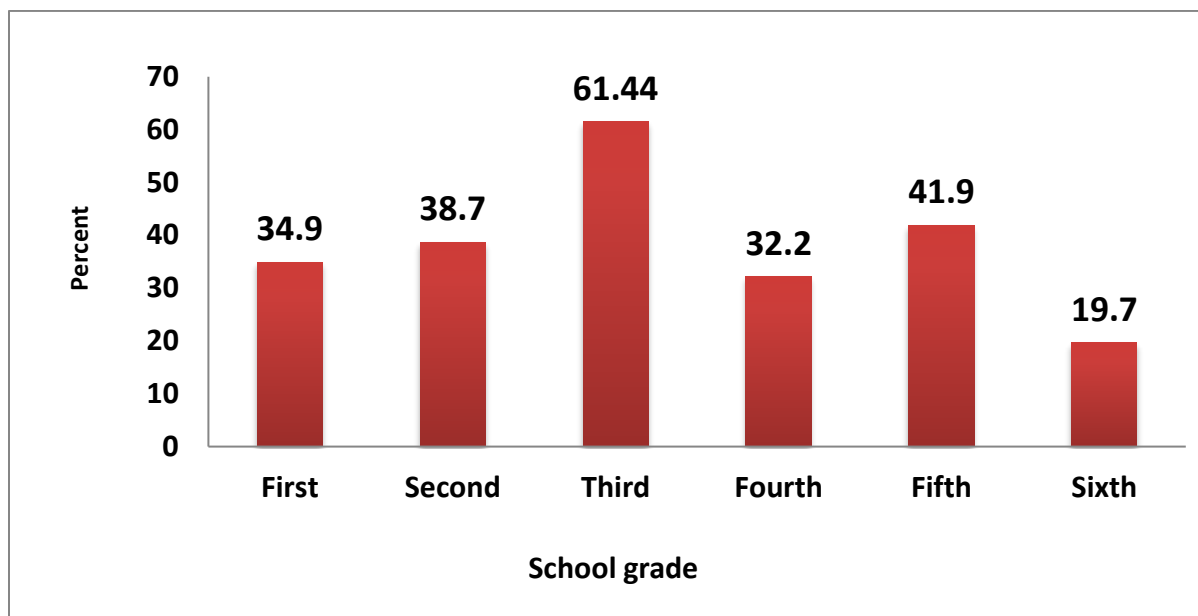
**Table 1** Prevalence of head lice infestation in relation to the sociodemographic status of the primary school pupils, such as geographical location, school type, mother's literacy, father's literacy, mother's job, father's job, family size, gender, and school grade in Karun County, southwestern Iran.

| Variables             |             |                         | Infestation<br>No (%) | Non-Infestation<br>No (%) | Total<br>No (%) | P Value |
|-----------------------|-------------|-------------------------|-----------------------|---------------------------|-----------------|---------|
| Geographical location |             | Urban Areas             | 81 (25.9)             | 232 (74.1)                | 313 (41.7)      | < 0.123 |
|                       |             | Rural Areas             | 136 (31.1)            | 302 (68.9)                | 438 (58.3)      |         |
| Gender                | Urban Areas | Female                  | 47 (30.9)             | 105 (69.1)                | 152 (48.6)      | < 0.048 |
|                       |             | Male                    | 34 (21.1)             | 127 (78.9)                | 161 (51.4)      |         |
|                       | Rural Areas | Female                  | 93 (42.3)             | 127 (57.7)                | 220 (50.2)      | < 0.001 |
|                       |             | Male                    | 43 (19.7)             | 175 (80.3)                | 218 (49.8)      |         |
|                       | County      | Female                  | 140 (37.6)            | 232 (62.4)                | 372 (49.5)      | < 0.001 |
|                       |             | Male                    | 77 (20.3)             | 302 (79.7)                | 379 (50.5)      |         |
| School Type           |             | Governmental<br>Schools | 194 (28.8)            | 479 (71.2)                | 673 (89.6)      | < 0.903 |
|                       |             | Private Schools         | 23(29.5)              | 55(70.5)                  | 78 (10.4)       |         |
|                       |             |                         |                       |                           |                 |         |
| School Grade          |             | First                   | 39 (31.0)             | 87 (69.0)                 | 126 (16.8)      | < 0.033 |
|                       |             | Second                  | 38(30.4)              | 87(69.6)                  | 125 (16.6)      |         |
|                       |             | Third                   | 47 (38.2)             | 76 (61.8)                 | 123 (16.4)      |         |
|                       |             | Fourth                  | 30 (24.4)             | 93 (75.6)                 | 123 (16.4)      |         |
|                       |             | Fifth                   | 37 (30.1)             | 86 (69.9)                 | 123 (16.4)      |         |
|                       |             | Sixth                   | 26 (19.8)             | 105 (80.2)                | 131 (17.4)      |         |
| Mother's Literacy     |             | Illiterate              | 55 (29.7)             | 130 (70.3)                | 185 (24.6)      | < 0.149 |
|                       |             | High School             | 121 (31.6)            | 262 (68.4)                | 383 (51.0)      |         |
|                       |             | Diploma                 | 36 (25.5)             | 105 (74.5)                | 141 (18.8)      |         |
|                       |             | Academic                | 3 (8.6)               | 32 (91.4)                 | 35 (4.7)        |         |
|                       |             | Literacy                | 2 (28.6)              | 5 (71.4)                  | 7 (0.9)         |         |
|                       |             | Unknown                 |                       |                           |                 |         |
| Father's Literacy     |             | Illiterate              | 39 (29.8)             | 92 (70.2)                 | 131 (17.4)      | < 0.005 |
|                       |             | High School             | 118 (35.3)            | 216 (64.7)                | 334 (44.5)      |         |
|                       |             | Diploma                 | 41 (22.0)             | 145 (78.0)                | 186 (24.8)      |         |
|                       |             | Academic                | 18 (20.5)             | 70 (79.5)                 | 88 (12.3)       |         |
|                       |             | Literacy                | 1 (8.3)               | 11 (91.7)                 | 12 (1.6)        |         |
|                       |             | Unknown                 |                       |                           |                 |         |
| Mother's Job          |             | Self-Employment         | 9 (33.3)              | 18 (66.7)                 | 27 (3.6)        | < 0.181 |
|                       |             | Housewife               | 206 (29.2)            | 499 (70.8)                | 705 (93.9)      |         |
|                       |             | Government's            | 2 (10.5)              | 17 (89.5)                 | 19 (2.5)        |         |
|                       |             | Employee                |                       |                           |                 |         |
| Father's Job          |             | Self-Employment         | 86 (25.5)             | 251 (74.5)                | 337 (44.9)      | < 0.048 |
|                       |             | Government's            | 24 (22.0)             | 85 (78.0)                 | 109 (14.5)      |         |
|                       |             | Employee Labor          | 34 (38.6)             | 54 (61.4)                 | 88 (11.7)       |         |
|                       |             | Unemployed              | 20 (36.4)             | 35 (63.6)                 | 55 (7.3)        |         |
|                       |             | Rancher                 | 13 (31.0)             | 29 (69.0)                 | 42 (5.6)        |         |
|                       |             | Farmer                  | 40 (33.3)             | 80 (66.7)                 | 120 (16.0)      |         |
| Family Size           |             | 3                       | 26 (32.5)             | 54 (67.5)                 | 80 (10.7)       | < 0.024 |
|                       |             | 4                       | 67 (26.1)             | 190 (73.9)                | 257 (34.2)      |         |
|                       |             | 5                       | 54 (24.3)             | 168 (75.7)                | 222 (29.6)      |         |
|                       |             | 6                       | 41 (40.6)             | 60 (59.4)                 | 101 (13.4)      |         |
|                       |             | 7                       | 10 (24.4)             | 31 (75.6)                 | 41 (5.5)        |         |
|                       |             | 8≥                      | 19 (38.0)             | 31 (62.0)                 | 50 (6.7)        |         |

**Table 2** Prevalence of head lice infestation in primary school pupils with relation to personal hygiene in Karun County, southwestern Iran.

| Variables                       |               | Infestation No (%) | Non-Infestation No (%) | Total No (%) | P Value |
|---------------------------------|---------------|--------------------|------------------------|--------------|---------|
| Access to Tap Water             | Yes           | 176 (26.3)         | 492 (73.7)             | 668 (88.9)   | < 0.001 |
|                                 | No            | 41 (49.4)          | 42 (50.6)              | 83 (11.1)    |         |
| Having Sanitary Bath at Home    | Yes           | 170 (25.8)         | 448 (74.2)             | 658 (87.6)   | < 0.001 |
|                                 | No            | 47 (50.5)          | 46 (49.5)              | 93(12.4)     |         |
| Number of Baths per Week        | 1             | 65(34.2)           | 125(65.8)              | 190(25.3)    | < 0.001 |
|                                 | ≥2            | 152(27.1)          | 409(72.9)              | 561(74.7)    |         |
| Sleeping in Shared Bedroom      | Yes           | 179 (30.0)         | 417 (70.0)             | 596 (79.4)   | < 0.177 |
|                                 | No            | 38 (24.5)          | 117 (75.5)             | 155 (20.6)   |         |
| Use Common Bedding Items        | Yes           | 121 (43.4)         | 158 (56.6)             | 279 (37.2)   | < 0.001 |
|                                 | No            | 96 (20.3)          | 376 (79.7)             | 472 (62.8)   |         |
| Personal Knowledge of Head Lice | Yes           | 60 (20.8)          | 229 (79.2)             | 289 (38.5)   | < 0.001 |
|                                 | No            | 157 (34.0)         | 305 (66.0)             | 462 (61.5)   |         |
| Having Health Trainer           | Yes           | 30 (19.4)          | 125 (80.6)             | 155 (20.6)   | < 0.003 |
|                                 | No            | 187 (31.4)         | 409 (68.6)             | 596 (79.4)   |         |
| Infestation in the Family       | Yes           | 78 (60.5)          | 51 (39.5)              | 129 (17.2)   | < 0.001 |
|                                 | No            | 139 (22.3)         | 483 (77.7)             | 622 (82.8)   |         |
| Previous Infestation History    | Yes           | 120 (47.1)         | 135 (52.9)             | 255 (34.0)   | < 0.001 |
|                                 | No            | 97 (19.6)          | 399 (80.4)             | 496 (66.0)   |         |
| Access to Health Services       | Yes           | 195 (27.5)         | 515 (72.5)             | 710 (94.5)   | < 0.001 |
|                                 | No            | 22 (53.7)          | 19 (46.3)              | 41 (5.5)     |         |
| Appearance in Terms of Health   | Yes           | 107 (20.3)         | 419 (79.7)             | 526 (70.0)   | < 0.001 |
|                                 | No            | 110 (48.9)         | 115 (51.1)             | 225 (30.0)   |         |
| Use a Common Comb               | Yes           | 131 (51.8)         | 122 (48.2)             | 253 (33.7)   | < 0.001 |
|                                 | No            | 86 (17.3)          | 412 (82.7)             | 498 (66.3)   |         |
| Number of Combs per Day         | NO            | 54 (60.0)          | 36 (40)                | 90 (12.0)    | < 0.001 |
|                                 | 1             | 109 (27.9)         | 282 (72.1)             | 391 (52.1)   |         |
|                                 | 2             | 40 (23.7)          | 129 (76.3)             | 169 (22.5)   |         |
|                                 | ≥3            | 14 (13.9)          | 87 (86.1)              | 101 (13.4)   |         |
| Use a Shared Towel              | Yes           | 135 (50.2)         | 134 (49.8)             | 269 (35.8)   | < 0.001 |
|                                 | No            | 82 (17.0)          | 400 (83.0)             | 482 (64.2)   |         |
| Use a Shared Scarf              | Yes           | 101 (65.2)         | 54 (34.8)              | 155 (20.6)   | < 0.001 |
|                                 | No            | 116 (19.5)         | 480 (80.5)             | 596 (79.4)   |         |
| Hair Type                       | Smooth        | 174 (27.3)         | 463 (72.7)             | 637 (84.8)   | < 0.024 |
|                                 | Curly         | 43 (37.7)          | 71 (62.3)              | 114 (15.2)   |         |
| Hair length                     | Long          | 129 (42)           | 187 (58)               | 307 (40.9)   | < 0.001 |
|                                 | Short         | 88 (19.8)          | 356 (80.2)             | 444 (59.1)   |         |
| Hair Density                    | High          | 149 (32.2)         | 314 (67.8)             | 463 (61.7)   | < 0.012 |
|                                 | Low           | 68 (23.6)          | 220 (76.4)             | 288 (38.3)   |         |
| Hair Color                      | Black         | 147 (33.0)         | 299 (67.0)             | 446 (59.4)   | < 0.005 |
|                                 | Brown         | 51(21.2)           | 190 (78.8)             | 241 (32.1))  |         |
|                                 | Blonde        | 19 (29.7)          | 45 (70.3)              | 64 (8.5)     |         |
| Having Dandruff                 | Yes           | 135 (47.4)         | 150(52.6)              | 285 (37.9)   | < 0.001 |
|                                 | No            | 82 (17.6)          | 384(82.4)              | 466 (62.1)   |         |
| Having Itching on the Head      | Yes           | 172 (61.6)         | 107 (38.4)             | 279 (37.2)   | < 0.001 |
|                                 | No            | 45 (9.5)           | 427 (90.5)             | 472 (62.8)   |         |
| Infestation Severity            | High          | 38 (17.5)          |                        |              |         |
|                                 | Medium        | 79 (36.4)          |                        |              |         |
|                                 | Low           | 100 (46.1)         |                        |              |         |
| Infestation Type                | Nit           | 133 (61.3)         |                        |              |         |
|                                 | Nit/Live Lice | 84 (38.7)          |                        |              |         |

The results of statistical test Chi-square showed that the rate of head lice infestation had significant relationships with gender, pupil grade in all schools, grade in all-girls schools, father's educational level and occupation, family size, connection to piped water, presence of a hygienic bathroom at home, number of showers per week, co-sleeping, awareness of head lice infestation, presence of a health educator at school, infestation in the family, previous history of infestation, access to healthcare services, appearance of pupils with respect to hygiene, use of a shared comb, frequency of combing per day, use of a shared towel or of a shared scarf, type, length, density and color of hair, dandruff and head itching. There were no significant relationships between the rate of head lice infestation and the other studied variables (school type, geographical area, the grade of all-boys pupils, mother's occupation and educational level and sleeping in the same bedroom).



**Figure 3** Frequent distribution of head lice infestation according to different educational grades in girl's primary schools in Karun County, southwestern Iran.

#### 4. DISCUSSION

In the present study, the prevalence of head lice infestation was 28.9% in the primary schools of Karun County. The rate of infestation was higher among female pupils (37.6%) than male pupils. The estimated rate of infestation in primary school pupil's in the villages of Abadan County (Khuzestan Province, Iran) was 4.33%, all of whom were girls. The difference between the head lice infestation and gender was statistically significant (Salehi et al., 2014). In a systematic review and meta-analysis in Iran from 2000 until 2015, head lice infestation among primary school pupils was recorded as 1.6% (1.2-2.05), 8.8% (7.6-9.9), and 7.4% (6.6- 8.2) for boys, girls, and all the children, respectively (Moosazadeh et al., 2015). In another systematic review and meta-analysis study in Iranian primary schools between 2000 and 2016, the results showed that the prevalence of head lice infestation was 6.4%. The prevalence of pediculosis capitis infestation among girls was 6.1% and in boys was 1.2% and in rural regions prevalence was more than urban regions (Sohrabivafa et al., 2020). In a study among school-aged children in Woreta town, northwest Ethiopia, the prevalence of head lice was 65.7% and gender of pupil was significantly associated with head lice infestation. Girls were 3.29 times more infested by head lice than boys (Dagne et al., 2019). The overall prevalence of infestation was 13.3% in primary schools of Al Mahwit Governorate, Yemen, with the infestation rates of 18.9% among girls and 8.6% among boys (Al-Maktari, 2008). The prevalence of head lice infestation among elementary school pupils in Buenos Aires, Argentina, was 29.7% with a significantly higher infestation rate among the girls compared to the boys (Tolozza et al., 2009). The prevalence of infestation was 16.59% among primary school students in Delhi, India (Khokhar, 2002). In Turkey, 9.1% of the pupils in eight primary schools in the rural areas of Kayseri Province had head lice infestation. In this study, rates of head lice infestation were 16.4% among girls and 2.1% among boys (Oğuzkaya Artan et al., 2006). As can be seen, the rates of infestation were higher in girls than boys in other relevant studies, too. In the present study also, there was a statistically significant between-gender difference in infestation rate, and the majority of the infested pupils were girls. This finding is consistent with the findings of the aforementioned studies. One of the most important reasons for the higher infestation rate among females could be their long hair compared to boys, long contacts among the girls and hair covering with the scarf by the girls (Salehi et al., 2014).



According to the findings of the present study, the highest prevalence rate of head lice was observed among pupils whose parents were either illiterate or had not finished high school. In contrast, the lowest prevalence rate was found among pupils whose parents had university education. Davari et al. in Sanandaj (Kurdistan Province, Iran) and Rafinejad et al. in Amalesh District (Gilan, Iran) reported similar results among primary and elementary school pupils, respectively (Soleimani Zadeh & Sharifi Sarasiabi 2002; Rafinejad et al., 2005). Farzinnia et al. in Qom, Yaghmaei et al. in Sanandaj and Doroodgar et al. in Aran -Bidgol (Isfahan Province) did not report any significant relationship between rate of head lice infestation among primary school students and educational level of their fathers. However, the rates of infestation decreased with higher levels of educational attainment of the fathers. Nonetheless, these studies reported a significant relationship between the levels of educational attainment of the mothers and rates of head lice infestation (Farzinnia et al., 2003; Yaghmaie et al., 2006; Doroudgar et al., 2011). In general, we can conclude that improving parental awareness and developing a correct attitude towards this infestation and increasing productivity of parent-teacher educational classes along with preventing, detecting and treating the infested pupils completely and in time are very effective.

In the present study, the majority of the infected pupils had unemployed mothers. Davari et al. and Rafinejad et al. reported a significant relationship between the mothers' occupation and rates of head lice infestation among the pupils (Davari & Yaghmaei 2005; Rafinejad et al., 2005). Farzinnia et al. also reported a significant relationship between the mothers' occupation and rates of head lice infestation among pupils (Farzinnia et al., 2003). It seems that holding educational classes in schools and medical centers and/or providing families with educational booklets and CDs and improving the parents' level of awareness will be effective steps in preventing the spread of this infection. Despite the lack of a significant relationship between place of residence (rural and urban areas) and the rate of head lice infestation, this rate was higher in rural areas. The study in the Amalesh District showed that the geographical, economic and cultural factors, along with access to sanitary facilities and equipment, influenced the prevalence of head lice infestation among pupils (Rafinejad et al., 2005).

The present study showed a significant relationship between presence of bath at home and head lice infestation among the primary school pupils. Davari et al. studied the risk factors for head lice infestation in primary school students in Sanandaj and reported this significant relationship (Davari & Yaghmaei, 2005). Having a bathroom at home is very important in improving personal hygiene among students. The present study also found a significant relationship between access to health-treatment service centers and the rate of head lice infestation among the primary school pupils, which is consistent with the findings of Nekouei Naeini et al. in all-girls primary schools in Isfahan (Nekouei Naeini & Mostafavi, 2002). More access to health-treatment service centers obviously enhances the physical and mental health of pupils. Besides, there was a significant difference in the prevalence of head lice infestation among pupils with and without health educators. Studies by Rafie et al. in all-girls elementary schools in Ahvaz City (Khuzestan Province, Iran) showed the major role played by health educators in preventing head lice infestation (Rafie et al., 2009). The results of this study concerning the significance of health educators were inconsistent with the findings of Motalebi and Minouian Haghighi in the elementary schools of Gonabad County, Iran. Although the infestation rates among the pupils without and with access to health educators were, respectively, 8.28% and only 2%, there was no significant relationship between rate of head lice infestation and having access to health educators (Matlabi & Minooeian Haghighi, 1989). This can be attributed to the poor performance of health educators in controlling the health problems of the pupils or to their ineffective presence at schools. Rafinejad et al. reported a significant relationship between head lice infestation and access to health educators in Tonekabon (Rafinejad et al., 2005).

People who have had head lice once are more likely to become infested than pupils who do not have a history of infestation. This study showed a significant relationship between a history of head lice infestation and current head lice infestation. This can be attributed to the remaining nits from the previous infection or to the continued presence of the source of infestation in the family or in people in contact with the family, and requires mass treatment. This finding is consistent with those of Rafinejad et al. and Farzinnia et al. in Amalesh and Qom, respectively. They reported a significant relationship between head lice infestation and having a history of infestation (Rafinejad et al., 2005; Farzinnia et al., 2003). It seems that parents in large size families have less opportunity to look after their children's health and personal hygiene. As a result, it is expected that close physical contacts in large size families will cause a higher infestation rate. The present study showed a significant relationship between the family size and rate of head lice infestation among the pupils, which is consistent with the findings of Ayvazi et al. in Islamabad-e-Gharb (Kermanshah, Iran) and Rafie et al. in Ahvaz (Khuzestan, Iran) (Rafie et al., 2009; Aivazi, 1986). A study in Qom showed a significant relationship between the rate of head lice infestation and family size with the highest prevalence observed in families of 10 members or more (Farzinnia et al., 2003). Having more children limits maternal opportunities (to take care of their children) and increases the chances of sharing personal belongings and enhances the risk of infestation by more direct contact with family members. Moreover, children from small families may have separate bedrooms and personal sleep supplies and clothing.



In the present study, the infestation rate was significantly lower among sixth grade students than other grades, which may be due to less physical contact between them in the classroom. Moreover, these pupils can look after their own personal hygiene including taking showers. Another reason could be higher awareness and knowledge of this age group than pupils at lower school grades. Farzinnia's study in Qom reported the lowest infestation rate among the first-grade pupils and the highest among the fourth and fifth grades, showed a significant relationship between the rate of head lice infestation and the grade the pupils were in at school (Farzinnia et al., 2003). Rafinejad et al. conducted a study in Amalesh District and reported the lowest infestation rate among the fifth-grade pupils and the highest among the first-grade pupils. However, the relationship between grade at school and head lice infestation was not significant (Rafinejad et al., 2005).

This study did not find any significant relationship between the school type (governmental or private) and head lice infestation. The infestation rates were 29.5% and 28.8% in private and governmental schools, respectively, which can be attributed to the equal sensitivity and responsibility of the parents and the school officials and teachers in relation to hygienic matters regardless of school type. Visits to governmental schools also showed that the principals and health educators in these schools, as those in private schools, directly supervised hygienic matters related to the pupils and were in close contact with health-medical staff at health service centers in relation to hygienic issues including head lice infestation and provision of anti-lice shampoo to treat the infested pupils. Together with their saliva, head lice secrete allergens containing irritating chemicals that are the main cause of itching in infested people. There was a significant relationship between head lice infestation and itchy scalp in pupils. Individuals who less frequently combed their hair were more prone to head lice infestation because their hair was excessively frizzy and dry. The results of the present research demonstrated that the rate of head lice infestation was significantly higher in pupils who did not comb their hair or did not comb it frequently enough. These findings were consistent with those of Rafinejad in Amalesh District (Rafinejad et al., 2005). Moosazadeh and et al. in a systematic review in Iran were found that the head lice infestation rate to be associated with low frequency of bathing, parent's job, using a common comb, family size, long hair, lack of bathrooms in the house, and a low educational level of parents (Moosazadeh et al., 2015).

## 5. CONCLUSION

The results of the present study indicated that the prevalence of pediculosis capitis among the primary school pupils in Karun County was higher than in many other parts of Iran and developing countries to the extent that head lice infestation has become a health issue in this County that necessities control, treatment and follow-up measures. Low levels of public health, along with economic factors, can influence prevalence of this problem. Absence of hygiene facilities and equipment, low awareness level, lack of proper attitude towards the disease, inappropriate use of head lice medications and resistance of lice to them can prepare the ground for higher prevalence of head lice infestation in primary schools. Given the role of health educators in improving awareness and hygiene and in conducting repeated examinations of pupils, it is recommended that the required measures be taken to train and employ health educators at schools. If this is not possible, educational courses can be offered to teachers at schools so that they can diagnose this infestation in pupils and take timely treatment measures in order to lower the prevalence of head lice infestation. Although regular showers and repeated combing of head hair reduce the number of adult and nymph lice, they do not affect the nits that are tightly glued to the head hair. It is recommended to provide health educators with metal or plastic combs with long, fine and dense teeth that are suitable for removing the lice and nits from the hair. In addition, prevalence of head lice infestation can be lowered by enhancing public awareness. Health educators play an important role in this regard by teaching personal hygiene skills to students.

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### Conflicts of interest

The authors report no conflicts of interest in this work.

### Authors' Contribution

Hamid Kassiri: manuscript preparation, the research project, scientific advisor, technical advisor, data analyzer, developing the study idea, performing experimental work, abstracted data and corresponding author; Mahmood Mehraghahi: cooperation in doing field work and collecting the data and Masoud Lotfi & Rozhin Kasiri: cooperation in data analysis and data summary.

### Availability of data and materials

The data set in the current study is available from the corresponding author upon request.

### Consent for publication

Not applicable

### Competing interests

The authors declare that they have no competing interests.

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