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Original Article

Epidemiologic characteristics of head lice infestation among primary schoolgirls of Qeshm Island in southern Iran

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Abstract

***Background & Aims*:** Human lice infestation is considered primordial in origin, and its control dates back several centuries. However, its social stigma and ostracism remain major public health issues, particularly among school children. The main aim of this survey was to determine the relative frequency of head lice and its effective qualitative parameters among primary schoolgirls on Qeshm Island, south of Iran.

***Materials & Methods*:** This descriptive analytic study was performed on Qeshm Island. From 38 private and municipal primary schools, six schools, each including at least 60 female students, were randomly selected; a sample size of about 270 was computed. Data were analyzed using SPSS version 22.

***Results*:** In this survey, 283 female primary school students with an average age of 9 ± 2.16 years were investigated, of whom 119 (42%) were infested with head lice. Infestation among 6 to 9- year-old students was significantly lower than in the higher age group ($p < 0.001$). There was also a significant association between the students' bathing frequency and lack of head lice infestation ($p < 0.05$). A significant relationship was evident between the mothers' education level and head lice infestation in students ($p < 0.001$).

***Conclusion*:** Low maternal literacy, inadequate bathing frequency, and 11-year-old girls were at risk of head lice infestation. To reduce this problem, there is an essential need for the implementation of health measures such as employing school nurses, promoting public access to health services, educating tutors, students, and their parents, conducting clinical exams, and periodic screening.

***Keywords*:** Ectoparasite, Iran, Nit, Pediculus humanus capitis, Student

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Introduction

Public health is a very important issue, and there is a direct relationship between public health promotion and development with the advancement of large communities (1). Although head lice infestation and its control have a history of several centuries, its persistence remains a major health problem in modern societies (2, 3). It has an ectoparasitic life on humans (4). It is commonly found in both high-and low-income Iranian families with several children. Its irritation causes scalp itching, which may lead to secondary bacterial infections (5). Three mainly distinct species, including head, body, and pubic lice, can cause human infestations (6).

Head louse is a wingless insect with an obligatory hemi-metabolic life history. Human head lice infestation (Pediculosis) is caused by *Pediculus humanus capitis* De Geer, 1767 (Phthiraptera; Anoplura: Pediculidae). This infestation induces deleterious community health problems in school-aged children of developing and developed countries alike (7). *Pediculosis capitis* is a prominent health issue among school students, and the cost of damages it incurs on the economy is far greater than could be estimated. More than 100 research studies on head louse infestations have been performed to date in Iran between 2010 and 2020, and all have been conducted in primary schools. This neglected parasitism is generally intolerable among western human populations. Affected families are often ashamed if their members have lice due to the common misunderstanding that this infestation emanates from a lack of hygiene. In some other populations, this infestation with lice is more acceptable. For instance, it is considered a "common condition among primary school children" of the Bedouin population of Jordan, where water is scarce and their nomadic lifestyle is semi-settled (8).

This infestation, also known as Vagabond's disease, though mostly symptomless, instigates intense irritation of the scalp and social ostracism. It may lead to anxiety and school exclusion (9). Head louse causes anemia and scalp pruritus due to blood feeding (10). Depression, psychotic irritations, educational failure, school absenteeism, and insomnia are some of its other signs (11, 12). In view of the variable morbidity, social stigma, and reduced efficiency associated with louse burden, the World Health Organization (WHO) has recently added "scabies and other ectoparasitic infestations" to the priority list of neglected tropical diseases (13).

Head lice cannot jump, fly, or swim, and transmission of infestation most often occurs directly by physical contact from infested to uninfested individuals. Indirect transmission via shared combs, clothes, head scarves, headbands, tiaras, towels, blankets, pillows, and other accessories could happen less frequently (14). Head lice infestation is among the major public health problems in the world, particularly in the developing world (15). Globally, about 6-12 million people are annually infested with this parasite (16). The prevalence of head lice infestation has been reported at 12% (CI 95% = 0.01-0.13) in Iran (17). Head lice infestation is a social stigma that involves most human societies. It is considered a cardinal health obstacle at home and school (18).

According to parents and school staff, most head lice infestations involve school-aged children (19). Head lice appear to be present in all age and gender groups (20). Most often, children in the age range of 3-11 years, specifically females, are nevertheless infested (21), possibly due to closer contact with each other than males, long hair, and shared accessories.

A quick overview of epidemiologic studies carried out in recent decades in Iran and the world reveals the wide spectrum of disease prevalence. For example, 0.75% of urban primary school students in Mazandaran province and 56% of those in Sirik in Hormozgan province of Iran have been reported to be infested (22).

This difference in prevalence in these two geographically distinct areas could be attributed to both demographic and socio-behavioral factors. Similarly, the prevalence of infestation with head lice in studies conducted at schools of different countries is reported to be 25.3% in Canada, 9.8% in Belgium, 28.3% in England, 29.7% in Argentina, 13.3% in Yemen, and

59.16% in New Delhi, of India (23). The prevalence of Pediculosis varies in different seasons and appears to be most common in fall (24).

With regard to the national need for sustained surveillance of debilitating parasitic diseases, the present survey is conducted to determine the relative frequency of head lice and its associated qualitative parameters specifically among primary schoolgirls based on our previous experience and published articles (2, 5, 25) in this study area. Using this acquired data could culminate in measures to control this infestation and its contributing factors among female primary students of Qeshm Island.

Materials & Methods

Study Area

This descriptive-analytic study in Qeshm Island, Hormozgan province, was performed to investigate the epidemiological characteristics of head lice among female primary school students in 2018-2019. Qeshm Island is the largest arrow-shaped island in the Persian Gulf. It lies within the strategic Strait of Hormuz on the southern coastal line of Iran, and east of the Persian Gulf (Figure 1). Qeshm Island, with its hot, humid climate and crowded schools, provides a suitable setting for head lice activity (26). It spans eastward from 26°34'N, 55°16'E, to 26°59'N, 56°17'E. The city of Qeshm, where sampling was carried out, lies on the easternmost tip of this island. The island has an area of more than 1,491 km^2 and extends to a length of about 135 km. The annual mean temperature on the island is about 27 °C, and the annual mean precipitation is about 183 mm.

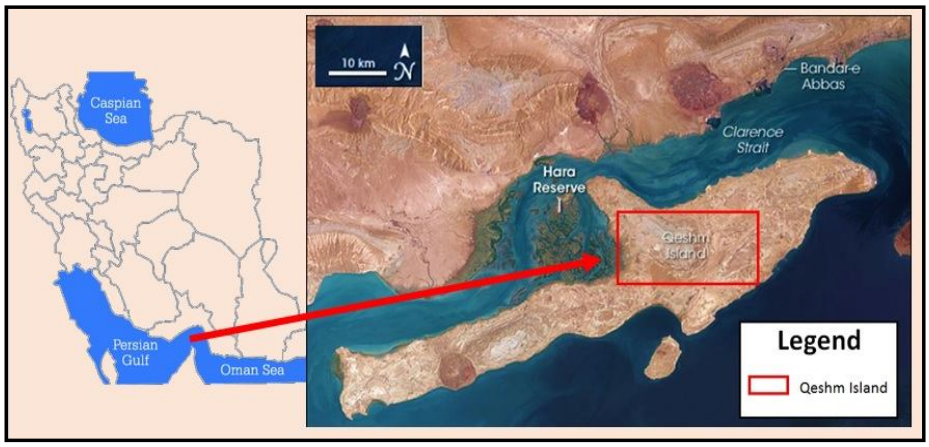

Fig. 1. Study area showing the map of Qeshm Island in the Persian Gulf, south of Iran.

Sampling Method and Identification

Initially, six primary schools, each with at least 60 female students, were randomly selected out of the 38 municipal and privately run schools in the city of Qeshm. The sample volume was computed to be 270 individuals with an error of 5% and $p = 0.23$ (27). Each student underwent direct visual head-checks, with a few (up to 5) strokes per head section of combing, for an average total time of 10 minutes per case. In each school, all schoolgirls were first screened for head louse infestation. All infested students then entered the study once they met the following criteria.

As described in our previous publications (25), in under-study schools, students were examined for head lice infestation with direct one-by-one scalp observation by healthcare and disease control officers using plastic detection combs (PDC) and manual magnifying hand lens among head hairs from roots to tips, particularly behind their ears. The presence of live, moving lice confirmed an active infestation. Eggs (nits), nymphs, and adult lice were sampled from infested students. The criteria to determine active head lice infestation were the presence and detection of live nits, nymphs, and adult lice by hand lens (10x) or

unarmed eyes of a trained medical entomologist. An 'infested' individual had live eggs attached to the hair, while dead or hatched egg states were irrelevant. Newly laid operculate eggs were firmly glued to the hair shaft by a cement-like adhesive material within 1.5 cm of the scalp. Older eggs were higher up on the hair shaft. The specific position of the glued egg on the hair shaft, its color, shape, and pressure were valuable in determining whether an egg was alive, dead, or hatched. They were hard to dislodge, while dandruff and hair muffs (known as 'pseudo nits') were easily slid and flicked away from the hair.

Inclusion/Exclusion Criteria

All students of selected schools who registered as being infested were included, pending the completion of a routinely provided ethical consent form signed by their parents to participate in this study. Students who were not available to participate, had a background in scalp disease, or did not have a completed consent form signed by their parents were excluded from this survey.

Data Analysis

The collated data were coded and uploaded in SPSS software. Descriptive statistics included percentages, means, and relative frequencies of the variables. The statistical Chi-square test was applied to determine any relationship between the variables under study and level of head lice infestation among participating students. The Chi-square test was used to determine the statistical significance of differences in relative frequencies. A p-value of less than 0.05 was considered statistically significant. In this study, Cronbach's Alpha test was applied to assess the coefficient of reliability or internal consistency. Each check-list included information on age, gender, educational level, parents' educational level, parent's occupation, presence of a bath at home, etc.

Results

In the current study, 283 female primary school students with a mean age of 9 ± 2.16 years were investigated, of whom 119 (42%) individuals were infested with head lice. The residential places of all students were rural areas, and 281 (99.3%) of their families had access to piped water. Only 27 (9.5%) students had a health instructor at school, of whom 16 (59.3%) were infested with head lice. It is noticeable that 260 (92%) students received training on head louse infestation and its prevention, of whom 107 (41.2%) were infested with head lice. In this survey, four (1.4%) students shared items with other people. Among all screened students, 47 (16.6%) girls had previously received Permethrin shampoo to treat head lice infestation in distant past.

Figure 2 and Table 1 depict details of data on the abundance and stages of head lice among infested students. The highest frequency (70.6%) of infestation was found with nits, while the lowest one (0.8%) was attributable to the presence of one adult louse on a student. The two most infested head areas (37.70% each) were behind the ears and mid-part of the hind head to nape, while the head top was the least (1.70%) infested area.

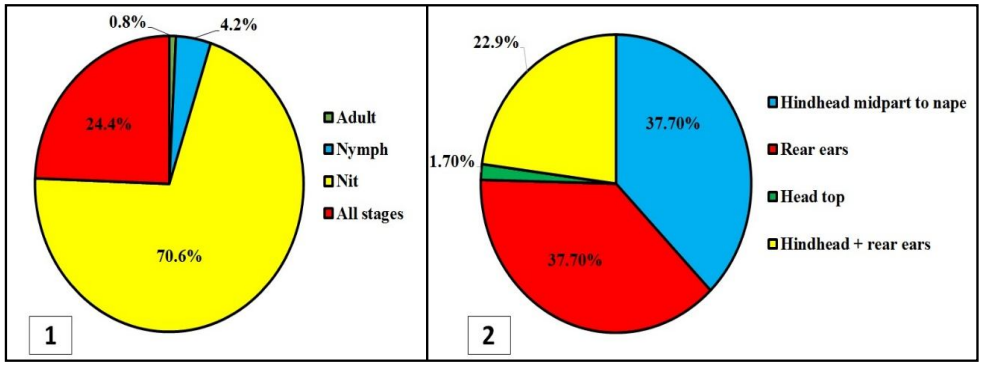

Fig. 2. Pie charts illustrate the relative frequencies of different head lice stages (1) and their places on the head (2).

Table 1. Students' age distribution, bathing frequency, and parents' educational status were tabulated against head lice infestations among uninfested and infested students.

Age group (year)	Uninfested (%)	Infested (%)	*p* value
6-9	120 (73.2)	51 (42.9)	< 0.001
10-13	44 (26.8)	68 (57.1)	
Total (6-13)	164 (57.95)	119 (42.05)	0.001
Bathing frequency (per week)			
1	24 (14.6)	32 (26.9)	
2	73 (44.5)	60 (50.4)	< 0.002
>2	67 (40.9)	27 (22.7)	
Total	164 (57.95)	119 (42.05)	0.002
Mother education status			
Illiterate and primary	42 (25.6)	57 (47.9)	
First intermediate	54 (32.9)	29 (24.4)	0.001
Second intermediate and higher	68 (41.5)	33 (27.7)	
Father education status			
Illiterate and primary	34 (20.7)	34 (28.6)	
First intermediate	71 (43.3)	52 (43.7)	0.200
Second intermediate and higher	59 (36.0)	33 (27.7)	

The relationship between students' age distribution and parent education level with head lice infestation is shown in Table 1. Accordingly, head lice infestation was significantly lower among 6-9 year-old students ($p < 0.001$). Of all infested students, 28 (23.5%) girls with an 11-year age (who studied at the fifth level of primary school) were infested with head lice, which revealed the highest infestation level among these students. To evaluate the relationship between parent education level and head lice infestation among students, three education levels were considered: illiterate and primary, first intermediate and second intermediate or higher degrees. As shown in Table 1, the data indicated that most infested students had mothers with no or primary literacy level. In addition, students whose mothers had first or second intermediate levels or higher degrees were significantly less infested with head lice than those whose mothers were illiterate ($p = 0.001$). In this survey, no statistically significant relationship was found between students' infestation level and their paternal educational status ($p = 0.2$).

In addition, there was a significant relationship between student bathing frequency and head lice infestation state ($p = 0.002$). The data indicated that the majority (85%) of students who had two or more baths per week were free from head lice infestation, while the remaining minority (≈15%) had one bath per week (Table 1). Likewise, more than three-quarters (77%) of girls, who had less than two baths per week, were infested with head lice.

Discussion

Despite remarkable health developments in various countries, parasitic infestations due to head lice remain a major public health obstacle in both developed and developing worlds. According to a World Health Organization (WHO) report, head lice infestation is prevalent in Iran (28). In recent years, head lice resistance to pyrethroid insecticides has been reported

in Iran, which has caused treatment failure against this insect (29, 30).

In the present study, the rate of head lice infestation was revealed to be 42%, which is far greater than those found earlier in this locality (23.9%) (31), and in disparate regions of mainland Iran, but less than a similar study (56%) in a nearby coastal county of Sirik in Hormozgan province (22). There are many reasons for this level of infestation in Qeshm city, such as poor sanitary conditions, low literacy levels of parents, high intermingling of children, etc. For instance, the rate of head lice infestation was 24.8% and 22% among female primary school students in the Iranian cities of Gilane-Gharb and Bushehr, respectively (32). Therefore, the prevalence of head lice, appears to be region-specific as it pertains to socio-demographic factors and human behavior to a considerable extent.

Likewise, head lice infestation rates among primary school children of Kalar district in the Iraqi Kurdistan region and Houn city of Libya were 14.43% and 21.9%, respectively (14, 33). Furthermore, epidemiologic studies on infestations at schools in different countries in the world reported head lice abundance in Jordan at 26.6%, Thailand at 23.32%, and Brazil at 43.4% (15). Head lice infestation prevalence was evidently different in disparate geographical regions depending on season, methodology, demography, and other confounding qualitative parameters (34, 35).

Earlier studies have revealed that health nurse activity at schools has played a prominent role in raising awareness and reducing the rate of infestation (36). In the current survey, about 60% of students who had access to health nurses were also infested with head lice. Therefore, the presence of the head nurse did not have a significant influence on ameliorating infestation prevalence among students. This finding is consistent with the results of other investigations (12, 37), but contradicts another study that found the presence of school nurses was instrumental in reducing the prevalence of head lice among students in the city of Qom (38). The ineffectiveness of health nurses in reducing infestation prevalence among students could be due to the fact that several schools are simultaneously under the coverage of a single health nurse, and it could also be due to the prejudice of infestation and avoidance behavior of school nurse towards infested students.

In this study, the prevalence of head lice infestation among students who received training on head louse infestation and its prevention was low, which is in line with another earlier survey (39). Although schools are high-risk settings for head lice infestation due to congestion and other parameters, their high potential to provide health education and consequently prevent and control head lice infestation should not be ignored. Therefore, schools should not be blamed for the prevalence of Pediculosis. Student health education can effectively prevent head lice infestation and its consequences. In the present survey, only 1.4% of infested students shared items (*e.g.* comb, towel, *etc.*) with others. Dependence on personal accessories or avoiding other people's items can lead to a decreased rate of head lice infestation, and this behavior contributes to containing the infestation (15).

In this investigation, there was a significant relationship between the rate of head lice infestation, age, and/or educational level. Most cases of head lice infestation were found among fifth graders (11-year-old schoolgirls), which is consistent with the aforementioned study from the city of Qom (38) and the Sirik study (22). The lower infestation rate among first to fourth grade students was most likely due to the fact that their mothers or siblings washed and combed their hair. However, bathing and hygienic measures at higher educational levels were assigned to students themselves who may not have acquired the necessary skills to implement personal health behaviors yet. It is therefore recommended that hygiene and bathing practices among students at higher educational levels be supervised by their mothers or next of kin to enhance the quality of activity, and thus prevent head lice settlement or start infestation treatment on time.

There was a significant link between lack of head lice infestation and the frequency of student bathing per week in the current study, which was in line with

previous studies conducted by other researchers (8, 33). Greasy, damp hairs were seldom washed and combed, making students most susceptible to head lice infestation. This condition could readily transfer the infestation to others through physical contact or indirectly via shared accessories (40).

Although a significant association was also observed between maternal education level and student head lice infestation in this study, no such association was found between father's education level and student infestation. The existence of this association was also reported elsewhere (12, 41, 42). These synchronized results implied the importance of parental education in children's care both to encounter and prevent infestation with head lice, as well as in its diagnosis and proper treatment.

Head lice cause scalp pruritus, leading to intense itching, which often culminates in secondary bacterial and fungal infections. There are reports of a few bacterial species being carried by *P. h. capitis* (43, 44), most remarkably the detection of *Acinetobacter spp.* DNA in about 42% of adult head lice from the poor, crowded communities of the East African island country of Madagascar corroborates earlier molecular data. It remains to be seen whether biotechnological breakthroughs in the coming decades could be manipulated to unravel ambiguities associated with symbiotic bacteria interacting with chemical insecticides within the body of head lice (45). Head lice have also been reported to carry *Rickettsia prowazekii* (typhus agent) in Africa, South America, and Asia (46). There have also been some reports of *Borrelia recurrentis* (relapsing fever agent) (23%) and *Bartonella quintana* (trench fever agent) (7%) being found in head lice in Ethiopia (47, 48).

One of the limitations of the present study was the multiplicity of questioners and examiners, which could culminate in internal variations. This was resolved by a prior pilot training session for them, conducted by the principal investigator, on how to interview and examine cases, which nearly harmonized the outcome. Another hurdle of this survey was the lack of interview permission with students as well as gaining entry into schools which was resolved by coordination with local health authorities and preemptive notices.

Cooperation and endeavor between health staff, teachers, and parents of students are warranted to safeguard efficient epidemiologic care. It is suggested that primary school teachers gain adequate awareness of student susceptibility to infection and infestation with various debilitating parasites, particularly under the current SARS-CoV-2 (COVID-19) pandemic. Their potential educative ability must be exploited to teach students, screen them, and follow them up for treatment. As there are increasing reports of head lice insensitivity to first-line treatment (mostly permethrin) (49, 50), we recommend complementary studies to be designed on sensitivity rates in any specific region towards a particular insecticide-based product.

Conclusions

In conclusion, based on the results of this study, low maternal literacy and inadequate bath frequency increased the risk of head lice infestation among 11-year-old girls. Therefore, there is an essential need to ameliorate this obstacle through major health planning, such as the employment of school nurses at all institutions, enhancement of people's access to health services, teacher/student/parent training, and periodical screening of high-risk groups.

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Authors' Contributions

S.A.J. and M.D.M. designed and conducted the study. S.A.J. and M.N. supervised the questionnaire preparation. Z.A., F.A., F.F., M.D., and S.M.M.N. carried out the field process. S.A.J. prepared the Figure map. S.A.J., I.S and M.D.M. drafted the original paper. All authors reviewed the final MS.

Data Availability

The data that support the findings of this study are available on request from the corresponding author.

Conflict of Interest

The authors declared no conflict of interest.

Ethical Statement

This study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of Shiraz University of Medical Sciences (SUMS) with protocol code: IR.SUMS.REC.1396.S414, date of approval: 17-1-2016.

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