Original Research Article

Evaluation of A potential Association between Head Lice (*Pediculus capitis*) Infestation and Anemia among Female Primary School Students in Holy Makkah, Saudi Arabia

ABSTRACT

Aims: This study aimed to determine if there was an association between head lice infestation and anemia among female primary schools students.

Study Design: Case-control study.

Place and Duration of Study: Holy Makkah, Saudi Arabia between August 2020 and November 2020.

Methodology: We conducted a case-control study by comparing hemoglobin levels among study subjects with and without head lice infestation. Female students at 6 randomly selected primary schools were examined for the presence of head lice. Hemoglobin levels were obtained from each study subject; both those with and without head lice. Selected characteristics of study subjects were recorded and examined to determine associations between those factors and anemia.

Results: A total of 82 subjects were included in the study; 44 subjects with head lice. The average (± standard deviation) age of subjects was 11 (± 2) (range: 6-11) years. We found a significant (p<0.028) association between the presence of head lice and hemoglobin level, the OR= 2.036 at 95% confidence interval 0.23 to 18.009. The mean of hemoglobin in subjects with lice was 13(±2) while the level in subjects without lice was 14.8(±2). Other factors significantly associated with the level of hemoglobin were being aged 10-11 years (p<0.05) and having a non-working mother (p<0.05).

Conclusion: In our study we found a significant association between head lice and level of hemoglobin among study subjects. Further studies are needed to determine the reason of this association in order to determine the appropriate management and prevention of this problem.

Keywords: Children, Hemoglobin, Lice, Makkah

1. INTRODUCTION

Pediculus capitis (head lice) infestation (HLI) has existed for more than 10,000 years [1]. There are three families of human lice: *P. corporis* (body louse), *Phtirus pubis* (pubic louse), and *Pediculus capitis* (head louse) [2]. These lice belong to the phylum Arthropoda, class insect, order Anoplura. Lice are wingless [3] obligate human blood-sucking, dorsoventrally flattened ectoparasites in humans. HLI is a common health problem in developing countries [4] and occurs only in humans [5].

HLI can be transmitted by head-to-head contact or by sharing clothing, hats, towels, hairbrushes or other personal items with an infested person [5]. Conjunctivitis, lymphadenopathy, pruritus, allergic reactions and, anemia have been reported to occur among schoolchildren with heavy *Pediculus capitis* infestation [6-11]. Psychological stress may occur among infested subjects and others due to the belief that head lice infestations are the result of being dirty [12]. However, schoolchildren aged 3-11 years are frequently affected by HLI in high-income as well as in developing countries [8].

The prevalence of HLI among schoolchildren has been reported to vary from < 5% to > 40% [13]. Epidemiological studies have found the prevalence of pediculosis to vary by country: 13.6% in Mexico [14], 15.3% in South Africa [15], 23.32% in Thailand [5], 26.4% in Nigeria [16], 26.6% in Jordan [17], and 28.3% in England [18]. One study estimated the average amount of blood imbibed at a single feed by an adult female louse (0.0001579 ml), adult male louse (0.0000657 ml) and louse nymph (0.0000387 ml) [19] . Assuming three feeds per day by an average infection of 30 lice (10 females, 10 males, and 10 nymphs), the average child with active pediculosis would loose 0.008 ml of blood per day. This amount of blood loss is not clinically significant even in iron-deficient children. However, a heavily infested child was observed to have up to 2657 lice which could result in the loss of up to 0.7 ml

blood/day or 20.8 ml/month, which could be of clinical importance on iron deficient child [19]. The aim of this study was to determine if there is an association between pediculosis and iron deficiency anemia among female primary school children in Holy Makkah City, Saudi Arabia in order to inform HLI control programs for this study population.

2. MATERIALS AND METHODS

2.1 Study design & population

We conducted a case-control study. Inclusion criteria for study subjects were: female sex, studying at one of the randomly selected primary schools during the study period of 13 April 2016 to 14 March 2017. Exclusion criteria for study subjects were: age < 6 years or > 13 years and no written informed consent from a parent/guardian to be included in the study. The number of study subjects was chosen based on the results of the clinical investigation [19] for infested group and number of students near to infested group was chosen as control.

The study schools chosen were public primary schools. Each study subject was examined for the presence of pediculus. Pediculosis was defined as the presence of at least one living adult, nymph or viable nit. Subjects born with and without pediculus had a finger prich for hemoglobin level examined by the Humameter Hg plus instrument (HUMAN®).

2.2 Ethical approval

Ethical approval for the study was obtained from the Ethics Committee, Faculty of Public Health and Health Informatics, Umm Al-Qura University, Kingdom of Saudi Arabia. Written informed consent was obtained from the parents of all subjects before inclusion in the study. Approval for the study was also obtained from the Ministry of Education, Holy Makkah.

2.3 Data analysis

Data obtained were analyzed using the Statistical Package for Social Sciences (SPSS Inc, IBM) version 20. The Chi^2 test was used to evaluate relationships between selected factors and HLI. A p-value < 0.05 was considered statistically significant.

3. RESULTS AND DISCUSSION

According to the ethnicity of the participants, Asian participants were more suspected to get infestation with lice ($p<0.05$) (Table-1).

The demographic characteristics of the subjects with or without anemia showed that anemia was detected more in children aged 12-13 years ($p<0.05$). There was no significance among ethnicity and anemia ($p>0.05$). There was a relationship between non-working mothers, and subjects with anemia ($p<0.05$) (Table- 2).

The mean ± SD hemoglobin concentration for subjects with lice was 13.23 ± 2.80 g/dl. In this group, the minimum value of hemoglobin was 6.8 g/dl; the maximum value was 18.65 g/dl; for those without lice, the mean ± SD hemoglobin concentration was 14.81 ± 2.70 g/dl; the minimum value was 10.70 g/dl and the maximum were 20.00 g/dl (Table -3).

The result demonstrated the relationship between lice infestation and anemia in children ($p<0.05$). We found a significant ($p<0.028$) association between the presence of head lice and hemoglobin level, the OR= 2.036 at 95% confidence interval 0.23 to 18.009 (Table-4).

Table 1 Demographic Characteristics of study subject with and without head lice

Characteristics	With head lice		Without head lice		Total		*p-value*
	N	%	n	%	n	%	
Ages in years							
6-7	3	3.6	2	2.4	5	6.1	0.686
8-9	5	6.1	8	9.8	13	15.9	
10-11	20	24.4	15	18.3	35	42.7	
12-13	16	19.5	13	15.9	29	35.4	
Total	44	53.6	38	46.4	82	100	
Ethnicity							
Arab	19	23.2	27	32.9	46	56.1	0.039*
Asian	22	26.8	10	12.2	32	39.0	
African	3	3.7	1	1.2	4	4.9	
Total	44	53.6	38	46.4	82	100	
Grade of Subject							
First	2	2.4	0	0.0	2	2.4	0.144
Second	4	4.8	6	7.3	10	12.2	
Third	2	2.4	3	3.7	5	6.1	
Fourth	6	7.3	9	10.9	15	18.3	
Fifth	24	29.2	11	13.4	35	42.7	
Sixth	6	7.3	9	10.9	15	18.3	
Total	44	53.6	38	46.4	82	100	
Father Working							
Yes	25	30.5	29	35.4	54	65.9	0.155
No	18	21.9	8	9.8	26	31.7	
Do not know	1	1.2	1	1.2	2	2.4	
Total	44	53.6	38	46.4	82	100	
Mother Working							
Yes	3	3.7	6	7.4	9	11.0	0.129
No	38	46.3	32	39.0	70	85.3	
Do not know	3	3.7	0	0.0	3	3.7	
Total	46	53.6	38	46.4	82	100	

Table 2 Demographic Characteristics of study subject with and without anemia

Characteristics	With anemia		Without anemia		Total		*p-value*
	N	%	n	%	N	%	
Ages in years							
6-7	4	4.9	1	1.2	5	6.1	0.015*
8-9	3	3.7	10	12.2	13	15.9	
10-11	5	6.1	30	36.6	35	42.7	
12-13	8	9.8	21	25.6	29	35.4	
Total	20	24.4	62	75.6	82	100	
Ethnicity							
Arab	13	15.9	33	40.2	46	56.1	0.412
Asian	7	8.5	25	30.5	32	39.0	
African	0	0.0	4	4.9	4	4.9	
Total	20	24.4	62	75.6	82	100	
Grade of subjects							
First	2	2.4	0	0.0	2	2.4	0.069
Second	4	4.8	6	7.3	10	12.2	
Third	1	1.2	4	4.8	5	6.1	
Fourth	1	1.2	14	17.1	15	18.3	
Fifth	8	9.8	27	32.9	35	42.7	
Sixth	4	4.8	11	13.4	15	18.3	
Total	20	24.4	62	75.6	82	100	
Father Working							
Yes	11	13.4	43	52.4	54	65.9	0.415
No	8	9.8	18	21.9	26	31.7	
Do not know	1	1.2	1	1.2	2	2.4	
Total	20	24.4	62	75.6	82	100	
Mother Working							
Yes	2	2.4	7	8.5	9	11.0	0.008*
No	15	18.3	55	67.1	70	85.3	
Do not know	3	3.7	0	0.0	3	3.7	
Total	20	24.4	62	75.6	82	100	

Table 3 Selected variables among subjects with and without head lice (N: 82)

Variable	With head lice	Without head lice
Number	44	38
Mean hemoglobin level	13.2	14.8
Standard deviation	2.8	2.4
Minimum	6.8	10.7
Maximum	18.7	20.00
Std, Error Mean	0.4	0.4

Table 4 Association between anemia and head lice infestation among study subjects

	With head lice n (%)	Without head lice n (%)	Total	*P-value*
Anemia*	15 (75.0)	05 (25.0)	20	0.028
No anemia	29 (46.8)	33 (53.2)	62	
Total	44 (53.7)	38 (46.3)	82	

*Anemia classified due to the level of hemoglobin, subjects who had lice were more suspected to have decreased in hemoglobin level.

3.1 DISCUSSION

The majority of suspected people belonged to Asian race. The head lice one of the threatening problems to public health in any society despite the high income and the variation of the characteristics and the behavioral habits of the students and their parents. Also differences in the environments and climates could be a reason that explains the high prevalence of head lice infestation in the students of the present study.

The main major points of the finding in the current study were four points, initially by the relationship between the Asian people and the head lice infestation, as well as the association between anemia and students aged [10-11], in addition to a high significant association between non-working mother and children with anemia, finally the finding in this article found statistical association between head lice infestation and anemia. The result could be different from study to another, from country to another or even from society to another, that might be due to the difference in the culture, habits, climate and weather, environment, educational level and socio-economic factors in developed and developing countries.

The overall prevalence rate of lice in our previous study in Makkah was found to be 31.2% [20], comparing with other studies around world, the prevalence in Iraq 48.9% and [21] Malaysia 35% [22] slightly higher than found in Makkah. The prevalence in Argentina was 29.7% almost similar to our finding [23] but The prevalence in Makkah was much higher than in Korea 4.1% [12], 3.3% in France [24] , and 1.6% in Poland and USA [25, 26].

In our study we found a significant association between anemia and head lice. A previous paper reported a case of an 11 years old child with heavy HLI and iron-deficiency anemia [27]. Another paper reported the case of 23 years old woman had severe iron deficiency anemia with heavy and chronic head lice infestation [28]. A

previous study [29] stated a primary school child needs about 1.5 mg of iron per day, and iron loss is about 0.6 mg/day and pediculosis can cause iron loss up to 1 mg of iron per day increasing the likelihood of iron deficiency anemia [3, 30]. There are previous studies revealed that the prevalence of anemia increased among male children [31-33]. These differences can be attributed to genetics or an increased incidence of iron deficiency in boys [34]. In contrast to that, all participants in this study were female students, and there was a significant relation between lice infestation and anemia which revealed that the prevalence of anemia is not concerned with boys only. The head lice infestation was found to be higher among females by 88.3% than males. Also, the transition of infection from an infected person to another was higher by 63.3% among their sisters, which means that *P. capitis* infection has a higher rate among females [35]. In the same way, the results of the current research might be explained by the nature of females and their close contact with each other and sharing their headscarf accessories [36]. In another study support our finding, a cross-sectional study that was conducted in the urban area of Athens in Greece. The overall infestation rate (5.30%) was mainly attributed to females, which manifested a higher rate (4.84%) than male children [37]. In the current study a highly significant percentage for anemia among girls having non-working mother (p = 0.008) was found. This reveals that housewife mothers can somehow don't pay attention to personal hygiene for their children and thus protect them from lice infestation. The same finding has been concluded as well in Korea where they found that even the occupation of parents can affect the prevalence of head lice and consequently anemia [38].

4. CONCULOSION

This study supported that pediculosis capitis is associated with anemia among female school children in primary schools in Holy Makkah. The finding of this article will help the decision maker, policy maker and public healthcare professionals to minimize children health risk behaviors and habits, also to promote their health and well-being. All authors recommend that is very necessary to well activate school health role and positions to implement the primary prevention.

CONSENT AND ETHICAL APPROVAL

Ethical approval for the study was obtained from the Ethics Committee, Faculty of Public Health and Health Informatics, Umm Al-Qura University, Kingdom of Saudi Arabia. Written informed consent was obtained from the parents of all subjects before inclusion in the study. Approval for the study was also obtained from the Ministry of Education, Holy Makkah.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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