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Study of The Prevalence (%) Of *Pediculus humanus capitis* (Head Louse) Infestation Among School Children in Karachi

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ABSTRACT

This study was planned to highlight the magnitude of prevalence of head louse infestation in school children in Karachi region of Pakistan. Comparative prevalence in Primary and Secondary, Government and Private, Girls and Boys Schools, were investigated. Prevalence at different age groups and in different class levels was also studied for determining the effect of different factors contributing to head lice transmission and their prevalence.

From five districts of Karachi, a total of 4025 students were examined, from each district 4 Primary (2 boys + 2 girls) and 4 Secondary (2 boys + 2 girls) Govt. schools and 4 Primary (2 boys + 2 girls) and 4 Secondary (2 boys + 2 girls) Private schools were selected randomly. Head combing was carried out with a frequency of 10 combs through the head of a student, data were recorded along with information on student's gender, age, class. Arithmetic average, the Standard Error of the Mean (SEM) was calculated. Correlation between age and infestation was calculated by Pearson's R and Spearman correlation. Analysis of variance (ANOVA) was used to determine whether a significant difference in infestation existed due to gender, class level, and school type.

The prevalence of head louse infestation in Karachi was 25.3%. A higher rate of infestation was found in Primary (28.72%) and Government school (32.90%) than in Secondary (21.90%). and Private (17.60%) school children. No significant difference of infestation was found between both sexes ($P>0.05$). Prevalence was found inversely related to age and academic class standards of students.

It was revealed from the present study that head louse infestation is common in Karachi and is found almost in all school children without any respect of Gender. Infestation is not noticeably different in Boys and Girls, but Primary and Government school children were more susceptible to infestation than Secondary and Private school children. It was also encountered that prevalence of infestation decreases in higher class students and age groups.

INTRODUCTION

Head louse belongs to blood-sucking obligatory (permanent) ectoparasite of man, highly adapted to survive on the head hair of their host, and is a small wingless, dorsoventrally flattened insect. The body composed of a head, thorax, sensory structures are

reduced, antennae are short 3-5 segmented and have three pairs relatively short legs, which terminate in claw used for clinging to the host hair, highly modified mouthparts for piercing and sucking. Lice existence has been documented through archeological findings among human civilization in many parts of the world covering thousands of years. Lice themselves have been around, for thousands of years (Pernet, T. 1918). Head lice (*Pediculus capitis* De Geer) have a worldwide distribution (Falagas *et al* 2008). The favorite site for the head louse is the hair on the back of the head and neck although the nits of head louse cemented to the parietal and occipital region. Scalp pruritis is a characteristic manifestation of head louse infestation. The irritating saliva injected during feeding produces a red papule accompanied by severe itching. Infestation produces general tiredness, irritability, rashes, eye infection, loss of sleep, intense discomfort. Infested persons feel uneasiness, weakness, do not work properly, feel ashamed in gatherings, and among friends; it produces a lack of confidence as well. Infestations can create psychological distress (Heukelbach J. 2010). In severe and untreated cases, the hairs may become matted with eggs (nits) parasite and exudates from the pustules that originate from the louse bite; this condition is known as “Plicaplonica” fungus may grow in the whole feted mass forming a carapace like covering under which a large number of lice may be found. Severe infestation may lead to scarring, indurations, pigmentation, and discoloration of the skin, and even ulceration. The skin becomes harder and deeply pigmented; giving the so-called vagabond’s disease infestation of eyelashes, through secondary infection leads phlyctenular conjunctivitis and keratitis. The Head louse is capable of serving as a reservoir host of bacteria. Several pathogenic bacteria have been found in lice. Acid-fast bacilli, *Salmonella typhosa* have been recovered from head louse (Steinhaus, E.A. 1947). Head louse has a high potential for transmitting typhus organisms. Wounds that are produced by lice help in the prevalence of the secondary bacterial infection. Head louse infestation in persons is usually acquired by direct head to head contact or by sharing of combs, hairbrushes, towels, beddings, and other items such as caps, scarves, headphones, helmets, coats, theater or car seats, or by loose hair prevalence.

In Karachi no detailed study has been carried out except some preliminary work of (Fatima *et al.*, 1999) on the prevalence of *Pediculus humanus capitis* (head louse).

The present study was planned to highlight the magnitude of prevalence of head louse infestation in school children in Karachi region. Comparative prevalence in primary and secondary, government and private, Girls and Boys Schools must be investigated for determining the effect of different factors contributing to head lice transmission and their prevalence.

MATERIALS AND METHODS

The survey-based study was conducted from the Districts of Karachi (Fig. 1a, b, c, d, e); it was divided into the following sections.

- a. Selection of study area
- b. Collection of infestation data
- c. Statistical analysis

a. Selection of Study Area:

A list of schools (Govt. and Private) of districts of Karachi was collected from the Directorate of School-Education, Karachi. The schools were arranged serial wise. From each district 4 Primary (2 boys + 2 girls) and 4 Secondary (2 boys + 2 girls) Govt. schools and 4 Primary (2 boys + 2 girls) and 4 Secondary (2 boys + 2 girls) Private schools were selected randomly for data collection of head louse infestation. 10 % of the total enrolled students were selected randomly for the collection of head louse infestation from each school. (Table 1).

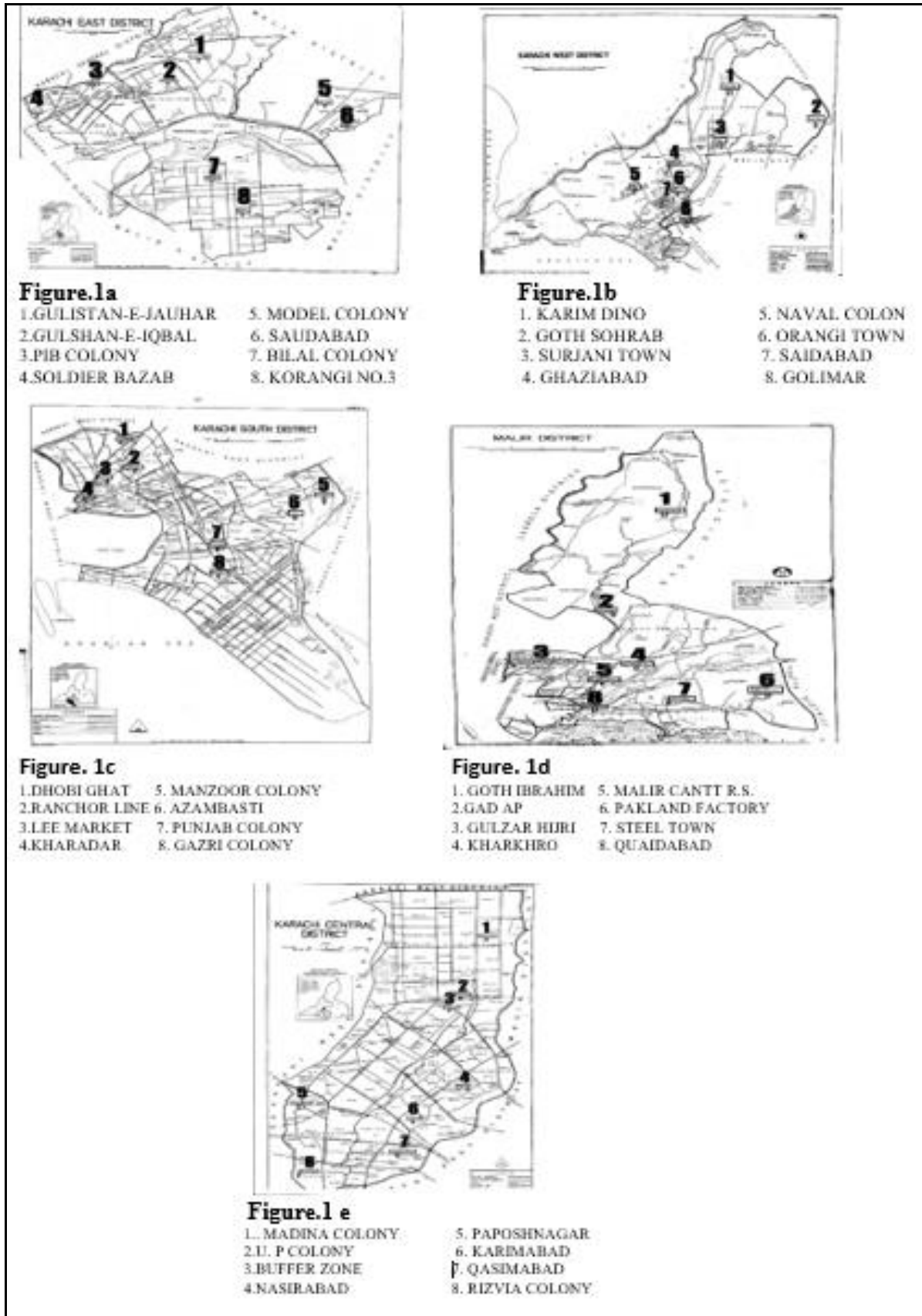


Fig. 1.(a, b, c, d, e) Maps of surveyed areas from Districts of Karachi

Table.1 Total number of school children surveyed for pediculosis, in Karachi

S. No.	Districts	No. of Schools	Government				Private				Total
			Primary		Secondary		Primary		Secondary		
			Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	
1.	Central	16	100	100	125	100	100	100	100	100	825
2.	East	16	100	100	100	100	100	100	100	100	800
3.	Malir	16	100	100	100	100	100	100	100	100	800
4.	South	16	100	100	100	100	100	100	100	100	800
5.	West	16	100	100	100	100	100	100	100	100	800
	Total	80	500	500	525	500	500	500	500	500	4025

b. Collection of Infestation Data:

Combing was carried out under good light and sometimes magnified glass was used for better observation. White piece of cloth was covered around the neck and the shoulder for preventing spread of lice and fallen-nit-carrying-hairs. Hair was detangled and straighten with a wide toothed comb, divided the hair in sections and fastened off that was not being worked on. Used fine toothed comb, went through each section from the scalp to the end of the hair. Head combing was carried out for every part of the head with a frequency of 10 combs through whole head of a child, using specialized plastic combs; netted with thread, infestation data were recorded in a proper data collecting sheet.

c. Statistical Analysis:

Analysis of variance (ANOVA) was used to determine whether a significant difference in infestation existed due to gender, class level, and school type. Correlation between age and infestation was calculated by Pearson's R and Spearman correlation.

Levels of significance were used on tests namely 0.05, 0.001, 0.0001. Data were presented with tables and graphs

RESULTS

Data analysis indicated the overall prevalence of head louse infestation in Karachi was 25.3% (1018) children were found to have head louse infestation (Table 2). The results obtained from the comparative prevalence of head louse infestation between Primary & Secondary school children in Karachi are shown in (Table 1). 4025 students were examined, out of which 2000 were Primary and 2025 were Secondary school students. Infestation between primary and secondary schools differed significantly ($F=4.596$, $P<0.05$) (Appendix 1). Infestation in Primary schools (28.72%) was found to be higher as compared to Secondary school children (21.90%) (Fig.2, Table 2). Mean infestation in Primary schools was found slightly higher (2.447) than that of the Secondary schools (2.144) (Table 3).

Comparative prevalence of head louse infestation between Government and Private school children in Karachi is shown in (Fig. 3 and Table. 5). A highly significant difference in intensity of infestation was found between Government and Private schools ($F=48.488$, $P<0.001$) (Appendix 2). Infestation in Govt. schools (32.90%) was found to be higher as compared to Private schools (17.60%) (Table.2). The average infestation was found more in Govt. schools (2.662) as compared to Private schools (1.655) (Table 4).

Table 2. Overall prevalence of *Pediculus humanus capitis* (Head louse) infestation among school children across all districts of Karachi.

Districts of Karachi	No. of Schools	No. of students examined	Infection			
			No		Yes	
			Number	%	Number	%
Central	16	825	558	67.6%	267	32.4%
East	16	800	605	75.6%	195	24.4%
Malir	16	800	629	78.6%	171	21.4%
South	16	800	648	81.0%	152	19.0%
West	16	800	567	70.9%	233	29.1%
Total	80	4025	3007	74.7%	1018	25.3%

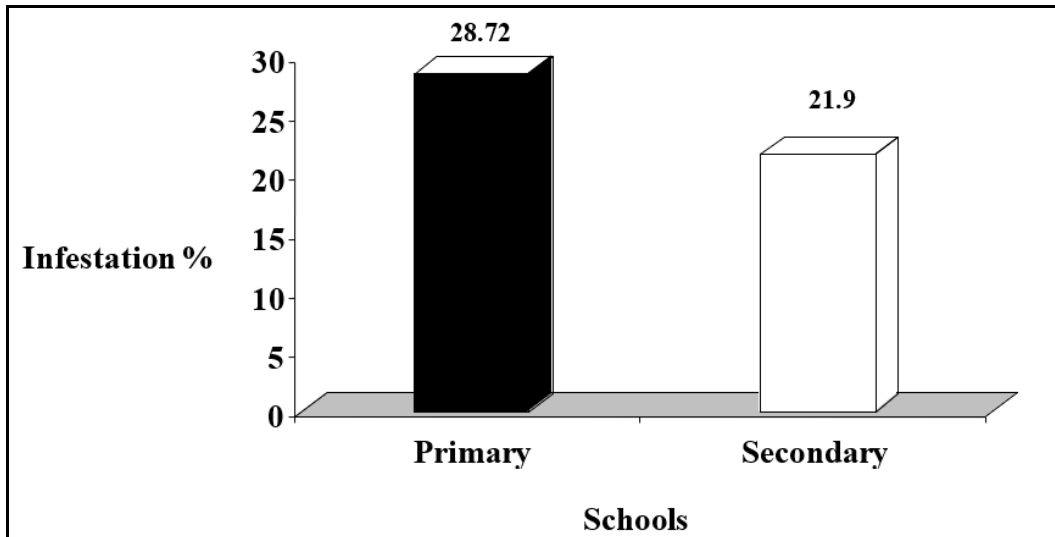


Fig.2 Comparative *Pediculus humanus capitis* (Head louse) infestation between Primary and Secondary schools of Karachi.

Table 3. Significance of means for prevalence of *Pediculus humanus capitis* (Head louse) infestation in school children across all districts of Karachi.

Sr#	Name of districts	No. infested	Means	Variance
1.	Central	267	2.831	9.366
2.	East	195	2.143	2.587
3.	Malir	171	2.087	3.409
4.	South	152	2.032	4.151
5.	West	233	2.218	3.551

Table 4. Average infestation (per student) of different stages of *Pediculus humanus capitis* (Head louse) across all Districts of Karachi.

Districts of Karachi	Different stages of louse			
	Adult	Nymph	Nits	Overall
	$\bar{X} \pm S. E$	$\bar{X} \pm S. E$	$\bar{X} \pm S. E$	$\bar{X} \pm S. E$
Central	0.41 ± 0.037	0.42 ± 0.047	0.09 ± 0.017	0.93 ± 0.076
East	0.20 ± 0.021	0.24 ± 0.025	0.10 ± 0.014	0.53 ± 0.044
Malir	0.22 ± 0.025	0.17 ± 0.024	0.05 ± 0.010	0.45 ± 0.043
South	0.20 ± 0.028	0.14 ± 0.021	0.04 ± 0.010	0.39 ± 0.042
West	0.23 ± 0.021	0.22 ± 0.027	0.20 ± 0.027	0.65 ± 0.051

Similarly, the comparative prevalence of head louse infestation between Boys and Girls school children is shown in (Fig. 3 and Table. 5). Comparative prevalence (%) of *Pediculus humanus capitis* (Head louse) infestation between primary and secondary schools of Karachi is given in Table 6. However, the prevalence of infestation between Boys and Girls schools did not differ significantly ($P > 0.05$) (Appendix. 3). Significance of means for comparative prevalence of *Pediculus humanus capitis* (Head louse) infestation between Primary and Secondary schools of Karachi presented in Table 7. Average infestation (per student) of different stages of *Pediculus humanus capitis* (Head louse) in Primary and Secondary schools of Karachi is tabulated in Table 8. Comparative prevalence (%) of *Pediculus humanus capitis* (Head louse) infestation between Government and Private schools across all districts of Karachi is given in Table 9. The table 10. Is showing Comparative prevalence (%) of *Pediculus humanus capitis* (Head louse) infestation between Government and Private schools of Karachi. Significance of means for comparative prevalence of *Pediculus humanus capitis* (Head louse) infestation between Government and Private schools of Karachi is tabulated in Table 11. Average infestation (per student) of different stages of *Pediculus humanus capitis* (Head louse) in Government and Private schools of Karachi Table 12. The prevalence of head louse infestation in Girls (27.80%) was found to be higher as compared to the Boys, (22.90%) (Table 13). Average infestation in Boys (2.31533) and in Girls (2.31531) is almost equal (Table 14). Significance of means for comparative prevalence of *Pediculus humanus capitis* (Head louse) infestation between Girls and Boys schools of Karachi is given in Table 15. Table. While average infestation (per student) of different stages of *Pediculus humanus capitis* (Head louse) in Boys and Girls schools of Karachi is shown in Table.16.

Head louse infestation in different classes is shown in (Fig. 4 and Table 17). The highest rate of infestation was found in class-VI (12.18%) and the lowest rate of infestation was found in Class-X (5.89%). The prevalence of infestation differed significantly ($F = 3.221$, $P < 0.001$) in different classes (Appendix 4). The significance of mean differences for the comparative prevalence of *Pediculus humanus capitis* (Head louse) infestation in different classes of school children in Karachi is shown in (Table 18). The infestation in different age students is shown in (Fig. 5 and Table 19). *Pediculus humanus capitis* (Head louse) infestation in different age of school children in Karachi region is shown in Fig.6. The highest rate of infestation was found in 12 years students (15.13%), while the lowest rate of infestation was found in 19 years students (0.09%). Correlation between age and infestation also indicated that infestation is negatively correlated by age (-0.079) (Appendix 5). The

significance of mean differences for the comparative prevalence of *Pediculus humanus capitis* (Head louse) infestation in different aged school children in Karachi is shown in (Table 20). Correlation between Age and Infestation of *Pediculus humanus capitis* (Head louse) is indicated in Appendix 6.

Table 5. Comparative prevalence (%) of *Pediculus humanus capitis* (Head louse) infestation between primary and secondary schools across all districts of Karachi.

Districts of Karachi	Infection			
	No		Yes	
	Number	%	Number	%
<i>Primary Schools</i>				
Central	262	65.5	138	34.5
East	275	68.75	125	31.25
Malir	317	79.25	83	20.75
South	321	80.25	79	19.75
West	251	62.75	149	37.25
Total	1426	71.3	574	28.72
<i>Secondary Schools</i>				
Central	296	69.65	129	30.35
East	330	82.5	70	17.5
Malir	312	78	88	22
South	327	81.75	73	18.25
West	316	79	84	21
Total	1581	78.07	444	21.90

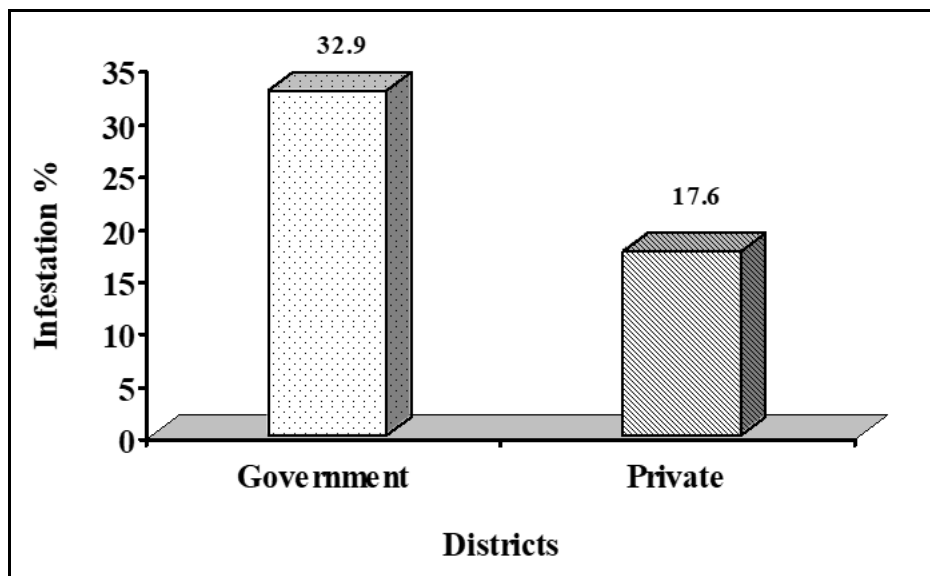


Fig.3: Comparative *Pediculus humanus capitis* (Head louse) infestation between Government and Private schools of Karachi

Table 6. Comparative prevalence (%) of *Pediculus humanus capitis* (Head louse) infestation between primary and secondary schools of Karachi.

School section	Infestation			
	No		Yes	
	Number	%	Number	%
Primary	1426	71.30%	574	28.72%
Secondary	1581	78.07%	444	21.90%
Total	3007	74.70%	1018	25.3 %

Table 7. Significance of means for comparative prevalence of *Pediculus humanus capitis* (Head louse) infestation between Primary and Secondary schools of Karachi

Sr#	Schools	No. infested	Means	Variance
1.	Primary	574	2.447	6.247
2.	Secondary	444	2.144	3.432

Table 8. Average infestation (per student) of different stages of *Pediculus humanus capitis* (Head louse) in Primary and Secondary schools of Karachi.

Districts Of Karachi	Different stages of louse			
	Adult	Nymph	Nits	Overall
	$\bar{X} \pm S. E$	$\bar{X} \pm S. E$	$\bar{X} \pm S. E$	$\bar{X} \pm S. E$
Primary	0.26 ± 0.016	0.30 ± 0.023	0.15 ± 0.014	0.71 ± 0.039
Secondary	0.25 ± 0.018	0.18 ± 0.014	0.05 ± 0.006	0.48 ± 0.028

Table 9. Comparative prevalence (%) of *Pediculus humanus capitis* (Head louse) infestation between Government and Private schools across all districts of Karachi.

Districts of Karachi	Infection			
	No		Yes	
	Number	%	Number	%
<i>Government Schools</i>				
Central	247	58.11	178	41.88
East	262	65.5	138	34.5
Malir	312	78	88	22
South	303	75.75	97	24.25
West	234	58.5	166	41.5
Total	1358	67.06	667	32.90
<i>Private Schools</i>				
Central	311	77.75	89	22.25
East	343	85.75	57	14.25
Malir	317	79.25	83	20.75
South	345	86.25	55	13.75
West	333	83.25	67	16.75
Total	1649	82.45	351	17.60

Table 10. Comparative prevalence (%) of *Pediculus humanus capitis* (Head louse) infestation between Government and Private schools of Karachi.

School type	Infestation			
	No		Yes	
	Number	%	Number	%
Government	1358	67.10%	667	32.90%
Private	1649	82.50%	351	17.60%
Total	3007	74.70%	1018	25.30%

Table 11. Significance of means for comparative prevalence of *Pediculus humanus capitis* (Head louse) infestation between Government and Private schools of Karachi

Sr#	Schools	No. infested	Means	Variance
1.	Government	667	2.662	6.473
2.	Private	351	1.655	1.655

Table 12. Average infestation (per student) of different stages of *Pediculus humanus capitis* (Head louse) in Government and Private schools of Karachi.

Schools of Karachi	Different stages of louse			
	Adult	Nymph	Nits	Overall
	$\bar{X} \pm S. E$	$\bar{X} \pm S. E$	$\bar{X} \pm S. E$	$\bar{X} \pm S. E$
Government	0.35 ± 0.021	0.37 ± 0.025	0.17 ± 0.014	0.89 ± 0.043
Private	0.16 ± 0.011	0.11 ± 0.010	0.02 ± 0.006	0.29 ± 0.019

Table 13. Comparative prevalence (%) of *Pediculus humanus capitis* (Head louse) infestation between Girls and Boys schools across all districts of Karachi.

Districts of Karachi	Infection			
	No		Yes	
	Number	%	Number	%
<i>Girls Schools</i>				
Central	236	59	164	41.0
East	300	75	100	25.0
Malir	318	79.5	82	20.5
South	322	80.5	78	19.5
West	269	67.25	131	32.75
Total	1445	72.3	555	27.80
<i>Boys Schools</i>				
Central	322	75.76	103	24.24
East	305	76.25	95	23.75
Malir	311	77.75	89	22.25
South	326	81.5	74	18.5
West	298	74.5	102	25.5
Total	1562	77.10	463	22.90

Table 14. Comparative prevalence (%) of *Pediculus humanus capitis* (Head louse) infestation between Girls and Boys schools of Karachi.

Sex	Infestation			
	No		Yes	
	Number	%	Number	%
Girls	1445	72.30%	555	27.80%
Boys	1562	77.10%	463	22.90%
Total	3007	74.70%	1018	25.3%

Table 15. Significance of means for comparative prevalence of *Pediculus humanus capitis* (Head louse) infestation between Girls and Boys schools of Karachi.

Sr#	Schools	No. infested	Means	Variance
1.	Boys	463	2.315335	4.095
2.	Girls	555	2.315315	5.833

Table 16. Average infestation (per student) of different stages of *Pediculus humanus capitis* (Head louse) in Boys and Girls schools of Karachi.

Schools Of Karachi	Different stages of louse			
	Adult	Nymph	Nits	Overall
	$\bar{X} \pm S. E$	$\bar{X} \pm S. E$	$\bar{X} \pm S. E$	$\bar{X} \pm S. E$
Boys	0.21 ± 0.014	0.22 ± 0.017	0.10 ± 0.011	0.53 ± 0.031
Girls	0.30 ± 0.020	0.25 ± 0.021	0.10 ± 0.010	0.65 ± 0.037

Table 17. Prevalence of *Pediculus humanus capitis* (Head louse) infestation in different classes of school children in Karachi.

Classes	Infestation				Total
	No		Yes		
	Number	%	Number	%	
I	278	9.26	122	11.98	400
II	280	9.31	120	11.78	400
III	280	9.31	120	11.78	400
IV	286	9.51	114	11.19	400
V	302	10.04	98	9.63	400
VI	281	9.34	124	12.18	405
VII	301	10.01	104	10.22	405
VIII	321	10.67	84	8.25	405
IX	333	11.07	72	7.07	405
X	345	11.47	60	5.89	405
Total	3007	74.71	1018	25.3	4025

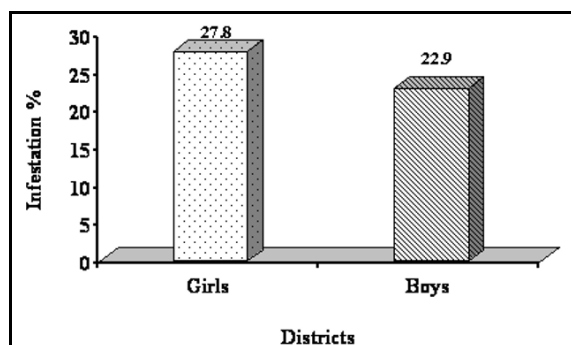


Fig.4: Comparative *Pediculus humanus capitis* (Head louse) infestation between Girls and Boys schools of Karachi.

Table 18. Significance of mean differences for comparative prevalence of *Pediculus humanus capitis* (Head louse) infestation in different classes of school children in Karachi

Class comparison	Mean difference	Std. error	Prob.	95% Confidence interval		
				Lower bound	Upper bound	
I	5	0.327(*)	0.107	0.002	0.12	0.54
	7	0.285(*)	0.106	0.007	0.08	0.49
	8	0.428(*)	0.106	0	0.22	0.64
	9	0.576(*)	0.106	0	0.37	0.78
	10	0.549(*)	0.106	0	0.34	0.76
II	8	0.253(*)	0.106	0.017	0.04	0.46
	9	0.401(*)	0.106	0	0.19	0.61
	10	0.374(*)	0.106	0	0.17	0.58
III	8	0.246(*)	0.106	0.021	0.04	0.45
	9	0.394(*)	0.106	0	0.19	0.6
	10	0.367(*)	0.106	0.001	0.16	0.58
IV	8	0.258(*)	0.106	0.015	0.05	0.47
	9	0.406(*)	0.106	0	0.2	0.61
	10	0.379(*)	0.106	0	0.17	0.59
V	1	-0.327(*)	0.107	0.002	-0.54	-0.12
	9	0.249(*)	0.106	0.019	0.04	0.46
	10	0.222(*)	0.106	0.037	0.01	0.43
VI	8	0.257(*)	0.106	0.016	0.05	0.46
	9	0.405(*)	0.106	0	0.2	0.61
	10	0.378(*)	0.106	0	0.17	0.59
VII	1	-0.285(*)	0.106	0.007	-0.49	-0.08
	9	0.291(*)	0.106	0.006	0.08	0.5
	10	0.264(*)	0.106	0.013	0.06	0.47
VIII	1	-0.428(*)	0.106	0	-0.64	-0.22
	2	-0.253(*)	0.106	0.017	-0.46	-0.04
	3	-0.246(*)	0.106	0.021	-0.45	-0.04
	4	-0.258(*)	0.106	0.015	-0.47	-0.05
	6	-0.257(*)	0.106	0.016	-0.46	-0.05
IX	1	-0.576(*)	0.106	0	-0.78	-0.37
	2	-0.401(*)	0.106	0	-0.61	-0.19
	3	-0.394(*)	0.106	0	-0.6	-0.19
	4	-0.406(*)	0.106	0	-0.61	-0.2
	5	-0.249(*)	0.106	0.019	-0.46	-0.04
	6	-0.405(*)	0.106	0	-0.61	-0.2
	7	-0.291(*)	0.106	0.006	-0.5	-0.08
X	1	-0.549(*)	0.106	0	-0.76	-0.34
	2	-0.374(*)	0.106	0	-0.58	-0.17
	3	-0.367(*)	0.106	0.001	-0.58	-0.16
	4	-0.379(*)	0.106	0	-0.59	-0.17
	5	-0.222(*)	0.106	0.037	-0.43	-0.01
	6	-0.378(*)	0.106	0	-0.59	-0.17
	7	-0.264(*)	0.106	0.013	-0.47	-0.06

• The mean difference is significant at the 0.05 level.

Table 19. Prevalence of *Pediculus humanus capitis* (Head louse) infestation in different aged school children in Karachi.

Age (In years)	Infestation				Total
	No		Yes		
	Number	%	Number	%	
4	3	0.09	0	0	3
5	44	1.46	17	1.67	61
6	106	3.53	60	5.89	166
7	180	5.98	71	6.97	251
8	233	7.75	93	9.14	326
9	230	7.65	82	8.06	312
10	328	10.91	134	13.16	462
11	332	11.04	139	13.65	471
12	457	15.19	154	15.13	611
13	318	10.58	109	10.71	427
14	347	11.54	74	7.27	421
15	235	7.82	57	5.59	292
16	151	5.02	20	1.96	171
17	33	1.09	4	0.39	37
18	7	0.23	3	0.29	10
19	3	0.09	1	0.09	4
Total	3007	74.71	1018	25.31	4025

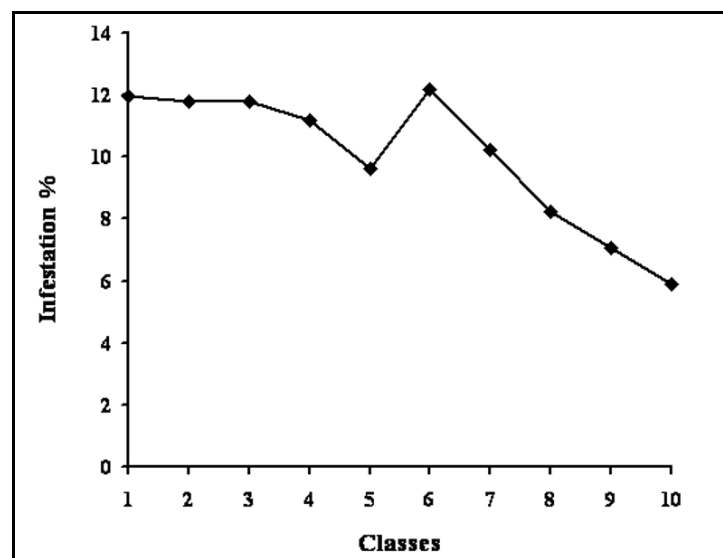
**Fig.5:** *Pediculus humanus capitis* (Head louse) infestation in different classes of school children in Karachi.

Table 20. Significance of mean differences for comparative prevalence of *Pediculus humanus capitis* (Head louse) infestation in different aged school children in Karachi.

Age comparison		Mean difference	Std. error	Prob.	95% Confidence interval	
					Lower bound	Upper bound
6	8	0.332(*)	0.144	0.021	0.05	0.61
	9	0.329(*)	0.145	0.024	0.04	0.61
	10	0.331(*)	0.137	0.015	0.06	0.6
	11	0.329(*)	0.136	0.016	0.06	0.6
	12	0.332(*)	0.132	0.012	0.07	0.59
	13	0.342(*)	0.138	0.013	0.07	0.61
	14	0.642(*)	0.139	0	0.37	0.91
7	15	0.597(*)	0.147	0	0.31	0.88
	16	0.683(*)	0.165	0	0.36	1.01
	17	0.673(*)	0.275	0.014	0.13	1.21
	14	0.397(*)	0.121	0.001	0.16	0.63
	15	0.352(*)	0.13	0.007	0.1	0.61
	16	0.439(*)	0.15	0.003	0.14	0.73
	18	-0.975(*)	0.488	0.046	-1.93	-0.02
8	6	-0.332(*)	0.144	0.021	-0.61	-0.05
	14	0.310(*)	0.112	0.005	0.09	0.53
	15	0.265(*)	0.122	0.03	0.03	0.5
	16	0.351(*)	0.143	0.014	0.07	0.63
	18	-1.062(*)	0.485	0.029	-2.01	-0.11
9	6	-0.329(*)	0.145	0.024	-0.61	-0.04
	14	0.313(*)	0.113	0.006	0.09	0.53
	15	0.268(*)	0.123	0.03	0.03	0.51
	16	0.354(*)	0.144	0.014	0.07	0.64
	18	-1.059(*)	0.486	0.029	-2.01	-0.11
10	6	-0.331(*)	0.137	0.015	-0.6	-0.06
	14	0.311(*)	0.102	0.002	0.11	0.51
	15	0.265(*)	0.113	0.019	0.04	0.49
	16	0.352(*)	0.135	0.009	0.09	0.62
	18	-1.061(*)	0.483	0.028	-2.01	-0.11
11	6	-0.329(*)	0.136	0.016	-0.6	-0.06
	14	0.313(*)	0.101	0.002	0.11	0.51
	15	0.268(*)	0.113	0.017	0.05	0.49
	16	0.355(*)	0.135	0.009	0.09	0.62
	18	-1.059(*)	0.483	0.029	-2.01	-0.11
12	6	-0.332(*)	0.132	0.012	-0.59	-0.07
	14	0.311(*)	0.096	0.001	0.12	0.5
	15	0.265(*)	0.108	0.014	0.05	0.48
	16	0.352(*)	0.131	0.007	0.1	0.61
	18	-1.062(*)	0.482	0.028	-2.01	-0.12

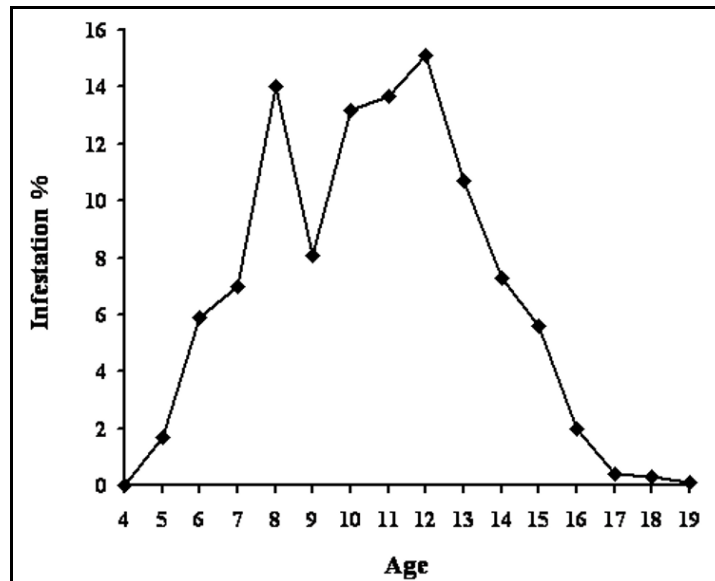


Fig. 6: *Pediculus humanus capitis* (Head louse) infestation in different age of school children in Karachi region.

APPENDIX:

Appendix 1. ANOVA for prevalence of *Pediculus humanus capitis* (Head louse) infestation in school children across all districts of Karachi.

Source	Degree of freedom	Sum of squares	Mean of squares	F-value	P-value	F crit
Between Districts	4	100.029	25.007	5.042519	0.001	2.380717
Within Districts	1013	5023.752	4.959			
Total	1017	5123.781				

Appendix 2. ANOVA for comparative prevalence of *Pediculus humanus capitis* (Head louse) infestation between Primary and Secondary schools of Karachi.

Source	Degree of freedom	Sum of squares	Mean of squares	F-value	P-value	F crit
Between Pri. & Sec.	1	23.074	23.074	4.596088166	0.032282	3.850627526
Within Pri. & Sec.	1016	5100.707	5.020			
Total	1017	5123.781				

Appendix 3. ANOVA for comparative prevalence of *Pediculus humanus capitis* (Head louse) infestation between Government and Private schools of Karachi.

Source	Degree of freedom	Sum of squares	Mean of squares	F-value	P-value	F crit
Between Govt. & Priv.	1	233.392	233.392	48.48839	5.95703E-12	3.85062753
Within Govt. & Priv.	1016	4890.388	4.813			
Total	1017	5123.781				

Appendix 4. ANOVA for comparative prevalence of *Pediculus humanus capitis* (Head louse) infestation between Boys and Girls schools of Karachi.

Source	Degree of freedom	Sum of squares	Mean of squares	F-value	P-value	F crit
Between Boys & Girls	1	9.55E-08	9.55E-08	1.8928E-08	0.999890254	3.85062753
Within Boys & Girls	1016	5123.781	5.043091			
Total	1017	5123.781				

Appendix 5. ANOVA for prevalence of *Pediculus humanus capitis* (Head louse) infestation in different classes of schools children in Karachi.

Source	Degree of freedom	Sum of squares	Mean square	F-value	Prob.
Between Classes	15	110.48	7.365	3.221	0.0001
Within Classes	4009	9166.95	2.287		
Total	4024	9277.42			

Appendix 6. Correlation between Age and Infestation of *Pediculus humanus capitis* (Head louse).

		Value	Prob
Pearson' s R	Interval by Interval	-0.079	0.0001(c)
Spearman correlation	Ordinal by Ordinal	-0.098	0.0001(c)
	Total	4025	

DISCUSSION

Head louse infestation is noted in both developed and developing countries. There are many surveys on the extent of head lice infestation, particularly among school children.

In the present study, the overall prevalence rate among school children has been found to be 25.3%. Previous studies in Pakistan by (Naheed, A. and Faiqa, R. 2004) in Dera Ismail Khan, (Kazmi *et al.*, 1993) in Lahore and (Suleman, M. and Fatima, T. 1988) in Peshawar reported 26%, 25.5%, and 46% infestation in school children respectively. Figures of (Naheed, A. and Faiqa, R. 2004) and (Kazmi *et al.*, 1993) are comparable to the present study. Present observations indicate that the prevalence of head louse in Primary and Government schools was found to be higher than Secondary and Private schools. One possible explanation may be: that Primary school children usually do not have awareness of good personal hygiene, close physical contact in classrooms as well as the closer physical contacts during play, make them more vulnerable to infestation. (Speare R. and Buettner PG 1999 and 2000) also studied that in Australia classes as the major arena of head louse transmission. On the other hand, Secondary school children have a better awareness of personal appearance and hygiene.

In Government schools of Karachi, education is nearly free of cost, but other facilities are not so good, so the majority of students in Government schools belong to poor or lower socio-economic classes, these people live in small houses with large family size, as well as a large number of children per family, they have a water problem, cannot maintain cleanliness for themselves, because of the large number of children in a family, ignorance is very common. In the majority of Government schools, regular or weakly health inspection and hygiene encouraging activities were not noticed during the survey, medical or nursing facilities for children were not also available. So lower socio-economic conditions, a large number of children, large family size, minimum health and hygiene facilities, less attention and ignorance may be the main factors of high infestation in Government schools (Fatima, S (2008), These findings are in agreement with the results from other studies: (Busvine, J.R. 1980) found that the percentage of head lice infestation increased with the number of persons in the family (Suleman, M. and Jabeen, N. 1989), (Mahmud et al, 2011) also identified that younger age,

household crowding and socioeconomic status, and infrequent bathing in summer independently associated with head lice infestation (Rukke *et al.*, 2011), suggested that increased head lice prevalence is related to the number of children, (Naheed A., and Faiqa, R. 2004) and (Kazmi *et al.*, 1993) reported more infestation in the lower socio-economic group. Cleanliness and frequent bath decrease the prevalence of the head lice infestation. Synchronized inspection and subsequent treatment remain the best strategy to remove a collective infestation within a short time Ibarra *et al.*, (2009). This is in line with earlier recommendations suggested by (Mumcuoglu *et al.*, 2007). Borrer, D.J., and Delong, D.M. 1971 are of the opinion that people who take bath and change clothes regularly seldom become infested with lice. Biannual nationwide campaigns supported by schools are important in this aspect as they improve checking frequency (Rukke *et al.*, 2012 & 2014).

In the present study age-specific prevalence rate also supports the factor that children of 4 to 8 years show increased infestation with the increase of age, the peak infestation is seen in the twelfth year of age but after twelve, infestation decreases gradually with increase of age, very low infestation was observed in 19 years of age. As the children are most active in the 12th year of age, so they are more susceptible to infestation. These findings are concordant with (Suleman, M. and Jabeen, N. 1989). (Borges, R. and Mendes, J. 2002) also observed an increase in the prevalence rate with an increase of age, up to 12 years. Prevalence is generally higher among children than adults (Burgess *et al.*, 1995).

In Quetta Pakistan (S. Saddozai and J.K. kakarsulemankhel.2008) observed that prevalence decreased with age in both sexes and was found to be high in five to nine-year-old age group. In Iran (Hodjati *et al.*, 2008) reported a lower infestation rate of 6.5% among girls aged 10 - 14 years and 1.6% among those aged 15 -18 years,(Pai *et al.*, 1989) identified a similar trend of decreasing infestation rates among women with increasing age after 12 year, but (Mossong *et al.*, 2008) found that contact rates were highest among 5-19-year-old individuals in Europe.

It is further revealed from the present study that infestation is found in all school children i.e. Primary, Secondary, Government, Private, Girls, and Boys. The rate of infestation among boys (22.90%) and girls (27.80%) does not show a significant difference, but the infestation is higher in girls than boys. Higher infestation in girls may be attributed to the long hairs in Karachi mostly girls have more long hairs than boys. The factor of hair-length may be present in different degrees of importance in head louse distribution. (Suleman, M. and Jabeen, N. 1989) indicated that a direct relationship between Pediculosis and hair length is now almost established, it has also been indicated in earlier studies (Busvine, J.R., and Reid, J.A. 1949); (Sinniah *et al.*, 1981, 1983); (Suleman, M. and Fatima, T. 1988); (Linardi *et al.*, 1989) and (Mumcuoglu *et al.*, 1990). Hair length proved more important than sex in one study (Willems *et al.*, 2005) whereas less important in another (Counahan *et al.*, 2004). Association of infestation with respect to student's academic class was also observed. It was demonstrated that with the increase of class standard, infestation decreases gradually, from class one to five, but surprisingly infestation increases in class sixth and then starts decreasing gradually with class standards. This sudden increase of infestation in class six may be due to the fact that class sixth is the first class in secondary school. Most children come from different Primary schools, in this class of Secondary school, they are more excited about the new school, and for better adjustment in this new class they interact with each other and make friends, so become more vulnerable to the infestation. (Fatima, S. 2008)

Conclusion

It is revealed from the present study that head louse infestation is common in Karachi and is found almost in all school children without any respect of Gender. Infestation is not noticeably different in Boys and Girls, but Primary and Government school children are more

susceptible to infestation than Secondary and Private school children. It is also encountered that prevalence of infestation decreases in higher class students and age groups. It is further concluded that hair length may be an important factor, but age, poverty, hygiene, physical contact, and ignorance are contributing factors in the spread of head lice, it is important to note that ignorance may be the most important factor.

Recommendations

Rising the awareness about maintaining personal hygiene at schools, homes can considerably improve the social and psychological health of school-going children. Use of effective soaps/shampoos for keeping personal hygiene, but emphasis should not be on antibacterial cleaning agents as they have toxic chemicals like triclosan which is a suspected carcinogen, and other pesticide agents should be avoided to use, machine oil, as this material can be harmful. Never use gasoline or kerosene or other flammable liquids as home remedies, children have been killed or severely burned as a result of the accident that occurred while using these flammable liquids. For public awareness, programs through electronic media such as lectures, discussions can be arranged with the help of experts on lice infestation, harmful effects, biology, prevention, and control measures.

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