Pakistan J. Zool., vol. 40(1), pp. 45-52, 2008.

Infestation of Head Lice, *Pediculus humanus capitis*, in School Children at Quetta City and its Suburban Areas, Pakistan*

SHAGUFTA SADDOZAI AND JUMA KHAN KAKARSULEMANKHEL**
Sardar Bahadur Khan Women University, Quetta (SS) and Department of Zoology, University of Balochistan, Quetta (JKK)

Abstract.- The incidence of human head lice infestation (HLI) among 1560 school children, both sexes, of Quetta city and its suburbs of different socio-economic levels with seasonal variation, bathing frequency, lubrication, hair length, age and sex, presence or absence of dandruff and with separate or shared bedding has been studied during June to August and November to December, 2005 and March 2006. Over all, 1352 students (87%) were found infested with nits, immature or adult of *Pediculus humanus capitis.* Girls showed a high prevalence (86%) than boys (14%). Among school girls, the HLI rates were 94%, 88% and 67% in L, M, and H socioeconomic groups, respectively. School children of 5 to 9 years-old exhibited higher prevalence rate (93% in girls and 49% in boys), while prevalence declined to 80% in girls and 36% in boys for 10-13 years-old, respectively. Prevalence decreased with age in both sex and was found to be inversely related to hair length. Infestation was observed to be high in five to nine years-old age group. Direct association of pediculosis was also found with hair lubrication and crowding, whereas, negative association was found with dandruff. This study concludes that socioeconomic status is a major factor influencing the occurrence of pediculosis among school children of both sexes in Quetta, Balochistan.

Key words: School children, pediculosis, *Pediculus humanus capitis*, Quetta, Pakistan

INTRODUCTION

Lice are permanent, obligatory ecto-parasites spending their entire life cycle on the host (Butler, 1985).Three distinct varietes of lice are specifically parasitic for humans. Two of them, *Pediculus humanus capitis* De Geer (Anoplura: Pediculidae), the head louse, and *Pediculus humanus humanus*, the body louse, are closely related variants of the same species, despite their different habits and habitats. The third species is *Phthirus pubis*, the pubic louse commonly known as the "crab louse" (Goldstein and Goldstein, 2006). Not only do the bites of *P.h. humanus* irritate but the victim can also become highly sensitive resulting in the tissue reaction that are extremely irritating. Human skin, subjected to lose bites over long period often become deeply pigmented – a condition known as vagabond's disease (Cheng, 1986). *P.h. humanus* is a major vector of three important diseases–relapsing fever, louse borne typhus and trench fever (Service, 1986). *P.h. humanus* can transmit impetigo, trachoma, and cholera by simple mechanical contamination and this louse is the vector of exanthematous typhus caused by *Rickettsia prowazeki*, of trench fever caused by *Rickettsia quintana* (*Borrelia quintana*) and of louse borne relapsing fever caused by *Spirochaeta recurrentis* (*Borrelia recurrenti*) (Noble and Noble, 1961; Service, 1986). However, according to National Association of School Nurses (NASN, 1999) and Vessey (2000) *P.h. capitis* are not known to be vectors for illnesses. Complications of infestations are rare and involve secondary bacterial skin infection. Pruritis is the most common symptom.

The number of cases of human louse infestation has increased world-wide since the mid-1960s (Gratz, 1998), reaching hundreds of millions annually (Taplin and Meinking, 1987). Lice infestation can spread rapidly and may reach epidemic proportions if left unchecked. In a group of people, such factors as age, race, sex, crowding at

0030-9923/2008/0001-0045 $ 8.00/0

* Part of M.Phil. thesis of first author, University of Balochistan, Quetta.

** Corresponding author: jumakhankakar@yahoo.co.uk

home, family size, method of closeting clothes and socioeconomic status influence the course and distribution of the disease (Slonka *et al.,* 1975; Weems-Jr and Thomas, 1999).

An increased rate of louse infestation was reported in recent years from a number of countries including north and south America, Europe, Asia and Australia (Gratz, 1998; Mumcuoglu, 1999; Speare and Buettner, 1999; Burkhart and Burkhart, 2000). Many families with young children have at least one encounter with the head louse, *P.h. capitis.* Head lice can infest people of all ages, but children are prone to infestations because of their habit of playing in close contact, sharing hats, head-phones, combs and brushes and clothing (Rust *et al.,* 2001). Several studies have been carried out on the prevalence of head lice infestation in school children in different parts of the world. The estimation of infestation rate in some reports were 2.4% in England (Donaldson, 1976), 10.7-12.9% in Malaysia (Sinniah *et al.,* 1981, 1983), 49% in Accra, Ghana (Kwaku-Kpikpi,1982), 5.7% in Nigeria (Ogunrinade and Oyejide, 1984), 17.1% in Kenya (Chunge, 1986), 12% in Saudi Arabia (Boyle, 1987), 46% in Peshawar, Pakistan (Suleman and Fatima, 1988), 25.5% in Lahore, Pakistan (Kazmi *et al.,*1993), 59.7% in Shillong, India (Roy and Tandon, 1992), 6.8% in Sierra Leone (Gbakima and Lebbie, 1992), 37.2% in Korea (Huh *et al.,*1993), 75% in Dhaka, Bangladesh (Burgess *et al.,* 1994), 81.5%, 80% and 61.4% in Argentina (Chouela *et al.,* 1997; Ramirez *et al.,* 2003; Catala *et al.,* 2005), 95% in Australia (Speare and Buettner, 1999), 5.59% in Egypt (El-Basheir and Fouad, 2002), 16.59% in Delhi (Khokhar, 2002), 14.2% in Thailand (Fan *et al.,* 2004), 8.9% in Belgium (Willems *et al.,* 2005) and 14.1% in Czech Republic (Rupes *et al.,* 2006). Petrelli *et al.* (1980) have also reported high prevalence of head lice in school children in Italy.

In Pakistan head lice infestation among school children was studied by Kazmi *et al.* (1993), Suleman and Fatima (1988), Suleman and Jabeen (1989), and Ali and Ramzan (2004). Different comments have been given by some of these authors about the role of factors like age, sex and hair length in the distribution of head lice among school children. In Balochistan Province no such type of investigation has ever been carried out before. This paper provides the information about the prevalence of head lice infestation in school children of Quetta city and suburban areas and effects of different factors contributing to their transmission and prevalence. Some practices that increase the infestation rate in Pakistani community are discussed.

PATIENTS AND METHODS

The prevalence of head lice infestation was studied among 1560 school children including 1345 girls and 215 boys in 12 schools of Quetta city and its sub urban areas. The list of schools, the number of students for each school surveyed and the sample of children monitored for pediculosis are reported in Table I. The surveys and collections of head lice have been conducted between June 2005 to August 2005 and as well as in November, December 2005 and March 2006 from different Government and Non-Governmental school population, from class one to class eight. Children from these classes were able to respond to the questionnaire used in the survey. The detection of lice or egg by visual examination of the child's head and their classification into "not infested" and infested was also made according to Wegner *et al.* (1994).

Sampling methods

In order to evaluate the variation of infestation rate at school and regional level, a multilevel sampling strategy was necessary. We examined all students present in the class. Standard metadata was designed to record information on students such hair texture, presence of dandruff, number of lining rooms in the home and number of persons in the family, bedding, bathing frequency, lubrication. Number and stages of head lice was recorded at the time of collection. Screening of each student was done by visual examination of the head in sufficient day light, by combing of the hair with fine toothed comb on white paper for about 3-5 minutes.

School children were grouped in to three socio economic classes: low income group (L) (< Pak Rs. 5000 per month), middle income group (M)

(Pak Rs.5000 to 10,000 per month) and high income group (H) (Pak Rs. ≥10,000 per month). Any lice recovered was counted and killed by transferring to 70% alcohol for laboratory examination.

Statistical analysis

Chi-square test was applied for determining the association between two variables and also for comparison of prevalence rates among different age groups.

RESULTS

Prevalence

The crude prevalence rate of head lice infestation for each of the 12 schools surveyed at Quetta city and its suburbs is reported in Table I. The survey included a sample of 1560 school children of which 1345 were girls (86%). The cumulative prevalence rate observed was 87%.

Age and sex

The infestation rate varied according to age and sex as shown in Table II. It varied from 75% to 98% in girls with a peak in the 5 yeas age group. And in boys it varied from 55% to 20%. Overall girls were more infected and had a higher infestation rate 93% than boys 56%.

Hair length

Hair length was categorized into short, medium and long following the scheme of Sinnah *et al.* (1983) and Suleman and Fatima (1988) as short (above collar and ear), medium (above shoulder) and long (extending below shoulder) in 1345 girls. All of 215 boys had short hair. The infestation rate did not differ significantly ($\chi^2 = 0.73$, $\chi^2_{tab\ (0.05)(2)} = 5.99$). The prevalence rate was higher in short hair category than in medium and long hair category shown in the Table III. However, over all rate is insignificantly but opposite to expected direction i.e. infestation rate was higher in short hair category than in the medium and long hair categories.

Social-economic Groups

The present research shows the relation of prevalence of head louse with socio-economic groups by classifying the subject into three groups: high income group (Rs.> 10,000 p.m.): middle income group (Rs.5000-10,000 p.m.); low income group (<Rs. 5000 p.m.) is shown in Table IV. The present study shows that infestation rate was not depended upon on socio-economic status (Table IV, $\chi^2_{(cal)} = 134.91$, $\chi^2_{tab(0.05)\ (2)} = 5.99$).

Dandruff

The prevalence of lice was associated with dandruff and shows some relation with dandruff as shown in Table IV. Presence of dandruff reflects the dryness and roughness of the scalp, where head lice probably do not thrive wel, females not only keep long hair but are also in the habit of frequent use of various forms of the hair lubricant which effects the infestation of head lice. Data from all schools subjected to χ^2 test gave mixed results. The association between head lice infestation and dandruff was tested and result showed that children with dandruff are less likely to have head lice infestation. (Table IV, $\chi^2_{(cal)} = 4.96$, $\chi^2_{tab(0.05)\ (1)} = 3.841$, d.f . =1).

Lubrication

It has been observed that frequent use of oil also affect the infestation rate shown in Table IV which shows positive association of head lice infestation and frequent use of oil (Table IV, $\chi^2_{(cal)} = 5.22$, $\chi^2_{tab(0.05)\ (1)} = 3.841$, d.f. = 1). χ^2 shows close positive association between head lice infestation and lubrication.

Bedding (*separate / shared*)

Children having separate bedding and those with shared bedding has different infestation rate. Table IV shows close positive association between separate bedding and head lice infestation. (Table IV, $\chi^2_{(cal)} = 63.16$, $\chi^2_{tab(0.05)\ (1)} = 3.841$, df =1).

Bathing

Prevalence of head lice infestation in relation to bathing frequency of children was analyzed. Table IV ($\chi^2_{cal} = 109.5$, $\chi^2_{tab\ 0.05\ (3)} = 7.82$) which indicates association between head lice infestation

and bathing frequency by thrice a week, twice a week and weekly, even it was though that lice might not infest a person who take bath on frequent basis.

Table I.- Prevalence of head lice infestation in children of different schools at Quetta city and its suburbs.

Sr. No.	Schools	Total	Students examine for infestation		Positive for lice (%)	Status
			Male	Female		
1.	Apwa Girls High School	875	-	205	189 (92%)	Govt.
2.	Malik Yahya Girls High School	900	-	168	154 (92%)	-
3.	Haji Ghabi Girls High School	850	-	88	63 (71%)	-
4.	Quaid Education High School English Medium	700	78	69	120 (82%)	Private
5.	Nazz Darss High School	750	59	90	133 (89%)	-
6.	Lady Sandeman Girls High School	1200	-	278	248 (89%)	Govt.
7.	Abid Public School English Medium	500	25	88	100 (88%)	Private
8.	Dost Mohammad Memorial School Quetta	450	15	75	74 (82%)	-
9.	Little Fox English Medium High School Quetta	675	38	45	69 (83%)	-
10.	Quaid Milat Girls High School	500	-	136	115 (84%)	Govt.
11.	Saraib Mill High School Quetta	450	-	55	48 (87%)	-
12.	Mohsin Public Girls High School Brewrory Road Quetta	460	-	48	39 (81)	-
Total		**1560**	**215**	**1345**	**1352 (87%)**	

Table II.- Comparison of age specific prevalence of head lice infestation in school girls and boys at Quetta and its suburbs based on pooled data.

Age (Years)	Girls			Boys			Comparison χ^2
	n	+ve	Prevalence (%)	n	+ve	Prevalence (%)	
5	265	258	97	65	36	55	96.23*
6	179	173	98	30	15	50	62.23*
7	298	291	98	25	11	44	86.35*
8	197	194	98	20	08	40	25.75*
9	53	49	92	15	06	40	20.80*
10	100	85	85	20	09	45	18.17*
11	95	70	80	15	06	40	5.59*
12	88	74	84	15	05	33	23.85*
13	79	60	76	10	02	20	13.15*
Total	**1354**	**1254**		**215**	**98**		**364.27***

* = difference is significant: $\chi^2 \geq X^2_{0.05\,(1)} = 3.84$; $\chi^2_{tab} = \chi^2_{(0.05)\,(1)} = 3.84$.

DISCUSSION

Head lice infestation is a public health problem among school children in both developed and developing countries (Ali and Ramzan, 2004). Certainly, personal hygiene practices and socioeconomic status influence the level of prevalence (Zuhair *et al.*, 2000). There are many reports on the extent of head lice infestation, particularly among school children, however, rate of infestation vary greatly from place to place. In our study, average infestation rate was 79% which is attributed to the lower living standards and lack of awareness. The previous studies in Pakistan by Suleman and Fatima (1988) in Peshawar, Kazmi *et al.* (1993) and Ali and Ramzan (2004) in D.I. Khan recorded 45%, 25.5% and 26% in school children respectively. The present study sets a baseline for

monitoring the prevalence of Head lice infestation in school going children of Quetta city and its suburbs.

Table III.- Prevalence of head lice infestation in relation to hair length in girls students based on pooled data from twelve schools students at Quetta city and its suburbs.

Age (Years)	Short			Medium			Long			Comparison χ^2
	Sample	+ve	Prevalence (%)	Sample	+ve	Prevalence (%)	Sample	+ve	Prevalence (%)	
5	95	89	94	45	39	86	20	18	90	6.86^{*}
6	79	76	96	38	35	92	19	18	94	12.35^{*}
7	74	72	97	31	28	90	17	14	82	5.7^{ns}
8	69	65	94	45	42	93	20	18	90	10.24^{*}
9	78	74	94	39	36	92	25	22	88	3.10^{ns}
10	68	65	95	45	42	93	26	24	92	4.42^{ns}
11	63	59	93	50	48	96	35	33	94	15.55^{*}
12	69	65	94	63	59	93	40	39	97	11.18^{*}
13	70	68	97	67	64	95	45	42	93	6.05^{*}
Total	**675**	**633**		**423**	**393**		**247**	**228**		$\mathbf{0.73^{ns}}$

ns = difference not significant .

* = difference is significant: $\chi^2 \geq \chi^2_{0.05\,(2)} = 5.99$

Table IV.- Association of socioeconomic status, dandruff, frequency of use of oil, separate bedding and frequency of bathing on the infestation of body lice in school children in Quetta.

		No. of children infested with lice		
		N	Percent	
Income group	Low	730	685	94
	Middle	536	471	88
	Higher	294	195	67
Dandruff	With	524	440	84
	Without	1036	912	88
Frequency of use of oil	With	940	827	88
	Without	620	525	85
Separate bedding	With	517	398	77
	Without	1043	954	915
Bathing frequency	Thrice a day	273	225	82
	Twice a day	476	439	92
	Once a day	114	85	75
	Weekly	667	603	90

	$\chi^2_{(cal)}$	$\chi^2_{tab\,(0.05)}$	df
Income group	134.91	5.99	1
Dandruff	4.96	3.481	1
Use of oil	5.22	3.841	1
Bathing frequency	109.51	7.82	1
Separate bedding	63.16	3.84	1

Present study demonstrates that the prevalence of head lice was more prevalent in girls (87%) than boys (14%) in all age groups. Our results correlate well with the reports of Sinniah *et al.* (1981), Khokhar (2002), Suleman and Fatima (1988), Gbakima and Lebbie (1992), Speare and Buettner, 1999), El-Basheir and Fouad (2002), Kokturk *et al.* (2003), Catala *et al.* (2004, 2005) and Heukelbach *et al.* (2005). In Inchon, Korea, Hong *et al.* (1995) while studying infestation rate of head lice in Primary school children reported that infestation rate for girls was 19 times higher than that of boys. In our study the prevalence of active infection was not found uniform between schools and classes. Chunge (1986) while studying head ice infestation in among primary school children in Kenya reported that infestation was not sex related. Similarly, the distribution of head louse in male and females was found to be broadly similar by Boyle (1987). Hair length factor was found to be correlated with pediculosis in our study as the same was also observed by Sinniah *et al.* (1981, 1983), Suleman and Fatima (1988), Schenonel and Lobos (1997), El-Basheir and Fouad (2002), Ramirez *et al.* (2003), Ali and Ramzan (2004), Willems *et al.* (2005). We observed that head lice infestation is not

only problem of low class, even children of high class were also found infected with low rate as Gulati *et al.* (1981), Sinniah *et al.* (1981, 1983), Gbakima and Lebbie (1992), Kazmi *et al.* (1993), Pollack (1997), El-Basheir and Fauad (2002), Willems *et al.* (2005) is also of the opinion that lice do not respect socio-economic class distinction. However, opposite opinion was observed by Chouela *et al.* (1997) while studying head lice infestation in Argentinean school children that socioeconomic conditions are not relevant for infestation. Our study indicates a negative association between head lice infestation and dandruff. Suleman and Fatima (1988) and Ali and Ramzan (2004) also reported similar situation in their studies and they suggested that probably head lice do not like the dry and scaly habitat, which is the common characteristic of the head with dandruff. Present results reveal the direct association of head lice infestation with frequent use of oil (lubrication of hair) as the same findings were reported by Ali and Ramzan (2004). Shared bedding was also observed to be positively affecting the rate of infestation in our study while the same was also found to be correlating by Chunge (1986), Gbakima and Lebbie (1992), Chouela *et. al.* (1997). Khokhar (2002) while studying head lice infestation among Primary school children in Delhi, observed that those who shared both beddings and comb showed a statistically higher significance as compared to others.

Bathing (washing) factor was also noted in our study to be indirectly correlating with infestation as it was also observed by Borror and Delong (1971), Chunge (1986), Schenonel and Lobos (1997) and Ali and Ramzan (2004). It is worth mentioning that children enrolled in the school never undergo a routine inspection by the school private / Government medical doctor. Some of the children's families have been migrated from Afghanistan and Iran and normally have low socio economic status. Therefore, economic condition have great association with head lice infestation because poor economic conditions are likely to result in crowding at home as the same has been reported by Ali and Ramzan (2004) as well as playing together. It is suggested to adapt position of the National Association of School Nurses (NASN), Maryland, USA (NASN, 1999), that the management of pediculosis should not disrupt the education process. Children found with live head lice should be referred to parents for treatment. Data does not support school exclusion for nits. Because no disease process is associated with head lice, schools are not advised to exclude students when nits remain after appropriate lice treatment, although further monitoring for signs of re-infestation is appropriate. The school nurse, as student advocate and nursing expert, should be included in school district-community planning, implementation, and evaluation of vector control programs for the school setting. The school nurse, if any, retains an important role in educating all constituencies about pediculosis and dispelling myths and stigmas regarding lice infestation.

AKNOWLEDGEMENT

Thanks are due to the administration of Schools, who provided us access to the children for this investigation. We are also grateful to the children for their great co-operation.

REFERENCES

ALI, N. AND RAMZAN, F., 2004. Head lice infestation in school children at Dera Ismail Khan. *Pakistan J. Zool.*, **36**: 273-280.

BORROR, D. J. AND DELONG, D.M., 1971. *An introduction to the study of insects*, 3rd Edition. Holt, Rinehart and Winston, New York.

BOYLE, P., 1987. Pilot study of the prevalence of head lice infestation in a population of Saudi Arabian children. *Fam Pract.*, **4**: 138-142.

BURGESS, I. F., BROWN, C.M. AND BURGESS, N.A., 1994. Synergized pyrethrin mousse, a new approach to head lice eradication: efficacy in field and laboratory studies. *Pyrethrum Post*, **19**: 41-46.

BURKHART, C. N. AND BURKHART, C.G., 2000. The route of head lice transmission needs enlightenment for proper epidemiologic evaluations. *Int. J. Dermatol.*, **39**: 878-879.

BUTLER, J. F., 1985. Lice affecting livestock. In: *Livestock entomology* (eds. R. E. Williams, R. D. Hall, A. B. Broce and P. J. Scholl). pp. 101-127. Wiley, New York.

CATALA, S., CARRIZO, L., CORDOBA, M., KHAIRALLAH, R., MOSCHELLA, F., BOCCA, J.N., CALVO, A.N., TORRES, J. AND TUTINO, R., 2004. Prevalence and parasitism intensity by *Pediculus*

humanus capitis in six to eleven year old school children. *Rev. Soc. Bras. Med. Trop*., **37**: 499-501.

CATALA, S., JUNCO, L. AND VAPORAKY, R., 2005. *Pediculus capitis* infestation according to sex and social factors in Argentina. *Rev Salud Publica.*, **39**:438-443.

CHENG, T. C., 1986. *General parasitology*. 2nd Edition. Academic Press College Division, New York.

CHOUELA, E., ABELDANO, A., CIRIGLIANO, M., DUCARD, M., NEGLIA, V., LA FORGIA, M. AND COLOMBO, A., 1997. Head louse infestation: epidemiologic survey and treatment evaluation in Argentinean schoolchildren. *Int. J. Dermatol.*, **36**: 819-825.

CHUNGE, R.N., 1986. A study of head lice among primary school children in Kenya. *Trans. R. Soc. trop. Med. Hyg*., **80**:42-46.

DONALDSON, R. J., 1976. The head louse in England, prevalence amongst school children. *R. Soc. Hlth. J.*, **96**: 55-57.

EL-BASHEIR, Z.M. AND FOUAD, M.A., 2002. A preliminary pilot survey on head lice, pediculosis in Sharkia Governorate and treatment of lice with natural plant extracts. *J. Egypt. Soc. Parasitol*., **32**: 725-736.

FAN, C.K, LIAO, C.W., WU, M.S., HU, N. Y. AND SU, K. E., 2004. Prevalence of *Pediculus capitis* infestation among schoolchildren of Chinese refugees residing in mountainous areas of northern Thailand. *Kaohsiung J. med. Sci.*, **20**: 183-187.

GBAKIMA, A.A. AND LEBBIE, A.R., 1992. The head louse in Sierra Leone: an epidemiological study among schoolchildren in the Njala area. *W. Afr. J. Med.*, **11**: 165-171.

GOLDSTEIN, A.O. AND GOLDSTEIN, B.G., 2006. Pediculosis. Upto Date Patient Information, Inc., pp.1-2.

GULATI, P.V., KAMAT, J. AND SINGH, K.P., 1981. A community based epidemiological study of louse infestation. *Clinician*, **45**: 177-181.

GRATZ, N.G., *Human lice, their prevalence, control and resistance to insecticides; a review, 1985-97*. World Health Organization Pesticide Evaluation Scheme, Document WHO/CTD/WHOPES/97.8,7: 176-179.

HEUKELBACH, J., WILCKE, T., WINTER, B. AND FELDMEIER, H., 2005. Epidemiology and morbidity of scabies and pediculosis capitis in resource –poor communities in Brazil. *Br. J. Dermatol.*, **153**: 150-156.

HONG, H.K., KIM, C.M., LEE, J.S., LEE, W.J. AND YANG, Y.C., 1995. Infestation rate of head lice in primary school children in Inchon, Korea. *Korean J. Parasitol*., **33**: 243-244.

HUH, S., PAI, K.S., LEE, S. J., KIM, K. J. AND KIM, N. H., 1993. Prevalence of head louse infestation in primary schoolchildren in Kangwon-do, Korea. *Korean J. Parasitol.*, **31**: 67-69.

KAZMI, S.A.H., BAJWA, U.M., MAHMOOD, K., SUHAIL, S., KHAN, A.N., CHAUDARY, A., SHAHZAD, N. AND HAROON. T.S., 1993. Prevalence of *Pediculus capitis* in school children. *Pak. J. med. Res*., **32** : 62-65.

KHOKHAR, A., 2002. A study of *Pediculus capitis* among primary school children in Delhi. *Indian J. med. Sci*., **56**: 449-452.

KOKTURK, A., BAZ, K., BUGDAYCI, R., SASMAZ, T., TURSEN, U., KAYA, T. I. AND IKIZOGLU, G., 2003. The prevalence of *Pediculus capitis* in school children in Mersin, Turkey. *Int. J. Dermatol*., **42**: 694-698.

KWAKU-KPIKPI, J. E., 1982. The incidence of the head louse (*Pediculus humanus capitis*) among pupils of two schools in Accra. *Trans. R. Soc. trop. Med. Hyg.*, **76**, 378.

MUMCUOGLU, K.Y., 1999. Prevention and treatment of head lice in children. *Pediatr. Drugs*, **1**: 211-218.

NATIONAL ASSOCIATION OF SCHOOL NURSES (NASN), 1999. *Position statement : Pediculosis in the school community*. NASN, Corporate Head Quarter, Silver Spring, Maryland, 20910, USA. pp. 1-4.

NOBLE, E. R. AND NOBLE, G. A., 1961. *Parasitology: The biology of animal parasites*. Henry Kimpton, London.

OGUNRINAD, A.F. AND OYEJIDE, C.O., 1984. *Pediculuis capitis* among rural and urban school children in Nigeria. *Trans. R. Soc. trop. Med. Hyg.*, **78**:590.

PETRELLI, G., MAJOVI, G., MAGGINI, M., TAGGI, F. AND MAROLI, M., 1980. The head house in Italy, epidemiological study among school children. *R. Soc. Hlth. J*., **100**: 64-66.

POLLACK, R. J., 1997. *Head lice infestation.* Harvard School of Public Health, Boston.

RAMIREZ, A., LUDUENA-ALMEIDA, F.F. AND ALMIRON, W.R., 2003. Prevalence of *Pediculus humanus capitis* infestation in school children at Despenaderos, Cordoba Province. *Rev. Fac. Cien. Med. Univ. Nac. Cordoba*., **60**: 43-53.

ROY, B. AND TANDON, V., 1992. Louse infestation in human population in Shillong, India. *Hlth. Hyg*., **13:** 15-20.

RUPES, V., VLCKOVA, J., MAZANEK, L., CHMELA, L. AND LEDVINKA, J., 2006. Pediatric head lice: taxonomy, incidence, resistance, delousing. *Epidemiol. Mikrobiol. Imunol*., **55**: 112-119.

RUST, M. K., KLOTZ, J. H., HINKLE, N. C. AND KLOTZ, S., 2001. Head lice. Pest notes. University of California, Agriculture and Natural Resources, Publication 7446, 1-4. http://www.ipm.ucdavis.edu

SCHENONEL, H. AND LOBOS, M., 1997. *Pediculus capitis*, a permanent and renewed problem. *Bol. Chil. Parasitol.*, **52**: 73-76.

SERVICE, M. W., 1986. Lecture notes on medical entomology. Blackwell Scientific Publications, Oxford, Melbourne.

SINNIAH, B., SINNIAH, D. AND RAJESWARI, B., 1981. Epidemiology of *Pediculus humanus capitis* infestation in Malaysian schoolchildren. *Am J. trop. Med. Hyg*., **30**: 734-738.

SINNIAH, B., SINNIAH, D. AND RAJESWARI, B., 1983. Epidemiology and control of human head louse in Malaysia. *Trop. Geogr. Med*., **35**: 337-342.

SLONKA, G. F., MCKINLEY, T. W., *ET AL*., 1975. Controlling head lice (unnumbered publication) *United States Dept. Health Education and Welfare, Public Health Service, Center for Disease Control, Atlanta, Georgia*, pp.1-16.

SPEARE, R. AND BUETTER, P.G., 1999. Head lice in pupils of a primary school in Australia and implications for control. *Int. J. Dermatol.*, **38**: 285-290.

SULEMAN, M. AND FATIMA, T., 1988. Epidemiology of head lice infestation in school children at Peshawer, Pakistan. *J. trop. Med. Hyg.*, **91**: 323-332.

SULEMAN, M. AND JABEEN, N., 1989. Head lice infestation in some urban localities of NWFP, Pakistan. *Ann. trop. med. Parasitol.*, **83:** 539-547.

TAPLIN, D. AND MEINKING, T.L., 1987. Pyrethrin and pyrethroid for the treatment of scabies and pediculosis. *Semin. Dermatol.*, **6**: 125-135.

VESSEY, J., 2000. *Current concept in pediculosis management Scarborough*, ME and Castle Rock, CO. National Association of School Nurses, Georgia Avenue, Silver Spring, MD. pp. 1-3.

WEEMS-Jr., H.V. AND THOMAS, R., 1999. *Pediculus humanus humanus* Linnaeus (Insecta: Phthiraptera (Anoplura): Pediculidae). Division of Plant Industry (DPI), Entomology Circular No. 175, Florida Department of Agriculture and Consumer Services, Division of Plant Industry, University of Florida. USA. pp. 1-6.

WEGNER, Z., RACEWICZ, M. AND STANCZAK, J., 1994. Occurrence of *Pediculus capitis* in a population of children from Gdansk, Sopot, Gdynia and the vicinities. *Appl. Parasitology*, **35**: 219-225.

WILLEMS, S., LAPEERE, H., HAEDENS, N., PASTEELS, I., NAEYAERT, J.M. AND DE-MAESENEER, J., 2005. The importance of socio-economic status and individual characteristics on the prevalence of head lice in school children. *Eur. J. Dermatol*., **15**: 387-392.

ZUHAIR, S. AND NUSIER, M.K., 2000. *Pediculosis capitis* in Northern Jordon. *Int. J. Dermatol*., **39**: 919-921.

(Received 5 June 2007; revised 25 November 2007)