PREVALENCE AND ASSOCIATED FACTORS OF HEAD LICE INFESTATION AMONG PRIMARY SCHOOLCHILDREN IN KELANTAN, MALAYSIA

Norsa'adah Bachok[1], Rusli Bin Nordin[2], Che Wil Awang[3] Noor Aini Ibrahim[3] and Lin Naing[2]

[1]Unit of Biostatistics and Research Methodology, School of Medical Sciences, Universiti Sains Malaysia, Kelantan; [2]School of Dental Sciences, Universiti Sains Malaysia; [3]District Health Office, Kuala Krai, Kelantan, Malaysia

Abstract. Head lice infestation contributes a significant morbidity among schoolchildren in Malaysia. A cross-sectional study was designed to determine the prevalence and associated factors of head lice infestation among primary schoolchildren in Kelantan, Malaysia. Six schools were randomly selected from three sub-districts of Kuala Krai, Kelantan. A total of 463 eleven-year-old pupils were screened by visual scalp examination and fine-toothed combing. Self-administered questionnaire was used to collect data on socio-demography and associated factors of head lice infestation. The prevalence of head lice infestation was 35.0% (95% CI: 30.6, 39.3) with 11.9% inactive, 23.1% active, 18.2% light and 16.8% heavy infestations. The associated factors were girls; family income of RM247 or less; head lice infestation of family member and having four or more siblings. The high prevalence of head lice infestation in this study indicates the need for regular school health program that emphasis on the eradication of head lice. The significant associated factors identified in this study reconfirm the importance of controlling the transmissibility of head lice. Pupils and parents should be informed regarding factors that may facilitate the transmission of head lice.

INTRODUCTION

Head lice infestation, or pediculosis, is the manifestation of the obligate ectoparasite, *Pediculus capitis,* which only infects the human scalp. Head lice are extremely transmissible, either by direct head-to-head contact or by indirect formite transmission. Items such as hats, helmets, clothing, hairbrushes, and towels have been known to transmit head lice. Transmission is enhanced in overcrowded dwellings where direct contact is very frequent. Reinfestation after successful treatment is also common. Fortunately, the head louse, unlike the body louse, is not known to be a vector of human disease. The infestation may be completely asymptomatic, or cause intense scalp itchiness, dermatitis, secondary bacterial infection, and an allergy reaction. Bite reactions, pruritus, excoriation, lymphadenopathy, and conjunctivitis have been frequently seen more infested children (Gratz, 1997). Since head lice feed on human blood, chronic heavy infestation among schoolchildren may lead to anemia, which is manifested as fatigue, sleepiness in the classroom, and poor learning performance and cognitive function. Infested children may also experience disturbance of sleep at night due to intense scratching. Head lice infestation can be very costly because of repeated treatments, time spent in eradication attempts and days absent from school. It also frequently causes psychological distress for the children and their families due to social stigmatization by the society following detection. The social stigma connected with infestation creates feelings of shame, anger, and embarrassment in them. Reactions towards head lice infestation vary greatly, depending upon the society. Some societies react to it with shock and blame, enforce isolation from other children, and adopt vigorous eradication efforts. In other societies, it is accepted as normal and not treated vigilantly.

Correspondence: Dr Norsa'adah Bachok, Unit of Biostatistics and Research Methodology, School of Medical Sciences, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia.
Tel: 609-7664896, Fax: 609-7653370
E-mail: norsaadah@kb.usm.my

Head lice infestation is a neglected disease, despite causing significant morbidity among school children worldwide, regardless of the development status of the country. Prevalence of more than 5% has been considered to be an epidemic (Speare and Buettner, 1999). In countries where there are other serious health priorities, head lice infestation is usually ignored. Gratz (1997) reviewed rates of head-lice infestation and concluded that it was endemic all over the world, both in developed and developing countries, and in tropical and temperate countries. The true prevalence of infection is unknown but probably much lower than public and professional perceptions (Frankowski and Weiner, 2002). Schoolchildren are the most commonly infested compared to general population. It was believed that at least one-quarter of schoolchildren were infested. A study conducted in Brazil reported that 5-6% population and 28.0-35.7% schoolchildren were infested with head lice (Combescot-Lang *et al*, 1986).

It was found to be the most common morbidity among schoolchildren in Malaysia, followed by scabies and worm infestation. The incidence rates among schoolchildren were 10.8% in 1990, and 9.3% in 1994 (Ministry of Health, Malaysia, 1996). Previous studies have reported that 10.7% of children in Peninsular Malaysia (Sinnah *et al*, 1981), and 12.9% of primary schoolchildren in Kuala Lumpur (Sinnah *et al*, 1983), were infested with head lice. The prevalence rate in Malaysia was higher in the economically poorer states of Terengganu (34%), Kelantan (23%) and Perlis (21%) compared to other states (4-13%) (Sinnah *et al*, 1981). The distribution of head lice was found to be affected by the season, age, sex, socio-economic status, hair length, family size, crowding in homes and classrooms, degree of infestation of other family members, modes of transport to school, use of headsets, and urban-rural location (Gratz, 1997; Speare and Buettner, 1999; Borges and Mendes, 2002; Kokturk *et al*, 2003; Buczek *et al*, 2004). A poor level of hygiene and personal grooming may have an effect on the prevalence, however, most literature has agreed that, conversely, head lice infestation is not an indicator of a lack of personal hygiene, and that it may infest anybody (Gratz, 1997). Other variables found to be significantly related to pediculosis included education level of parents and pet ownership (Kokturk *et al*, 2003); and accessibility to and consumption of water, and better health care systems (Buczek *et al*, 2004).

We conducted this study in view of the high prevalence rate and lack of recent local data regarding head lice. Identifying the factors that influence the infestation by head lice may help in the planning of intervention programs at schools. The objectives of this study were to determine the prevalence and associated factors of head lice infestation among primary schoolchildren.

MATERIALS AND METHODS

Subjects

Permission to conduct the study was obtained from the District Education Office, schools, and students' parents or guardians of the study area. The study was carried out from April to June 2001. There were 41 primary schools in Kuala Krai District, Kelantan that were divided into three sub-districts. We used a simple random sampling method to select two primary schools from each sub-district and one class from Standard 1 to Standard 6 (students aged 7-12 year-old). The six selected schools were SK [*Sekolah Kebangsaan*, (Malay) national school] Kuala Gris, SK Kemubu, SK Manik Urai Baru, SK Laloh, SK Batu Jong and SK Peria. All Standard 5 pupils from the selected schools were eligible for this cross-sectional study. We selected 16% (472) out of 2,953 Standard 5 pupils in 41 primary schools in Kuala Krai District. Pupils who were absent during the team's visits, illiterate, or who did not complete the questionnaires were excluded from the final analysis. Parental refusal to allow their children to participate was another exclusion criterion.

Questionnaire

The pupils were given self-administered structured questionnaires to complete. The items included socio-demographic characteristics, family and personal history of head lice infestation, history of asthma and skin diseases, frequency of washing hair, home water supply, and number of rooms at home.

Family income data were collected from the administrative offices of the respective schools and categorized according to the classification of incomes drawn up by the Malaysian Government: "poverty" designated as RM493 or less, and "hardcore poverty" designated as RM247 or less (Department of Statistics, Malaysia, 2000).

Examination

Two trained examiners assessed the infestation status by visually examining the pupils' heads and using fine-toothed combs at three main areas: frontal, temporal behind ears, and occipital. We were using both visual inspection of scalp and fine-tooth combing to detect infestation since they were sensitive methods for head lice detection (De Maeseneer *et al*, 2000), as well as cheap and easy to perform on field. The pupils were further assessed for general cleanliness, type and length of hair, and the presence of skin diseases.

The pupils would be considered as positive for head lice infestation if there was any evidence of head lice, such as detected head lice or nymphs, and live or dead eggs (Kokturk *et al*, 2003). Infestation is divided into active and inactive. Active infestation is indicated by the presence of live adult or nymph lice, or viable eggs; and inactive infestation is indicated by the presence of hatched eggs and the absence of adult or nymph lice. No infestation indicated that the scalp is free from lice and eggs, regardless of viability (Speare and Buettner, 1999). Infestation was further subdivided into heavy infestation, if there were more than 10 eggs present, and light infestation when there was 10 or less egg present. Viable eggs were identified by their glistening, full appearance or by crushing them. The viable eggs were also laid closer to the base of hair shafts when compared to non-viable eggs.

The heights and weights of the pupils were measured using a calibrated scale and tape meter. Each pupil's measurements were taken three times, calibrated by one decimal point of kilogram weight and two decimal points of meter height. The mean of the three measurements was taken as the final measurement. The body mass index was determined by dividing weight in kilograms by the square of height in meters. Classification of body mass index according to age and sex was determined by using body mass index for age percentile developed by WHO (1995). Underweight body mass index for age was less than a fifth percentile and at risk overweight or overweight was for 85th or more percentile.

Pre-test

A pre-test study was conducted in one of the non-selected schools in the same district. One Standard 5 class of 40 pupils was used as respondents. The questionnaire was tested for structure, feasibility, reliability, content, and duration taken for the real study; and it was found to be satisfactory. We also trained the two examiners to standardize the procedures of detecting head lice.

Data analysis

Data entry and analysis were conducted using SPSS (version 11.0). Frequency, percentage, and 95% confidence interval were calculated for prevalence of head lice. The associations between infestation and variables at univariate level were analyzed by using chi-square test. The level of significance was set at p less than 0.05 for all hypotheses tests in this study. Kappa statistics was used to measure the agreement between self-reported infestation and positive clinical examination.

Multiple logistic regression modeling was later used for multivariate analysis to eliminate the effects of potential confounders. Infestations status was a dichotomous binary outcome. Stepwise backward elimination procedure was used when selecting significant variables in the model. The final model was tested and confirmed for fitness by using the Hosmer-Lemeshow goodness-of-fit test. The crude odds ratios (OR), adjusted OR, and 95% confidence intervals (CI) were estimated for factors associated with head lice infestation.

RESULTS

A total of 472 pupils was eligible, but we included only 463 (98.1%) in the prevalence study and 426 (90.3%) in the multivariate analy-

Table 1
Prevalence of head lice infestation according to schools.

Schools	No. of pupils	No. of pupils examined	Infestation frequency	Infestation prevalence (%)	95% CI[a]
SK Kuala Gris	91	90	35	38.9	28.6, 49.2
SK Manik Urai Baru	106	102	31	30.4	21.3, 39.5
SK Batu Jong	48	47	17	36.2	21.9, 50.4
SK Kemubu	72	72	21	29.2	18.4, 39.9
SK Laloh	84	83	19	22.9	13.7, 32.1
SK Peria	71	69	39	56.5	44.5, 68.5
Total	472	463	162	35.0	30.6, 39.3

[a]Confidence Interval
SK stands for National School

Table 2
Socio-demographic characteristics of the pupils.

Socio-demographic characteristics	Head lice infestation frequency (%)		p-value[a]
	Yes	No	
Sex			<0.001
Male	25 (10.3)	218 (89.7)	
Female	137 (62.3)	83 (37.7)	
Father's occupation			0.116
Rubber taper	70 (38.7)	111 (61.3)	
Service	24 (32.4)	50 (67.6)	
Agricultural	14 (50.0)	14 (50.0)	
Labor	19 (36.5)	33 (63.5)	
Others	30 (27.3)	84 (72.7)	
Mother's occupation			0.643
Housewife	94 (36.9)	161 (63.1)	
Rubber taper	37 (32.5)	77 (67.5)	
Others	30 (33.0)	62 (67.0)	
Family income (RM)			0.012
>493	40 (27.4)	104 (72.6)	
248-493	47 (33.1)	95 (66.9)	
<248	72 (43.0)	97 (57.0)	

[a]Chi-square test

sis because of absence from school, illiteracy, or incomplete questionnaires. They were all Malays and born in the year 1990, thus aged 11 years old at the time of the study.

The prevalence of infestation was 35% (95% CI: 31, 39%). The prevalence ranged from 22.9% to 56.5% according to school (Table 1). Among the affected pupils, 11.9% were inactive and 23.1% were active; and 18.2% had light and 16.8% had heavy infestations.

The agreement between self-reported infestation and positive examination was moderate with kappa statistics = 0.460 ($p < 0.001$).

Table 2 shows the socio-demographic characteristics of pupils with head lice compared to those without head lice. There were significant

Table 3
Univariate analysis of associated factors for head lice infestation.

Associated factors	Head lice infestation frequency (%)		p-value[a]
	Yes	No	
Previous infestation			<0.001
Yes	114 (46.0)	134 (54.0)	
No	43 (21.5)	157 (78.5)	
At least one family member affected			<0.001
Yes	109 (44.1)	138 (55.9)	
No	49 (24.5)	151 (75.5)	
Number of siblings			0.006
≤3	149 (37.6)	247 (62.4)	
≥4	13 (20.0)	52 (80.0)	
Number of rooms at home			0.227
≤2	94 (37.5)	157 (62.5)	
≥3	68 (32.1)	144 (67.9)	
Hair type			0.011
Straight	146 (33.6)	289 (66.4)	
Curly	16 (57.1)	12 (42.9)	
Length of hair			<0.001
At hairline	44 (16.1)	230 (83.9)	
Just above shoulder	64 (62.1)	39 (37.9)	
Below shoulder	54 (62.8)	32 (37.2)	
Presence of skin disease			0.224
No	116 (33.4)	231 (66.6)	
Yes	46 (39.7)	70 (60.3)	
Presence of asthma			0.417
No	160 (35.2)	294 (64.8)	
Yes	2 (22.2)	7 (77.8)	
Cleanliness level			0.006
Clean	25 (22.5)	86 (77.5)	
Moderate	128 (39.1)	199 (60.9)	
Dirty	9 (36.0)	16 (64.0)	
Body mass index			0.408
Underweight	55 (32.4)	115 (67.6)	
Normal	89 (38.9)	140 (61.1)	
At risk of overweight / Overweight	13 (36.1)	23 (63.9)	
Frequency of washing hair			0.772
1-3 times per week	59 (33.5)	117 (66.5)	
Weekly	64 (34.6)	121 (65.4)	
Less than once per week	19 (35.2)	35 (64.8)	
Never	20 (41.7)	28 (58.3)	
Water supply			0.889
Kelantan Water Company	143 (34.9)	267 (65.1)	
Other sources	19 (35.8)	34 (64.2)	

[a]Chi-square test

differences in infestation rate between gender and by family-income groups.

Table 3 shows factors associated with infestation of head lice. There were significant associations of head lice infestation with previous infestation, affected family members, number of siblings, type and length of hair, and level of cleanliness.

Table 4 shows the final multiple logistic modeling of factors associated with head lice

Table 4
Multiple logistic regression model of the associated factors for head lice infestation.

Risk factors	Crude odds ratio[a]	Adjusted odds ratio[b]	95% CI[c]	p-value
Sex				<0.001
Male	1.0	1.0		
Female	14.4	24.7	13.5-45.2	
Family income (RM)				
>493	1.0	1.0		
248-493	1.3	1.6	0.8-3.1	0.149
<248	1.9	2.5	1.3-4.7	0.006
At least one family member affected				
No	1.0	1.0		
Yes	2.4	3.9	2.2-6.8	<0.001
Number of siblings				
3 or less	1.0	1.0		
4 or more	2.4	2.5	1.0-5.9	0.042

[a]Simple logistic regression; [b]Multiple logistic regression (final model)
[c]Confidence Interval
Hosmer-Lemenshow test, p=0.472
Overall classification=85.9%
ROC=0.864 (95% CI: 0.829, 0.899)

infestation. The significant variables included sex, family income, affected family members, and number of siblings.

DISCUSSION

Our study was conducted among the 11-year-olds of Malay ethnicity in rural schools. We found the prevalence of head lice infestation was 35%, with 23.1% active infestation, which was higher compared to those, reported by the Ministry of Health Malaysia, 1996.

This study found the prevalence of infestation was significantly higher among girls than boys, which was consistent with many other studies (Wegner *et al*, 1994; Gratz, 1997; Estrada and Morris, 2000; Mumcuoglu *et al*, 2001; Borges and Mendes, 2002; Kokturk *et al*, 2003; Buczek *et al*, 2004). A clear preponderance among girls is related to the behavioral differences between sexes. Boys have a tendency only in brief contacts during sports or rough activities, while girls have closer, prolonged and more intimate head contacts in small groups, in particular pairs (Speare and Buettner, 1999). However, all the girls in this study were wearing head cover due to their Islam religion. The transmission of head lice should be less likely since their heads were covered. On the other hand, covering head might facilitate the infestation for creating better and ideal scalp humidity and temperature for the head lice to thrive and multiply. Furthermore, most Muslim girls will cover their head only in public but not at home thus transmission may still occur.

The tendency of girls to keep their hair long is the reason frequently cited for gender differences in head lice infestation. Incidence of infestation was ten times higher among children with long hair (Sinniah *et al*, 1981; Gratz, 1997). However, our study failed to detect the association between infestation and length or type of hair, which was similar with a study conducted in Argentina (Gratz, 1997). The association between infestation degree and hair length was only significant for boys (Ramirez *et al*, 2003). The highest prevalence rate was observed in black, female children, with long, dark, wavy hairs (Borges and Mendes, 2002). The frequency of children infested was significantly lower when

they had short hair. The infestation rate was significantly higher in children with long (68.9%) and medium-length (63.9%) hair than in children with short hair (44.0%) (Mumcuoglu *et al*, 2000).

The literature has suggested that there is no significant association between head lice infestation and poor hygiene or low socio-economic status (Frankowski *et al*, 2002, Kokturk *et al*, 2003). Schoolchildren are the most infested of all socio-economic strata and not just the poor, uneducated, or those living in unhygienic conditions (Gratz, 1997). However, we found that pupils from very low family income were at significantly higher risk of having head lice, which was similar to a study in Jordan (Amr and Nusier, 2000). A study in Malaysia reported that 34.0% of the economically disadvantages children had head lice (Sinniah *et al*, 1981). Extreme poverty was closely related to overcrowded dwellings, poor hygiene, poor attitude of less concern about head lice infestation, poor knowledge about transmission and less accessibility to health care.

Pupils with many siblings and affected family members were significantly associated with head lice infestation. This was supported by a study in which 48.9% of the repeated reinfested pupils originated from families with four or more children (Wegner *et al*, 1994). Close contact between siblings and an overcrowded home facilitates the transmission of head lice, especially if there have another affected family member. Transmission at home was more likely for these pupils because all of the infested girls were wearing head cover while at school. Treating the infested pupils alone is not enough. The whole household of the affected pupils should be screened and treated for the infestation as well.

Health care professionals are frequently having difficulty in diagnosing head lice. Overdiagnosis and failure to distinguish active from extinct infestations lead to inappropriate applications of pediculicidal therapeutic regimens (Pollack *et al*, 2000). Infestation rate depends greatly on the method of examination, competency of the examiners, and how meticulous is the search for the lice or eggs (Gratz, 1997). Tools and methods used for diagnosing head lice need to have acceptable sensitivity and specificity. The gold standard for diagnosing head lice is set by finding a live louse on the head (Frankowski *et al*, 2002). The techniques used for diagnosis of head lice infestation in this study were direct visual examination and hair combing method. Another study has reported that the diagnosis of lice infestation using a louse comb was four times more efficient than, and twice as fast as, direct visual examination (Mumcuoglu *et al*, 2001). The best procedure of screening for head lice is by both visual inspection of scalp and fine-tooth combing. Relying only on visual scalp inspection for detecting adult lice was found to be inaccurate (Roberts *et al*, 2000). Visual scalp examination had 0.7 positive predictive value and 0.9 negative predictive value, while fine tooth combing showed an improvement of the sensitivity of diagnosis (De Maeseneer *et al*, 2000). In addition, fine tooth combing was also found to be a cheap, self-sufficient, and feasible technique for the treatment of head lice. Light microscopy (Pollack *et al*, 2000; Frankowski *et al*, 2002) is another better tool for detecting the presence of viable eggs, but it is expensive and difficult to use in the field.

We believe that the sample of this study was representative of the eleven-year-old population because we used multi-stage probability sampling when selecting our sample. This study had a high response rate and used an adequate sample size. We also tried to limit inter-observer bias by using only two trained examiners. In conclusion, this study found a high prevalence of head lice infestation among rural schoolchildren in Malaysia. The significantly associated factors that were identified in this study included girls gender, lowest family income, affected family member with head lice, and having many siblings that indicated the importance of close contact as a mode of transmission for head lice. Health education and regular screening among schoolchildren are very much needed to reduce the prevalence effectively. Pupils and parents should be informed regarding the factors that are associated with the transmission of head lice, which would include advice against close head-to-head contact, and avoiding the sharing of personal belongings such as headgear, combs, and so forth. We suggest that each school should have a health education program that

puts emphasis on the provision of information regarding the mode of transmission, treatment, and prevention of head lice.

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