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ORIGINAL PAPER

Epidemiology of *Pediculosis capitis* in elementary schools of Buenos Aires, Argentina

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Abstract The infestation with the human obligate ectoparasite *Pediculus humanus capitis* De Geer is a common public health problem affecting mainly schoolchildren worldwide. The aim of the present study was to investigate the infestation levels of head lice in elementary schools from Buenos Aires with resistant levels to permethrin >100. A total of 1,856 children aged 3–13 years old from eight selected elementary schools were examined for head lice. Pediculosis was observed in all the studied schools. The overall infestation rate was 29.7%. Girls were statistically significant more infested than boys, with infestation rate values of 36.1% and 26.7%, respectively ($P<0.0001$). Only 42 of the infested girls (12%) and 23 of the infested boys (11.4%) had >10 lice on their hair. The proportions of infested children—both girls and boys—in each age group were not found to differ significantly from one another. The infestation rate among schools varied from 19.12% to 42.74%. This indicated that pediculosis is relatively common in elementary schools from Buenos Aires, and those levels are of epidemic importance. The differences of pediculosis among the studied schools could be explained by the different control strategies applied by parents or advisors to eradicate head lice.

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Introduction

The infestation with the human obligate ectoparasite *Pediculus humanus capitis* De Geer is a common public health problem, which affect million of children worldwide (Gratz 1997). There are more cases of head louse infestation among elementary-school-age children than there are of all other communicable diseases combined, except for the common cold (Hensel 2000). Although some children with louse infestation are asymptomatic, the most common symptom is pruritus, which occurs due to sensitization to both louse salivary and fecal antigens and may be so intense that excoriations and secondary bacterial infection may occur (Malcolm and Bergman 2007). Transmission of head lice occurs through direct physical contact, especially head-to-head contact and via inanimate objects, also known as fomites (Takano-Lee et al. 2005). During the 1990s, pediculosis has increased worldwide as a result of product failures through resistance, improper application, formulation changes, and misdiagnosis (Burgess 2004; Kim et al. 2004). The rate of head louse infestation varies greatly from place to place throughout the world, and the most affected group consisted of children 3–14 years of age (Gratz 1997).

In Argentina, resistance to permethrin was first reported by Picollo et al. (1998), and further complementary studies were done (Picollo et al. 2000; Vassena et al. (2003); Gónzalez Audino et al. 2005; Mougabure Cueto et al. 2008).

Even though the epidemiological studies reported were in different cities of Argentina (Castro et al. 1994; Chouela et al. 1997; Doucet et al. 1997), these works were done more than 10 years ago before pyrethroid resistance was found in head louse populations. Thus, the aim of the present study was to investigate the infestation levels of

head lice in elementary schools from Buenos Aires with high resistant levels to permethrin.

Materials and methods

Head lice

A total of 1,856 children aged 3–13 years old from eight selected elementary schools in Buenos Aires were examined for head lice during the period March to April 2006. Selected schools were those that had demonstrated high levels of permethrin resistance in previous studies of our laboratory (Picollo et al. 1998; Vassena et al. 2003). For the study at the schools, permission to perform the study was obtained from the educational authority of the Government of Buenos Aires City. In average, four to five consecutive visits were necessary to examined all the age groups in every school. All the studied schools were Argentinean Government owned and non-fee-paying. Only pupils whose parents had given informed consent for participation were examined. The freedom to refuse to participate in the research was clearly and amply established in each case. The entire head was examined carefully although special attention was paid to the nape of the head and behind the ears. The scalp was examined for a period of 5 min. Pediculosis was defined as the presence of at least one living adult, nymph and viable nit. Head lice were removed using a fine toothed antilouse metal comb. A form was filled for each examined pupil with the age and hair characteristics. Head lice were collected and transported to our laboratory as previously reported by Picollo et al. (1998). The protocol for lice collection was approved by the ad hoc committee of the Centro de Investigaciones en Plagas e Insecticidas (Research Center of Pests and Insecticides, Buenos Aires, Argentina) and archived in our laboratory.

Statistical analysis

The data were compared using cross-tabulation with the chi-square test to study the bivariate relationships between the dependent variable (prevalence of lice) and independent variables. Statistical significance was considered at a $P<0.05$. The average percentage of the eight schools was used for all calculations.

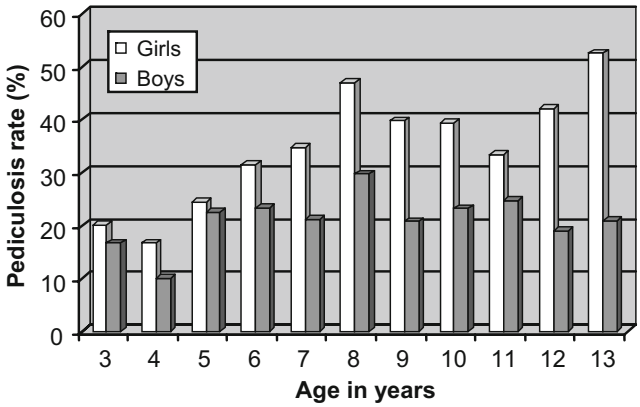

Fig. 1 Prevalence of head lice infestation in different age groups

Results

Pediculosis was observed in all the studied schools. The overall infestation rate was 29.7%. Girls were significantly more infested than boys, with infestation rate values of 36.1 and 26.7, respectively ($P<0.0001$; Table 1). More than 98% of the children had the permission of their parents. Concerning hair characteristics, most of the studied girls possessed long hair ($n=960$), and the boys had short hair ($n=885$). Thus, it was not possible to analyze infestation in relation to hair length. Only 42 of the infested girls (12%) and 23 of the infested boys (11.4%) had >10 lice on their hair. However, no significant differences were found ($\chi^2=0.04$; $P=0.85$). Concerning the total of children examined, the girls and boys infested with >10 lice on their hair represented 4.3% and 2.6% of the infested pupils, respectively. In this case, significant differences were found ($\chi^2=4.12$; $P=0.04$).

The prevalence of infestation in either girls or boys varied by age from 16.7% in age 4 to 52.6% in age 13; and from 10% in age 4 to 29.8% in age 8, respectively (Fig. 1). However, the proportions of infested children—both girls and boys—in each age group were not found to differ significantly from one another (Tables 2 and 3). The infestation rate among schools varied from 19.12% to 42.74% (Table 4).

Table 1 Prevalence of head louse infestation among different sexes

Gender	No. children examined	No. children with lice	% with lice	χ^2	*P* value
Girls	970	350	36.08	–	–
Boys	886	201	22.67	–	–
Total	1,856	551	29.69	39.81	0.0001

Table 2 Severity of pediculosis among girls

Age	No. children examined	No. children with lice	% with lice
3	25	5	20.0
4	54	9	16.67
5	45	11	24.44
6	146	46	31.51
7	112	39	34.82
8	151	71	47.02
9	108	43	39.81
10	127	50	39.37
11	126	42	33.33
12	57	24	42.10
13	19	10	52.63
χ^2			18.10
P value			0.053

Discussion

The 29.7% infestation rate found in the present work shows the problem of head lice in schools from Buenos Aires. This value is higher than 5%, the infestation value when *P. h. capitis* is considered of epidemic importance (Clore 1988). In addition, all the examined schools possessed infestation values above it. This indicated that pediculosis is relatively common in elementary schools from Buenos Aires. This value is similar to those reported by different authors previously to the detection of pyrethroid resistance in head lice from Buenos Aires. For example, Castro et al. (1994) reported that pediculosis in Buenos Aires Province ranged from 12% to 56.8% with an annual mean of 38.04%. Moreover, Perotti et al. (2004) found that the 29.8% of examined pupil in La Rioja Province exhibited at least one living head louse. Upper infestation rates were reported by Doucet et al. (1997) in primary schools of Córdoba Province with an average infestation of 45.32%.

Table 3 Severity of pediculosis among boys

Age	No. children examined	No. children with lice	% with lice
3	18	3	16.67
4	40	4	10
5	31	7	22.58
6	124	29	23.39
7	99	21	21.21
8	141	42	29.79
9	130	27	20.77
10	95	22	23.16
11	105	26	24.77
12	79	15	18.99
13	24	5	20.81
χ^2			7.31
P value			0.695

Table 4 Head lice infestation by school

School	No. children examined	No. children with lice	% with lice
1	165	39	23.64
2	387	74	19.12
3	183	64	34.97
4	578	178	30.79
5	80	25	31.25
6	94	31	32.98
7	245	87	35.51
8	124	53	42.74

Our study showed that girls were more infected with head lice than boys. This is in accordance with the 37.82% and 53.07% infestation levels found in boys and girls in 1993 in Argentina by Doucet et al. (1997). This tendency has also been reported by many authors in different countries like the UK, Australia, South Africa, Turkey, and Brazil (Downs et al. 1999; Speare and Buettner 1999; Govere et al. 2003; Kokturk et al. 2003; Heukelbach et al. 2005). These findings could be explained by the fact that girls tend to spend more time playing in close contact with each other than boys. This gender-related behavioral difference is of considerable importance since head-to-head contact is an important route of transmission as well as the passive transference like combing, air movements, and toweling (Takano-Lee et al. 2005).

These indicate that pediculosis in Argentina is a serious sanitary problem affecting mostly school children. There are innumerable studies on the prevalence of head lice in school-aged children worldwide. For example, in Israel, Australia, South Africa, Poland, Brazil, the UK, and Gaza, 0.48–43.4% of children were found to be infested (Rosenfeld et al. 1993; Speare and Buettner 1999; Govere et al. 2003; Buczek et al. 2004; Heukelbach et al. 2005; Thomas et al. 2006; Al-Shawa 2006). The addition of data set collected in schools or entire populations into mathematical epidemic models, as proposed by Stone et al. (2008), would bring new insights in order to predict and understand the infestation dynamic of head lice.

In Argentina, although the actual tendency in every non-fee-paying school is not to exclude the children having nits or adults, a writing note is sent to the parents or advisors indicating that the children has lice and that a treatment is required. The differences of pediculosis among the studied schools could be explained by the different control strategies applied by parents or advisors to eradicate head lice. In Argentina, there are two basic treatment options for head louse: wet combing and topical insecticide formula-

tions. The most common insecticides applied against head lice contain as active ingredient permethrin, D-phenothrin, cyclic silicones, botanical extracts, benzyl alcohol, vinegar, or essential oils. Moreover, the only prescript pediculicide available contains lindane. Unfortunately, most of the OTC products available in Argentina have not been tested against head lice in in vitro assays. Finally, the lack of guidelines for the detection and management of head lice in elementary schools from Buenos Aires, as well as the insecticide problem, has probably led to high infestation levels such as the reported in this work.

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