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ORIGINAL PAPER

Prevalence of *Pediculus humanus capitis* infestation among kindergarten children in Bahía Blanca city, Argentina

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Abstract The human head louse, *Pediculus humanus capitis* De Geer (Anoplura: Pediculidae), is a worldwide public health concern. This human obligate ectoparasite usually infests school age children. The aim of this work was to investigate the prevalence of head lice in kindergarten children from Bahia Blanca. In addition, the influence of risk factors for pediculosis infestation, such as gender, hair characteristics, and socioeconomic class, was studied in relation to the prevalence of this ectoparasite. From a total of 220 pupils examined (125 girls and 95 boys), 94 showed pediculosis. The overall prevalence of head lice infestation was 42.7 %. Pediculosis was more frequent in girls (53.6 %) than in boys (28.4 %) and in medium, long, and very long hairs. No differences were found between socioeconomic classes. This indicated that head lice are relatively common in kindergarten children from Bahía Blanca.

Introduction

The human head louse, *Pediculus humanus capitis* De Geer (Anoplura: Pediculidae) is a worldwide public health concern (Lee et al. 2010). This human obligate ectoparasite usually infests school age children (Burgess 2004).

P. h. capitis is a holometabolous insect, completing its entire cycle on head hair from eggs (nits) to adults through three nymphal instars (nymphs and adults are the trophic stage) in about 45 days (Rossini et al. 2008). Transmission occurs mainly by direct host-to-host contact and by inanimate objects called fomites (Toloza et al. 2010).

The head louse is a blood-sucking insect which can cause pruritus (the most common symptom), excoriation, conjunctivitis, and secondary bacterial infestation (Fan et al. 2004). Repeated head lice infestation may cause chronic anemia, myasis, plica polonica, and allergic reactions such as nasal obstruction, rhinorrhea, and nightly whistles (Al-Shawa 2006; Cazorla et al. 2007; Toloza et al. 2009). Head lice are not known to be disease vectors, although they have been artificially infected in the laboratory with *Rickettsia prowazekii* (Robinson et al. 2003; Kim et al. 2011).

Bahia Blanca City is located at 38° 43′ 2″S, 62° 15′ 54″W, in Buenos Aires province, southern Argentina, with 301,572 inhabitants (INDEC 2010). It possesses 55 public kindergartens; during 2010, 8,495 children attended these establishments.

In our city, no studies about pediculosis infestation levels have been conducted in recent years. The aim of this work was to investigate the prevalence of head lice in kindergarten children from Bahia Blanca. In addition, the influence of risk factors for pediculosis infestation, such as gender, hair characteristics, and socioeconomic class, were studied in relation to the prevalence of this ectoparasite.

Materials and methods

This was a descriptive cross-sectional study conducted in public establishments of pre-school education in the city of Bahía Blanca, from June to August 2011. A permission to

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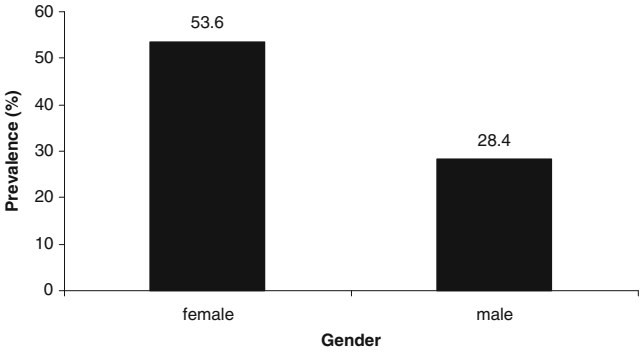

Fig. 1 Pediculosis prevalence among different genders

perform the study was obtained from the educational authority of Jefatura Distrital de Educación (District Education Board) from Bahía Blanca. During a preparatory phase, contacts were made with kindergarten principals and meetings with the parents in order to explain the objectives of the present study. Only the pupils whose parents had given consent for participation were examined.

The kindergartens were classified in three categories using the unsatisfied basic needs (UBN) value, which considers housing characteristics, economic resources, level of education, accessibility, and consumption of drinking water and health care systems. The categories were as follows: class I, UBN <20 %; class II, 20 %≤UBN≤60 %; class III, UBN <60 %. Ranges were established from the distribution that the UBN presented in the kindergartens considered.

The sample size was determined by considering an expected prevalence of 39 % (Castro et al. 1994) with an absolute error of 6.5 % (relative error=17 %) and a 95 % confidence, which resulted in 210 children. It was decided to include a total of 220 children from 3 to 6 years of age.

The screening of each pupil was done by visual examination of the head in sufficient daylight, for about 5 min, paying special attention to the neck and behind the ears (Borges and Mendes 2002). The number and position of nits in relation to the scalp and the presence of any trophic stages were recorded.

In order to evaluate the influence of risk factors for pediculosis prevalence, an epidemiological survey was designed to record information about gender, hair characteristics, and infestation level. Pediculosis was defined as the presence of at least one living adult, nymph, or viable nit (Pollack et al. 2000). Hair was classified in relation to type as straight and wavy; regarding thickness, as thin or thick; and for length, as short (above collar and ear), medium (above the shoulder), long (between shoulder and waist), and very long (extending below the waist).

Five infestation levels (IL) were established according to Catalá et al. (2005):

IL type I No presence of parasites (no development stage)
IL type II Children with evidence of past infestation: empty nits at more than 1 cm from the scalp
IL type III Children with a recent infestation and low probability of active parasitism: 1–10 nits less than 1 cm from the scalp, with no trophic stages and empty nits
IL type IV Children with a recent infestation and high probability of active parasitism: up to 10 nits less than 1 cm from the scalp, with no trophic stages
IL type V Children with an active pediculosis: up to 10 nits less than 1 cm from the scalp, with trophic stages

Statistical analysis

The chi square test for homogeneity of proportions was used to compare the prevalence between strata, between gender, and between lengths of hair. Confidence intervals (CI) of 95 % for prevalence were determined. The statistical analysis was conducted with statistical software SPSS 15.

Results

Of the 220 pupils examined (125 girls and 95 boys), 94 showed pediculosis. The overall prevalence of head lice infestation was 42.7 % (CI 95 % 35.9 %, 49.5 %). Pediculosis was more frequent in girls (67 out of 125, 53.6 %) than in boys (27 out of 95, 28.4 %) (P<0.001) (Fig. 1).

Suspecting that this difference was not due to gender per se, but the long hair, was stratified by this variable, and effectively, the association between gender and positive diagnosis is diluted, and differences in prevalence between genders disappeared. When the relation of pediculosis and

Table 1 Prevalence of pediculosis by socioeconomic class

		Socioeconomic class			Total
		Class I	Class II	Class III	
Pediculosis	Positive	84 (60.4 %)	22 (55 %)	20 (48.8 %)	126 (57.3 %)
	Negative	55 (39.6 %)	18 (45.0 %)	21 (51.2 %)	94 (42.7 %)
	Total	139 (100 %)	40 (100 %)	41 (100 %)	220 (100 %)

socioeconomic classes was analyzed, no differences were found between them (P=0.17) (Table 1).

For the statistical analysis, the hair length categories were grouped as short and not short (medium, long, and very long) resulting with the last one with a high prevalence (P<0.01). The prevalence ratio of pediculosis was calculated between both groups, resulting in 1.7 (CI 95 % 1.21, 2.45) (Fig. 2).

When hair type was compared, no differences were observed between straight and wavy (P=0.87). Regarding hair thickness, no differences were found between thin and thick (P=0.58).

When examining the total prevalence of pediculosis differentiated by the infestation level, we found that more than half of the children were in type I and type II (40.9 and 16.4 %, respectively). The rest of the children (42.7 %) were distributed within the three infestation levels, type V predominating (28.6 %), followed by type III (7.3 %) and type IV (6.8 %) (Fig. 3). From 220 children examined, 17 (7.7 %) had more than 10 adult lice.

When the relation of the infestation level and sex was analyzed, significant differences were found (P<0.001) (Fig. 4).

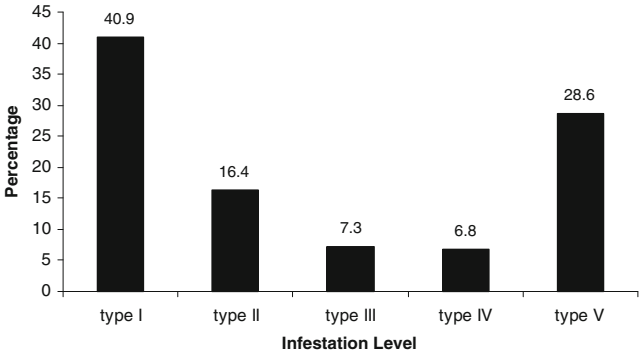

Fig. 3 Percentage of children on each infestation level

Discussion

Since 1988, there has been no research on the recent status of pediculosis in Bahia Blanca (Garcia and Basabe 2008). This lack of data on the epidemiology of head lice could hamper the strategy for pediculosis control in our city.

Pediculosis is considered an epidemic illness when 5 % or more of students are infested (Clore and Longyear 1990). In our study, the overall prevalence was 42.7 %. This value confirms that head lice are common ectoparasites in kindergartens from Bahia Blanca. In kindergartens and elementary schools from La Plata and Buenos Aires cities (Buenos Aires province), previous works informed a prevalence ranging from to 29.7 to 40 % (Villalobos et al. 2003; Toloza et al. 2009). In other regions, high prevalence rates were also found; for example, in Santa Ana de los Guácaras (Corrientes province), the infestation was 57 % (Milano et al. 2007); in Comodoro Rivadavia (Chubut province), it was 31.3 % (Delgado et al. 2010), and in La Rioja, the general prevalence was 61.4 % (Catalá et al. 2005). Other epidemiological studies from different countries reported prevalence values between 26 and 100 % (Schenone et al. 1973; Taplin and Meinking 1995; Heukelbach et al. 2005; Saddozai and Kakarsulemankhel 2008; Oh et al. 2010; Bibi et al. 2011).

Many authors consider that head lice prevalence can be associated with many factors such as gender, hair characteristics, and socioeconomics conditions, among others (Nazari and Saidijam 2007; Soultana et al. 2009; Bibi et al. 2011). The analyses indicated that the prevalence rate in girls was higher than in boys, and this result was found by multiple studies (Gbakima and Lebbie 1992; Heukelbach et al. 2005; Toloza et al. 2009; Soultana et al. 2009; Oh et al. 2010; Bibi et al. 2011). Generally, this fact is explained by the differences between girls' and boys' behavior and their hair length (Cazorla et al. 2007; Ríos et al. 2008). According to this, the girls usually have close contact with each other during play and use and share diverse fomites (hair accessories, brushes, combs, helmets) that can help in head louse transmission (Heukelbach et al. 2005; Burkhart and Burkhart 2007; Motovali-Emami et al. 2008). Besides, the predominance of long hair in girls could provide a good shelter for survival and reproduction of lice (Borges and Mendes 2002; Nazari and Saidijam 2007; Oh et al. 2010; Bibi et al. 2011). In our study,

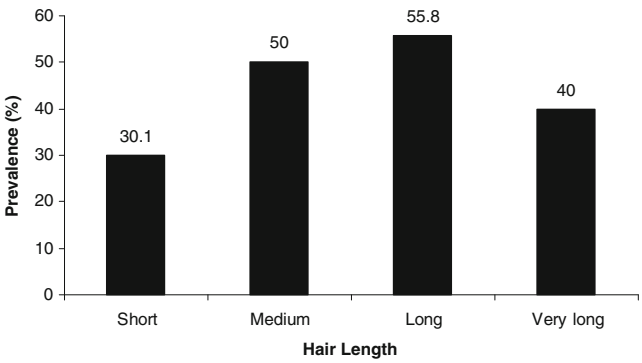

Fig. 2 Prevalence of pediculosis in relation to hair length

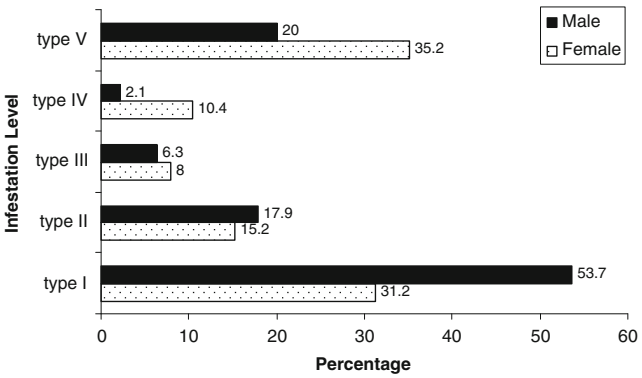

Fig. 4 Association between infestation level and gender

we found that medium, long, or very long hair can be a risk factor. Also, some hormonal effects (principally progesterone and prolactin levels) may be associated with this tendency (Catalá et al. 2004; Akhter et al. 2010).

We also observed that the prevalence rate was not modified by hair type or hair thickness. Similar results were informed by Chouela et al. (1997), Borges and Mendes (2002), and Piquero-Casals et al. (2004).

Some authors have claimed that head lice are more frequent in low socioeconomic classes (Amr and Nusier 2000; Piquero-Casals et al. 2004; Kamiabi and Nakhaei 2005; Akhter et al. 2010; Borges-Moroni et al. 2011) while others reported that pediculosis is found in all classes (Chouela et al. 1997; Saddozai and Kakarsulemankhel 2008). In our study, no differences were found between the socioeconomic classes. Possibly, in low classes, the educational and sanitary conditions could have a bearing on head louse development, and in high classes, the massive use of pediculicides could make the removal of the illness difficult due to resistance phenomena (Vassena et al. 2003; Fan et al. 2004; Nazari and Saidijam 2007; Motovali-Emami et al. 2008).

According to Catalá et al. (2004), the infestation level is considered a good parameter to establish the kind of treatment. For IL type I and II, no treatment is required. The children who showed nits less than 1 cm from the scalp but with no trophic stage (IL type III and IV) are not indicated for treatment with pediculicides, but they should use fine-tooth combs. Only active pediculosis (IL type V) requires treatment with pediculicides. In educational establishments, these children are considered the focus of infestation, and they should be specially supervised in order to prevent new infestations. So, according to our data, from the 42.7 % of the infested children, 14.1 % do not require pediculicide treatment. However, in our region, the use pediculicides is a common practice. It is known that the lack of effectiveness of these products depends on a variety of reasons such as the sale of ineffective products, the incorrect use of pediculicides, and the development of lice resistance to insecticides. Taking into account these reasons (and because none of the pediculicides is 100 % ovicidal), the physical remotion of the lice is the most recommended treatment.

This study indicates that head lice are a common problem and should be the target of control measures in children from Bahia Blanca. The whole community plays an important role in the control of this insect, and campaigns are recommended in order to inform about the correct treatment, involving the participation of families and educational institutions.

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