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CONTROL OF PARASITIC INFECTIONS AMONG SCHOOL CHILDREN IN THE PERI-URBAN AREA OF BOTUCATU, SÃO PAULO, BRAZIL

Regina Coeli Cunha Dórea, Ednir Salata, Carlos Roberto Padovani and Gilberto Lupi dos Anjos

The prevalence of intestinal parasitosis was investigated in a primary school located in Rubião Júnior, a peri-urban district of Botucatu, São Paulo state, Brazil, in order to assess the effect of treatment and practical measures of prophylaxis in the control of parasitic infections among 7-to-18-year-old school children of a low socio-economic status. The first series of parasitological examinations included 219 school children, of which 123 (56.1 %) were found to be infected with one or more parasite species. Eighty-four children carrying pathogenic parasites were submitted to various anti-parasitic treatment schedules. We re-evaluated 75 (89 %) students after 4 to 6 months post-chemotherapy. The results indicate that the combination of treatment with prophylactic measures has been successful in the control of parasitic infections, since reinfection rates were generally low (≤ 5.3 %), except for Giardia lamblia *infections (18.6 %), and a marked reduction on the prevalence rates was observed with a significant percentage of cure (≥ 73.1 %) in children infected with most parasite species. The reasons for the apparent failure in the control of infections caused by* Hymenolepis nana *and* Strongyloides stercoralis *are discussed.*

Key-words: Intestinal parasitosis. Prevalence. Treatment. Prophylaxis. School children.

Intestinal parasitic infections are amongst the most widespread disorders that affect school-age children living in poor urban communities, despite efforts from some public health authorities to improve primary health care and sanitation conditions[4]. Due to the availability of relatively simple, cheap and accurate diagnostic techniques, a number of surveys has investigated the prevalence of parasitic infections, as a determinant of child health status[3,15]. Temporary measures such as the use of antiprotozoan and anthelmintic drugs may have some impact in the reduction of infection rates. However, particularly for low-income children, the risk of infection increases with the shortage of clean drinking water, lack of care in preparing raw vegetables, inadequate garbage removals and poor standards of public and personal hygiene. In developing countries, some of these conditions may occur in school environments and are prone to change under proper guidelines. It is therefore essential to generate epidemiological data on parasitic infections at the local level in order to formulate suitable control programmes[17].

Earlier studies from Botucatu, western São Paulo State, Brazil have focused the population of urban areas, where prevalence of parasitic infections was found to range between 47% and 82%[7,12,15]. This work was designed to investigate the effect of treatment and prophylactic measures on the prevalence of intestinal parasites among school children living in the outskirts of Botucatu.

MATERIAL AND METHODS

We surveyed a sample of 219 children who were regularly registered at EEPG João Queiroz Marques, a primary public school in Rubião Júnior district, located 6km from downtown Botucatu. That sample was taken out of a total of 525 students and represented the number of children (42%) who provided material to the study, after being informed

Departamentos de Parasitologia e de Bioestatística do Instituto de Biociências, Secretaria Estadual de Saúde e Faculdade de Medicina, Universidade Estadual Paulista (UNESP), Botucatu, SP.
Address to: Drª. Regina C.C. Dórea. Departamento de Ciências Biológicas/FCL/UNESP. Caixa Postal: 335, 19800-000, Assis, SP.
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along with their parents on the project aims. Study participants were 107 males and 112 females with ages ranging from 7 to 18 years. All of them resided in poorly urbanized areas neighboring the school.

For each child, one fresh stool specimen was obtained and immediately processed through the methods of Faust et al[6], Hoffman et al[10] and Rugai et al[11]. The first series of parasitological examinations was carried out between August and October, 1991. All children found to be infected with pathogenic parasites were treated as follows: (i) for *G. lamblia* infections, it was used metronidazole at a dose of 20mg/kg body weight, twice daily for 10 days; (ii) for *A. lumbricoides* infections, we used levamisole in a single dose of 80mg (7 yrs old) or 150mg (> 7yrs old); (iii) for *S. stercoralis* infections, thiabendazole was used at a single dose of 30mg/kg body weight and (iv) for all other helminth infections, mebendazole was used at a dose of 100mg, twice daily for 3 days. Those drugs were administered orally at home and offered free by CEME (Central de Medicamentos)/Ministry of Health, Brazil. School personnel and infected children were taught of practical measures for prophylaxis and a video was presented at the university facilities, as a means to explain parasite transmission and awake health awareness.

For re-evaluation purposes, a second series of parasitological examinations was performed between February and March, 1992. Cure rates were expressed following treatment, as the percentage of children with one negative stool examination, in relation to the total number of children found to be infected with a particular parasite species before treatment.

The prevalence rates between groups of interest were compared by the Goodman test[8,9] and significance was set at $p < 0.05$.

RESULTS

A total of 123 (56.1%) of the study participants were found to be infected with one or more parasites listed in Table 1. Infection rates for the protozoan *Entamoeba coli* (28.3%) and the helminth *Trichuris trichiura* (16.4%) were significantly higher compared to those found for hookworm (6.8%), *Hymenolepis nana* (6.8%), *Strongyloides stercoralis* (4.1%) and *Enterobius vermicularis* (3.7%).

Table 1 - Prevalence rates according to parasite species among 219 school children from the peri-urban area of Botucatu, São Paulo, Brazil.

Parasite species	Positive examinations*		Negative examinations	
	nº	%	nº	%
E. coli	62	28.3c**	157	71.7
G. lamblia	22	10.0ab	197	90.0
A. lumbricoides	26	11.5ab	193	88.5
Hookworm	15	6.8a	204	93.2
T. trichiura	36	16.4bc	183	83.6
E. vermicularis	8	3.7a	211	96.3
S. stercoralis	9	4.1a	210	95.9
H.nana	15	6.8a	204	93.2

* Positive examinations include both single and multiple infections.

** Prevalence rates were compared by the Goodman test: non-significant differences are indicated by equal letters, whereas for parasitic infections represented by different letters, $p < 0.05$.

As shown in Figure 1, the group more frequently parasitized was that of school children with ages between 7 and 10. For the two older groups, differences between positive and negative parasitological findings were not statistically significant ($p > 0.05$).

Results of prevalence rates according to sex are depicted on Table 2. The male group tended to present higher prevalence rates than the female group. The rates were however significantly different only for A.lumbricoides (m = 76.9%; f = 23.1%) and hookworm (m = 73.3%; f = 26.7%). When the number of single or multiple parasitic infections was compared by sex (Figure 2), a significant difference was found for multiple parasitic infections predominating in males (27.7%) rather than in females (13.8%). Parasitic associations more frequently encountered were those which included *A. lumbricoides* plus *T. trichiura* and *E. coli* plus *T. trichiura*. For both associations, individual frequencies amounted 10.5%, corresponding to 13 infected children each.

Table 2 - Positive stool examinations according to parasite species and sex among school chidren from the peri-urban area of Botucatu, São Paulo, Brazil.

Parasite species	Positive examinations				Total
	Males		Fermales		
	nº	%	nº	%	
E. coli	31	50.0	31	50.0	62
G. lamblia	12	54.5	10	45.5	22
A. lumbricoides	20	76.9*	6	23.1	26
Hookworm	11	73.3*	4	26.7	15
T. trichiura	22	61.1	14	38.9	36
E. vermicularis	4	50.0	4	50.0	8
S. stercoralis	4	44.4	5	55.6	9
H.nana	8	53.3	7	46.7	15

* $p < 0.05$ - males vs. females.

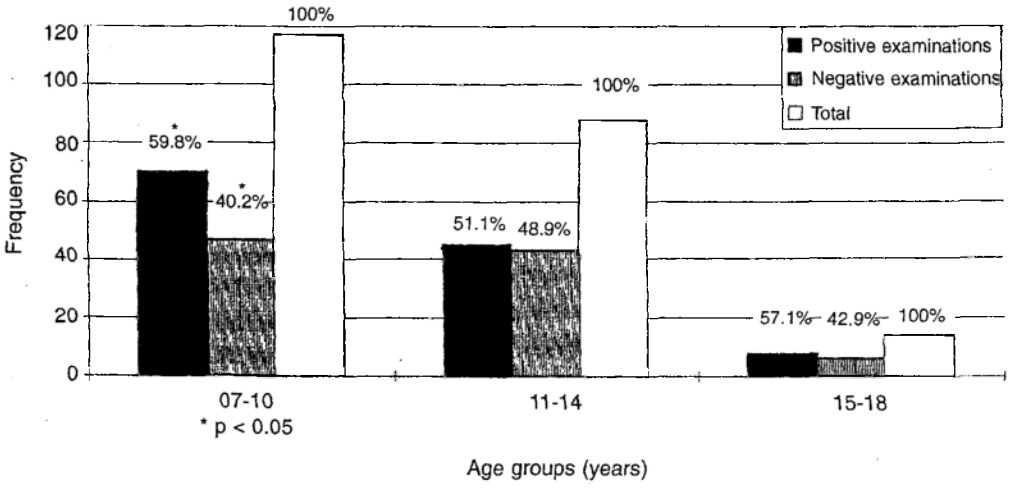

Figure 1 - Frequency of positive and negative stool examinations according to age among 219 school children from the peri-urban area of Botucatu, São Paulo, Brazil.

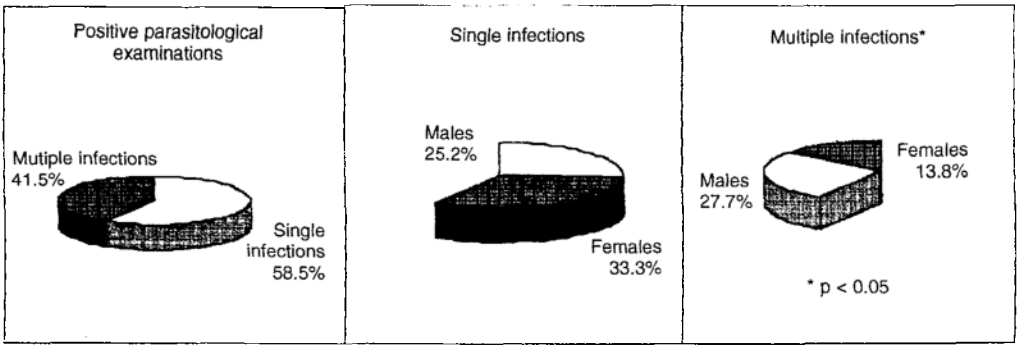

Figure 2 - Frequency of positive stool examinations according to the number of parasitic infections and sex among school children from the peri-urban area of Botucatu, São Paulo, Brazil.

Eighty-four children carrying pathogenic parasites were submitted to treatment. Of these, we re-evaluated 75 (89%) after 4 to 6 months post-chemotherapy. Households of the 75 school children were surveyed within the same time frame, as an attempt to evaluate their living conditions. It was noted that: (i) 59 (79%) children belonged to low-income families of 6 people on average; (ii) 38 (50%) houses were served with sewage lines; (iii) for 51 (68%) families drinking-water sources were restricted to tap water, without further treatment and (iv) the majority of households was not assisted by adequate garbage removal.

Results of parasitological examinations after treatment are shown in Table 3. A total of 36 (48%) school children turned out negative. Statistical analyses revealed that cure was attained for infections with *G. lamblia* (73.7%), *A. lumbricoides* (86.4 %), hookworm (100%), *T. trichiura* (73.1%) and *E. vermicularis* (85.7%); whereas only 50 % of the individuals infected with *S. stercoralis* cured after therapy

(not significant). For *H. nana* infections, non-cure was greater than cure ($p < 0.05$) and this may reflect that the anthelmintic drug used (mebendazole) was not effective. Reinfections by *G. lamblia* were particularly frequent (14 out of 75 children; 18.6%), but infection rates varied from 1.3% to 5.3% for other parasite species (Table 3).

Table 3 - Results of stool examinations after treatment according to parasite species amongst 75 school children from the peri-urban area of Botucatu, São Paulo, Brazil.

Parasite species	Results after treatment				Reinfection rates	
	Cure		Non-cure			
	nº	%	nº	%	nº	%
G. lamblia	14/19	73.7[a]	5/19	26.3	14/75	18.6
A. lumbricoides	19/22	86.4[a]	3/22	13.6	4/75	5.3
Hookworm	11/11	100.0[a]	0/11	0.0	1/75	1.3
T. trichiura	19/26	73.1[a]	7/26	26.9	1/75	1.3
E. vermicularis	6/7	85.7[a]	1/7	14.3	2/75	2.6
S stercoralis	3/6	50.0	3/6	50.0	2/75	2.6
H.nana	2/13	15.4[b]	11/13	84.6	2/75	2.6

[a] cure > non-cure ($p < 0.05$).
[b] cure < non-cure ($p < 0.05$).

DISCUSSION

It became apparent that even though nearly 20 years have elapsed from previous studies[7,12,15] the prevalence of intestinal parasites is still high in a poor suburban community of Botucatu, accounting for as many as 56.1% infected children of the total number studied. This is consistent with the overall prevalence rate of 55.3% for parasitic infections obtained by Campos & Briques[3] in a countrywide survey targeted at 7-to-14-year-old school children in Brazil.

Pre-treatment values pointed out that infection rates ranged from 3.7% to 28.8% for 2 protozoan species and 6 helminth species detected. Irrespective of the degree of parasitism, it is important to note that we examined every stool specimen through 3 coprological techniques, whose scope was broad enough to detect all cysts of protozoans and most helminth eggs and larvae that are frequently discharged in human stools. However, since special techniques such as anal swab examinations have not been performed for the high level of cooperation required, we presume that infections with *E. vermicularis* herein reported are underestimated. For similar reasons, although *Taenia* sp. ova have been undetected, we cannot exclude this parasitosis in the sample studied. We would expect the prevalences for both parasitosis to be low however, as judged by earlier work[7,12,15] in the same area that demonstrated prevalence rates $\leq$ 3.7% and $\leq$ 1.62% to respectively *E. vermicularis* and *Taenia* sp.

That single or multiple infections with *E. coli*, *T. trichiura*, *A. lumbricoides* and *G. lamblia* were the most prevalent ones is not unexpected, since these parasite species share, to a certain extent, the mode of transmission and are likely to be contaminating both the school and domestic environments, where infective eggs or cysts can be ingested by the school children.

The group of 7-to-10-year-old children was found to be the most frequently parasitized. Although this group has clearly outnumbered the other two age groups, the degree of exposure to soil-transmitted parasites seems to be higher for children up to 10 years old in the present study. This is particularly evident for single infections with *A. lumbricoides* or hookworm, which were found to predominate significantly in males rather than in females. Despite the fact that poor standards of hygiene are widespread among children of a low socio-economic status, some indication of activity-based differences between both sexes comes from the observations in the school play area, where mainly boys used to play on soil ground before and after classes. This in conjunction with the irregular use of footwear might have served to promote their contact with infective stages, in spite of the fact that all children studied were asymptomatic.

The combination of treatment with prophylactic measures of practical importance used in this study have provided an effective means for control of parasitic infections at the school level. Not only 48% of the school children have shown negative parasitological examinations, but also we have obtained cure rates that were significantly high ($\geq$ 73.1%) for most parasite species. Apart from some differences in the therapeutic schedules used, our results have confirmed the findings of previous smaller studies in which cure rates of parasitic infections were found to be higher among school children, only when treatment was associated with adequate prophylaxis[11].

The data regarding infections with *H. nana* were by far less satisfactory. In fact, mebendazole was the anthelmintic agent

chosen for its broad-spectrum of activity and for the number of children found to be infected with two or more helminth species (other than *S. stercoralis*) was as high as 20 (27%) children out of 75. On the other hand, the low-cure rates obtained (15.4 %) suggests that mebendazole was ineffective for *H. nana* infections, even taking into account that a second course of treatment have been recommended for all study participants. This confirms the findings of Camargo et al[2] and Schenone et al[16], who demonstrated that mebendazole exhibited respectively none or partial action against that helminth. According to Rey[13], the treatment of infections caused by *H. nana* is made difficult, since self-infections are not uncommon and the cysticercoid larvae are known to remain for several days deeply in the intestinal villi, where they can be proteceted from luminal drugs. Adult worm burdens would thus be expected to increase rapidly after treatment, as larval worms mature.

For infections with *S. stercoralis*, children have been treated with thiabendazole in addition to any further treatment for other parasitic infection eventually needed. The 50% cure rate obtained for such infections was somehow unexpected. The reasons for this are unclear, but the inappropriate consumption of the recommended drug(s) cannot be overlooked, since all medication has been administered at home.

Of interest are the observations that reinfection rates were generally low for the majority of parasite species detected. This reinforces the notion that prophylactic measures have been useful for the children surveyed. Reinfection rates for *G. lamblia* were an exception and can be attributed to its mode of transmission, with cysts being easily ingested either by contaminated food or from drinking-water sources that were consumed inside or outside the houses.

This study illustrates the importance of treatment combined with prophylactic measures for the control of parasitic infections using a school-based approach. In the long run, a regular control may be envisaged through active actions of the community itself, as well as by the related health authorities in improving to local communities permanent benefits such as education, medical care, sanitation and adequate refuse removal.

RESUMO

Procedeu-se o estudo da prevalência de enteroparasitoses entre escolares de 7 a 18 anos, de condições sócio-econômicas baixas e residentes no distrito peri-urbano de Rubião Júnior, município de Botucatu, São Paulo, com o objetivo de analisar o papel de medidas profiláticas e terapêuticas no controle das parasitoses diagnosticadas. Dos 219 alunos estudados na primeira avaliação parasitológica, 123 (56.1%) mostraram-se positivos para uma ou mais parasitoses. O tratamento foi aplicado para 84 escolares, por serem estes portadores de parasitos patogênicos. A segunda avaliação parasitológica foi realizada 4 a 6 meses após o tratamento em 75 (89%) escolares. Os resultados indicam que o uso combinado do tratamento e medidas profiláticas foi capaz de limitar a ocorrência de novas infecções para níveis ≤ 5.3 % — exceto para Giardia lamblia, *que incidiu sobre 18.6% dos casos — e reduzir significativamente a prevalência, já que taxas de cura ≥ 73.1% foram encontradas para a maioria das parasitoses, exceto nas infecções por* Hymenolepis nana *e* Strongyloides stercoralis, *discutindo-se as razões prováveis.*

Palavras-chaves: Enteroparasitoses. Prevalência. Tratamento. Profilaxia. Escolares.

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