

## Intestinal Parasites in Ecotourism Region of the State of Paraná, Brazil

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### ABSTRACT

To determine the indices of prevalence of intestinal parasites and commensals in the residents of ecotourism region of Paraná State, a retrospective study was conducted, from January/2003 to December/2004 on 3,764 fecal parasitological examinations performed by a private laboratory of Ubiratã using the Baermann-Moraes, water-sedimentation and Willis methods. Among the individuals aged eight months to 89 years, 522 (13.9%) cases were positive. *Giardia lamblia* (175/522; 24.2%) was the most prevalent parasite ( $p < 0.000$ ). *Entamoeba coli* was the most common commensal, with 238/552 (32.9%) cases ( $p < 0.000$ ), being frequently associated with other species, either parasitic or commensal. The children of preschool age (2-6 years old) and school age (7-14 years) were mainly parasitized (66.0% of positivity;  $p < 0.0000$ ). More individuals harbored a single species of parasite (233; 44.6%) than had multiple species (169; 32.4%). These results indicated a significant degree of the environmental contamination in the cities of Paraná, mainly the medium- and small-sized ones, which was a cause for concern in view of the increase in ecotourism in the region.

**Key words:** Intestinal Parasites, Ecotourism, Travelers Parasitology, Paraná

### INTRODUCTION

The world is a complex ecosystem in which human disease patterns vary from one country to another (Jekel et al., 1999). The presence of different species of the intestinal parasites and the rates of the intestinal parasitism can be viewed as a digital impression, because it is intimately correlated with the climate and economic factors such as per capita income, lifestyle and occupation (Tashima and Simões, 2004). Still a serious public health problem, mainly in the developing countries, intestinal parasitoses are cosmopolitan

especially in the tropical regions (Crompton and Savioli, 1993). In spite of the urbanization in Latin America over the last four decades, which led to decreased percentages of intestinal parasitic infections, the absolute number of the cases of the intestinal parasitoses in both urban and rural regions has increased (Cancrini et al., 1989; Costa-Macedo and Rey, 2000). Associated with a framework of the chronic diarrhea and malnutrition, the intestinal parasitoses often compromise the physical and intellectual development, especially among the youngest age groups in a population (Ludwig et al., 1999).

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The population studies of the intestinal parasites in different regions of Brazil reveal frequencies that differ greatly according to the local sanitation conditions and the characteristics of the sample analyzed (Tavares-Dias and Grandini, 1999; Rocha et al., 2000; Giraldo et al., 2001; Amato Neto et al., 2004). However, in a country where intestinal parasitoses figure among the main public-health problems, the parasitological investigation has been widely neglected (Ferreira and Marçal Jr., 1997).

In Paraná, thorough investigations of the fecal parasites have focused mainly on the school-age children residing in the larger cities such as Curitiba, Londrina, Maringá and Cascavel (Ogliari and Passos, 2002; Márquez et al., 2002; Ferreira et al., 2004; Pupulim et al., 2004). Little is known about the prevalence of the intestinal parasites and commensals in the medium-sized and small cities in the state. In order to broaden the knowledge of the health conditions in Paraná, and in particular because the city of Ubitatã is located on the ecotourism route in this state, this study was conducted to determine the indices of the prevalence of intestinal parasites and commensals in the residents of Ubitatã, Paraná.

## MATERIAL AND METHODS

The Municipality of Ubitatã is located in the Central-Western meso-region of Paraná and in the Goioerê micro-region, 535 km from Curitiba (Secretaria Estadual de Desenvolvimento Urbano do Estado do Paraná – SEDU/PR). Located at latitude 24° 32' 10" S and longitude 52° 58' 50" W, the city has an altitude of 550 m. The climate is mesothermal humid subtropical, with hot summers when the rainfall tends to be higher (mean temperature above 22° C), and winters with infrequent frosts (mean temperature below 18° C); there is no defined dry season (Secretaria Estadual de Desenvolvimento Urbano do Estado do Paraná – SEDU/PR). Ubitatã has 22,593 inhabitants, 17,240 of whom reside in the urban zone and 5,353 in the rural zone (IBGE. Cidades@). Agriculture is the main socio-economic activity in the municipality. The city of Ubitatã is a route of the people who consider the ecotourism or radical sports as a tandem flight or rafting about the risk of parasite infections, as the region has beautiful waterfalls, streams and hills.

This study analyzed all the results of fecal examinations performed by a private laboratory in Ubitatã over the period January 2003 through December 2004. The examinations, all of which had been requested by the doctors, were performed by the Baermann-Moraes, Hoffman and Willis methods (De Carli, 2001).

The data were analyzed by the program Statistica (version 6.0). The observed differences in the annual and overall prevalences and the distribution of the cases by the sex and age group were tested by the Chi-square test at a significance level of 5.0%.

## RESULTS

Over the two years, 3,764 fecal examinations were done: 2,690 were subsidized through the Federal Health Care System (Sistema Único de Saúde – SUS) (71.5 %), and 1,074 were paid for privately or through health plans (28.5 %). A total of 522 (13.9%) examinations revealed at least one species of the protozoan or helminth. The prevalence of parasites and commensals is shown in Table 1.

There was no difference between the percentage of the positive fecal examinations in 2004 (13.8%) compared to 2003 (13.9%) ( $p = 0.9368$ ). *G. intestinalis* was most common parasite with 175 (24.2%) parasitized persons ( $p < 0.000$ ) and *E. coli* predominated among the commensals with 238 (32.9%) positive cases ( $p < 0.000$ ). The ages of the individuals ranged from eight months to 89 years, with a median of 10 years. There was no difference between the general prevalence of the parasites among the age groups analyzed ( $p = 0.8843$ ). The children of pre-school (2 to 6 years) and school age (7 to 14 years) were most affected ( $p < 0.0000$ ), constituting 66.0 % of the positive fecal examinations (Table 1). The incidence of the infection in the children aged 7 to 14 was 1.3 times higher than in the children aged 2 to 6, and 6.2 times higher than the other age groups. The most frequent parasite in the 0-14 age group was *G. intestinalis* (27.8%), followed by *Ascaris lumbricoides* and *Enterobius vermicularis*. In the 21 to 30-year age group, Ancylostomatidae were the most prevalent parasites (Table 1). There was no significant difference in the percentages of the positivity for the parasitized females (18.9%) and males (19.4%) ( $p = 0.8341$ ) (Table 2).

**Table 1** - Distribution of intestinal commensals and parasites by age group, in residents of Ubiratã, Paraná, from January 2003 through December 2004.

Commensals and parasites	Age group (years)												Total					
	0 - 1		2 - 6		7 - 14		15 - 20		21 - 30		31 - 40			41 - 50		> 50		
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)		n	(%)	n	(%)	
<i>Endolimax nana</i>	0	(0.0)	2	(0.2)	3	(0.2)	1	(0.3)	2	(0.7)	1	(0.6)	1	(0.6)	0	(0.0)	10	(0.3)
<i>E. coli</i>	3	(2.1)	43	(4.1)	102	(7.5)	23	(6.6)	20	(6.6)	17	(9.4)	15	(8.5)	15	(7.4)	238	(6.3)
<i>Iodamoeba butschlii</i>	0	(0.0)	1	(0.1)	2	(0.1)	0	(0.0)	0	(0.0)	1	(0.6)	0	(0.0)	0	(0.0)	4	(0.1)
<i>E. histolytica / E. dispar</i>	0	(0.0)	16	(1.5)	41	(3.0)	10	(2.9)	10	(3.3)	3	(1.7)	6	(3.4)	6	(3.0)	92	(2.4)
<i>Giardia intestinalis</i>	20	(14.3)	78	(7.5)	47	(3.4)	11	(3.1)	8	(2.7)	4	(2.2)	1	(0.6)	6	(3.0)	175	(4.6)
<i>Ancylostomatidae</i>	0	(0.0)	6	(0.6)	8	(0.6)	4	(1.1)	9	(3.0)	2	(1.1)	4	(2.3)	5	(2.5)	38	(1.0)
<i>Ascaris lumbricoides</i>	1	(0.7)	23	(2.2)	39	(2.9)	9	(2.6)	2	(0.7)	0	(0.0)	1	(0.6)	3	(1.5)	78	(2.1)
<i>Enterobius vermicularis</i>	1	(0.7)	5	(0.5)	15	(1.1)	4	(1.1)	1	(0.3)	2	(1.1)	0	(0.0)	0	(0.0)	28	(0.7)
<i>Hymenolepis nana</i>	2	(1.4)	1	(0.1)	11	(0.8)	1	(0.3)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	15	(0.4)
<i>Strongyloides stercoralis</i>	0	(0.0)	3	(0.3)	10	(0.7)	2	(0.6)	6	(2.0)	3	(1.7)	6	(3.4)	4	(2.0)	34	(0.9)
<i>Trichuris trichiura</i>	0	(0.0)	3	(0.3)	4	(0.3)	2	(0.6)	1	(0.3)	0	(0.0)	0	(0.0)	0	(0.0)	10	(0.3)
<b>Total examined</b>	<b>140</b>	<b>(19.3)</b>	<b>1046</b>	<b>(17.3)</b>	<b>1366</b>	<b>(20.6)</b>	<b>350</b>	<b>(19.1)</b>	<b>301</b>	<b>(19.6)</b>	<b>181</b>	<b>(18.2)</b>	<b>177</b>	<b>(19.2)</b>	<b>203</b>	<b>(19.2)</b>	<b>3,764</b>	<b>(13.9)*</b>

\* prevalence of intestinal commensals and parasites in the population (522/3764).

**Table 2** - Distribution of intestinal commensals and parasites in male and female residents of Ubiratã, Paraná, from January 2003 through December 2004.

Commensals and parasites	Sex				Total	
	Male		Female		n	(%)
	n	(%)	n	(%)		
<i>Endolimax nana</i>	5	(0.3)	5	(0.3)	10	(0.3)
<i>Entamoeba coli</i>	129	(7.0)	109	(5.7)	238	(6.3)
<i>Iodamoeba butschlii</i>	0	(0.0)	4	(0.2)	4	(0.1)
<i>E. histolytica / E. dispar</i>	49	(2.7)	43	(2.2)	92	(2.4)
<i>Giardia intestinalis</i>	72	(3.9)	103	(5.4)	175	(4.6)
<i>Ancylostomatidae</i>	18	(1.0)	20	(1.0)	38	(1.0)
<i>Ascaris lumbricoides</i>	33	(1.8)	45	(2.3)	78	(2.1)
<i>Enterobius vermicularis</i>	15	(0.8)	13	(0.7)	28	(0.7)
<i>Hymenolepis nana</i>	6	(0.3)	9	(0.5)	15	(0.4)
<i>Strongyloides stercoralis</i>	18	(1.0)	16	(0.8)	34	(0.9)
<i>Trichuris trichiura</i>	4	(0.2)	6	(0.3)	10	(0.3)
<b>Total patients examined</b>	<b>1846</b>	<b>(18.9)</b>	<b>1918</b>	<b>(19.44)</b>	<b>3764</b>	<b>(13.9)</b>

More individuals harbored only a single parasite species (233; 44.6%) than the multiple parasite species (169; 32.4%). *E. coli* was the species most frequently associated with other species, parasitic or commensal (Tables 3). In 69 examinations, which comprised 13.2% of the positive cases, *E. coli* occurred together with *Entamoeba histolytica/Entamoeba dispar*. *Ascaris lumbricoides* was the intestinal parasite associated with the highest number (ten) of different species. Two species were associated in 140 (26.8%) cases, and three or more species in 29 (5.6%) cases (Table 3). The association between the parasites and commensals was significantly ( $p < 0.0000$ ) higher among the parasites (Tables 3).

## DISCUSSION

This investigation utilized the results of 3,760 fecal examinations. Considering the calculation of the sample based on the population of the municipality determined by the program EPI-INFO 2002 – version 6.0, with an expected frequency of 23% (Porcu and Watanabe, 1998), an acceptable 17% error and 99.99% confidence level, 1,560 examinations were required to accurately estimate the prevalence of the parasites in Ubitatã. Therefore, the present results were considered consistent. The large number of the examinations carried out in two years was equivalent to analyzing 16.7% of the population of the municipality of Ubitatã.

**Table 3** - Single and multiple-species parasitism in residents of Ubitatã, Paraná, from January 2003 through December 2004.

Single-species parasitism	N
<i>A. lumbricoides</i>	42
Ancylostomatidae	17
<i>E. histolytica/E. dispar</i>	1
<i>E. vermicularis</i>	18
<i>G. intestinalis</i>	129
<i>H. nana</i>	7
<i>S. stercoralis</i>	15
<i>T. trichiura</i>	4
<b>Total</b>	<b>233</b>
Multiple-species parasitism	N
<i>A. lumbricoides</i> + <i>E. vermicularis</i>	1
<i>A. lumbricoides</i> + <i>G. intestinalis</i>	12
<i>A. lumbricoides</i> + <i>H. nana</i>	1
<i>A. lumbricoides</i> + <i>T. trichiura</i>	1
Ancylostomatidae + <i>A. lumbricoides</i>	1
Ancylostomatidae + <i>G. intestinalis</i>	6
Ancylostomatidae + <i>S. stercoralis</i>	8
Ancylostomatidae + <i>G. intestinalis</i> + <i>S. stercoralis</i>	1
<i>E. vermicularis</i> + Ancylostomatidae	1
<i>E. vermicularis</i> + <i>G. intestinalis</i>	1
<i>E. vermicularis</i> + <i>S. stercoralis</i>	1
<i>E. vermicularis</i> + <i>T. trichiura</i>	1
<i>H. nana</i> + <i>G. intestinalis</i>	1
<i>S. stercoralis</i> + <i>A. lumbricoides</i>	2
<i>S. stercoralis</i> + <i>A. lumbricoides</i> + <i>G. intestinalis</i>	1
<i>S. stercoralis</i> + <i>G. intestinalis</i>	4
<i>T. trichiura</i> + Ancylostomatidae	1
<b>Total</b>	<b>44</b>

In this municipality, where the per capita income was R\$ 382.00 per month, a high percentage of patients used SUS rather than health plans or individual payment for the examinations.

According to the IBGE, in 2000 in Paraná, only 20.9% (156) of the municipalities had sewage treatment systems. In Ubitatã, only 70 of the 6,276 households were connected to the sewage system, 5,207 residences had the running water, and 4,985 had trash collection (IBGE-cidades@). In 2002 and 2003, nine deaths caused by the infectious and parasitic diseases were recorded. In agreement with the Human Development Index (HDI) of 2000, Ubitatã ranked 228th among the municipalities in the state of Paraná and 2327th among the Brazilian cities; i.e., it was not included in the middle of the more prosperous cities in the country (IBGE-cidades@). It could be concluded that the environmental contamination in the cities of Paraná, primarily medium- and small cities, were high. Nevertheless, the prevalence of the intestinal parasites and commensals observed in Ubitatã was 13.9%, lower than the levels found in the larger municipalities such as Maringá, where 23% of 4,939 fecal parasitological examinations were positive (Porcu and Watanabe, 1998). Apparently the data were underestimates in the present investigation, since the laboratory did not use the specific methodology for the protozoans and only one sample was collected per individual. *Giardia intestinalis*, a protozoan frequently found in the children up to six years old, in proportions varying from 5.6% (Machado et al., 1999) to 78.3% (Machado and Costa-Cruz, 1998), was the principal parasite found in the population studied. The prevalence of this parasite, together with the fecal-orally transmitted commensals such as *Entamoeba coli*, found in 32.9% of the population of Ubitatã, functioned as the bioindicators of the socio-environmental conditions, hygiene, basic sanitation and quality of the life of the population (Costa-Macedo et al., 1999; Faulkner et al., 2003). Person-to-person transmission of the giardiasis could also be an important factor, because in the closed communities such as the schools and day-care centers, or in the residences that were very close to each other, fecal-oral propagation of many intestinal parasites and commensals could be facilitated (Guilherme et al., 2004; Pupulin et al., 2004). Although the prevalence of *G. intestinalis* in Ubitatã were similar to the prevalence levels in other cities in Paraná (Márquez et al., 2002; Ferreira et al., 2004; Giraldo et al., 2004; Pupulin

et al., 2004), this prevalence might be higher, because this protozoan, in addition to the reasons listed at the end of the previous paragraph, shedded cysts intermittently (Rocha et al., 2000).

The progressive increase in the prevalence of the intestinal parasites up to 14 years could be due to the behavioral changes in the process of the growth and child development that favored the mobility and interaction with the environment, increasing the exposure time to the environments lacking of adequate basic sanitation (Costa-Macedo et al., 1998; Tashima and Simões, 2004). The decrease in prevalence rates at ages over 15 years could be explained in part by the immune-mediated resistance, acquired through the successive contacts with the parasite, and partly through more effective personal hygiene as the child grew (Rocha et al., 2000). According to Giraldo et al. (2001), contact with soil was one of the most important factors in transmission of the parasitoses to the children under six, whereas the contamination of the water and food was significant in ages over six.

The prevalence of the helminths *A. lumbricoides* and *E. vermicularis* in the preschool- and school-aged children, at a rate of 5.4%, was higher than reported by other investigators (Tavares-Dias and Grandini, 1999; Rocha et al., 2000; Giraldo et al., 2001; Tashima and Simões, 2004), although this study used no specific methodology for *E. vermicularis*. This finding indicated the existence of poor hygiene conditions in the environments where the individuals were crowded together in a population that could easily be reached by the education about sanitation, because it consisted mainly of the students.

The finding of infected children under the age of two raised the possibility that the hands, pacifiers and domestic animals were vehicles for acquiring the parasites, reflecting the degree of domiciliary and peridomestic contamination resulting from the unsatisfactory conditions of the basic sanitation (Costa-Macedo et al., 1999; Giovannoni and Kubiak, 2001). Investigating the means of transmission of protozoans and helminths on the pacifiers of children from 0 to 7 years old residing in the Alfenas neighborhood in Minas Gerais, Pedroso and Siqueira (1997) found that 10/86 (11.6%) of the pacifiers were contaminated, mainly by *A. lumbricoides* and *E. vermicularis*.

The prevalence of multiple parasitism in the population investigated was high. The association between parasites and commensals occurred

because of the imbalance in the intestinal flora and physiology caused by the presence of the parasites. This imbalance facilitated the intestinal colonization by the commensals such as *Entamoeba coli*. According to Foratini (2001) the establishment of the parasite communities presupposed a series of the metabolic and trophic advantages that increased the probability of the survival of the parasites.

According to UNICEF (1995), the prevalence of the intestinal parasites in the population under five years of age closely reflected the degree of environmental contamination of a region, because these individuals had less mobility and were more vulnerable. The data in the present work allied to the information mentioned above and the location of Ubiratã on the ecotourism route that according Lutterbach et al. (2001) facilitated the environmental contamination, highlighted the question of the adequacy of the health policy and intervention to limit the spread of the diseases related to the poor environmental sanitation.

## RESUMO

A prevalência de enteroparasitas e comensais, de janeiro/2003 a dezembro/2004, foi determinada em residentes de região de ecoturismo do Paraná por meio de estudo retrospectivo. Foram examinados os resultados de 3.764 exames coproparasitológicos efetuados em laboratório privado de Ubiratã Entre indivíduos de 8 meses a 89 anos, 522 (13,9%) exames foram positivos. *Giardia intestinalis* (175/522; 24,2%) foi o parasita prevalente ( $p < 0,000$ ). *Entamoeba coli* mostrou-se o commensal mais comum, com 238/552 (32,9%) casos ( $p < 0,000$ ), encontrando-se frequentemente associado com outras espécies, parasitas ou comensais. Crianças em idade pré-escolar (2-6 anos) e escolar (7-14 anos) apresentaram-se mais parasitados (66,0% de positividade;  $p < 0,0000$ ). A maioria dos indivíduos encontrava-se parasitado por uma única espécie (233; 44.6%) do que por várias espécies (169; 32.4%). Estes resultados indicam um grau significativo de contaminação ambiental em cidades do Paraná, principalmente aquelas de médio e pequeno porte, representando fonte de preocupação em vista do crescimento do ecoturismo na região.

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