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Enteroparasites and commensals among individuals living in rural and urban areas in Abadia dos Dourados, Minas Gerais state, Brazil

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ABSTRACT

*The aim of this study was to evaluate the enteroparasite and commensal occurrence in inhabitants living in the city of Abadia dos Dourados, Minas Gerais, Brazil. Three hundred and seventy six people were selected at random, 188 living in the rural area and 188 living in the urban area, from January through December of 1996. Using the Lutz method 177 (47.1%) individuals infected: 102 (57.6%) in the rural population and 75 (39.9%) in the urban population ($P < 0.05$). Of the total 177 enteroparasite and commensal occurrences diagnosed were: *Entamoeba coli* (18.3%), hookworm (17.8%), *Endolimax nana* (6.1%), *Giardia lamblia* (5.8%), *Ascaris lumbricoides* (2.6%), *Entamoeba hartmanni* (2.1%), *Iodamoeba bütschlii* (1.6%), *Strongyloides stercoralis* (1.3%), *Enterobius vermicularis* (0.5%), and *Trichostrongylus* sp (0.5%). Geohelminths were predominant in the rural area, with an occurrence of hookworm infections at 28.2% in these individuals and 7.4% in the urban people (OR: 14.33 CI: 6.230 to 32.970). The infection rate of enteroparasites was high in the population studied. In conclusion, it is necessary to implement regular parasitological exams and education about the forms and consequences of transmitting parasites, primarily among people living in the rural area.*

Key words: Intestinal parasite, diagnostic, epidemiology, public health, Brazil.

INTRODUCTION

Enteroparasite infection is still a serious public health problem in the world, especially in developing countries¹⁻⁴. These infections are the result of multiple factors, such as, socio-economic, cultural, historical, and political conditions⁵. Control strategies involving improved drinking water supplies, sewage disposal and management, adequate sanitation, and education have been related to the reduced prevalence of intestinal parasitism⁶.

Nowadays, despite biomedical advances, parasite infections remain and continue to be an example of the parasite - host interaction complex. Nevertheless, the eradication of helminthiasis is still very difficult, due to many factors that determine this prevalence. The improvement of environmental conditions together with personal hygiene, direct care, and participating research would be capable of decreasing the rate of enteroparasitosis incidence in the world^{6,7}.

Several studies conducted in different

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countries and populations revealed a varying rate of prevalence of enteroparasite infection from 14.6% to 91.0%⁸⁻¹³. In Brazil, the rate of infection is high at 88.4%¹⁴⁻¹⁶.

The incidence of enteroparasite infections in the Alto Paranaíba region is an epidemiological indicator that actions regarding the control and sanitary education programs against different parasitosis should be implemented. In this study, we investigated the occurrence of enteroparasites and commensal organisms in individuals living in rural and urban regions of Abadia dos Dourados, Minas Gerais state, Brazil.

MATERIAL AND METHODS

Abadia dos Dourados district occupies an area of 8200 Km², and it is located at 18° 29' 08" S latitude and 47° 24' 11" W longitude in the Alto Paranaíba region, Minas Gerais state, Brazil. There are 6,446 inhabitants in this municipality, 2,519 living in the rural area and 3,927 in the urban area (IBGE, Brazilian Geography and Statistic Institute, 2000). The rural population works as small farmers and are subsistence farmers, while the urban population works primarily in business. Both populations living in the area use raw sewage water to irrigate their crops, which is responsible for an increased risk of pathogenic parasites.

The size of the sample was calculated using the formula: $n = Z^2 \times P \times Q / d^2$ considering (Z) of 95%; (d) of 5%; (P) of 42.91%, obtained in a pilot study conducted in the municipality of Abadia dos Dourados and a non-observed value (Q) of 57.09%; with the size of the sample (n) evaluated at 376 people¹⁵. These individuals were

selected at random, resulting in 188 participants that live in the rural area and 188 participants that live in the urban area. Fecal samples were collected after the individuals were identified by gender and age and consent was given by their parents or relatives for their participation in the study.

Two fecal samples from each person were collected in plastic vials with preservatives in intervals of four to six days. The samples were stored in boxes and analyzed using the Lutz method¹⁷. Six slides were prepared of each sample and analyzed by two researchers. The total number of slides examined was 2,256. All of the individuals received the results from the laboratory. The positive cases were referred to the Municipal Hospital, where they received specific treatment.

The results of the parasitological exams were analyzed using Difference between Proportions, Odds Ratio, Fisher's Exact Test; Chi-Square Test (χ^2), with 95% confidence interval and statistical significance of $P < 0.05$ (Instat Program).

RESULTS

Of the 376 individuals, 157 (41.8%) were males, 83 of them (22.1%) were living in the rural area and 74 (19.7%) were living in the urban area. Of the 376 individuals, 219 (58.2%) were females, 105 (27.9%) of them were living in the rural area and 114 (30.3%) were living in the urban area. The age range between participants varied from 2 to 95 years of age.

Of the 177 (47.1%) individuals who tested positive for enteroparasites, 102 (57.6%) were from the rural area and 75 (42.4%) were from

Table 1. Distribution of positive cases of enteroparasites and commensals in 177 individuals by sex and age from rural and urban areas in Abadia dos Dourados, Minas Gerais state, Brazil, (January to December 1996)

Area	Sex								Total			
	Male				Female				Male		Female	
	Age (Years)		Age (Years)		Age (Years)		Age (Years)		Age (Years)		Age (Years)	
	0-14	%	>14	%	0-14	%	>14	%	n	%	n	%
Rural	20	19.6	31*	30.4	21	20.6	30	29.4	51*	50.0	51	50.0
Urban	18	24.0	11	14.7	13	17.3	33	44.0	29	38.7	46	61.3

n: numbers; %: percentage; * Significance: $P < .05$.

the urban area. The distribution of positive cases by sex and age in the two areas studied is demonstrated in Table 1. The number of positive cases was significantly higher in the rural area than in the urban area ($P < 0.05$). Male individuals over 14 years of age living in the rural area have a 3.177 ($P < 0.05$) greater chance of being infected with enteroparasites than male individuals of similar age living in the urban area (OR: 3,177 CI: 1.545 to 6.533).

The frequency of these parasites in the two areas was analyzed and is shown in Table 2. The positive cases of hookworm, *Strongyloides stercoralis*, and *Giardia lamblia* in the rural area were significantly higher than in the urban area ($P < 0.05$). Positive cases of hookworm were significantly higher than *S. stercoralis* ($P < 0.05$ and OR: 20.98; CI: 7.880 to 55.88), and the *Endolimax nana* case numbers were significantly higher in the urban area than in the rural area.

Of the total 177 positive cases, there were 141 (37.5%) cases of monoparasitism, 33 (8.8%) cases of bi-parasitism, and 3 (0.8%) cases of poly-parasitism. In the rural area, there were 80 (42.6%) individuals who tested positive for monoparasitism, 19 (10.1%) for bi-parasitism, and 3 (1.6%) for poly-parasitism. In the urban area, there were 61 (32.5%) individuals who tested positive for monoparasitism, 14 (7.4%) for bi-parasitism, and no cases of poly-parasitism. The possibility of individuals living in the rural area having one bi or poly-association was 2,469 times more likely than individuals living in the

urban area (OR: 2,469 CI: 0.9571 to 6.372). The association among pathogenic parasites and commensals between the two areas studied is demonstrated in Table 3.

DISCUSSION

The occurrence of enteroparasites in 47.1% of individuals between the ages of 2 and 74 years of age reveal a higher prevalence of enteric parasites and commensals in people living in Abadia dos Dourados. This data confirms the rate of infection diagnosed and described in the national literature^{18,19}.

The significant difference between the number of positive cases in the rural and urban areas can be attributed to poor basic sanitary conditions, the absence of piped water and a drainage system, and the habit of people walking barefoot in the rural area. These conditions are less common in urban areas.

The rate of enteroparasite infections diagnosed in the rural area was classified as high, and in the urban area it was classified as moderate, considering that part of this percentage was commensal protozoa considered not harmful to humans. However, it is possible that the rate of infection would be higher if the research had used specific methods to diagnose larvae of helminths and cysts of protozoa. This was not possible due to the difficulties presented in the collection and preservation of the fecal samples without preservatives¹⁵.

Table 2. Distribution of enteroparasites and commensals in 177 individuals in the rural and urban areas in Abadia dos Dourados, Minas Gerais state of Brazil, (January to December 1996)

Enteroparasite and Commensal	Rural area		Urban area		Total	
	n	%	n	%	n	%
<i>Entamoeba coli</i>	31	16.5	38	20.2	69	18.3
Hookworm	53*	28.2	14	7.4	67	17.8
<i>E. nana</i>	7	3.7	16*	8.5	23	6.1
<i>G. lamblia</i>	16*	8.5	6	3.2	22	5.8
<i>A. lumbricoides</i>	6	3.2	4	2.1	10	2.6
<i>E. hartmanni</i>	3	1.6	5	2.7	8	2.1
<i>I. bütschlii</i>	0	0	6	3.2	6	1.6
<i>S. stercoralis</i>	5*#	2.6	0	0	5	1.3
<i>E. vermicularis</i>	2	1.1	0	0	2	0.5
<i>Trichostrongylus</i> sp	2	1.1	0	0	2	0.5

n: numbers; %: percentage; ** Significance: $P < 0.05$; * Rural district versus urban district; # Hookworm versus *S. stercoralis*.

Table 3. Distribution of association between enteroparasites and commensals from rural and urban areas in Abadia dos Dourados, Minas Gerais state, Brazil, (January to December 1996)

Parasite association	Rural area		Urban area		Total	
	n	%	n	%	n	%
Hookworm + <i>E. coli</i>	7	31.8	2	14.3	9	25.0
Hookworm + <i>S. stercoralis</i>	2	9.1	0	0	2	5.5
Hookworm + <i>Trichostrongylus</i> sp	1	4.5	0	0	1	2.8
Hookworm + <i>E. vermicularis</i>	1	4.5	0	0	1	2.8
Hookworm + <i>A. lumbricoides</i>	2	9.1	0	0	2	5.5
Hookworm + <i>E. hartmanni</i>	1	4.5	0	0	1	2.8
Hookworm + <i>E. nana</i>	1	4.5	1	7.1	2	5.5
<i>G. lamblia</i> + <i>E. coli</i>	2	9.1	1	7.1	3	8.3
<i>G. lamblia</i> + <i>E. nana</i>	1	4.5	0	0	1	2.8
<i>G. lamblia</i> + <i>I. butschlii</i>	0	0	1	7.1	1	2.8
<i>E. coli</i> + <i>A. lumbricoides</i>	1	4.5	1	7.1	2	5.5
<i>E. coli</i> + <i>E. nana</i>	0	0	3	21.4	3	8.3
<i>E. coli</i> + <i>E. hartmanni</i>	0	0	1	7.1	1	2.8
<i>E. coli</i> + <i>I. butschlii</i>	0	0	3	21.4	3	8.3
<i>E. nana</i> + <i>I. butschlii</i>	0	0	1	7.1	1	2.8
Hookworm + <i>A. lumbricoides</i> + <i>E. coli</i>	1	4.5	0	0	1	2.8
Hookworm + <i>E. nana</i> + <i>E. coli</i>	1	4.5	0	0	1	2.8
Hookworm + <i>S. stercoralis</i> + <i>G. lamblia</i>	1	4.5	0	0	1	2.8
Total	22*	100	14	100	36	100

n: numbers; %: percentage; OR: 2,469; CI: 0.9571 to 6.372; Significance: $P < 0.05$.

The positive cases of hookworm and *S. stercoralis* in the rural area were significantly higher than in the urban area. This result is due to the similarities between the forms of infection of two nematodes that actively cause infected larvae to penetrate the skin and mucosal membrane when people handle soil or ingest food or contaminated water. Both helminths are soil-dwelling roundworms mainly found in the tropics and the subtropics²⁰. The data found in the rural area showed that this region is hyperendemic to these parasitosis. However, the people living in the rural area had 20.98% higher chance of infection with hookworm than with *S. stercoralis*. The data dealing with hookworm and *S. stercoralis* were lower than the positive rate of these parasites described in other rural areas^{20,21}. Nevertheless, in comparative studies in the literature about helminth infections in men in rural communities of the Niger Delta, Nigeria, showed similar results to those found in this research²².

The other helminths *Ascaris lumbricoides*, *Enterobius vermicularis*, and *Trichostrongylus* sp were diagnosed, but only parasite *A. lumbricoides* was diagnosed in both the rural and urban areas. *E. vermicularis* and *Trichostrongylus* sp were

diagnosed only in the rural area. The results of *A. lumbricoides* and *E. vermicularis* were similar to the data described in the literature^{18,23}. In Brazil, there is no literature showing the occurrence of human infection of *Trichostrongylus* sp in rural or urban populations. This study is the first in Brazil in which evidence of *Trichostrongylus* sp infection is similar to the epidemiological studies in rural areas described in the literature in which the percentage rate of this parasite is 0.5%^{24,25}. The low incidence of *E. vermicularis* is due to the fact that the Graham method was not used in diagnosing his presence.

G. lamblia was the only pathogenic protozoa found in both areas studied. The incidence of this parasite in the rural area was higher than in the urban area. This data suggest that the difference between the two areas is a result of poor hygiene of the people who live in the rural area. Approximately 90% of these individuals use toilets, but they do not wash their hands with soap. Normally, they have long, dirty nails, and they put their hands in their mouths or ingest food contaminated with cysts of *G. lamblia*. Another possibility is the use of unfiltered water that may be contaminated by fecal residue of humans or animals that live freely together with

man on the farm. However, the data found that *G. lamblia* show similar results to that described in the national literature^{18,26}.

The amoebae found in the gastrointestinal tract, *Entamoeba coli*, *Entamoeba hartmanni*, *E. nana*, and *Iodamoeba butschlii*, are not harmful to humans, but many people are infected²⁷. However, these species of amoebae must be diagnosed and described in the literature, because the form of infection of these commensals is similar to other pathogenic parasites. The rate of positivity for *E. coli*, *E. hartmanni*, and *I. butschlii* were similar in the two areas studied. Nevertheless, the *E. nana* case numbers were significantly higher in the urban area than in the rural area. These results did not confirm the expectations of the researchers, since 95% of the rural population studied drinks unfiltered and unpiped water, whereas 99% of the urban population drinks piped and filtered water. However, the cases found in this study are similar to results of different studies described by other authors^{18,28}. The occurrence of bi and poly-parasitism can aggravate the general state of health of the individual. There were 15 cases of bi-associations and 3 cases of poly-associations, and hookworm infection was present in seven cases of bi-parasitism and in three cases of poly-parasitism, making up a total of 58.3% of the associations. The bi and poly-associations are important and attract attention because at least one of the cases of parasitism involved was pathogenic.

Concurrent programs of nutrition, immunization, family planning, and de-worming have been shown to effectively promote health by influencing the knowledge, perceptions, and behaviours of parents and relatives toward intestinal parasitic infections in different countries. This has been effective in the control of enteroparasites²⁹⁻³². These results described in this study indicate the need to identify different areas in which enteroparasites are endemic in Brazil, the rate of people becoming infected, and the species of parasites most frequently found through epidemiological studies. This knowledge makes it easier to start social programs to control parasite infections in Brazil. Through the media, health work, and factors related to the country side, people are encouraged to know the etiological agents of the enteroparasitoses, the means of infection, and prophylactic approaches

that can reduce these infections. This allows people to stay informed in terms of the importance of the enteroparasitoses in their lives and to adapt their personal behaviors as part of basic hygiene practices.

RESUMEN

El objetivo de este estudio fue evaluar la presencia de enteroparasitas y comensales en habitantes de la ciudad de Abadia dos Dourados, Minas Gerais, Brasil. 376 personas fueron seleccionadas aleatoriamente, 188 viviendo en el área rural y 188 viviendo en el área urbana, enero a diciembre de 1996. Usando el método de Lutz, 177 (47,1%) individuos estaban infectados, siendo 102 (57,6%) del área rural y 75 (39,9%) del área urbana ($P < 0,05$). Del total de 177 positivos, la ocurrencia de entoparasitas y començais diagnosticadas fueron: *Entamoeba coli* (18,3%), hookworm (17,8%), *Endolimax nana* (6,1%), *Giardia lamblia* (5,8%), *Ascaris lumbricoides* (2,6%), *Entamoeba hartmanni* (2,1%), *Iodamoeba bütschlii* (1,6%), *Strongyloides stercoralis* (1,3%), *Enterobius vermicularis* (0,5%), y *Trichostrongylus* sp (0,5%). Geohelmintos fueron predominantes en el área rural, con 28,2% de infección para hookworm en esta población y 7,4% en la población urbana (OR: 14,33 CI: 6.230 para 32.970). La tasa de infección para enteroparasitas fue alta en los individuos estudiados, siendo necesario hacer exámenes parasitologicos regulares en estas personas y adoptar medidas profilácticas sobre las formas y consecuencias de transmisión de parasitas, principalmente entre personas que viven en el área rural.

REFERENCES

- 1.- LINDO J F, VALIDUM L, AGER A L, et al. Intestinal parasites among young children in the interior of Guyana. West Indian Med J 2002; 51: 25-7.
- 2.- BUNDY D A P: Immunoepidemiology of intestinal helminthic infections. 1. The global burden of intestinal nematode disease. Trans R Soc Trop Med Hyg 1994; 88: 259-61.
- 3.- YASSIN M M, SHUBAIR M E, AL-HINDI A I, JADALLAH S Y. Prevalence of intestinal parasites among school children in Gaza City, Gaza Strip. J Egypt Soc Parasitol 1999; 29: 365-73.
- 4.- NORHAYATI M, FATMAH M S, YUSOF S, EDARIAH A B. Intestinal parasitic infections in man: a review. Med J Malaysia 2003; 58: 296-305.

- 5.- PEARCE N. Traditional epidemiology, modern epidemiology, and public health. *Am J Public Health* 1996; 86: 678-83.
- 6.- QUIHUI L, VALENCIAL M E, CROMPTON W T D, et al. Role of the employment status and education of mothers in the prevalence of intestinal parasitic infections in Mexican rural schoolchildren. *BMC Public Health* 2006; 6: 225.
- 7.- MELLO D A, MARTINS C B, BITTENCOURT-JUNIOR A C, et al. Pesquisa participante na intervenção da transmissão de helmintoses intestinais (Cidade Satélite Paranoá - Distrito Federal). *Rev Soc Bras Med Trop* 1995; 28: 223-32.
- 8.- FERNÁNDEZ M C, VERGHESE S, BHUVANESWARI R, et al. A comparative study of the intestinal parasites prevalent among children living in rural and urban settings in and around Chennai. *J Commun Dis* 2002; 34: 35-9.
- 9.- KHURANA S, AGGARWAL A, MALLA N. Comparative analysis of intestinal parasitic infections in slum, rural and urban populations in and around union Territory, Chandigarh. *J Commun Dis* 2005; 37: 239-43.
- 10.- MALHOTRA R, LAL P, PRAKASH S K, et al. Study of hand hygiene and enteroparasite infestation among food handlers working in a medical college of North India. *Indian J Pathol Microbiol* 2006; 49: 296-301.
- 11.- AL-MEKHLAFI M S, AZLIN M, NOR A U, et al. Prevalence and distribution of soil-transmitted helminthiasis among Orang Asli children living in peripheral Selangor, Malaysia. *Southeast Asian J Trop Med Public Health* 2006; 37: 40-7.
- 12.- AK M, KELESE K, KARACASU F, et al. The distribution of the intestinal parasitic diseases in the Southeast Anatolian (GAP=SEAP) region of Turkey. *Parasitol Res* 2006; 99: 146-52.
- 13.- SPINELLI R, BRANDONISIO O, SERIO G, et al. Intestinal parasites in healthy subjects in Albania. *Eur J Epidemiol* 2006; 21: 161-6.
- 14.- FLEMING F M, BROOKER S, GEIGER S M, et al. Synergistic associations between hookworm and other helminth species in a rural community in Brazil. *Trop Med Int Health* 2006; 11: 56-64.
- 15.- MACHADO E R, COSTA-CRUZ J M. *Strongyloides stercoralis* and other enteroparasites in children at Uberlândia city, state of Minas Gerais, Brazil. *Mem Inst Oswaldo Cruz* 1998; 93: 161-4.
- 16.- FERREIRA P, LIMA M R, OLIVEIRA F B, et al. Occurrence of intestinal parasites and commensal organisms among schoolchildren living in a 'landless farm workers' settlement in Campo Florido, Minas Gerais, State Brazil. *Rev Soc Bras Med Trop* 2003; 36: 109-11.
- 17.- LUTZ A V. *Schistosoma mansoni* e a schistosomose, segundo observações feitas no Brasil. *Mem Inst Oswaldo Cruz* 1919; 11: 121-5.
- 18.- KOBAYASHI J, HASEGAWA H, FORLI A A, et al. Prevalence of intestinal parasitic infection in five farms in Holambra, São Paulo, Brazil. *Rev Inst Med Trop São Paulo* 1995; 37: 13-8.
- 19.- SALDIVA S R, SILVEIRA A S, PHILIPPI S T, et al. *Ascaris-Trichuris* association and malnutrition in Brazilian children. *Paediatr Perinat Epidemiol* 1999; 13: 89-98.
- 20.- GONCALVES J F, TANABE M, MEDEIROS F P, et al. Parasitological and serological studies on amebiasis and other intestinal parasitic infections in the rural sector around Recife, northeast Brazil. *Rev Inst Med Trop São Paulo* 1990; 32: 428-35.
- 21.- BROOKER S, ALEXANDER N, GEIGER S, et al. Contrasting patterns in the small-scale heterogeneity of human helminth infections in urban and rural environments in Brazil. *Int J Parasitol* 2006; 36: 1143-51.
- 22.- AGI P I. Comparative helminth infections of man in two rural communities of the Niger Delta, Nigeria. *West Afr J Med* 1997; 16: 232-6.
- 23.- CARNEIRO F F, CIFUENTES E, TELLEZ-ROJOM M, ROMIEU I. The risk of *Ascaris lumbricoides* infection in children as an environmental health indicator to guide preventive activities in Caparaó and Alto Caparaó, Brazil. *Bull World Health Organ* 2002; 80: 40-6.
- 24.- HONG S J, WOO H C, HAN J H, SEONG Y K. Intestinal parasite infections among inhabitants in two islands of Tongyeong-gun, Kyeongsangnam-do. *Kisaengchunghak Chapchi* 1990; 28: 63-7.
- 25.- LEE S K, SHIN B M, CHUNG N S, et al. Second report on intestinal parasites among the patients of Seoul Paik Hospital (1984-1992). *Korean J Parasitol* 1994; 32: 27-33.
- 26.- SANTOS R V, COIMBRA JUNIOR C E, FLOWERS N M, SILVA J P. Intestinal parasitism in the Xavante Indians, central Brazil. *Rev Inst Med Trop São Paulo* 1995; 37: 145-8.
- 27.- GENDREL D. Parasitic diarrhea in eutrophic and malnourished children. *Med Trop (Mars)* 2003; 63: 442-8.
- 28.- GUIMARAES S, SOGAYAR M I. Occurrence of *Giardia lamblia* in children of municipal day-care centers from Botucatu, São Paulo State, Brazil. *Rev Inst Med Trop São Paulo* 1995; 37: 501-6.
- 29.- PAYAPVIPAPONG P. Self-reliance of the IP from parasite control to preventive health. In: Yokogawa VM, Hayashi S, Kobayashi A, Kagei N, Kunii C, Hara T., editor. *Collected Papers on the Control of Soil-Transmitted Helminthiasis*. V. Tokyo, Japan. The Asian Parasite Control Organization; 1993. pp. 318-23.
- 30.- CONTRERAS C F. Integrated project in Guatemala. In: YOKOGAWA V M, HAYASHI S, KOBAYASHI A et al, editor. *Collected Papers on the Control of Soil-Transmitted Helminthiasis*, V. Tokyo, Japan. The Asian Parasite Control Organization; 1993. pp. 335-7.
- 31.- CURTALE F, PEZZOTTI P, SHARBINI A L, et al. Knowledge, perceptions and behaviour of mothers toward intestinal helminths in upper Egypt: implications for control. *Health Policy Plan* 1998; 13: 423-32.
- 32.- WAMANI H, TYLLESKAR T, NORDREHAUG-ASTROM A, TUMWINE J K, Peterson S. Mothers' education but not fathers' education, household assets or land ownership is the best predictor of child health inequalities in rural Uganda. *Int J Equity Health* 2004; 3: 1186-94.

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