

ASCARIASIS IN THE SUBDISTRICT OF CAVACOS, MUNICIPALITY OF ALTEROSA (MG), BRAZIL: EFFECT OF MASS TREATMENT WITH ALBENDAZOLE ON THE INTENSITY OF INFECTION

Marcos T. MACHADO(1), Telma M. S. MACHADO(1), Roberto M. YOSHIKAE(1), Ana Lúcia A. SCHMIDT(1), Rita de Cássia A. FARIA(1), Maria A. PASCHOALOTTI(1), Rita de Cássia B. BARATA(1) & Pedro P. CHIEFFI(1, 2)

SUMMARY

The clinical and epidemiologic aspects of infection with *Ascaris lumbricoides* were studied in a random stratified sample of the population of the subdistrict of Cavacos, municipality of Alterosa (Minas Gerais, Brazil). The effect of mass treatment with a single dose of albendazole on the prevalence and intensity of infection was also studied six months later in the same population.

During the first phase of the study, a questionnaire was applied to 248 individuals to obtain information about the socioeconomic, sanitary and clinical conditions of the population surveyed. A total of 230 fecal samples were also examined by the Kato-Katz technique in order to determine the intensity of *A. lumbricoides* infection. Two hundred and two individuals were simultaneously submitted to blood counts and 70 children aged 12 years or less were evaluated for nutritional status. The presence of *A. lumbricoides* and other helminth eggs was also determined in 22 soil samples collected in the urban zone of Cavacos.

Infection with enteroparasitic helminths was detected in 29.1% of the sample, with a predominance of *A. lumbricoides* (23.9%). Parasitism and/or intensity of *A. lumbricoides* infection were significantly correlated with age range (15 years or less), social class, sanitary and living conditions (water, sewage and domiciliary area per person), and presence of abdominal pain. However, these parameters were not correlated with nutritional status or hematocrit levels.

During the second phase of the study, a slight but not statistically significant decrease in the prevalence of *A. lumbricoides* infection was detected after treatment with albendazole. However, an important and significant reduction in the amount of *A. lumbricoides* eggs eliminated through the feces was detected, indicating that the intensity of *A. lumbricoides* infection was lower in all the age ranges of the Cavacos population, especially among younger individuals, even six months after administration of the anthelmintic agent.

KEYWORDS: Ascariasis; *Ascaris lumbricoides*; Morbidity, prevalence and intensity of infection; Single-dose mass treatment; Albendazole.

INTRODUCTION

Enteroparasitic helminths are highly common infectious agents frequently causing varying signs and symptoms of morbidity, as well as mortality among human be-

ings⁷. *Ascaris lumbricoides* is one of the most prevalent among them⁸ and is often responsible for organic disorders and significant host involvement²⁹.

(1) Faculdade de Ciências Médicas da Santa Casa de São Paulo, São Paulo, SP, Brasil.

(2) Instituto de Medicina Tropical de São Paulo (LIM 06), São Paulo, SP, Brasil.

Correspondence to: Dr. Pedro Paulo Chieffi, Instituto de Medicina Tropical de São Paulo, Av. Dr. Enéas de Carvalho Aguiar, 470, 05403-000 São Paulo, SP, Brasil. E-mail: pchieffi@usp.br

Ascariasis predominates in regions where poverty and inadequate sanitary conditions are present, especially in tropical and subtropical areas²². The intense fecal contamination of soil in these regions is a preponderant factor in the maintenance of the endemic nature of the disease.

The prevalence of *A. lumbricoides* infection is quite variable in Brazil. In some regions almost half the population is infected, whereas in others, especially the more developed ones, the frequency of *A. lumbricoides* infection has decreased^{11,21,27}. However, few studies are available about the intensity of infection¹¹ and especially about its relationship with indicators of the socioeconomic level of the population.

In the present investigation we studied the clinical and epidemiologic aspects of *A. lumbricoides* infection in a random stratified sample of the population of Cavacos, a subdistrict located in the municipality of Alterosa (state of Minas Gerais, Brazil), as well as the effect of mass treatment with a single dose of albendazole on the prevalence and intensity of infection with this nematode six months after administration of the anthelmintic agent.

MATERIALS AND METHODS

The study was conducted in the subdistrict of Cavacos which occupies a 1.5 km² area in the municipality of Alterosa, southern state of Minas Gerais, Brazil. Cavacos has approximately 1,100 inhabitants whose major occupations are agriculture and animal husbandry.

Considering previous data which estimated the frequency of the enteroparasites to be approximately 30% in the Cavacos population, the sample to be investigated was determined according to the technique recommended by the Pan American Health Organization³. We opted for a 90% confidence interval and, considering a possible loss of about 10%, we fixed at 220 the number of persons to be studied in Cavacos (1/5 of the population). The first domicile to be visited was picked at random and 1/5 of the existing dwellings were visited starting from this house and adopting a sampling interval of 5 houses. Thus, we visited a total of 55 dwellings comprising 248 persons interviewed.

Using a specially prepared questionnaire, information was collected in each dwelling with respect to family constitution, socioeconomic and housing conditions, as well as the occurrence of gastrointestinal signs and symptoms attributable to the presence of enteroparasites and to the use of anthelmintic agents. Each inhabitant of the dwellings picked for investigation was also asked to provide a fecal sample. A total of 230 samples were obtained and analyzed by the Kato-Katz technique¹⁸ which involves the quantitation of eliminated eggs per gram of

feces. The intensity of *A. lumbricoides* parasitism was considered high in samples containing more than 5,000 eggs per gram of feces.

Children aged 12 years or younger were submitted to nutritional evaluation based on anthropometric measurements³. Seventy of the 78 children in this age range were examined. The anthropometric data were divided by percentile and the children in the 10th percentile or lower were considered to present a high degree of malnutrition.

A blood sample was obtained from the finger pad of 202 adults and children for the determination of microhematocrit, which was classified as normal or low according to international standards¹².

Soil contamination with helminth eggs was determined in 22 samples collected at different sites uniformly distributed in the urban area of Cavacos. The soil samples were examined by the technique of Caldwell, cited by SPINDLER²⁴.

The study sample was divided into social classes according to the criterion of BRONFMAN & TUIRÁN⁴.

TABLE I

Demographic and socioeconomic profile of the population sample in Cavacos, municipality of Alterosa (Minas Gerais, Brazil) in April 1992.

Profile	No.	%
Sex		
Male	117	50.9
Female	113	49.1
Age		
Up to 15 years	93	40.4
More than 15 years	137	59.6
Education		
Illiterate	26	11.3
Up to 3 rd grade of elementary school	72	31.3
Up to 4 th grade of elementary school	60	26.1
Fifth grade or more	32	13.9
Outside the school range	40	17.4
Social class		
Subproletariat	181	78.7
Proletariat	29	12.6
Lower middle class	20	8.7
Lighting		
Electric light	219	95.2
Other	11	4.8
Water supply		
Domiciliary	209	90.9
Other	21	9.1
Sewage		
Sanitary	161	70.0
Other	69	30.0
Garbage disposal		
Burned	84	36.5
Dumped on the ground	75	32.6
Both	71	30.9

However, to determine the effect of social class on the frequency and intensity of *A. lumbricoides* infection we only considered two groups, one consisting of the subproletariat and the other of proletariat and lower middle class.

In the assessment of housing conditions, the type of water supply was divided into three groups: piped water inside the house, piped water outside the house and wells. The sewage system was classified into two categories: sanitary (presence of a flush toilet) and non-sanitary (all other conditions).

The data obtained were processed using the Epi-Info software and analyzed statistically by the chi-square test when the sample size permitted it, or by the Fisher test for smaller samples. The level of significance was set at 5% ($p < 0.05$).

After parasitologic examination of the feces, a single dose of albendazole (400 mg) was administered to all Cavacos inhabitants except pregnant women and children less than 2 years old. After six months, a new fe-

cal sample was obtained from the same individuals, for a total of 160 samples that were also examined by the Kato-Katz technique.

The study was conducted between April and October 1992. All individuals gave informed consent to participate in the study after receiving a detailed explanation of its objectives.

RESULTS

Fifty-one of the 55 houses studied (92.8%) were made of bricks and the remaining ones (7.2%) were built with other materials. Thirty-three (60%) had a cement floor, 17 had a finished floor and 5 had a brick floor. The variables related to the socioeconomic and demographic profile of the population sample studied are listed in Table 1.

Of the 230 individuals submitted to parasitologic examination of the feces, 67 (29.1%) harbored some species of enteroparasitic helminths. The prevalence of infection by helminth species and the distribution of *A. lumbricoides* infection by age, sex and social class are presented in Tables 2 and 3.

TABLE 2
Prevalence of enteroparasitic helminths in 230 and 160 fecal samples examined in Cavacos, municipality of Alterosa (Minas Gerais, Brazil), in April and October 1992, respectively.

Helminths	April			October		
	No.	%	CI*	No.	%	CI*
<i>Ascaris lumbricoides</i>	55	23.9	(18.7-29.7)	31	19.4	(13.8-26.0)
<i>Trichuris trichiura</i>	15	6.5	(3.8-10.3)	10	6.3	(3.2-10.9)
<i>Taenia</i> sp.	5	2.2	(0.8-4.8)	3	1.9	(0.5-5.0)
<i>Enterobius vermicularis</i>	3	1.3	(0.3-3.5)	2	1.3	(0.2-4.1)
<i>Schistosoma mansoni</i>	2	0.9	(0.1-2.8)	2	1.3	(0.2-4.1)
Ancylostomids	2	0.9	(0.1-2.8)	1	0.6	(0.0-3.0)

* CI = Confidence interval

TABLE 3
Prevalence and intensity of *A. lumbricoides* infection by sex, age and social class in Cavacos, municipality of Alterosa (Minas Gerais, Brazil), in April 1992.

Variables	Parasitism		Odds Ratio	Intensity		Odds Ratio
	Present	Absent		High	Low	
Sex						
Male	29 (24.8%)	88 (75.2%)		11 (40.7%)	16 (59.3%)*	
Female	26 (23.0%)	87 (77.0%)		10 (38.5%)	16 (61.5%)	
Age						
Up to 15 years	33 (35.5%)	60 (64.5%)	2.88 (1.48-5.63)	17 (51.5%)	16 (48.5%)	4.25 (1.01-19.14)
More than 15 years	22 (16.1%)	115 (83.9%)		4 (20.0%)	16 (80.0%)	
Social class						
Subproletariat	49 (27.1%)	132 (72.9%)	2.66 (1.00-7.44)	19 (40.4%)	28 (59.6%)	1.36
Others	6 (12.2%)	43 (87.8%)		2 (33.3%)	4 (66.7%)	
Total	55	175		21	32	

* It was not possible to determine the intensity of *A. lumbricoides* infection in two individuals.

No significant sex differences were observed in prevalence or intensity of infection. With respect to age range, individuals aged 15 years or younger showed a higher prevalence and intensity of *A. lumbricoides* infection (chi square = 11.49, $p < 0.0007$ and 5.17, $p < 0.023$, respectively).

Table 3 also shows a higher prevalence of *A. lumbricoides* infection among subproletarian individuals compared to the remaining social classes (chi-square = 4.66, $p < 0.030$). However, no significant difference was observed between the various social classes in terms of intensity of infection.

Analysis of Table 4 shows that the absence of sanitary sewage and/or water inside the dwelling, as well as an area of less than 5 m² per person were significantly correlated with greater prevalence and intensity of *A. lumbricoides* infection.

There was also a significant correlation between presence of abdominal pain and intensity of *A.*

lumbricoides infection (Table 5), although this was not the case for prevalence.

The anthropometric data obtained for the group of 70 children aged 12 years or less revealed that 12 (17.1%) were in the < 10th percentile in terms of weight and 21 (30%) in terms of height. However, no correlation was observed between higher frequency or intensity of *A. lumbricoides* infection and anthropometric data for these children.

Microhematocrit also showed no significant difference in terms of presence and intensity of *A. lumbricoides* infection.

Soil examination revealed the presence of *Ascaris* eggs in almost all samples examined (Table 6). The eggs that could not be identified belonged to nematodes, probably parasites of either domestic or synanthropic animals, whose definitive identification could only be obtained by larval culture.

TABLE 4

Prevalence and intensity of *A. lumbricoides* infection according to the presence of sewage, water supply and area available to each dweller in Cavacos, municipality of Alterosa (Minas Gerais, Brazil), in april 1992.

Dwelling	Parasitism		Odds Ratio	Intensity		Odds Ratio
	Present	Absent		High	Low	
Sewage						
Sanitary	28 (17.4%)	133 (82.6%)	2.94 (1.48-5.84)	6 (22.2%)	21 (77.8%)	4.77 (1.25-19.04)
Other	26 (39.1%)	42 (60.9%)		15 (57.7%)	11 (42.3%)	
Water						
Domiciliary	44 (21.1%)	165 (78.9%)	4.13 (1.51-11.34)	14 (33.3%)	28 (66.7%)	3.50 (0.7-17.5)*
Extra-domiciliary	8 (53.3%)	7 (46.7%)		7 (87.5%)	1 (12.5%)	
Other	3 (50.0%)	3 (50.0%)		0	3 (100.0%)	
Available area						
Up to 5 m ²	22 (51.2%)	21 (48.8%)	4.89 (2.28-10.53)	12 (57.1%)	9 (42.9%)	3.41 (0.9-12.9)*
5 m ² or more	33 (17.6%)	154 (82.4%)		9 (28.1%)	23 (71.9%)	
Total	55	175		21	32	

* Nonsignificant

TABLE 5

Prevalence and intensity of *A. lumbricoides* infection and presence of abdominal pain in Cavacos, municipality of Alterosa (Minas Gerais, Brazil), in April 1992.

Abdominal pain	Parasitism*		Intensity		Odds Ratio
	Present	Absent	High	Low	
Present	23 (24.0%)	73 (76.0%)	14 (63.6%)	8 (36.4%)	7.00 (1.73-30.16)
Absent	31 (24.6%)	95 (75.4%)	6 (20.0%)	24 (80.0%)	
Total	54	168	20	32	

* Eight of the 230 patients examined did not report the presence or absence of abdominal pain.

TABLE 6

Frequency of detection of helminth eggs in 22 soil samples obtained in Cavacos, municipality of Alterosa (Minas Gerais, Brazil), in April 1992.

Helminths	No.	% (CI)*
<i>Ascaris</i> sp.	21	95.5 (79.5-99.8)
<i>Trichuris</i> sp.	3	13.6 (3.6-32.8)
<i>Toxocara</i> sp.	3	13.6 (3.6-32.8)
<i>Taenia</i> sp.	2	9.1 (1.6-26.9)
<i>Enterobius vermicularis</i>	1	4.5 (0.2-20.4)
Unidentified	9	40.9

* CI = confidence interval.

Administration of mass treatment with a single dose of albendazole resulted in a significant reduction of *A. lumbricoides* infection (Table 7) as indicated by the decrease in the number of eggs eliminated by infected individuals who were submitted to a new parasitologic examination 6 months after treatment (160 of the 230 individuals belonging to the initial sample). However, the frequency of *A. lumbricoides* infection and of infection with other species observed before treatment did not show significant changes (Table 2).

TABLE 7

Mean number of *A. lumbricoides* eggs eliminated per individual examined in Cavacos, municipality of Alterosa (Minas Gerais, Brazil), before and six months after treatment with a single dose of albendazole.

Age (years)	Before	After 6 months	Reduction (%)
Up to 15	5,325 (31)*	84 (16)	98.4
More than 15	730 (22)	48 (15)	93.4

p < 0.05

* The values in parenthesis correspond to the number of patients who eliminated *A. lumbricoides* eggs.

DISCUSSION

The present data indicate that the frequency of intestinal parasitic helminths in the Cavacos population, although reaching approximately 30% of the population, is below the prevalence levels reported for other regions both abroad^{1,2,5,15,17} and in many Brazilian regions²⁶. These levels, however, are close to those detected in most of the regions in the State of São Paulo^{6,11,21,27}. These discrepancies may be explained in part by the method used for feces examination since the Kato-Katz method is inappropriate for the diagnosis of certain enteroparasitic helminths such as *Strongyloides stercoralis* and *Enterobius vermicularis*. It should be pointed out, however, that the quality of life enjoyed by most of the Cavacos residents is superior to that observed in regions where enteroparasitoses represent an

important health problem for human beings. As indicated in Table 1, most of the Cavacos inhabitants live in brick houses with piped water and approximately 70% have an adequate system of sewage and waste disposal.

In any case, the frequency of *A. lumbricoides* infection, a helminthiasis diagnosed in 24% of the individuals examined, was high, with a sharp predominance in the age range up to 15 years, a pattern similar to that seen at other locations, although usually with a higher prevalence⁵.

The KATO-KATZ¹⁸ technique utilized here permitted the evaluation of the intensity of *A. lumbricoides* infection, which was high in 21 of the 55 infected individuals (38.2%), who eliminated more than 5,000 eggs per gram of feces. This fact was more frequent among the younger subjects and among those who lived in the worst conditions (Tables 3 and 5).

When the population sample studied was classified in terms of social stratum according to the method proposed by BRONFMAN & TUIRÁN⁴, there was a sharp predominance of the subproletariat, which corresponded to 78.7% of the individuals interviewed. A significantly higher frequency of *A. lumbricoides* infection was detected in this segment, although the same was not true with respect to the intensity of infection. Thus, the influence of social class on the morbidity of ascariasis appears to be somehow attenuated since, the higher the worm load, the greater the probability of the occurrence of complications. However, it should be kept in mind that the remaining social segments were little represented in the sample studied although they adequately expressed the real composition of the local population.

Among the symptoms reported by the subjects interviewed during the two weeks that preceded application of the questionnaire, only abdominal pain was associated with the presence of intense *A. lumbricoides* infection. Thus, approximately 43% of the individuals studied reported the occurrence of abdominal pain, with no significant difference between the groups infected with *A. lumbricoides* or not. However, when we consider only those who harbored *A. lumbricoides*, the occurrence of abdominal pain was more frequent among individuals with high egg counts in the feces (Table 5), indicating that more intense infection produces more serious symptoms.

When the subgroup of children up to 12 years of age was submitted to nutritional evaluation, 17% and 30% presented nutritional deficits in terms of weight and height, respectively, suggesting a greater influence of factors causing chronic malnutrition despite the limita-

tion inherent in the determination of only these parameters. However, as pointed out by other authors^{13,19}, there was no significant association between prevalence and intensity of *A. lumbricoides* infection and malnutrition^{14,25,28}.

It is possible that the absence of correlation between *A. lumbricoides* parasitism and malnutrition in the present sample was due to the relatively low prevalence of the helminth in the population studied, since the prevalence of infection is usually more elevated when nutritional problems are associated with the ascariasis²⁵.

The examination of soil samples showed the presence of eggs of helminths potentially pathogenic to human beings. In addition to *Ascaris* eggs, we detected *Toxocara* and *Taenia* eggs, which may be associated with serious clinical signs and symptoms²³.

Ascaris eggs were recovered from almost all soil samples examined. Although it is not possible to differentiate *A. lumbricoides* from *A. suum* eggs in terms of morphology, the absence of swine farms within the limits of the urban region where the samples were collected supports the hypothesis that the eggs belonged to the species that parasitizes man. Although *Ascaris* eggs were recovered from the different sites within the urban area where soil was collected, indicating the possibility of widespread transmission of the infection, the prevalence rate detected (23.9%) suggests that other factors in addition to soil contamination influenced the occurrence of human infection. It is possible that, even if living in an area where *A. lumbricoides* eggs are detected in soil, individual with reasonable living conditions are not easily infected. The present results support this hypothesis. On this basis, the population studied, with water available in their homes in most cases and an adequate system of waste disposal in 70% of cases, revealed moderate rates of *A. lumbricoides* infection despite exposure to soil frequently contaminated with *A. lumbricoides* eggs.

Administration of mass treatment with a single dose of albendazole was not sufficient to cause a significant change in the frequency of infection by parasitic enterohelminths evaluated six months after treatment (Table 2). However, an intense and significant decrease in the intensity of *A. lumbricoides* infection was observed, especially among the younger individuals. A similar situation has been reported by others^{10,15,16,17}, suggesting that the morbidity due to *A. lumbricoides* infection can be reduced by the use of this treatment scheme.

RESUMO

Ascariose no subdistrito de Cavacos, município de Alterosa (MG), Brasil. Efeito do tratamento em massa com albendazol sobre a intensidade de infecção

Em amostra aleatória e estratificada da população do subdistrito de Cavacos, no município de Alterosa (Minas Gerais, Brasil) estudaram-se os aspectos clínicos e epidemiológicos da infecção por *Ascaris lumbricoides*. Avaliou-se, também, na mesma amostra, seis meses mais tarde, o efeito do tratamento em massa com albendazol sobre a prevalência e intensidade de infecção por esse nematóide.

Na primeira fase do estudo, realizou-se inquérito em 248 indivíduos, utilizando questionário que investigava aspectos relativos a condições socioeconômicas, sanitárias e clínicas. Foram, também, examinadas 230 amostras de fezes pela técnica de Kato-Katz, visando determinação da prevalência e intensidade de infecção por *A. lumbricoides*. Ao mesmo tempo, 202 indivíduos foram submetidos a micro-hematócrito e em 70 crianças com idade menor ou igual a 12 anos efetuou-se avaliação do estado nutricional. Determinou-se, ainda, a presença de ovos de *A. lumbricoides* e outros helmintos em 22 amostras de solo colhidas na zona urbana de Cavacos.

Os resultados mostraram ocorrência de infecção por helmintos enteroparasitas em 29,1% da amostra examinada, com predomínio de *A. lumbricoides* (23,9%). Observou-se relação significativa do parasitismo e/ou intensidade de infecção por *A. lumbricoides* com faixa etária (idade menor ou igual a 15 anos), classe social, condições sanitárias e de habitação (água, esgoto e área domiciliar por pessoa) e presença de dor abdominal. Não se notou, entretanto, associação desses parâmetros com o estado nutricional e níveis de hematócrito.

Na segunda fase do estudo, encontrou-se discreta diminuição na prevalência de infecção por *A. lumbricoides*, sem significância do ponto de vista estatístico, seis meses após tratamento em massa com albendazol. Notou-se, entretanto, importante e significativa redução na quantidade de ovos de *A. lumbricoides* eliminados pelas fezes, indicando que mesmo seis meses após administração do anti-helmíntico é menor a intensidade de infecção por *A. lumbricoides* em todas as faixas etárias da população de Cavacos, especialmente entre os mais jovens.

ACKNOWLEDGEMENTS

The authors are indebted to SmithKline Beecham Laboratories for supplying the albendazole doses used in Cavacos' mass treatment.

REFERENCES

1. ANDERSON, T.J.C.; ZIZZA, C.A.; LECHE, G.M. et al. – The distribution of intestinal helminth infections in a rural village in Guatemala. *Mem. Inst. Oswaldo Cruz*, **88**:53-65, 1993.
2. ASHFORD, R.W.; CRAIG, P.S. & OPPENHEIMER, S.J. – Polyparasitism on the Kenya coast. I. Prevalence, and association between parasitic infections. *Ann. trop. Med. Parasit.*, **86**:671-679, 1992.
3. BARROS, F.C. & VICTORA, C.G. – **Epidemiologia de saúde infantil: um manual para diagnósticos comunitários**. São Paulo, Hucitec, Unesco, 1991.
4. BRONFMAN, M. & TUIRÁN, R.A. – La desigualdad social ante la muerte: clases sociales y mortalidad en la niñez. *Cuad. Med. soc.*, **29/30**:198-204, 1985.
5. BUNDY, D.A.P.; COOPER, E.S.; THOMPSON, D.E.; DIDIER, J.M. & SIMMONS, I. – Epidemiology and population dynamics of *Ascaris lumbricoides* and *Trichuris trichiura* infection in the same community. *Trans. roy. Soc. trop. Med. Hyg.*, **81**:987-993, 1987.
6. CHIEFFI, P.P.; WALDMAN, E.A.; DIAS, R.M.D.S.; TORRES, D.M.A.G.V. et al. – Enteroparasitoses no município de Guarulhos, SP, Brasil. I. Prevalência de infecção entre escolares residentes no bairro de Taboão, em junho de 1984. *Rev. Inst. Adolfo Lutz*, **48**:75-80, 1988.
7. COOK, G.C. – Gastrointestinal helminth infections. The clinical significance of gastrointestinal helminths – a review. *Trans. roy. Soc. trop. Med. Hyg.*, **80**:675-685, 1986.
8. CROLL, N.A.; ANDERSON, R.M.; GYORKOS, T.W. & GHADIRIAN, E. – The population biology and control of *Ascaris lumbricoides* in a rural community in Iran. *Trans. roy. Soc. trop. Med. Hyg.*, **76**:187-197, 1982.
9. CROMPTON, D.W.T. – Nutritional aspects of infection. *Trans. roy. Soc. trop. Med. Hyg.*, **80**:697-705, 1986.
10. ELKINS, D.B.; HASWELL-ELKINS, M. & ANDERSON, R.M. – The importance of host age and sex to patterns of reinfection with *Ascaris lumbricoides* following mass anthelmintic treatment in a South Indian fishing community. *Parasitology*, **96**:171-184, 1988.
11. FERREIRA, C.S.; FERREIRA, M.U. & NOGUEIRA, M.R. – The prevalence of infection by intestinal parasites in an urban slum in São Paulo, Brazil. *J. trop. Med. Hyg.*, **97**:121-127, 1994.
12. GUIMARÃES, R.X. & GUERRA, C.C.C. – **O laboratório para o clínico**. 7ª ed. São Paulo, Sarvier, 1991.
13. GUPTA, M.C. & URRUTIA, J.J. – Effect of periodic anti-ascaris and anti-giardia treatment upon nutritional status of pre-school children. *Amer. J. clin. Nutr.*, **36**:79-86, 1982.
14. GUPTA, M.C.; ARORA, K.L.; MITHAL, S. & TANDON, B.N. – Effect of periodic deworming on nutritional status of *Ascaris* infected pre-school children receiving supplementary food. *Lancet*, **2**:108-110, 1977.
15. HLAING, T.; SAW, T. & LWIN, M. – Reinfection of people with *Ascaris lumbricoides* following single, 6-month and 12-month interval mass chemotherapy in Okpo village, rural Burma. *Trans. roy. Soc. trop. Med. Hyg.*, **81**:140-146, 1987.
16. HLAING, T.; SAW, T.; AYE, H.H.; LWIN, M. & MYINT, T.M. – Epidemiology and transmission dynamics of *Ascaris lumbricoides* in Okpo village, rural Burma. *Trans. roy. Soc. trop. Med. Hyg.*, **78**:497-504, 1984.
17. HOLLAND, C.V.; ASAOLU, S.O.; CROMPTON, D.W. et al. – The epidemiology of *Ascaris lumbricoides* and other soil-transmitted helminths in primary school children from Ile-Ife, Nigeria. *Parasitology*, **99**:275-285, 1989.
18. KATZ, N.; CHAVES, A. & PELLEGRINO, J. – A simple device for quantitative stool thick smear technic in schistosomiasis mansoni. *Rev. Inst. Med. trop. S. Paulo*, **14**:397-400, 1972.
19. KLOETZEL, K.; MARTINS FILHO, T.J. & KLOETZEL, D. – Ascariasis and malnutrition in a group of Brazilian children – a follow up study. *J. trop. Pediatr.*, **28**:41-43, 1982.
20. MARCONDES, E.; MACHADO, D.V.M.; SETIAN, N. & CARRAZA, F.R. – Crescimento e desenvolvimento. In: MARCONDES, E., coord. **Pediatria básica**. 8ª ed. São Paulo, Sarvier, 1992, p. 35-63.
21. MONTEIRO, C.A.; CHIEFFI, P.P.; BENÍCIO, M.H.A. et al. – Estudo das condições de saúde das crianças do município de São Paulo (Brasil), 1984/1985. VII. Parasitoses intestinais. *Rev. Saúde públ. (S. Paulo)*, **22**:8-15, 1988.
22. PAWLOWSKI, Z.S. – Ascariasis. *Baillière's Clin. trop. Med. Commun. Dis.*, **2**:595-615, 1987.
23. SCHANTZ, P.M. – Parasitic zoonosis in perspective. *Int. J. Parasit.*, **21**:161-170, 1991.
24. SPINDLER, L.A. – On the use of a method for the isolation of *Ascaris* eggs from soil. *Amer. J. Hyg.*, **10**:157-164, 1929.
25. STEPHENSON, L.S.; CROMPTON, D.W.; LATHAM, M.C. et al. – Relationship between *Ascaris* infection and growth of malnourished pre-school children in Kenya. *Amer. J. clin. Nutr.*, **33**:1165-1172, 1980.
26. VINHA, C. – Incidência no Brasil de helmintos transmitidos pelo solo. Rotina coprocópica do ex-Departamento Nacional de Endemias Rurais. *Rev. bras. Malar.*, **23**:3-17, 1971.
27. WALDMAN, E.A. & CHIEFFI, P.P. – Enteroparasitoses no estado de São Paulo: questão de Saúde Pública. *Rev. Inst. Adolfo Lutz*, **49**:93-99, 1989.
28. WILLET, W.C.; KILAMA, W.L. & KIHAMIA, C.M. – *Ascaris* and growth rates: a randomized trial of treatment. *Amer. J. publ. Hlth.*, **69**:987-991, 1979.
29. WORLD HEALTH ORGANIZATION – Intestinal protozoan and helminth infections. *Wld. Hlth. Org. techn. Rep. Ser.*, (666). 1981.

Recebido para publicação em 13/06/1996
Aceito para publicação em 30/09/1996