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ORIGINAL PAPER

Prevalence of intestinal parasites versus knowledge, attitudes, and practices of inhabitants of low-income communities of Campos dos Goytacazes, Rio de Janeiro State, Brazil

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Abstract Intestinal parasites are the causative agents of common infections responsible for significant public health problems in developing countries and generally linked to lack of sanitation, safe water, and improper hygiene. More than two billion people throughout the world live with unrelenting illness due to intestinal parasitic infections (IPIs). The purposes of this study are to assess knowledge, attitudes, and practices on IPIs and investigate the relationship with prevalence of intestinal parasites among a low-income group of inhabitants from two communities of the Travessão District area, Campos dos Goytacazes, north of Rio de Janeiro State, Brazil. The two communities are known as "Parque Santuário," which is an urban slum with miserable living conditions, and "Arraial," where the socioeconomic and educational levels are better, neither having a sanitary infrastructure with an excreta collection system. Questionnaires revealed that both communities had local and specific codification to denominate the intestinal parasites and present correct knowledge on the theme but ignored some aspects of IPI transmission, with the Arraial population being better informed ($p<0.05$). The overall prevalence of IPIs in

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Parque Santuário (49.7%) was greater than in Arraial (27.2%) ($p<0.001$; prevalence ratio/95% confidence interval 1.83/1.50–2.23). This study reports the real IPI situation in the Travessão District and also reinforces the need to continue the investigation on the impact of combined prophylactic methods, educational measures, and socioeconomic and sanitary improvements by governmental authorities and the local popular organization.

Introduction

Intestinal parasites are the causative agents of common infections responsible for significant public health problems in developing countries, and more than two billion people throughout the world live with unrelenting illness due to intestinal parasitic infections (IPIs) (Dagci et al. 2008; WHO 2005a). Parasitic infections are associated with lack of sanitation and access to safe water, depriving poor populations of health and well-being and contributing to social marginalization through economic progress prevention (Mehraj et al. 2008; WHO 2005a). Approximately 300 million people suffer severe morbidity associated with these parasites, at least 50% of which are school-age children affected by massive infections (Keiser and Utzinger 2008). IPIs rarely lead to death, but because the problem is widespread, the global number of related deaths is substantial (WHO 2004, 2005a). About 39 million people lose years of productivity due to disability adjusted life years from IPIs, thus representing a formidable economic burden (Stephenson et al. 2000).

Ascaris lumbricoides, *Trichuris trichiura*, and hookworms, collectively referred to as soil-transmitted helminths (STHs), are the most common intestinal parasites (Bethony et al. 2006). *A. lumbricoides* is the largest and most frequent helminth parasitizing the human intestine, currently infecting about one billion people worldwide (CDC 2006). *Giardia lamblia*, the most prevalent protozoan parasite worldwide with about 200 million people currently infected (Pillai and Kain 2003; Minenoa and Avery 2003), has been increasingly worrying public health authorities since the emergence of strains resistant to conventional therapeutic agents (SVS 2005). Approximately 10% of the world population is infected by *Entamoeba histolytica*, 90% of which are asymptomatic (Reed 2001). Of the roughly 50 million symptomatic cases each year, up to 100,000 are fatal (Kucik et al. 2004).

Several health education programs have been developed based on knowledge, attitudes, and practices (KAP) in low-income communities to prevent and reduce IPIs (Omoigberale and Airauhi 2006; Garg et al. 2002). These programs take advantage of the school environment as an operational basis, possess low cost-effectiveness, and encourage public involvement, instigating change in habits resulting in healthy behavioral practices (WHO 2005b; Mascie-Taylor et al. 2003; Montresor et al. 2002). Consequently, instructed teachers and students can function as disseminators of information on health habits within their community, therefore contributing to endemic disease control (Uchôa et al. 2004).

Deworming has made impressive advances in the realm of public health. Millions of people, especially school-age children, have gained access to affordable, effective anti-helminthic drugs, which has resulted in improved health and well-being. Progress has been so evident that in May 2001, the 54th Session of the World Health Assembly (WHA) adopted Resolution WHA 54.19. The prevailing deworming strategy was endorsed, member states were urged to intensify control activities, and the United Nations organizations together with bilateral agencies were encouraged to intensify support for control activities. The Resolution also asked the director-general of the World Health Organization (WHO) to expedite the formation and work of partnerships for the control of schistosomiasis and STHs in high transmission areas. The Resolution WHA 54.19 goals are, in the short-term, to reduce morbidity through drug access (praziquantel and broad-spectrum anthelminthics), implement good case management in all health services, and offer regular treatment to at least 75% of school-age children by 2010, targeting other high-risk groups (young children, women of childbearing age, occupational groups) through existing public health programs and channels (WHO 2005a). In addition, the 49th Directing Council at the 61st Session of The Regional Committee establishes that efforts must be employed to go forward in eliminating or at least reducing the burden of neglected and poverty-related diseases by 2015, especially with regard to STHs in Latin America and the Caribbean, where 13 of the 14 countries, according to available information, present at least one area with an STH prevalence higher than 20% (WHO 2009).

Previous studies (Barçante et al. 2008; Bóia et al. 2006; Ferreira and Andrade 2005) in several Brazilian low-income communities have exhibited diverse prevalence rates of IPIs. These variations occur with respect to sanitation levels and the cultural characteristics of the analyzed populations. More IPIs are found in rural zones and the peripheries of major cities (Bencke et al. 2006). Detrimental sociocultural influences within these populations would include lack of education, personal hygiene, and nutritional habits; absence of proper plumbing facilities; overcrowding in homes; indiscretion in contact with animals; and inadequate refuse disposal (Gamboa et al. 1998). The purpose of this study is both to assess the KAP related to IPIs among inhabitants in the low-income communities of Travessão District area, Campos dos

Goytacazes, north of Rio de Janeiro State, Southeastern Brazil, and investigate whether or not there is any relationship between these features and the prevalence of intestinal parasites in this area.

Materials and methods

Studied area and population

The Travessão District is located 18 km from the downtown of Campos dos Goytacazes, located in the north of Rio de Janeiro State, Southeastern Brazil (21°35′52″S, 41°19′3″W) (Fig. 1). The average annual temperature, relative humidity, and precipitation from 2004 to 2008 were 22.9°C, 80.1%, and 1,186.5 mm, respectively, according to data obtained from the Empresa de Pesquisa Agropecuária (PESAGRO), Campos dos Goytacazes, RJ, Laboratório de Engenharia Agrícola (LEAG)/UENF, weather station. The population is 18,000 people, distributed in higher density in the urban center than the rural areas (IBGE 2009). In this study, samples obtained from two neighborhoods (with approximately 3,000 inhabitants each) within the urban area of Travessão were analyzed: (i) “Parque Santuário” (PS: 21°36′54″S, 41°18′37″W) presented aspects of an urban slum with miserable living conditions; muddy, unpaved streets; and dwellings of which for the most part are improvised with minimum comfort (Fig. 2a–c); and (ii) “Arraial” (AR: 21°36′2″S, 41°18′49″W) exhibited better conditions with paved and illuminated streets and domiciles of solid and lasting construction involving standard building materials such as timber, concrete, and brick (Fig. 2e, f). However, neither community possessed sanitary infrastructure with a city sewage system. The water supply was from superficial wells (Fig. 2d) exposed to environmental contamination from septic tanks (Costa and Alves 2007). In both communities, there was periodic garbage collection.

Survey of resident socioeconomic conditions

The socioeconomic data were obtained in a questionnaire on number of people per household, age, education, income, domicile characteristics, drinking water, and garbage collection.

Collection and processing of KAP for IPIs and fecal sample data

The data acquisition was obtained through the application of questionnaires of Mello et al. (1988) for the parents or legal responsible persons (respondents) of each of the families studied (AR n=177 and PS n=258) and was aimed at identifying the KAP of inhabitants of both

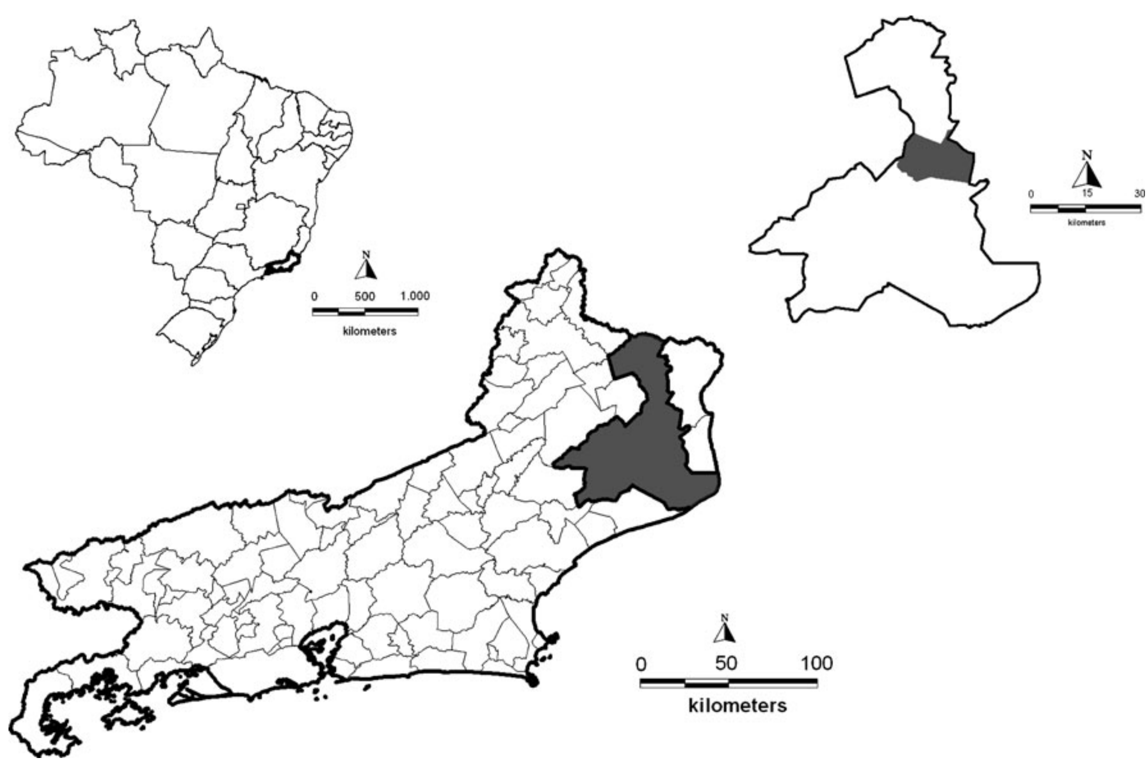

Fig. 1 Localization of Travessão District in Campos dos Goytacazes, Rio de Janeiro State, Brazil

Fig. 2 **a–f** Overview of PS and AR communities from Travessão District, Campos dos Goytacazes, Rio de Janeiro State, Brazil. **a–c** PS community: the streets are unpaved and muddy; there is no urban sewage system and no regular garbage collection. The dwellings are, for the most part, improvised and of flimsy, makeshift materials affording only a bare minimum of comfort and protection from the elements. **d** The water is supplied obtained from superficial wells exposed to environmental contamination from faulty septic tanks of neighboring habitations in both communities. **e–f** AR community: the streets were paved and illuminated. The dwellings were of solid and lasting construction involving standard building materials such as timber, concrete, and brick

communities concerned with IPIs. All residences situated in these communities were visited, and a census for IPIs performed.

The questionnaire answers were categorized according to concepts of parasitology adopted by Rey (2002) in *correct*, *partly correct*, *incorrect*, and *unknown* (quantitative analysis) and by answer frequency. The fecal material collection was performed in the domiciles, which were visited by students and researchers from "Programa Parasitoses do Norte Fluminense" of the "Universidade Estadual do Norte Fluminense" and from the "Laboratório de Ecoepidemiologia e Controle da Esquistossomose e Geohelmintoses," "Instituto Oswaldo Cruz," FIOCRUZ. Three hundred sixteen individuals from PS in 2004 and 2005 and 375 from AR in 2008 returned fecal samples for this study. The samples were analyzed through sedimentation procedure (Lutz 1919) by experienced laboratory technologists from "Laboratório Regional de Patologia Clínica" ("Hospital Geral de Guarús") and "Laboratório de Análises Clínicas Plínio Bacelar", both with ISO 9001 certification.

Water analysis

The presence of coliform group bacteria in water samples is considered by the WHO (2006a) as a parameter for water quality evaluation. WHO does not determine a rigid criteria for the classification of human consumption potability because these criteria are subject to present regional variation. In Brazil, the Ministry of Health regulates the pattern of water potability for human consumption by ordinance 518/2004, which stipulates that water quality must be evaluated by the presence of total and thermotolerant coliform, preferably *Escherichia coli*, and both must be absent from a 100-ml sample (MS 2004). Water samples were randomly taken from residences that utilized water from superficial wells for consumption. Samples from 31 wells in the PS community and 5 in AR were analyzed using the multiple-tube technique (APHA 1998). Samples were collected in sterile flasks, kept in ice, and analyzed up to 2 hours afterwards. In the multiple-tube fermentation technique, samples are inoculated in lactose broth (presumptive test for coliform bacteria group). Positive samples are inoculated in brilliant Green bile 2% broth (confirmative test for total coliform) and EC broth for detection of *E. coli* bacteria. Coliform bacteria are gram-negative, non-spore-forming rods that ferment lactose with acid and gas formation after 48 hours at 35°C. They include the genera *Klebsiella*, *Enterobacter*, *Citrobacter*, and *Escherichia* from the Enterobacteriaceae family and are usually considered as indicators for water contamination. Fecal coliform bacteria are a subset of the total coliform group that proliferate at 44.5°C and are capable of limited survival and growth in the environment, being considered indicative for fecal contamination in water.

Treatment of parasited individuals

The drugs in the treatment were provided by Farmanguinhos, FIOCRUZ, and by the public health authorities of Campos dos Goytacazes. Every parasited individual in this survey was home-treated by physicians of the Programa Parasitoses do Norte Fluminense. Treatment protocol was as follows: individuals parasited by STHs were given orally, under supervision, two 100 mg doses per day of mebendazole for 3 days, repeated after 10 days, whereas for protozoan infections (giardiasis and amoebiasis), three 250 mg doses per day of metronidazole were administered for 7 days. Individuals with mixed infections were formerly treated with mebendazole and later with metronidazole. Pregnant women and those with amenorrhea were excluded from the survey.

Data management and statistical analysis

During data collection, completed questionnaires were checked regularly to rectify any discrepancy or missing values. Data from questionnaires and water analysis were entered in an EXCEL datasheet, and data from stool examinations by ACCESS (Microsoft Office 2007 for Windows) and then exported to Epiinfo version 3.5.1 and to Statistical Package for the Social Sciences (SPSS) version 15.0, respectively, for statistical analysis.

The chi-square test was used to verify associations. The level of statistical significance was set as $p<0.05$, and for each statistically significant factor, a prevalence ratio (PR) and 95% confidence interval (CI) was computed.

Strengths and limitations

As to our knowledge, this is the first study in low-income areas of Campos dos Goytacazes, Rio de Janeiro, Brazil. The stool sample tested by a routine ova and parasite method in conjunction with a concentration technique increased the validity of the estimates. Some individuals absent or refusing to cooperate was a limitation that must be considered for result interpretation. In PS, the refusals corresponded to 14% of the total residences, whereas in AR, the percentage was much greater, 55%. This high index of refusals in AR was due to these individuals declaring they had private health plans. Another interference is that not all respondents gave their feces, which reduced the sample size and decreased the precision of the estimates. In water analysis, few samples were collected because of the proximity of the collection points, considering that all wells in the region were superficial, therefore most probably sharing the same ground water.

Ethics

Every family was recruited for the survey following signature of a standard consent form by the legally responsible person. The protocol of this research was approved by FIOCRUZ Committee for Ethics on Research (Protocol Number 404/07).

Results

The educational and socioeconomic status with other features of community residents are shown in Table 1.

In most water samples analyzed, the presence of total bacteria extrapolates the sensitivity of the technique (Table 2) in both presumptive and confirmative tests, indicating that water of both communities is improper for human consumption and highly contaminated. *E. coli*, an indicative of fecal contamination, was detected in all five AR samples and 60% of the 31 PS samples.

Concerning questionnaire answers on KAP related to IPIs, in Table 3, there are data related to parasite life cycles, and in Table 4, etiology, life cycles, diagnostics, and symptomology. The respondents of the AR community displayed better knowledge on IPIs ($p<0.05$, to the majority of issues), and about half of the PS respondents (47.3%) admitted ignorance concerning this subject (Table 4). The populations of both communities had their own codifications for the intestinal parasites, most frequent being “lombriga,” “giardia,” “solitária,” or “tenia.”

The most common symptoms described by the respondents in both communities (AR and PS) were bellyache (AR=33.3%, PS=27.9%), nausea (AR=19.2%, PS=17.0%), and vomiting (AR=18.6%, PS=16.7%). They also related the habit of spiting frequently and eating clay brick and sweets, associated with harboring parasites. With respect to treatment, most (AR=84.2%, PS=88.4%) sought medical attention, both doctor or health center, and used antiparasitic medication (AR=75.7%, PS=53.9%). As alternative treatments, home remedies were mentioned such as mint tea (*Mentha* sp, with

Table 1 Socioeconomic profile of residents from AR and PS communities located in Travessão District, Campos dos Goytacazes, Rio de Janeiro, Brazil

Aspect evaluated	Answer	AR (%)	PS (%)
Age Bracket	0 to 9	16.8	22.8
	10 to 19	23.8	19.9
	≥20	59.4	57.3
Gender	Male	50.6	49.7
	Female	49.4	50.3
Scholarity	Illiterate	17.7	12.9
	Incomplete elementary school	61.6	74.4
	Complete elementary school	1.6	0.0
	Incomplete high school	9.2	4.2
	Complete high school	8.8	8.1
	Incomplete higher education	0.4	0.0
	Complete higher education	0.7	0.4
Monthly income	Less than 1 MSM[a]	2.2	4.9
	1 MSM	38.1	45.9
	2 to 4 MSM	59.7	49.2
Resident n/Domicile	1 to 3	41.0	92.6
	4 to 6	47.8	3.3
	7 to13	11.2	4.1
Water for human consumption	Supplied by public water treatment plant	26.9	73.2
	Mineral water	73.1	26.8
Habitation	Proprietary	92.6	92.6
	Rented	5.2	3.3
	Property of others	2.2	4.1
Floor	Wood	0.0	0.8
	Ceramic	75.4	63.4
	Concrete	24.6	35.8
Wall	Bricks without rendering	14.2	21.1
	Bricks with rendering	85.8	78.9
Toilet	Don't have	2.2	0.8
	Have	97.8	99.2
Garbage discard	Public collection	100.0	96.7
	Vacant	0.0	3.3

AR (n=177) and PS (n=258).

[a] MSM = minimum monthly salary: 1 minimum salary is the least that a worker can receive monthly in a regular job in Brazil, established by government (corresponds to US$ 247. 27, R$ 465.00).

Table 2 Occurrence of total coliform (bacteria group) and fecal coliform in AR and PS communities located in Travessão District, Campos dos Goytacazes, Rio de Janeiro, Brazil

Test	AR							PS						
	<1.1	2.2	6.9	12	16	23	>23	<1.1	2.2	6.9	12	16	23	>23
Presuntive test for total coliform[a]	–	–	–	–	–	1	3	–	–	–	–	–	–	29
Confirmative test for total coliform[a]	–	–	–	–	–	2	2	–	–	1	1	–	3	24
Fecal coliform[b]	–	–	–	–	1	3	–	9	1	1	1	3	2	12

Results are expressed as most probable number of bacteria present in a 100-ml sample, measured by considering the number of positive samples in 10 × 10-ml tubes.

[a] Number of positive tubes in 10×10-ml tubes.

[b] Most Probable Number of bacteria present per 100-mL sample.

Table 3 Frequency of the multiple answers to the questionnaire on knowledge of inhabitants of AR and PS communities located in Travessão District, Campos dos Goytacazes, Rio de Janeiro, Brazil, concerning some aspects of the life cycle of the intestinal parasites

Evaluated aspect	Answers	Families number			
		AR		PS	
		n	%	*n*	%
Infection source	Barefooted	66	37	92	36
	Foods unwashed	47	27	44	17
	Unknown	43	24	76	29
	Contaminated water	34	19	32	12
	Unclean hands	30	17	27	10
	Sand	22	12	34	13
	Hygiene lack	14	8	21	8
	Sweets	11	6	28	11
	Garbage	9	5	4	2
	Other forms	24	14	42	16
Site of infection	Unknown	60	34	139	54
	Feet	34	19	37	14
	Mouth	31	18	18	7
	Food	30	17	24	9
	Skin	18	10	10	4
	Unclean hands/nails	21	12	21	8
	Other forms	36	20	46	18
Habitat in human body	Gut	66	37	77	30
	Unknown	38	21	55	21
	Abdomen	31	18	74	29
	Stomach	18	10	27	10
	Blood	16	9	14	5
	Liver	15	8	17	7
	Stool	6	3	5	2
	Anus	5	3	5	2
	Migration in the body	5	3	5	2
	Skin	2	1	4	2
	Other forms	16	9	17	7
Ways of elimination and place of deposition of the parasites	Unknown	88	50	163	63
	Stool	28	16	19	7
	Gut	13	7	21	8
	Abdomen	7	4	15	6
	Sewage	6	3	6	2
	Anus	4	2	1	0
	Blood	2	1	9	3
	Liver	2	1	6	2
	Stomach	2	1	3	1
	Other forms	27	15	26	10
Survival of the parasite in the interior of the organism	Survive	126	71	180	70
	Unknown	20	11	28	11
	Not survive	11	6	23	9
	Other forms	10	6	29	11
Survival of the parasite out of the body	Unknown	75	42	145	56
	Die	61	34	70	27
	Live	7	4	13	5
	Pass to another person	12	7	5	2
	Other forms	18	10	27	10

AR (n=177) and PS (n=258).

Table 4 Quantitative analysis of answers to the questionnaire questions of inhabitants of AR and PS communities located in Travessão District, Campos dos Goytacazes, Rio de Janeiro, Brazil, about KAP related to IPIs

Questions	AR				PS			
Status (%)	Correct	Parcially Correct	Wrong	Unknown	Correct	Parcially Correct	Wrong	Unknown
What do you know about IPIs?*	69.4	3.4	4.0	23.2	39.1	7.4	6.2	47.3
What causes IPIs?*	48.6	7.3	13.6	30.5	27.9	9.7	24.4	38.0
How do you acquire IPIs?	64.4	5.6	4.0	26.0	54.2	10.5	5.8	29.5
Where do you acquire IPIs?*	53	1.1	9.0	36.7	43.5	3.1	5.0	48.4
How do intestinal parasites infect human beings?	57.1	1.1	6.2	35.6	39.1	3.1	3.9	53.9
Where do intestinal parasites lodge after infection?	74.6	1.1	2.3	22.0	74.8	2.7	1.2	21.3
What is the destiny of the worms inside a person?*	23.7	5.1	26.0	45.2	10.9	5.0	28.3	55.8
Where do the worms go?*	42.4	1.7	2.8	53.1	20.5	10.9	5.4	63.2
How long do intestinal parasites survive in the body?	74.6	1.1	13.0	11.3	74.0	2.7	12.4	10.9
What happens with the intestinal parasites out of the body?	46.8	2.3	6.8	44.1	32.1	1.2	10.5	56.2
What does the person feel when he has worms?	82.4	4.0	2.3	11.3	79.4	3.5	3.1	14.0
Why does the person feel this way?*	46.3	2.8	8.5	42.4	40.3	3.5	2.3	53.9

AR (n=177) and PS (n=258). Category values are expressed in percentage.

*p<0.05.

or without milk), balm mint (*Melissa* sp), pumpkin seeds, creosote with milk, vinegar, cat's claw (*Uncaria* sp), eggplant, and water with salt.

Regarding preventive measures, more than half of the AR respondents (64.4%) and just a third from PS (28.3%) declared taking any action to avoid intestinal parasites. The most common preventions were use of shoes (AR=31.6%, PS=61.6%), washing food (AR=40.4%, PS=47.9%), and drinking treated water (AR=21.9%, PS=30.1%); some families reported the utilization of medicines and abstinence of candy consumption. Other responses referring to intestinal parasite infection are presented in Table 5.

The overall prevalence (95% CI) of the IPIs was 49.7% (i.e., 157 positive out of 316) and 27.2% (i.e., 102 positive out of 375) for PS and AR, respectively (Tables 6 and 7). The percentage of positive samples that contained a single parasite was 53.5% in PS and 96.1% in AR (Table 6). There was no relationship between IPIs and gender. The age groups with the greatest number of positive samples were children (0 to 9 years, i.e., 59 of 93 samples) and adults (≥20 years, i.e., 59 of 146 samples) in PS, where in AR, the highest numbers were in adults (i.e., 58 of 222 samples) (Table 7).

The protozoan intestinal infections were more common than helminths in both communities, 44.1 (CI 95% 38.7-49.5) vs. 15.2 (CI 95% 11.6-19.5) in PS and 25.3 (CI 95% 20.9-29.7) vs. 1.9 (CI 95% 0.5-3.2) in AR (Table 7). The prevalence of these IPIs was two and a half times greater in the 0-to-9-year age group in PS when compared to AR, and this difference was statistically significant for this age group of these communities (p=0.039). Moreover, the prevalence of IPIs by helminths in PS was eight times greater than in AR, and in the 10-to-19 age group, nine times greater. However, within the PS age groups, these infections were most common in the 0-to-9-year-old children (p<0.001) (Table 7).

In this study, we detected in stool samples the protozoan *E. histolytica*, *Entamoeba coli*, *G. lamblia*, and *Iodamoeba butschlli* and the helminths *A. lumbricoides*, *T. trichiura*, *Strongyloides stercoralis*, *Enterobius vermicularis*, *Hymenolepis nana*, *Ancylostoma duodenale*, and *Taenia* spp. The most frequent association among the parasites was *E. histolytica* with *E. coli*, apparent in PS samples. In addition, in 15.5% of the positive samples for *G. lamblia* in PS, coinfection with *A. lumbricoides* was also observed, probably due to the common environmental factors that may affect their transmission. In contrast, in AR, mixed infections were present in few positive samples, the most frequent being *E. coli* with *G. lamblia.*

The most frequent parasite association in PS samples was *E. histolytica* with *E. coli* in 16.5% of the positive samples (26 of 157). In addition, in 15.5% of the *G. lamblia*-positive samples from PS (12 of 77), there was also coinfection with *A. lumbricoides*. In AR, mixed infections were present in few positive samples, the most frequent being *E. coli* with *G. lamblia* (in 3 of 102). Table 8 compares the quantitative analysis of answers to the questions about KAP and the frequency of IPIs of respondents in the communities studied. There was no

Table 5 Frequency of the multiple answers to the questionnaire on knowledge of inhabitants of AR and PS communities located in Travessão District, Campos dos Goytacazes, Rio de Janeiro, Brazil, concerning some aspects related to importance and preventive care

Questions	Why	AR		PS	
		n	%	*n*	%
Do worms cause problems for people?	Yes	172	97.2	248	96.1
	Don't know	54	31.4	157	63.3
	Due to symptoms	57	33.1	28	11.3
	Lead to death	12	7.0	11	4.4
	It's a disease	8	4.7	11	4.4
	Other ways	41	23.8	51	20.7
	No	5	2.8	10	3.9
	Don't know	5	100.0	10	100.0
Are worms bad for people?	Yes	167	94.4	245	95.0
	Don't know	40	24.0	137	55.9
	Due to symptoms	36	21.6	29	11.8
	Lead to death	15	9.0	21	8.6
	It's a disease	21	12.6	19	7.8
	Other ways	55	32.9	39	15.9
	No	10	5.6	13	5.0
	Don't know	4	40.0	9	69.2
	The cure exists	5	50.0	–	–
	There are worse diseases	1	10.0	–	–
Is it important not to contract worms?	Yes	176	99.4	249	96.5
	Don't know	32	18.2	111	44.6
	It is harmful to health	61	34.7	43	17.3
	It's a disease	31	17.6	20	8.0
	It's preferable to avoid	9	5.1	22	8.8
	Other ways	43	24.4	52	20.9
	No	1	0.6	9	3.5
	Don't know	1	100.0	9	100.0

AR (n=177) and PS (n=258).

correlation between these data, except in the question "What causes IPIs?" in AR (p=0,027).

Discussion

In this study, we assessed the KAP related to IPIs among residents of two low-income communities of the Travessão District area, Campos dos Goytacazes, RJ, Brazil, and investigated whether there was a correlation between these features and IPI prevalence. Water analysis confirmed that all underground water of this area was highly contaminated. Thus, despite some families with better economic conditions being able to consume industrialized mineral water, most families in both communities drink either inappropriate water for consumption from superficial wells or treated

Table 6 Prevalence of IPIs in inhabitants of AR and PS communities located in Travessão District, Campos dos Goytacazes, Rio de Janeiro, Brazil

Characteristic	AR		PS	
	n	% (95% CI)	*n*	% (95% CI)
IPIs* [a]	102	27.2 (22.7 to 31.7)	157	49.7 (44.1 to 55.1)
Monoparasitism*	98	96.1 (92.3 to 99.9)	84	53.5 (42.8 to 64.2)
Polyparasitism				
2	4	3.9 (0.1 to 7.7)	52	33.1 (20.3 to 45.9)
3	–	–	15	9.6 (-5.3 to 24.5)
4	–	–	4	2.5 (-12.8 to 17.8)
5	–	–	2	1.3 (-14.4 to 17.0)

AR (n=375) and PS (n=316).

*p<0.001.

[a] PR (95% CI) = 1.83 (1.50–2.23).

Table 7 Comparison of IPIs frequencies in two communities of Travessão District, Campos dos Goytacazes, Rio de Janeiro, Brazil

Age group (years)	0 to 9			10 to 19			≥20			Total		
Parasite	AR (*n*=68) *n* (%)	PS (*n*=93) *n* (%)	PR (95% CI)	AR (*n*=85) *n* (%)	PS (*n*=77) *n* (%)	PR (95% CI)	AR (*n*=222) *n* (%)	PS (*n*=146) *n* (%)	PR (95% CI)	AR (*n*=375) *n* (%)	PS (*n*=316) *n* (%)	PR (95% CI)
Overall prevalence	18 (26.5)	59 (63.4[§])	2.4 (1.6–3.7)	26 (30.6)	39 (50.6)	1.67 (1.1–2.4)	58 (26.1)	59 (40.4)	1.5 (1.1–2.0)	102 (27.2)	157 (49.7)	1.8 (1.5–2.2)
Any protozoan	15 (22.1)	51 (54.8)	2.5[Ψ] (1.5–4.0)	24 (28.2)	32 (41.6)	1.5 (1.0–2.3)	56 (25.2)	56 (38.4)	1.5 (1.1–2.1)	95 (25.3)	139 (44.1)	1.7 (1.4–2.2)
E. histolytica	–	25 (26.9[†])	–	–	9 (11.7)	–	–	21 (14.4)	–	–	55 (17.4)	–
Entamoeba coli	2 (2.9)	27 (29.0[¥])	–	4 (2.4)	11 (14.3)	–	8 (3.6)	28 (19.2)	–	14 (3.7)	66 (20.9)	–
G. lamblia	13 (19.1)	29 (31.2)	1.6 (0.9–2.9)	22 (25.9)	20 (26.0)	1.0 (0.6–1.7)	49 (22.1)	28 (19.2)	0.9 (0.6–1.3)	84 (22.4)	77 (24.4)	1.1 (0.8–1.4)
Any helminth	3 (4.4)	24 (25.8[¶])	5.8 (1.8–18.6)	2 (2.4)	17 (22.1)	9.4 (2.2–39.3)	2 (0.9)	7 (4.8)	5.3 (1.1–25.2)	7 (1.9)	48 (15.2)	8.1 (3.7–17.7)
A. lumbricoides[a]	–	20 (21.5[¶])	–	1 (1.2)	16 (20.8)	–	1 (0.5)	5 (3.4)	–	2 (0.5)	41 (13.0)	–
T. trichiura[a]	0	5 (5.4)	–	1 (1.2)	3 (3.9)	–	0	0	–	1 (0.3)	8 (2.5)	–
S. stercoralis	–	3 (3.2)	–	1 (1.2)	–	–	–	–	–	1 (0.3)	3 (0.9)	–
E. vermicularis	2 (2.9)	–	–	–	1 (1.0)	–	1 (0.5)	–	–	3 (0.8)	1 (0.3)	–

[a] One individual presented mixed infection by *A. lumbricoides* and *T. trichiura*.

[§] p=0.002; [Ψ] p=0.039; [†] p=0.014; [¥] p=0.049; [¶] p<0.001.

Table 8 Comparison between the quantitative analysis of answers to the questions about KAP and frequency (%) of IPIs in respondents of two communities of Travessão District, Campos dos Goytacazes, Rio de Janeiro, Brazil

Questions	AR (*n*=79)		PS (*n*=56)	
	n	% IPIs	*n*	% IPIs
What do you know about IPIs?				
Correct	58	19.0	21	42.9
Wrong or unknown	21	19.0	35	48.6
What causes IPIs?[a]				
Correct	36	8.3*	17	29.4
Wrong or unknown	43	27.9	39	53.8
How do you acquire IPIs?				
Correct	50	20.0	31	51.6
Wrong or unknown	29	17.2	25	40.0
Where do you acquire IPIs?				
Correct	38	18.4	24	45.8
Wrong or unknown	41	19.5	32	46.9
How do intestinal parasites infect human beings?				
Correct	47	17.0	24	50.0
Wrong or unknown	32	21.9	32	43.8
Where do intestinal parasites lodge after infection?				
Correct	63	19.0	45	51.1
Wrong or unknown	16	18.8	11	27.3
How long do intestinal parasites survive in the body?				
Correct	58	17.2	37	48.6
Wrong or unknown	21	23.8	19	42.1
What happens with the intestinal parasites out of the body?				
Correct	38	21.1	21	42.9
Wrong or unknown	41	17.1	35	48.6

*p<0.05.

[a] The association between IPIs prevalence and answers was observed.

water transported by trucks supplied by the city hall, which is not sufficient for the community needs, hence being supplemented with contaminated ground water from domestic wells. In our results (Table 2), we determined a high contribution of fecal contamination in well water, probably because of the inadequate sanitation, with sewage dispensed directly in the soil in some points and visible leakage together with inadequate, negligent routine maintenance in some septic tank systems. This certainly contributes for dissemination of diseases caused by parasites, presenting a fecal-oral transmission route.

The dwellings of the AR community presented the better conditions, and their inhabitants had social and educational levels better than those from PS, probably due to a greater per-capita income. Besides, in PS, the streets are unpaved, there are several animals roaming the streets, and a sugar cane plantation close to the houses serves as a deposit for resident garbage despite the regular municipal government garbage collection (Fig. 2). Such living conditions readily facilitated soil contamination by human and animal feces, infiltrating the superficial wells of freshwater, consumed mainly without any treatment by the residents and verified by us as highly contaminated (Table 2). Based on our results from socioeconomic data (Table 1) and field observations in these communities, we verified that the environmental variables associated with a low-income level and lack of education resulted in a population with not only scant resources but also a high likelihood of IPI transmission.

Previous studies correlated the prevalence of IPIs with KAP (Mehraj et al. 2008; Curtale et al. 1998; Mello et al. 1988). Questionnaire analysis of both communities revealed that the residents had a special codification to denominate intestinal parasites. The analysis related to aspects of parasite biology, interesting for epidemiological studies (Rey 2002), indicates that the respondents from both communities presented reasonably correct knowledge about the matter (Tables 3 and 4). Most answered appropriately in relation to infection sources and gateway of parasites (barefoot, unwashed food, contaminated water, lack of hygiene and sanitation); however, some individuals associated the ingestion of sweets as a possible source of infection, which was a wrong concept strongly sedimented in popular culture. Nevertheless, the "habitat" of the parasites in man was indicated correctly, even though they did not know all the migration of the worms in the human body, as well as the stages of development and reproduction (evolutionary cycle). Most of the respondents did not know the disposal routes, although some correctly answered that it was by feces. Many were unable to identify the infective form for man (cysts, eggs, and/or larvae). In addition, they were not able to relate the elimination of parasites with environmental contamination and transmission of intestinal parasites. In particular, there was great confusion and contradiction by the respondents from both communities concerning their knowledge on transmission mechanisms.

The respondents of the AR community demonstrated better knowledge in relation to most of the issues concerning IPIs ($p<0.05$), which was maintained with respect to the other categories (Table 4). In accordance with Mehraj et al. (2008) and Mello et al. (1988), this fact can be related to the educational level of the respondents and ease of access to information sources. It is also probable that children transfer the knowledge acquired in the school to their parents.

Regarding the importance of IPIs for the residents, in both communities, most respondents affirmed that IPIs cause health problems that are associated to several symptoms. They said that although IPIs are diseases that may lead to death, worse illnesses exist. In contrast, other respondents did not recognize the due importance because they believe that IPIs are curable as are "normal diseases" and that more serious diseases deserve attention. These results are in agreement with Gazzinelli et al. (2002), where the respondents affirm that cardiovascular diseases are more important than IPIs.

High prevalence of IPIs has been consistently reported in a number of studies conducted in similar populations (Barçante et al. 2008; Silva and Santos 2001; Gamboa et al. 1998). Our results show that the overall prevalence of IPIs in PS (49.7%) was greater than in AR (27.2%), as well as the cases of polyparasitism and parasite diversity (Tables 6 and 7). The age groups more infected were children (0 to 9 years) and adults (≥20 years) in PS. The adult group was also more affected in AR (Table 7). This can be explained by complex interactions between hosts, parasites, and environment, that is, by environmental variables (conditions of homes and sanitation) as much as by habits of residents, in the case of adults of both communities. The prevalence of IPIs in children can be justified because they are more immunologically susceptible to the development of these infections, aggravated by habits determining reinfection occurrence (Silva and Santos 2001). In addition, in the PS community, a high degree of peridomiciliary and domiciliary environmental contamination prevails, resulting from the precarious living conditions of the inhabitants, which increases exposure and transmission of intestinal parasites.

Except for the question "What causes IPIs?" we observed that there was no correlation between KAP and the frequency of IPIs of respondents in the communities studied. Our findings are justified by the fact that not always does the knowledge of the respondents reflect their habits (attitudes and practices) (WHO 2006b). This is aggravated by the impossibility of change in the environmental conditions for the inhabitants of the communities, which do not have the resources and support of the state authorities. On the other hand, there is a misunderstanding on the part of the residents that most IPIs are asymptomatic, and therefore, individuals require access to medical care and an effective policy of IPI control.

In agreement with the National Plan of Environmental Health in Brazil, the Unified Health System must promote the necessary adaptations for the improvement of basic health attention regarding specialized medical assistance, privileging disease prevention, and control as well as health promotion. There has been flagrant negligence in Brazil in this sphere of public health administration, mainly regarding poor communities, where intestinal parasite transmission assumes alarming proportions. These data reflect incongruities in the National Plan of Surveillance and Control of Enteroparasitosis (NPSCE), in the extent of the Bureau of Sanitary Surveillance (Ministry of Health), where the national and regional indexes stay based in estimates.

NPSCE (SVS 2005) stipulates that “within is established the use of information about prevalence, morbidity and mortality caused or associated to parasitic infections, generating analytical studies drawn from the epidemic evaluation of the registered data, and it strives for the definition of strategies for the control of the enteroparasitosis. NPSCE should be instituted and constituted, respecting the competence areas and government levels, for the organs that develop activities of Epidemic, Sanitary and Environmental Surveillance, Sanitation, Health Education, Diagnosis and Attendance.” We note that there is an asynchrony between the government levels and a total ignorance of the real indexes of prevalence and morbidity by the public administrators as well as the population about control and prevention measures.

On the other hand, in Brazil, there is the pressing need for the teaching of parasitology to be reviewed by medical area careers, in universities, where there is a compartmentalization of the contents that are not integrated in the country's social reality. The knowledge requires recycling, and the excessive number of theoretical classes is detrimental, sacrificing practice, which lessens the teaching–learning process quality.

Innovative educational practices bringing science and art to the classroom have been producing exciting results, starting from student–teacher participation to engagement of the entire school administration towards disease prevention (Japiassu 1988). These practices should be better explored and stimulated in the educational environment once the “Health at School Program” (MEC 2004) of the Brazilian Federal Government, instituted by presidential ordinance no. 6.286, December 5, 2007, foresees an intersectorial policy between the Ministries of Health and Education with the prospect to integrate health attention (prevention, promotion, and basic attention) with the participation of family health teams (Health of the Family Program) among the children and adolescents of public schools (preschool, elementary, and high school education) as well as young adult and adult education and professional and technical schools.

In conclusion, the transmission and prevalence of intestinal parasites in low-income communities of Campos dos Goytacazes, RJ, Brazil, is probably associated with a combination of multiple and complex factors that determine the interaction between the parasite, the host, and the environment. These factors are worsened by social determinants that could be minimized by the adoption of prophylactic measures recognized and accepted by residents and authorities for the interruption of IPI transmission.

Our results encourage new studies in the area, evaluating the impact of prophylactic and educational measures in health, together with the awareness of public authorities to promote improvements in sanitation conditions and in homes, as well as wide range medical care access. We believe that these efforts will greatly contribute to the prevention and reduction of IPIs in communities with similar characteristics to those presented herein.

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