ORIGINAL RESEARCH

CONTROL OF INTESTINAL PARASITES AMONG CHILDREN IN TWO COMMUNITIES OF SOUTH SAINT LUCIA

RAJINI KURUP

Department of Microbiology, International American University, Vieux Fort, Saint Lucia.

Corresponding Author: Rajini Kurup (kuruprajini@yahoo.com)

ABSTRACT

Objective: To determine the epidemiology and control of intestinal parasitic infection among children in two communities of south Saint Lucia. Methods: Eight hundred ninety seven children participated in this study. Parasitic infections were confirmed by two stool examinations using the Kato Katz method and the mini-parasep concentration method. Control methods used were treatment of all infected children and awareness campaigns. Praziquantel (40 mg/kg) for schistosomiasis and albendazole (400mg) were used for treatment of intestinal parasites. The efficacy rate following treatment was determined as the percentage of children with two fecal samples negative by Kato Katz and the mini-parasep methods. Results: The overall prevalence rate of various parasitic infections was 52.2% (468 of 897), 44.0% (n=395) were infected with a single parasitic infection and 8.1% (n=73) with mixed infections. Within protozoan infection, *Giardia lamblia* was the most commonly identified pathogenic parasite (2.6%) and *Entamoeba coli* was the most commonly identified non pathogenic parasite (10.9%). Prevalence of helminthic infection showed *Ascaris lumbricoides* and hookworm infestations with higher prevalence, 11.7% and 11.6% respectively. The rate of infection after control intervention using drug treatment and education campaigns reduced from 52.2% to 2.0%, a cure rate of 96.2%. Conclusion: This study has identified prevalence and intensity of intestinal parasitic infection among children in two communities of Saint Lucia and the use of albendazole and praziquantel as an effective tool in reducing the intestinal parasitic infection. Health education also had a positive impact on the study population in reducing transmission and re-infection of intestinal parasites.

KEY WORDS: Control; Risk factors; Saint Lucia; Cure rate; Soil-transmitted helminths; Intestinal protozoa.

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INTRODUCTION

Intestinal protozoa and soil-transmitted helminths (STH) are continuing to be a major health problem worldwide, especially in the tropical and sub-tropical regions of the world (Savioli *et al.* 1992). Intestinal worm infections are common worldwide but thrive in poor communities in the tropics where poor water supply and poor sanitation are common (Steketee, 2003). The burden of infection is estimated to exceed 1000 million infected persons each for roundworm (*Ascaris lumbricoides*), hookworm (*Ancylostoma duodenal* and *Necator americanus*) and whipworm (*Trichuris trichiura*) (Crompton, 1999 & 2000).

The Pan American Health Organization/ World Health Organization (PAHO/WHO) estimates that 20% to 30% of those living in Latin America and the Caribbean are infected with one of the several intestinal helminths and/or schistosomiasis. In the Caribbean, helminth infections are more likely to be an indicator of other social and economic problems such as poverty, inaccessibility to health care, or disruption of healthcare services (PAHO/WHO, 2007). Intestinal parasites have been associated with stunting of linear growth, physical weakness, iron deficiency, anemia and low educational achievements in schoolchildren, adversely affecting cognitive development in childhood (Chan *et al.* 1994; Crompton and Nesheim, 2002).

Unfortunately, there is a lack of recent school or community based studies which provide information on the epidemiology of these infections in this community. The objectives of this study were to understand the pattern of intestinal parasitic infections, to assess the impact of treatment with praziquantel (40mg/kg) for *Schistosoma mansoni* infections and albendazole (400mg) for other intestinal parasites, and to examine the incidence of re-infection after treatment.

MATERIALS AND METHODS

Study site

Saint Lucia is a mountainous volcanic island in the eastern Caribbean Sea on the boundary with the Atlantic Ocean. The local climate is tropical, moderated by northeast trade winds, with a dry season from January to April and a rainy season from May to December. The population of Saint Lucia is of mostly African descent and a minority representing Indo-Caribbean. The total size of Saint Lucia is 620 km² with an estimated population of 160,000.

The study was conducted in two small communities, Augier and Pierrot in Vieux Fort town (Region 5) of south Saint Lucia. Vieux Fort is the second largest town and has a population of approximately 23,300. Region 5 has previously been identified with the highest prevalence of intestinal parasitic infection on the island (Kurup & Hunjan, 2010). Pierrot and Augier are less than 4 km away from the town. Pierrot has one secondary school and two day-care centers whereas Augier has one secondary school.

Study design

This study was carried out during the period of October 2006 to March 2007. All the available children attending the two schools and two day-care centers were examined. The study population consisted of all children between 1 to 15 years of age. Two participants were older than 15 years and their stool examinations

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were negative. The objectives of the study were explained to the teachers and parents or guardian, and written informed consent was obtained by the teachers. A total of 897 children were examined for intestinal parasites using the Kato-Katz method and the sedimentation method (mini-parasep).

Data collection: Stool sample collection and laboratory testing

The participants were given two dry, clean, leak proof containers labeled with their name, age and identification number for collection of stool samples the next day. Parents were instructed on how to collect the sample during the parents meeting. Assessment of eggs per gram of faeces (intensity) was determined by analyzing stool sample using the Kato-Katz technique for soil transmitted helminthes and *Schistosoma sp*. (Katz *et al.* 1972; WHO, 1994) whereas the sedimentation method (mini-parasep) was used to obtain the prevalence of all other intestinal parasites. Mini-parasep tubes were used for the concentration method in order to achieve high diagnostic sensitivity. The tubes are closed, single use tubes with built-in filter which were filled with 6 ml of 10% buffered formalin, one drop Triton-X and 2 ml aethyl acetate and used for the sedimentation technique in accordance with the manufacturer's instruction sheet (DiaSys Europe Ltd., Berkshire, United Kingdom). Slides were examined within 45 min of slide preparation to avoid clearing of hookworm eggs. Definitions of infestation rate were based on thresholds of egg counts proposed by WHO (WHO, 2002)(eggs per gram of faeces, epg):

Ascaris: light, 1-4999 epg; medium 5,000 to 49,999 epg; heavy >49,999 epg;

Trichuris: light, 1-999 epg; medium 1,000 to 10,000 epg; heavy >10, 000 epg;

Hookworm: light, 1-1,999 epg; medium 2,000 to 4,000 epg; heavy. >4,000 epg; and

S. mansoni: light, 1-99 epg; medium 100-399 epg; heavy, > 4000 epg.

Intervention methods

The first control method applied was treatment of the parasite infected population with a single oral dose of albendazole 400 mg. Children infected with schistosomiasis were treated with a single oral dose of praziquantel 40 mg/kg. To analyze the efficacy rate of treatment, stool samples from positive cases were tested after four months post treatment.

The second control method was educating the study population with awareness campaigns and meetings. Slide shows were showed to the participants emphasizing the importance of good hygiene for themselves and for the community. Lifecycles of parasites were also explained. The need to wash hands, to wash fresh food, to trim nails and to wear shoes was highlighted. Meetings were conducted in schools and day-care centres involving children, parents and all staff members of the school. Staff from the public health departments and local nurses also participated in the meetings. In order to assess the effects of the educational campaigns on the study population, questionnaires were administered by the researchers before and after the campaigns.

Statistical analysis

Data analysis was carried out using SPSS software (SPSS Inc, Chicago, Illinois). Prevalence of infection was presented with 95% confidence interval (95%-CI). Statistical tests conducted included analysis of variance, chi-square test, and logistic regression analysis in order to identify factors associated with parasitic infections. A significant level of 0.05 was adopted for all tests. Infection intensities are expressed as eggs per gram of faeces (epg) calculated as the arithmetic mean number of eggs per thick smear multiplied by 24.

Ethical considerations

The study was approved by the Ethics Committee of the "International American University" and the local health authorities of Saint Lucia. The school teachers obtained written consent from parents or legal guardians on behalf of children for participation in the study. The children who were found positive for parasitic infections were provided with anti-parasitic treatment, albendazole and/or praziquantel under consultation of a physician free of cost.

RESULTS

All enrolled 897 children were tested for intestinal parasites (100% participation rate). The study recruited 49.4% male children. There were only two participants aged older than 15 years. They were not separately shown in the tables. The overall prevalence of intestinal parasitic infection was 52.2% (95%-CI 48.9, 55.5). Infection with helminths was higher (37.7%; 95%-CI 34.5, 40.9) than protozoan infection (18.2%; 95%-CI 15.7, 20.9).

Table 1 shows the prevalence of main intestinal helminth and protozoan infections stratified by age groups and gender. The prevalence of parasites found were: *Ascaris lumbricoides* (11.7%), hookworm (11.6%), *Strongyloides stercoralis* (9.5%), *Trichuris trichiura* (6.0%), *Enterobius vermicularis* (1.7%), *Taenia spp.*(0.2%), *Schistosoma mansoni* (0.2%), *Entamoeba coli* (10.9%), *Iodamoeba butschlii* (3.3%), *Endolimax nana (2.5%), Giardia lamblia* (2.6%) and *Entamoeba histolytica/dispar/ moshkovskii* (0.4%). *Ascaris* and hookworm were the most common helminths identified with a prevalence of 11.7% and 11.6%; they were more frequent in the five to 14 year age groups. *Giardia lamblia* was the commonest pathogenic protozoan (2.6%) occurring most frequently in the five to nine year age group. *E. coli* (10.9%) was recorded as the most common non-pathogenic protozoan within the five to nine year age group (Table 1).

A total of 8.1% (95%-CI 6.4, 10.1) children harbored mixed infections. The most common combination were infection with helminths and protozoa (5.4%) followed by two helminth infections (1.6%). Prevalence of single infection was recorded for 395 children (44.0%; 95%-CI 40.8, 47.4). Most infections were single occurrences and most helminth infections were light. Three cases of moderate infections were recorded within *Ascaris*. Three hookworm infections were moderate as were infections with *Trichuris,* while two infections with *Strongyloides* were classified as moderate.

Table 1: Age group prevalence and gender prevalence of parasitic infection among children in two communities of south St Lucia.

	Age			Gender		Total
	0 to 4 years (n=68)	5 to 9 years (n=477)	10 to 14 years (n=350)	Male (n=443)	Female (n=454)	(n=897)
Ascaris lumbricoides	3 (4.4%)	59 (12.4%)	43 (12.3%)	29 (6.5%)	76 (16.7%)	105 (11.7%)
Hookworm	2 (2.9%)	57 (11.9%)	45 (12.9%)	66 (14.9%)	38 (8.4%)	104 (11.6%)
Strongyloides	1 (1.5%)	48 (10.1%)	36 (10.3%)	42 (9.5%)	43 (9.5%)	85 (9.5%)
Trichuris trichiura	0	32 (6.7%)	22 (6.3%)	31 (7.0%)	23 (5.1%)	54 (6.0%)
Enterobius vermicularis	0	6 (1.3%)	9 (2.6%)	5 (1.1%)	10 (2.2)	15 (1.7%)
Taenia solium	0	0	2 (0.6%)	1 (0.2%)	1 (0.2%)	2 (0.2%)
Schistosoma mansoni	0	2 (0.4%)	0	1 (0.2%)	1 (0.2%)	2 (0.2%)
E. coli	8 (11.8%)	54 (11.3%)	36 (10.3)	44 (9.9%)	54 (11.9%)	98 (10.9%)
I. butschlii	2 (2.9%)	17 (3.6%)	11 (3.1%)	20 (4.5%)	10 (2.2%)	30 (3.3%)
E. histolytica	0	3 (0.6%)	1 (0.3%)	1 (0.2%)	3 (0.7%)	4 (0.4%)
Giardia lamblia	0	15 (3.1%)	8 (2.3%)	6 (1.4%)	17 (3.7%)	23 (2.6%)
E. nana	1 (1.5%)	13 (2.7%)	8 (2.3%)	10 (2.3%)	12 (2.6%)	22 (2.5%)

Table 2: Association of intestinal parasitic infection and associated factors in children.

Factors associated		Number of children	Number infected (%)	p-value	Odds-ratio	95% Confidence interval	
Walking bare foot	Yes	553	346 (62.6%)	P<0.001	3.042	2.299	4.025
	No	344	122 (35.5%)		1		
Eating without washing hand	Yes	189	155 (82.0)	P<0.001	5.753	3.858	8.580
	No	708	313 (44.2)		1		
Not trimming Nails	Yes	152	133 (87.5)		1		
	No	745	335 (45.0)	P<0.001	0.117	0.071	0.193
Nail Biting	Yes	180	162 (90.0)	P<0.001	12.088	7.267	20.109
	No	717	306 (42.7)		1		
Gender	Male	443	223 (50.3)	P=0.280	0.865	0.665	1.124
	Female	454	245 (54.0)		1		

Table 2 shows the results of the logistic regression analysis assessing factors that indicated an association to parasitic infections. Children who bit their nails were more likely to be infected with intestinal parasites (OR= 12.1; 95% CI: 7.27 – 20.1). Children who ate without washing their hands had a higher likelihood of infection with intestinal parasites (OR= 5.7; 95% CI: 3.86 – 8.58). Not trimming nails and walking bare foot also showed statistically significant relationships with intestinal parasitic infections (Table 2).

Table 3 shows the prevalence of intestinal parasitic infections retested four months after treatment with albendazole 400 mg and praziquantel 40 mg/kg. The treatment significantly reduced the prevalence of infection from 52.2% to 2.0% (95%-CI 1.2, 3.2). No moderate infection or mixed infections were observed after treatment. Albendazole and praziquantel reduced the prevalence and intensity of all parasitic infection by 100% except for infections with hookworm (96.2%), *Strongyloides* (98.8%), *Trichuris trichiura* (90.7%) and *Giardia lamblia* (65.2%)(Table 3). Table 4 shows the overall intensity of helminth infections before and after the control program.

Results of the educational intervention were assessed by questionnaires. Before the educational campaigns 20.2% of the participants bit their nails, 21.1% did not wash their hands before having food, 61.6% walked barefoot, and 16.9% had long finger nails. After the awareness campaign there were significant ($p<0.001$, respectively) reductions in unhygienic behaviors amongst the children with prevalence of 3.4%, 5.4%, 2.1% and 2.9%, respectively.

Discussion

This study estimated the epidemiology and control of intestinal parasitic infections among children one to 15 years of age from two communities of south Saint Lucia. The prevalence of infections with intestinal parasites was estimated to be about 50 percent which is less compared to a previous study done among schoolchildren in rural areas of south Saint Lucia with 61.6% (Kurup & Hunjan, unpublished data). Our findings suggest that conditions for the existence and transmission of parasites are favorable in both rural and urban communities in Saint Lucia.

Ascaris lumbricoides and hookworm had the highest prevalence followed by *Strongyloides* and *Trichuris trichuira.* This result is in contrast with findings from the previous study from St Lucia which found *Trichuris trichiura* to be the predominant parasite (Bundy, 1986). The factor that *A. lumbricoides* was the predominant helminth in this study is most likely due to the fact that the *ova* of this species is more resistant to extreme temperatures as compared to the more delicate whipworm ova (Smyth, 1976; Bonilla *et al* 1998). The prevalence of *A. lumbricoides* was higher in the five to 15 year age group, a result that agrees with studies from other geographical locations (Holland, 1989; Crompton, 1994; Miller, 2003). In addition, female children were more likely to be infected than males with *Ascaris lumbricoides* (Kirwan *et al.* 2009).

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Table 3: Prevalence and intensity of parasitic infection in 897 children pre treatment and four month post treatment with albendazole and praziquantel.

Parasite	Pre treatment n (%)	Post treatment n (%)	Cure rate	Mean eggs per gram faeces (epg)	Egg reduction rate
Ascaris lumbricoides	105 (11.7%)	0	100%	692	100%
Hookworm	104 (11.6%)	3(0.3%)	97.1%	429	96.1%
Strongyloides	85 (9.5%)	1 (0.1%)	98.8%	n.a.*	n.a.
Trichuris trichiura	54 (6.0%)	5 (0.6%)	90.7%	306	84.1%
Enterobius vermicularis	15 (1.5%)	0	100%	n.a.	n.a.
Taenia solium	2 (0.2%)	0	100%	n.a.	n.a.
Schistosoma mansoni	2 (0.2%)	0	100%	72	100%
Entamoeba coli	98 (10.1%)	0	100%	n.a.	n.a.
Enatamoeba histolytica	4 (0.4%)	0	100%	n.a.	n.a.
Endolimax nana	22 (2.3%)	0	100%	n.a.	n.a.
Iodamoeba butschlii	30 (3.1%)	0	100%	n.a.	n.a.
Giardia lamblia	23 (2.6%)	7 (0.8%)	69.6%	n.a.	n.a.

*n.a. = not applicable; Kato Katz method is used for quantification of hookworm.

Table 4: Intensity of infection before and after treatment in 897 children from St Lucia.

Parasite		Intensity (eggs per gram of faeces)
Ascaris lumbricoides	Pre treatment	5388.5
	Post treatment	216.0
Trichuris trichiura	Pre treatment	853.2
	Post treatment	136.0
Hookworm	Pre treatment	883.7
	Post treatment	0
Schistosoma mansoni	Pre treatment	72.0
	Post treatment	0

The prevalence of hookworm infection was second largest with higher infection rates in older children. The age-dependency of the prevalence of hookworm infection was very similar to *Ascaris* infection (Fleming *et al.* 2006). Our study confirmed that infections with hookworms are higher in males than in females (Hotez *et al.* 2004). This discrepancy could be because children in semi urban villages are less exposed to the rivers or ponds. However, numbers were small and not further investigated.

School-based studies provide a better infrastructure and can improve compliance considerably (Magnussen *et al.* 1997; Albonico *et al.* 1999; Cooper *et al.* 2006). Previous studies have shown that treating school-aged children has a considerable effect on their nutritional status (Stoltzfus *et al.* 2004), anemia, physical fitness, appetite, growth (Stephenson, Latham and Ottesen, 2000), and intellectual development (Drake *et al.* 2000). School-based de-worming is not only beneficial in a number of health-related issues but provides major advantages for the whole community by reducing helminth transmission through soil resulting in a lower disease burden, especially for *ascariasis* and *trichuriasis* (Bundy *et al.* 1990; Guyatt *et al.* 2001; de Silva, 2003; Horton, 2003; World Bank, 2004; Miguel and Kremer, 2004). In the current study albendazole and praziquantel successfully cured common intestinal parasitic infections. The cure rates for *Ascaris, Strongyloides*, *Schistosoma mansoni* following a single-dose albendazole/praziquantel treatment were high compared with rates for *Trichuris trichiura* and hookworm (Bartoloni *et al.*1993; Albonico *et al.* 1994). This study also suggests that albendazole enhances efficacy against both intestinal helminths and protozoans. Among protozoan infections, *Giardia lamblia* showed a relatively low cure rate when treated with albendazole (Escobedo, 2003).

In addition, this study also focused on promoting health education through awareness campaigns conducted at the participating schools using flyers and visual aids which aimed to reduce soil and water contamination. During a parents and teachers meeting children were encouraged to use slippers, wash hands before food, trim their finger nails and practice other hygienic behaviors. These educational sessions were aimed to create long-term preventive habits which may reduce transmission and re-infection rates (Montresor *et al.* 2002; WHO, 2002; Hotez *et al.* 2005, 2006).

Conclusion

This study has identified prevalence and intensity of intestinal parasitic infection among children in two semi-urban communities of south Saint Lucia. The control program through treatment and health education was highly effective in reducing the worm burden among the children. Four months after treatment, only two percent of treated children were found to still have a positive stool result.

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