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

RAJNI 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: Eighty-nine children, seventeen of whom participated in this study, had stool examinations performed using the Kato-Katz and the mini-parasep concentration method. 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. Control methods used were treatment of all infected children and awareness campaigns. Praziquantel (40 mg/kg) for schistosomiasis and albendazole (400 mg) were used for treatment of intestinal parasites.

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, Entamoeba coli was the most commonly identified non-pathogenic parasite (10.9%) and Entamoeba coli was the most commonly identified non-pathogenic parasite (2.6%). 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.

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 duodenale 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, helmint 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, anaemia 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 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...
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 ethyl 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, 5000 to 49,999 epg; heavy >49,999 epg;
- Trichuris: light, 1-999 epg; medium, 1000 to 10,000 epg; heavy >10,000 epg;
- Hookworm: light, 1-1,999 epg; medium, 2000 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. Infestation 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.

<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
<th>Number of children</th>
<th>Number infected (%)</th>
<th>p-value</th>
<th>Odds-ratio</th>
<th>95% Confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 4 years</td>
<td>Male</td>
<td>344</td>
<td>122 (35.3%)</td>
<td>0.665</td>
<td>1.124</td>
<td>0.408 – 2.521</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>553</td>
<td>346 (62.6%)</td>
<td>&lt;0.001</td>
<td>3.042</td>
<td>2.299 – 4.025</td>
</tr>
<tr>
<td>5 to 9 years</td>
<td>Male</td>
<td>708</td>
<td>313 (44.2%)</td>
<td>0.865</td>
<td>1.071</td>
<td>0.658 – 1.702</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>189</td>
<td>155 (82.0%)</td>
<td>&lt;0.001</td>
<td>5.753</td>
<td>3.858 – 8.580</td>
</tr>
<tr>
<td>10 to 14 years</td>
<td>Male</td>
<td>745</td>
<td>335 (45.0%)</td>
<td>&lt;0.001</td>
<td>3.042</td>
<td>2.299 – 4.025</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>152</td>
<td>133 (87.5%)</td>
<td>&lt;0.001</td>
<td>0.071</td>
<td>0.031 – 0.193</td>
</tr>
<tr>
<td>Total</td>
<td>Male</td>
<td>1,197</td>
<td>798 (66.2%)</td>
<td>&lt;0.001</td>
<td>3.858</td>
<td>2.299 – 6.124</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>942</td>
<td>579 (61.3%)</td>
<td>&lt;0.001</td>
<td>1.124</td>
<td>0.408 – 3.271</td>
</tr>
</tbody>
</table>

Table 2 shows the results of the logistic regression analysis assessing factors that indicated an association to parasitic infections. 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 barefoot also showed statistically significant relationships with intestinal parasitic infections (Table 2).

Table 3 shows the prevalence of intestinal parasitic infections tested 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 (98.6%), Trichuris trichiura (90.7%) and Giardia lamblia (65.2%). 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 fingernails. 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 St 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 St 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 trichiura. 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).
The prevalence of hookworm infection was second largest with intensity of infection before and after treatment in 897 children from St Lucia.

<table>
<thead>
<tr>
<th>Parasite</th>
<th>Pre treatment n (%)</th>
<th>Post treatment n (%)</th>
<th>Cure rate</th>
<th>Mean eggs per gram faeces (epg)</th>
<th>Egg reduction rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascaris lumbricoides</td>
<td>105 (11.7%)</td>
<td>0</td>
<td>100%</td>
<td>5368.5</td>
<td>100%</td>
</tr>
<tr>
<td>Hookworm</td>
<td>104 (11.6%)</td>
<td>0</td>
<td>100%</td>
<td>216.0</td>
<td>100%</td>
</tr>
<tr>
<td>Strongyloides</td>
<td>85 (9.5%)</td>
<td>1</td>
<td>98.8%</td>
<td>n.a.*</td>
<td>n.a.</td>
</tr>
<tr>
<td>Trichuris trichiura</td>
<td>54 (6.0%)</td>
<td>5</td>
<td>90.7%</td>
<td>n.a.*</td>
<td>84.1%</td>
</tr>
<tr>
<td>Enterobius vermicularis</td>
<td>15 (1.5%)</td>
<td>0</td>
<td>100%</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Taenia solium</td>
<td>2 (0.2%)</td>
<td>0</td>
<td>100%</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Schistosoma mansoni</td>
<td>2 (0.2%)</td>
<td>0</td>
<td>100%</td>
<td>72</td>
<td>100%</td>
</tr>
<tr>
<td>Entamoeba coli</td>
<td>88 (10.1%)</td>
<td>0</td>
<td>100%</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Entamoeba histolytica</td>
<td>4 (0.4%)</td>
<td>0</td>
<td>100%</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Endolimax nana</td>
<td>22 (2.3%)</td>
<td>0</td>
<td>100%</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Iodamoeba butschlii</td>
<td>30 (3.1%)</td>
<td>0</td>
<td>100%</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Giardia lamblia</td>
<td>23 (2.6%)</td>
<td>7</td>
<td>69.6%</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

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

Table 4: Prevalence and intensity of parasitic infection in 897 children pre treatment and four month post treatment with albendazole and praziquantel.

<table>
<thead>
<tr>
<th>Parasite</th>
<th>Mean eggs per gram faeces (epg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascaris lumbricoides</td>
<td>5368.5</td>
</tr>
<tr>
<td>Trichuris trichiura</td>
<td>853.2</td>
</tr>
<tr>
<td>Hookworm</td>
<td>883.7</td>
</tr>
<tr>
<td>Schistosoma mansoni</td>
<td>72.0</td>
</tr>
</tbody>
</table>

REFERENCES

Albonico M, Smith PG, Hall A, Chwaya HM, Alawa KS & Savioli L. (1994) A randomized controlled trial comparing metbendazole and albendazole to prevent helminth infections in school children in 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.

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 (Stoltzfujs et al. 2004), anemia, physical fitness, appetite, growth (Stephenson, Latham and Ottesen, 2000), and intellectual development (Draike 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. 1993; 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.


