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Epidemiology and control of Schistosomiasis and other intestinal parasitic infections among school children in three rural villages of south Saint Lucia

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Abstract

Objective: The purpose of this study was to determine the epidemiology of parasitic infections and the efficacy of treatment among school children in rural villages of south Saint Lucia.

Method: A total of 554 school children participated in this study. Parasitic infections were confirmed by using Kato-Katz method.

Results & conclusion: Overall, 61.6% of the school children were infected by any parasitic infection. The helminths identified were *Ascaris lumbricoides* (15.7%), Hookworm (11.9%), *Strongyloides* (9.7%), *Trichuris trichiura* (4.7%), *Schistosoma mansoni* (0.6%), *Taenia solium* (0.8%) and *Enterobius vermicularis* (2.1%), *Entamoeba coli* (9.7%), *Iodameba butschlii* (5%), *Entamoeba histolytica* (1.1%), *Giardia lamblia* (1.8%) and *Endolimax nana* (2.1%). The control intervention included treatment with albendazole 400 mg and praziquantel 40 mg/kg as well as awareness campaigns. Post-interventional assessment showed the total prevalence of intestinal parasitic infection reduced from 61.6 to 3.6% with a cure rate of 94.2%, following the control methods.

Key words Control; cure rate; helminths; IPI; protozoan; risk factors; Saint Lucia; soil-transmitted helminths

Introduction

Intestinal protozoan and soil-transmitted helminths (STH) are major problems in health worldwide, especially in the tropical and sub-tropical regions[1]. Intestinal parasitic infections are globally endemic and constitute greatest single worldwide cause of illness and disease[2,3].

Schistosomiasis affects about 200 million people worldwide, and more than 650 million people live in endemic areas[4]. The burden of disease caused by infection with schistosomiasis and soil-transmitted helminths (STH) remains enormous. About two billion people are affected worldwide, of whom 300 million suffer associated severe morbidity[5]. Pan American Health Organization/World Health Organization estimates that 20–30% of those living in Latin America and the Caribbean are infected with one of several intestinal helminths and/or schistosomiasis. In the Caribbean, STH prevalence appears to be higher in certain countries, such as Guyana, Belize, and Jamaica whereas St. Lucia is the only country in the Caribbean Islands that is currently reporting schistosomiasis infection[6]. In school age populations of developing countries, intestinal helminth infections rank first among the causes of communicable and non-communicable diseases[7]. Hygiene and play habits among male children especially make them vulnerable to schistosomiasis and STH infections. It is estimated that 400 million school-age children who are infected are often physically and intellectually compromised by anaemia, leading to attention deficits, learning disabilities, school absenteeism and higher

dropout rates[8]. The development of effective parasite control is possible by regular periodic chemotherapy, using anti-helminthics to school-aged children delivered through the school system which can be the main intervention strategy[9,10]. Unfortunately, there is no recent school based studies which provide information on the epidemiology of the parasitic infections in the *Schistosoma* endemic island of Saint Lucia.

The present study, therefore, attempts to address this dearth of information and describes the prevalence, characteristics and control of schistosomiais and other intestinal parasitic infections among school children from three rural villages of south St. Lucia.

Material & 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 (82.5% of the population) with a significant mixed minority representing 11.9%, with Indo-Caribbean, small European origin minority. The total size of Saint Lucia is 620 km² with an estimated population of 160,000. The study was conducted in three rural villages Vigier, Bellvue and Grace located at south of Saint Lucia. At the time of survey Bellvue and Grace had one health center but no health center facility was present in Grace.

Study design: The study populations were school children aged between 0 and 19 yr. All schools in the area participated in this study. Bellvue village has one secondary school and 2 day care centers, Grace has one secondary school and Vigier has one primary school. A total of 554 children attending the schools were examined. The objectives and method of the study were explained to the teachers and parents/guardians in a series of meetings and full informed consent was obtained. Stool samples of all students were screened for intestinal parasitic infection using Kato-Katz method and parasep concentration method.

Treatment: At the end of the epidemiological survey, participants found infected with *S. mansoni* were treated with praziquantel single oral dose of 40 mg/kg. Individuals infected with other intestinal parasitic infections were treated with a single dose of albendazole (400 mg). To analyze the efficacy of treatment, stool samples from positive cases were tested after four months post-treatment. Treatment of infected children was administered by the nurses under supervision of District Medical Officer.

Data collection

Stool sample collection and laboratory testing: The school children were given the same day two dry, clean, leak proof containers labeled with their name, age and identification number. Parents/guardians were also instructed to deposit one fecal sample per day of the participant into each container and return immediately to the nearby collection center. The school children participating in the study and their parents/guardians were guided on how to collect the sample during the parents meeting.

Presence of infection (prevalence) and assessment of eggs per gram of feces (intensity) were determined by analyzing two samples of stool using Kato-Katz technique[11]. Slides were examined within 45 min of slide preparation to avoid clearing of hookworm eggs. Helminth's ova counts were made using the standard smear egg count technique, and the results were expressed as eggs per gram feces (epg).

Statistical analysis: Data collected were analyzed using SPSS 9.0 version. Tests included analysis of variance, the chi-squared test, cross-tabulation and logistic regression analysis to identify risk and protective factors associated with parasitic infections. A significant level of 0.05 was adopted for all tests.

Ethical considerations: The study was approved by the Ethics Committee of the Institute "International

American University" and the local health authorities of St. Lucia. The school teachers obtained written consent from parents or legal guardians on behalf of their children for participation in the study. The stool test positive children were also provided with anti-parasitic treatment, albendazole and/or praziquantel under consultation of a physician free of cost.

Results

All selected 554 school children participated in the study with a response rate of 100%. The study started in April 2006 with a sampling period of six months. The study had participation of 49.5% girls and 50.5% boys. The total prevalence of children infected with parasitic infection was 61.6%, the prevalence of helminths infection was 45.6% and protozoan infection was 19.8%.

The parasites found were: *Ascaris lumbricoides* (15.7%), hookworm (11.9%), *Strongyloides stercoralis* (9.7%), *Trichuris trichiura* (4.7%), *Enterobius vermicularis* (2.1%), *Taenia solium* (0.8%), *Schistosoma mansoni* (0.6%), *Entamoeba coli* (9.7%), *Iodamoeba butschlii* (5%), *Endolimax nana (2.1%), Giardia lamblia* (1.8%) and *Entamoeba histolytica* (1.1%).

Table 1 shows the helminths and protozoan infections found within the male and female cohorts and within different age groups. Total intestinal parasites were more frequent in females (70.6%) than in males (60.1%) and females (51.9%) recorded more helminth infections than males (39.2%). Among the total infected cases, 17.3% of individuals harboured mixed infections. The most common combinations were infection with double helminths (9.3%) followed by double protozoans (5.3%). There were 282 subjects with single infection (50.9%), 56 with double infection (10.1%) and three with triple infection (0.5%).

Egg intensity of helminths showed most cases with light infections. *Ascaris* had six cases of heavy infection and twelve cases of moderate infections. Hookworm showed six heavy and six moderate infections whereas *Trichuris* had only one heavy and five moderate infections. Only one moderate infection was recorded with *Schistosoma mansoni*.

Table 2 shows analysis of demographic data and risk factor of parasitic infection that indicated an asso-

Table 1. Prevalence and number of intestinal parasites in three rural villages in south St. Lucia by age groups and gender

Parasite species	Age group (yr)				Male	Female	Total
	0–4	5–9	10–14	15–19			
Ascaris 1umbricoids	1 (3)	49 (16.7)	46 (16.5)	1 (10)	31 (10.1)	66 (21.3)	97 (15.7)
Hookworm		36 (12.2)	35 (12.5)	2 (20)	37 (12.1)	36 (11.6)	73 (11.9)
Strongyloides		30 (10.2)	27 (9.7)	3 (30.3)	(10.5)	2 (9)	(9.7)
Enterobius vermicularis		8 (2.7)	5 (1.8)		6 (2)	7 (2.3)	13 (2.1)
Trichuris trichiura		16 (5.4)	13 (4.7)		9 (2.9)	20 (6.5)	29 (4.7)
Taenia solium		2 (0.7)	3 (1.1)		3 (1)	2 (0.6)	5 (0.8)
Entamoeba coli	1 (3)	29 (9.9)	30 (10.8)		28 (9.2)	32 (10.3)	60 (9.7)
Endolimax histolytica		3 (1)	4 (1.4)		3 (1)	4 (1.3)	7 (1.1)
Endolimax nana		6 (2)	7 (2.5)		9 (2.9)	4 (1.3)	13 (2.1)
Iodamoeba butschlii		13 (4.4)	17 (6.1)	1 (10)	20 (6.5)	11 (3.5)	31 (5)
Schistosoma mansoni		2 (0.7)	2 (0.7)		2 (0.7)	2 (0.6)	4 (0.6)
Giardia lamblia		3 (1)	8 (2.9)		4 (1.3)	7 (2.3)	11 (1.8)

Figures in parentheses indicate percentages.

Table 2. Logistic regression analysis of parasite prevalence in three rural villages of south St. Lucia for factors associated with the infection

Factors		Chi-square	df	Sig	Odds ratio	95% CI	
						Upper	Lower
Wearing shoes	Yes: No	28.8	1	0	3.18	2.08	4.85
Washing hands before meal	Yes: No	68.5	1	0	6.06	3.96	90.29
Trim nails	Yes: No	4.24	1	0.04	0.46	0.22	0.96
Recreation		11.51	3	0.01			
Swimming in fresh water	Yes: No	0.97	1	0.32	0.61	0.23	1.63
Fishing in fresh water	Yes: No	0.16	1	0.68	0.84	0.36	1.96
Playing cricket bare feet	Yes: No	10.9	1	0	0.48	0.31	0.74
Gender	Male : Female	2.32	1	0.13	0.74	0.50	1.09

ciation between infection and risk factors. Children who do not wear shoes or those who do not wash their hand before having food showed high risk for acquiring parasitic infection.

Treatment with albendazole and praziquantel resulted in a significant decrease in prevalence and intensity of infection after four months. The efficacy rate following treatment was determined from diagnosing the infected individual negative by using Kato-Katz method (94.2%, 321 of 341). Post-treatment of total infections showed no heavy or moderate levels of infections. Infection that persisted beyond treatment was *Ascaris lumbricoides, Trichuris trichiura, Giardia lamblia* and *Strongyloides.* Albendazole was effective with cure rate for *Ascaris* 96.9%, *Trichuris* 82.7%, *Strongyloides* 93.3% and *Giardia lamblia* 81.8% (Table 3).

Discussion

The study aimed to identify the prevalence and intensity of intestinal parasitic infections among school children and identify risk factors and role of pharmacological control of the infections in three rural villages of Saint Lucia. To date a systematic study on intestinal parasitic infection on school based control has not be done in the country and this study therefore focus on epidemiology of intestinal parasites as well as targets school based treatment in reducing the prevalence and intensity of intestinal parasites.

More than half (61.6%) of the tested population had positive stool specimens, the majority only had a single parasite identified. Soil transmitted helminths were the most common intestinal parasites observed in the current study as seen in other parts of the world[12, 13]. There are reports of high prevalence of three major intestinal helminths infections—ascariasis, trichuriasis, and hookworm infection in the poorest areas of the Caribbean, particularly in the Dominican Republic, Haiti, and Jamaica, Barbados and Trinidad and Tobago as well as in other parts of the world[14, 15]. *Ascaris lumbricoides* was the most common parasite in the given study. This could be because the infective stages of *A. lumbricoides,* the embryonated eggs have enormous capacity for withstanding the environmental extremes of urban environments[16.]

This study found older age group most heavily infected age group particularly with STH followed by the 5–9 yr age group. This increased prevalence could be due to the behavior of this particular age group. Children use to play in the environment and are more prone to exposure to contaminated soil, high level of soil contact activity and low personal hygiene in this age group. Similar finding is supported by a previous report from India[17]. The prevalence rate of overall intestinal parasitic infection and helminthic infection in females (70.6 and 51.9%) was significantly higher than in males (60.1 and 39.2%). Other studies also revealed sex specific differences among para-

Table 3. Prevalence and intensity of parasitic infection within school children pre-treatment and four month post-treatment with albendazole and praziquantel

Parasites	Pre-treatment n (%)	Post-treatment n (%)	Cure rate n (%)	Mean EPG	ERR (%)
Ascaris lumbricoides	97 (15.7)	3 (0.5)	94 (96.9)	5389	96
Hookworm	73 (11.9)	0	73 (100)	884	100
Strongyloides	60 (9.7)	4 (0.65)	56 (93.3)	n.a.	n.a.
Trichuris trichiura	29 (4.7)	5 (0.8)	24 (82.8)	853	84
Enterobius vermicularis	13 (2.1)	0	13 (100)	n.a.	n.a
Taenia solium	5 (0.8)	0	5 (100)	n.a.	n.a.
Schistosoma mansoni	4 (0.6)	0	4 (100)	78	100
Entamoeba coli	60 (9.7)	0	60 (100)	n.a.	n.a.
Entamoeba histolytica	7 (1.1)	0	7 (100)	n.a.	n.a.
Endolimax nana	13 (2.1)	0	13 (100)	n.a.	n.a.
Iodamoeba butschlii	31 (5)	0	31 (100)	n.a.	n.a.
Giardia lamblia	11 (1.8)	2 (0.3)	9 (81.8)	n.a.	n.a.

sitic infections[18]. Male children were more infected than female children with Hookworm and Strongyloides as examined in other studies[19, 20].

High rates of Hookworm after *Ascaris* infection in this study agrees with similar studies done in similar climatic conditions of tropics of Paraguay and Peru as well as in parts of Central America and in Surinam[14,21, 22]. Strongyloidiasis was recorded as third high infection rate in this study is endemic in Latin America and Caribbean, with no estimates of their regional prevalence[23].

Though the rate of *Schistosoma mansoni* infection was low in children with only one moderate case but if not treated could act as a potential infective pool for rest of the community. There are reports that almost 4400 cases of *Schistosoma mansoni* occur in Guadeloupe, and transmission still occurs in Saint Lucia and Antigua and Barbuda[24].

Among Protozoan infection *E. coli* and *I. butschlii* were the most common intestinal protozoa among the study population were as Giardia was the common pathogenic protozoa. Both can be transmitted orally by drinking infected water and both are environmental contaminants of the water supply. There are reports of *Giardia* and *E. coli being the* most common protozoan in the western part of Turkey[25]. Analysis of risk factors was evaluated based on the presence of infection. Infection rate was significantly higher in children who do not wear shoes, who do not wash hand before having food, who do not trim their nails and those who play cricket bare foot at ground[26].

This current study showed successful effort to control intestinal parasitic infection, focusing the school age population. In several Asian and Latin American countries, there has been a dramatic decrease in prevalence rates, largely because of national control activities together with social and economic development[27]. Treatment of infected children (albendazole 400 mg and praziquantel, according to body weight), health education campaigns using fliers and power point presentations as recommended by WHO[28, 29], during parent teacher meeting has showed high cure rates.

Conclusion

This study has identified prevalence and intensity of

intestinal parasitic infection among school children in rural St. Lucia. The control program by treatment and health education was a good demonstration of treating infected school children and creating awareness among them.

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References

1. Savioli L, Bundy DAP, Tomkins A. Intestinal parasitic infections: a soluble public health problem. *Trans R Soc Trop Med Hyg* 1992; *86:* 353–4.
2. Bethony J, Brooker S, Albonico M, Geiger SM, Loukas A, *et al*. Soil-transmitted helminth infections: ascariasis, trichuriasis, and hookworm. *Lancet* 2006; *367:* 1521–32.
3. Curtale F, Pezzotti P, Sharbini AL, al Maadat H, Ingrosso P, *et al.* Knowledge, perceptions and behaviour of mothers toward intestinal helminths in Upper Egypt: implications for control. *Health Policy Plan* 1998; *13:* 423–32.
4. Programmes and projects. .Schistosomiasis: a major public health problem. Geneva: World Health Organization 2009.
5. Savioli L, Stansfield S, Bundy DA, Mitchell A, Bhatia, et al. Schistosomiasis and soil-transmitted helminth infections: forging control efforts. *Trans R Soc Trop Med Hyg* 2002; *96:* 577–9.
6. Control of soil-transmitted helminth infections in the English- and French-speaking Caribbean: towards world health assembly resolution. Kingston, Jamaica: *PAHO* 2007; p. 54.19.
7. Prevention and control of schistosomiasis and soil-transmitted helminthiasis. *WHO Tech Rep Ser* No. 912. Geneva: World Health Organization 2002.
8. Control of schistosomiasis and soil-transmitted helminth infections. Report by the Secretariat. Executive Board 107th session. Provisional agenda item 3.3 (EB107/31). Geneva: World Health Organization 2001.
9. Awasthi S, Bundy DAP, Savioli L. Helminthic infections. *British Med J* 2003; *23:* 431–3.
10. Hotez PJ, Bundy DAP, Beegle K, Brooker S, de Silva N, Montresor A, *et al*. Disease control priorities in developing countries: helminth infections. II edn. *WHO, World Bank*, NIH, Oxford University Press 2005.
11. Katz N, Chaves A, Pelligrino J. A simple device for quantitative stool thick-smear technique in Schistosomiasis mansoni. *Revue Instituto Medicina Tropical* 1972; *14:* 817–20.
12. Escobedo A. A, Cañete R, Núñez FA. Prevalence, Risk Factors and Clinical Features Associated with Intestinal Parasitic Infections in Children from San Juan y Martínez, Pinar del Río, Cuba. *West Indian Med J* 2008; *57*(4): 378.
13. Abolfath SA, Alaghehbandan R, Akhlaghi L, Shahi M, Rasregar AL. Prevalence of intestinal parasites in a population in south of Tehran, Iran. *Rev Inst Med Trop S Paulo* 2008; *50*(3): 145–9.
14. De Silva NR, Brooker S, Hotez PJ, Montresor A, Engels D, *et al*. Soil-transmitted helminth infections: updating the global picture. *Trends Parasitol* 2003; *19*: 547–51.
15. Peter J. Hotez, Maria Elena Bottazzi, Carlos Franco-Paredes, Steven K. Ault, and Mirta Roses Periago. The Neglected Tropical Diseases of Latin America and the Caribbean: A Review of Disease Burden and Distribution and a Roadmap for Control and Elimination. *PLoS Negl Trop Dis* 2008; *2*(9): e300.
16. Hotez PJ, da Silva N, Brooker S, Bethony J. Soil-transmitted helminth infections: the nature, causes and burden of the condition. Working Paper No. 3: *Disease Control Priority Project*. Behesda, Manyland: Fogarty International Centre, National Institute 2003.
17. Naish S, McCarthy J, Williams GM. Prevalence, intensity and risk factors for soil-transmitted helminth infection in a South Indian fishing village. *Acta Trop* 2004; *91:* 177–87.
18. Okay P, Ertug S, Gultekin B, Onen O, Beser E. Intestinal parasites prevalence and related factors in school children, a western city sample -Turkey. *BMC Public Health*, 2004; *4:* 64.
19. Albonico M, Crompton DW, Savioli L. Control strategies for human intestinal nematode infections. *Adv Parasitol* 1999; *42:* 277–341.
20. Odikamnoro OO, Ikeh IM. Prevalence of common intestinal nematode infection among primary School children

in Kpirikpiri community of Abakaliki, Nigeria. *Nig J Parasitol*, 2004; *24:* 71–9.

21. Casapia M, Joseph SA, Nunez C, Rahme E, Gyorkos TW. Parasite risk factors for stunting in grade 5 students in a community of extreme poverty in Peru. *Int J Parasitol* 2006; *36*(7): 741–7.
22. Labiano-Abello N, Canese J, Velazquez ME, Hawdon JM, Wilson ML, et al. Epidemiology of hookworm infection in Itagua, Paraguay: A cross sectional study. *Mem Inst Oswaldo Cruz* 1999; *94*(5): 583–6.
23. Olsen A, Van Lieshout L, Marti H, Polderman T, Polman K, Steinmann P, *et al*. Strongyloidiasis—the most neglected of the neglected tropical disease? *Trans R Soc Trop Med Hyg 103*(10): 967–72.
24. Steinmann P, Keiser J, Bos R, Tanner M, Utzinger J. Schistosomiasis and water resources development: systematic review, meta-analysis, and estimates of people at risk. *Lancet Infect Dis* 2006; *6*(7): 411–25.
25. Kuman HA, Ertug S, Yurdagul C, Ertabaklar H, Dayangac N, Uner A. The treatment of intestinal parasitic infections with albendazole. *Acta Parasitolocica Turcica* 2001; *25:* 155–8.
26. Idowu OA, Rowland SA. Oral fecal parasites and personal hygiene of food handlers in Abeokuta, Nigeria. *Afr Health Sci* 2006; *6:* 160–4.
27. Reunion sobre el control de las helmintiasis intestinales en el contexto de AIEPI, Rio de Janeiro, Brasil, *PAHO* 2005.
28. Montressor A, Crompton DWT, Gyorkos TW, Savioli L. Helminth control in school age children — a guide for managers of control programmes. Geneva: World Health Organization 2002.
29. Bundy DAP, Wong MS, Lewis LL, Horton J. Control of geohelminths by delivery of targeted chemotherapy through schools. *Trans R Soc Trop Med Hyg* 1990; *84:* 115–20.

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