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ORIGINAL ARTICLE

ENTEROPARASITOSIS IN PUBLIC SCHOOLS IN BAHIA: PARASITOLOGY LEARNING

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ABSTRACT

Parasitic diseases hamper progress in underdeveloped nations, compromising child physical and cognitive development. In order to control intestinal parasites, the popularization of science may enable prophylactic measures. Questionnaires were used to assess the students' knowledge, attitudes and practices. Health fairs were held as an educational tool and subsequently questionnaires on parasitic diseases and prevention were administered. Stool examinations were performed and infected students were treated. Prevalence of *Entamoeba histolytica/ dispar, Ascaris lumbricoides, Trichuris trichiura* was 7.1%, 5% and 3.5% respectively in the Anísio Teixeira Institute students and 7.2%, 8%, 3.6% in the Raymundo Matta School students in a suburb. The students at both schools displayed limited knowledge on parasitic disease prevention. The school participation in the prophylaxis of parasitic diseases, was not acknowledged by the students. Reviewing *curricula* is required, addressing themes related to health, possibly establishing partnerships with health services, universities and/or research centers with the effective involvement of the community performing articulated actions in different health districts, so that education will lead to community empowerment in regard to quotidian issues and improving public health conditions.

KEY WORDS: Health promotion; prophylaxis; school health.

INTRODUCTION

Enteroparasites are globally distributed, with high prevalences in tropical regions of developing nations, including Brazil. In low-income populations parasitic diseases reduce physical (Assis et al, 2004; Mondal et al. 2006) and mental development in children (Taylor-Robinson et al, 2012; 2015), increasing their vulnerability to other diseases potentially causing malnutrition and death. School-age children are frequently affected for behavioral and immunological reasons and are particularly vulnerable due to physiological/developmental properties. Cognitive impairment can restrict educational accomplishments (De Gier et al., 2014; Ojha et al., 2014; Liu et

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al., 2015) and hence professional qualification. This disease-poverty vicious circle is part of the perennial social injustice in the country, comprising a remarkable public health problem that is closely related to underdevelopment, lack of sanitation, poor education and misinformation about hygiene (Prado et al., 2001). Therefore, actions undertaken to control parasitic/infectious diseases, within the school environment, are fundamental for public health. Thus, the Popularization of Science, especially targeting young audiences, can produce sustainable effects, since these may constitute enthusiastic multipliers in neighborhoods, schools and others. In this regard, hygiene practices such as hand washing may effectively prevent the spread of numerous infections (Allegranzi & Pittet, 2009) including soil-transmitted helminth infection (Strunz et al., 2014).

The purpose of this study was to perform a comparative evaluation of aspects of population knowledge, attitudes and practices (KAP) which may influence the transmission of parasitic diseases (De Moraes Neto et al., 2010), as well as the prevalences of intestinal parasites in students from 5th to 8th grades from one urban and one suburban public schools. In addition, interventions including education, diagnosis and treatment were performed to promote prophylactic measures among the students at the Instituto Anísio Teixeira (EAIAT) and the Colégio Estadual Raymundo Matta (CERM). These schools are located in different areas of the city, so that student populations were approached under different social and environmental conditions.

METHODS

This cross-sectional study was carried out from 2008 to 2014 in Salvador, Bahia, involving 559 students (aged 9-19 years) from the 5th to 8th grades morning shift of elementary school, enrolled in EAIAT, located in the São Marcos neighborhood (Figure 1A) in the Pau da Lima Sanitary District (SD); and 397 students from the 5th to 8th grades, morning and afternoon shifts of elementary school, enrolled in the CERM, located in the Lobato locality (Figure 1B), in the Ferroviário suburb SD, both in the 1B Regional Directorate of Education and Culture (DIREC).

The study was divided into four stages, with voluntary participation. In the first stage, 80.1% (448) of EAIAT students and 88.6% (352) of the CERM students answered questionnaires anonymously to evaluate prior levels of knowledge on intestinal parasites and treatment practices, including self-medication and folklore procedures. The participation of all students enrolled in the school was allowed in the second stage, i.e. performing educational interventions on prevention of intestinal parasites, as well as endemic infections, through health fairs. In the third stage, only 25.2% (141) of EAIAT and 43.3% (172) of CERM students, delivered biological samples (feces) to perform fecal examinations for which their guardians signed the Informed Consent Forms

(ICF). In the fourth stage, 37.7% (211) of the students at EAIAT and 34.2% (136) at CERM, answered a questionnaire, in order to assess the level of knowledge on intestinal parasites acquired by the students after the educational interventions. Parasitological diagnosis was performed utilizing fecal samples from voluntary students. In the fourth stage 39.5% (221) and 29.2% (116)0f the students from EAIAT and CERM, respectively, answered the questionnaire. In order to calculate the sample size to assess parasitic diseases, the Epi Info 3.5 software was used, based on a previous study (Guimarães & Tavares-Neto, 2006) carried out in the CERM area in a Salvador suburb, estimating 226 and 160 students from EAIAT and CERM, respectively.

Figure 1. Satellite photographs displaying A: *Escola de Aplicação Instituto Anísio Teixeira* (EAIAT) - 12°55'49.7"S 38°24'59.9"W and B: *Colégio Estadual Raymundo Matta* (CERM) - 12°55'15.3"S 38°29'10.4"W. C: Inappropriate garbage disposal at Lobato community, near CERM.
Source: Google Maps A-B. C: project "*Ciência na Estrada: educação e cidadania*".

The "Popularization of Science" activities for health promotion were performed by the "Science on the Road: Education and Citizenship" team (www.bahia.fiocruz.br/cienciana estrada/ and www.youtube.com/user/MarcosVannier). This team was trained to act in low-income areas, particularly in endemic areas, using materials and activities specially designed for these populations (Deccache-Maia et al., 2010; Vannier-Santos & Deccache-Maia, 2007; Suarez-Fontes et al., 2014), together with other valuable initiatives that associate epidemiological and educational approaches (De Moraes et al., 2010; Souza et al., 2014). The teachers, students and parents or guardians attended lectures and health fairs to understand the study; as well as the relevance of parasitic disease control, particularly for children and teenagers.

The biological samples for parasitological diagnosis were processed by Hoffman, Pons and Janer (1934) method and analyzed in the Laboratory of Parasite Biology, FIOCRUZ, BA. For quality control, 10% of the samples were also analyzed in a reference laboratory in the city of Salvador, where the results were confirmed. Students received results individually in the presence of their legal guardians and were instructed about the parasite(s) found, and then underwent clinical examinations performed by medical personnel. The prescribed drugs were provided by the Municipal Health Office.

Statistical analysis

Pairwise comparisons of data from the two schools were performed using the chi-square test, with 5% significance level ($p < 0.05$).

Ethics

All the procedures applied here were approved by the Centro de Pesquisa Gonçalo Moniz, Fundação Oswaldo Cruz Ethics Committee, according to the ethical principles in the Ministry of Health Resolution 466/2012 (Conselho Nacional de Saúde).

RESULTS

The main characteristics of the study population were similar (Table 1) in both phases, showing a slightly higher number of females in both schools. In the first phase there was greater participation among EAIAT 6th graders and in CERM, 7th graders.

Regarding the study population, the level of parental education reported in the first questionnaire, was limited to the middle school. The same questionnaire addressed students' knowledge about parasitic disease symptoms (Table 2) and the public services available near their homes. A small difference was noted concerning the services offered between the school neighborhoods. Students from both CERM and EAIAT reported that circa 90% of the dwellings were connected to sewage systems. Nevertheless, 55.7% of the CERM students reported lack of rain water drainage whereas only 24.6% of the EAIAT students reported this deficiency. Domestic garbage discarded in suburban streets is frequently associated with accumulated water, particularly in the rainy season (Figure 1C). This recent photograph indicates the environmental conditions in the area, which have not improved since then. Stool examinations were performed to determine the prevalences of intestinal parasites (Table 3). The differences among most parasite species were not statistically significant. Nevertheless, the comparison of the positive cases between the schools revealed that significantly more CERM students presented at least one parasite/commensal ($p= 0.0005$), but clinical examination showed that most students from both schools were asymptomatic.

Table 1. Distribution of students features in the Colégio Estadual Raymundo Matta (CERM) and Escola de Aplicação do Instituto Anísio Teixeira (EAIAT).

Features	Schools - 1st Phase				Schools - 4th Phase			
	EAIAT n=448		CERM n=352		EAIAT n=211		CERM n=136	
	n	%	n	%	n	%	n	%
gender								
male	201	44.9	170	48.3	91	43.1	58	42.6
Female	247	55.1	182	51.7	120	56.9	78	57.3
ages								
09 to 11 ys	109	24.3	76	21.6	57	27.0	28	20.6
12 to 14 ys	282	63.0	150	42.6	87	41.2	55	40.4
15 to 17 ys	53	12.0	114	32.4	51	24.2	50	36.8
18 to 19 ys	04	00.9	12	03.4	16	07.6	03	02.2
5th	160	35.7	108	30.7	112	53.0	62	45.6
6th	234	52.2	79	22.4	27	12.8	16	11.8
7th	48	10.7	122	34.6	67	31.8	28	20.6
8th	06	01.3	43	12.2	05	02.4	30	22.0

Table 2. Knowledge of EAIAT and CERM students on symptoms and transmission of parasitc diseases after educational interventions.

Knowledge	EAIAT n=211		CERM n=136		χ^2	p
	n	%	n	%		
Amoebiasis Symptoms						
Correct	127	(60)	93	(68)	2.05	0.15
Incorrect	84	(40)	43	(32)		
Giardiasis Symptoms						
Correct	120	(57)	70	(51)	0.77	0.38
Incorrect	91	(43)	66	(49)		
Schistosomiasis Transmission						
Correct	132	(62)	112	(82)		0.001
Incorrect	79	(38)	24	(18)	14.59	
Taeniasis Transmission						
Correct	142	(67)	109	(80)	6.20	0.01
Incorrect	69	(33)	27	(20)		

Chi-square test, p value < 0.05.

Table 3. Parasites detected in feces examinations from students from the Colégio Estadual Raymundo Matta (CERM) and the Escola de Aplicação do Instituto Anísio Teixeira (EAIAT).

Parasite	CERM n = 172		EAIAT n = 141		*p* value
	n	%	n	%	
Endolimax nana	27	15.8	7	4.8	0.002*
Entamoeba coli	22	12.5	10	7.6	0.131
Entamoeba histolytica/dispar	10	6.2	6	4.1	0.533
Ascaris lumbricoides	10	6.2	6	4.1	0.388
Trichuris Trichiura	6	3.6	3	2.5	0.513
Giardia duodenalis	3	2.0	4	2.8	0.423
Iodamoeba bustchlii	1	0.8	2	1.8	0.449
Enterobius vermicularis	2	1.2	1	0.7	0.167
Schistosoma mansoni	2	1.2	1	0.7	0.681
Ancylostomidae	1	0.8	1	0.7	0.019
Strongyloides stercolaris	0	0.0	1	0.7	0.268
Hymenolepis nana	0	0.0	1	0.7	0.268
Taenia sp.	1	0.8	0	0.0	0.364

*Chi-square p-values, significance level $p < 0.05$.

The question: "do you discuss environmental factors (e.g. waste, sewage, water) in disease transmission at your school?" revealed that many students do not take part in such discussions, although they were reported to take place at school (vide infra).

Concerning questions on the responsibility for health, EAIAT and CERM students attributed similar responsibilities to "health services", "health professionals", "the individual" and "family". Teachers and schools came fourth in this rating (37.9 to 39.1%), after "politicians". The popular term "worm" ('lombriga' in Portuguese, from Latin *Lumbricus*) was the best-known among the students from both schools, cited by 87% and 77% of the students, whereas *Trichuris* denomination was cited by only 5% and 6% of EAIAT and CERM students, respectively. Terms describing parasitic diseases (e.g. schistosomiasis and ancylostomiasis) were known to at least 50% of the students involved in the study. Interestingly the term "caseira" (from 'casa' = house) for designing *Enterobius vermicularis* is widely used in Bahia, indicating the domestic transmission.

For analysis of the attitudes required for the prevention of parasitic diseases, the responses were grouped into: personal attitudes, social condition and basic sanitation. Personal attitudes were considered the most important (over 80%). The responses were similar for all alternatives referred to by the students from both schools (Table 4).

Table 4. Students Recognized Social Condition required for health maintenance.

Recognized Condition	Grades and Schools								
	5th grade		6th grade		7th grade		8th grade		
	EAIAT n =160 n %	CERM n= 110 n %	EAIAT n= 234 n %	CERM n= 79 n %	EAIAT n= 48 n %	CERM n= 122 n %	EAIAT n= 06 n %	CERM n= 43 n %	p-value
Personal Attitudes									
Healthy nutrition	155 (97)	98 (89)	204 (87)	67 (85)	46 (96)	106 (87)	06 (100)	35 (81)	0.015
Good hygiene	129 (81)	82 (75)	204 (87)	57 (72)	48 (100)	102(84)	05 (83)	41 (95)	0.908
Drinkable water	139 (87)	88 (80)	195 (83)	61 (77)	46 (96)	104(85)	06 (100)	38 (88)	0.124
Periodical medical checkups	128 (80)	74 (67)	177 (76)	54 (68)	39 (81)	84 (69)	05 (83)	34 (79)	0.006
Regular examinations	114 (71)	59 (54)	168 (72)	48 (61)	40 (83)	81 (66)	05 (83)	30 (70)	0.0005
Social Conditions									
Health service in neighborhood	114 (71)	68 (62)	148 (63)	55 (70)	34 (71)	80 (65)	02 (33)	28 (65)	0.707
Leisure activities	86 (54)	44 (40)	81 (35)	26 (33)	18 (37)	38 (31)	03 (50)	10 (23)	0.012
School	64 (40)	47 (43)	52 (22)	21 (26)	14 (29)	30 (25)	03 (50)	06 (14)	0.924
Job	55 (34)	31 (28)	33 (14)	15 (19)	12 (25)	25 (20)	01 (16)	01 (02)	0.450
Sanitary Service									
Sewer and Garbage collection	103 (64)	66 (60)	178 (76)	55 (70)	39 (81)	86 (70)	05 (83)	34 (79)	0.168

Chi-square test, p value < 0.05.

Regarding the students' knowledge of practices and services required for health, "health services" were cited by over 66% in both schools whereas the alternative "having school" was cited by 30% from EAIAT and 29% from CERM, surpassing only the option "to have a job" (Table 3). In cases of parasitic diseases, EAIAT and CERM students reported that 97% and 73% of the families respectively counted on medical assistance. Nevertheless, 30% and 27% respectively also reported self-medication or use of non-prescribed medicines.

DISCUSSION

Most of the mothers of students from both schools work as house cleaners and the fathers mostly work as guards or in freelance jobs (Novais, 2009). A previous study carried out in three Brazilian capitals, showed that young people with low monthly per capita income, i.e. negroes, as well as housewife mothers, have the most irregular school accomplishments. This tends to perpetuate and/or promote social inequalities, already substantial in Brazil (Quihui et al., 2006).

Discussions on health are ineffective or non-existent in most public schools. Thus, the knowledge of the terms that identified the most prevalent parasites in Brazil, by school grade, showed that the 6th grade EAIAT students generally had more knowledge, followed by the 7th and 8th graders at CERM. This may indicate little or no involvement of the school in the level of the students' health understanding. Interestingly CERM students showed significantly higher understanding ($p<0.05$) about parasitic disease symptomatology after the educational activities. This fact may be due, at least in part, to the enthusiastic participation of the suburban students.

In regard to the evaluation of students' knowledge on the transmission mode of parasites, over 60% of the students correlated inadequate hygiene habits and the incidence of parasitic diseases (Novais, 2009). The poor sewage and drainage systems indicate that the suburban population suffers a higher risk of infection, particularly since incorrectly disposed of garbage often clogs the drains, leading to flooding and the dissemination of parasite cysts and ova, therefore enhancing the incidence of parasitic diseases, as well as infections transmitted by contaminated water via contact or ingestion, such as leptospirosis, hepatitis A and E, bacterial diarrheas and, to a lesser extent, typhoid and cholera. This garbage also enhances the proliferation of non-hematophagous synanthropic arthropods, such as flies and roaches, that may be involved in the mechanical transmission of intestinal parasitic diseases caused by both protozoa (Graczyk et al., 2005; Fetene & Worku, 2009; Getachew et al., 2007; Adenusi & Adewoga, 2013) and helminths (Sulaiman et al., 1988; Fetene & Worku, 2009; Getachew et al., 2007; Adenusi & Adewoga, 2013).

The role of these insects was not recognized by most students from both schools (Novais, 2009), and this is cause for concern since many of them live in areas not fully covered by garbage collection, and often presenting sewage leaks and inappropriate waste disposal, leading to insect and rat dissemination, including the CERM neighborhood (Figure 1C) even within the school walls (not shown).

It was previously noted (Novais, 2009) that 54% and 47% of the students from EAIAT and CERM, respectively, considered the use of public toilets as a form of intestinal parasites transmission. Preschool restrooms (Silva et al., 2011) may be implicated in parasitic disease transmission. River bathing, but not swimming in the sea was mentioned regarding the acquisition of parasitic diseases by about 50% of the respondents, demonstrating a partial knowledge on the part of the students from both schools. The information on the subject is presumably due to previous studies in the area (Guimarães & Tavares-Neto, 2006).

Water accumulation in garbage is also of concern as *Aedes aegypti* can proliferate in the vicinity of homes and schools (Ribeiro et al., 2006), even in brackish, sewer- or oil-containing water spreading dengue, zika, chikungunya and yellow fever viruses presently transmitted in Brazil.

As water supply and sewage conditions were similar in the studied areas, it is reasonable to infer the participation of poor hygiene and uncollected garbage as risk factors, as reported previously (Leite et al., 2014; Santos et al., 2014a; Costa et al. 2012).

The general analysis of the data displayed in Table 4, compared using chi-square, reveals that periodical medical check-ups and regular examinations were more frequently reported by EAIAT students, although the availability of medical services in both neighbourhoods was not significantly different. This may be partly due to the higher mobility of families living near the Juracy Magalhães highway, a connection to hospitals, bus/metro stations etc. In addition, EAIAT students reported healthy eating habits more frequently, which may be related to parasite susceptibility diminishing due to better nutrition (Neves, 2016).

Although parks and sandboxes in schools or day care centres may present parasites (Albano et al., 2016; Chen & Mucci, 2012; Figueiredo et al., 2012; Vargas et al., 2013), possibly leading to enteroparasitism in children and students (Giraldi et al., 2001), the EAIAT more often informed leisure activities, possibly indicating better urban infrastructure for sport practices. Unoccupied areas in low-income vicinities often present accumulated garbage, permitting the proliferations of insects, rats etc., therefore comprising risk factors.

As for the conduct adopted by families to deal with intestinal parasitosis, “looking for medical assistance” was reported by about 73% and 97% of the students at the CERM and EAIAT schools, respectively (Novais,

2009). According to Loyola Filho et al. (2002), self-medication is a common practice, for treating or alleviating symptoms, making use of both industrial and homemade remedies. A small percentage of the families use faith healing procedures as alternative treatment for parasitic diseases (Ruiz, 2010).

Although most (62.5-69.9%) students intended having their feces analyzed for parasitic disease diagnosis and treatment, only 25.2 (43.3%) delivered samples.

Those who stated "not interested" informed they were "shy", "disliked" or "distrusted" the activity. A certain amount of psychological abuse or bullying was noted towards students delivering samples, presumably due to a scatological taboo. That may partially explain the reduced amount of samples obtained, particularly from girls, who answered more questionnaires, but delivered less samples. Educational campaigns for disease prevention must be planned to overcome this problem.

Contrary to rural (Biolchi et al., 2015; Elyana et al., 2016) and riverbank populations (Silva et al., 2012), protozoa such as *Endolimax nana, Entamoeba coli* and *Iodamoeba butchilli* were more prevalent than helminths in the two schools studied. Similarly, commensal protozoa such as *E. nana, E. coli* were highly prevalent in schools and daycare centers (Basso et al., 2008; Cavagnolli et al., 2015; Correia et al., 2005; Seixas, 2011). The low prevalence of helminths may be due to mass treatment. The most prevalent helminth species were *A. lumbricoides* and *T. trichiura*, geo-helminths that share transmission mechanisms. Prevalences differed from other studies that show a percentage around 30%, of these parasitic diseases (Barreto et al., 2001; Pereira et al., 2012; Vasconcelos et al., 2011). It is noteworthy that the data analysis is limited, as it is a convenience sample from students who spend several hours a day in the school and showed little interest in the study.

The CERM students were more aware of schistosomiasis transmission presumably because they are in an endemic area where previous studies had been carried out (Guimarães & Tavares-Neto, 2006).

According to Ferreira & Andrade (2005), educational practices can lead to public awareness and therefore parasite prevention. Health education regarding the control of intestinal parasitic infections has proved to be a low cost strategy able to achieve significant and lasting results (Rossi et al., 2012). It is noteworthy that educational practices were shown to be as effective as basic sanitation, and more effective than long-term mass treatment (Asaolu & Ofoezie, 2003). In this regard, a sanitation program spent millions of USD on sewage systems in different cities in the bay area, including Salvador (Prado et al., 1998), but little improvement was detected in the incidence of diarrhoea and parasitic diseases (Santos et al., 2014b). Hygiene habits and garbage disposal presumably play important roles. Hygiene habits were equally reported by students from both schools, but the fact that many people tend not to admit bad hygiene habits cannot be ruled out.

More specific approaches to health promotion in schools could be more effective in stimulating the prophylaxis of various endemic diseases (Cunha, 2006, Silva et al. 2013). It is surprising that students show little faith in education in relation to promoting health since the Brazilian government carries out two valuable programs on School Health (MEC 2015a-b). Such preventive measures will only be effective with community involvement.

The frequent mention of the term "worm" ("lombriga") is presumably due to the eventual release of adult ectopic specimens of *A. lumbricoides*. Teachers from low-income towns in Bahia have eventually witnessed this (even in classrooms) and described such events.

The infrequent citation of "school" as an essential requirement for health may be related to the cultural view of curative over preventive medicine as well as the scarce preventive interventions. This inference is in agreement with the discredit of the school role in health among older students. In addition, school *curricula* seldom face every day, local problems. Interestingly, regarding the 5th to 8th grades, the longer the time spent in schools, the higher the students' disbelief in the school role in health promotion. The 8th grade data do not comprise a *bona fide* sample due to the small "n" values.

Health education should be based on the environment where one lives, particularly addressing communities at risk, where there is a demand for effective disease prevention. Endemic diseases have been inappropriately addressed in Brazilian textbooks (Amendoeira et al., 2013; Assis et al. 2013a; França et al., 2011; Murta et al., 2014), and promotional material (Assis et al. 2013b), as well as on the internet; Massara et al., 2013), therefore, qualified professionals from universities and research centers could prepare and/or supervise the preparation of effective explanatory materials on parasitic diseases. Once again, community participation is desirable.

The results of this study indicate the need for new health education activities on parasitic diseases making use of the school role as a multiplying agent, spreading information on control measures and promoting health (Deccache-Maia et al., 2010; Pereira et al., 2012). These results also confirm the cultural complexity (Gazzinelli et al., 2006) of the communities and the need for educational programs including environment education on a local practical level to allow prevention, not only of parasitic diseases, but also of different endemic infections. The integrated strategies for information, education, health communication and community mobilization could modify the KAP, contributing to disease prevention (Deccache-Maia et al., 2010; De Moraes Neto et al., 2010; Novais, 2009; Vannier-Santos & Deccache-Maia, 2007; Suarez-Fontes et al. 2014).

The high frequency of non-pathogenic protozoa and enteroparasites may indicate extensive fecal-oral contamination. Schools could play a pivotal health-promoting role in low-income areas. Educational activities and *curricula* revision, with a view to prophylaxis of parasitic and infectious diseases could

be performed combining theory and practice in the community milieu with effective population participation.

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