Research Article

Assessment of sanitary conditions and prevalence of enteric parasitic infections among school children of Visakhapatnam

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Abstract

Background: Sanitation in schools is the significant factor that holds an important role in children's health and their performance. Recent studies in southern India revealed that the prevalence of soil-transmitted helminths was almost 7.8% varying from school to school.

Objective: To assess the sanitary facilities in the government-aided schools and the prevalence of parasitic enteric infections in school children.

Materials and Methods: A total of 2,250 stool samples were taken from the children of age group ranging 6–13 years and examined using the formalin–ethyl acetate concentration method.

Result: Among the 2,250 children, a total of 288 children were infected with one or more enteric parasitic infections. There was predominance in single infection (204 cases) in relation to multiple infections (84 cases). Of the 204 single infection cases, 143 pupils were infected with protozoa infections and 61 pupils with helminths infections. The highest prevalent helminths was "hook worm" (0.6%) and protozoan "*Blastocystis hominis*"(2.5%).

Conclusion: All the children are vulnerable to the risk of enteric parasitic infections. The reasons might be owing to improper sanitation facilities in schools, lack of awareness about enteric infections, and no provision for safe disposal fecal matter. First, a periodic treatment should be given to students once or twice a year. This intervention can reduce the morbidity of parasitic infections. Second, the provision of health and hygiene components such as promotion of handwashing and improved sanitation can reduce the prevalence of parasitic infections.

KEY WORDS: Enteric parasitic infection, sanitation, school children

Introduction

Sanitation is the neglected issue in the majority of schools. Students should be enlightened about personal hygiene as a part of education in school, but it is not happening. Children are more prone to infectious diseases if no proper sanitary facilities are provided in schools. The common infection reported in school children in association with improper sanitation is enteric parasitic infection in developing countries. According to the WHO (2000),[1] approximately, 3.5 billion people are affected with parasitic infections, and 450 million children are sick owing to these infections. The parasitic infection affects the mental and physical developments of the children, which leads to the absenteeism.

The United Nations Millennium Development Goal 2. A is to "ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling."[2]

It has been estimated that the factors such as the poor supply of water and insufficient provision for sanitation in the school environment are responsible for interrupting the success of this goal. Insufficient water supply and scarce sanitation facilities in numerous schools in the developing and developed nations are related to the likely harmful consequences on health and school attendance.[3,4]

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In Asia, intestinal parasitosis is a major public health problem.[5] It has been reported that, globally, among the intestinal helminths, *Ascaris lumbricoides*, hook worm, and *Trichuris tricihura* affect 1.4 billion, 1.3 billion, and 1.0 billion people, respectively.[5] Recent studies at Vellore, in southern India, reported that the prevalence of soil-transmitted heliminth infection was 7.8%, varying from school to school.[6] This study assessed the sanitary conditions and the incidence of the enteric parasitic infections among school children on gender bias in the selected schools of Visakhapatnam, Andhra Pradesh, India.

Materials and Methods

The study was conducted in 15 selected government-aided schools of Visakhapatnam, which were established two decades back and located at polluted areas and at traffic-dense centers [Figure 1]. The study was carried for 1 year (June 2013 to June 2014). With the consent of the respective head masters, the stool samples were collected from 2,250 children, with the age group of 6–13 years. The procedure was clearly explained under the supervision of their teachers, and sterilized plastic containers were distributed to all the students before the sample collection. After collecting, the samples were directly taken to the laboratory for further experimental studies. A few samples were preserved in 10% formalin.[7] A simple questionnaire was also distributed to get the brief picture about the sanitary conditions in the sampled schools.

Fecal Examination

Microscopic examination for the screening of enteric parasites was performed by adopting the formalin–ethyl acetate concentration technique.[7] The specimens were observed for enteric protozoa, eggs, and larvae of enteric helminths under the microscope.

Statistical Analysis

Statistical analysis was done by using one-way ANOVA from the online website (available at: http://turner.faculty.swau.edu/mathematics/math241/materials/anova/aentry.php).

Result

About 53% of the sampled schools did not possess more than two toilets and 67% of the teachers said that both the teachers and students were using the same toilets (data not shown in the article). The prevalence of enteric parasitic infections among the school children of the 15 schools is given in Table 1. The overall prevalence of enteric parasitic infections was 12.8% (288/2,250). Among the 15 schools, the highest prevalence of parasitic infection (22.7%) was observed in the school-"C," while school-"G" presented the lowest prevalence (6.33%). This clearly shows that a

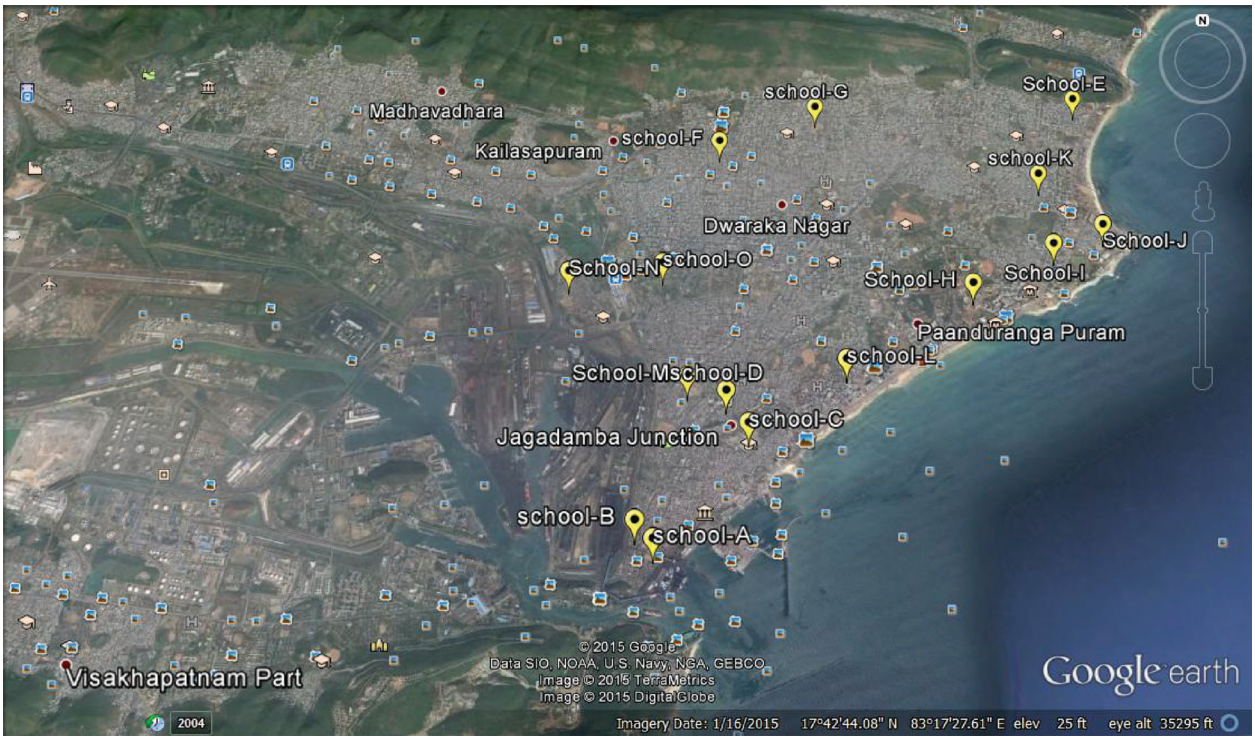

Figure 1: Location of the sampled schools.

Table 1: Prevalence of enteric parasitic infections in children from the selected schools of Visakhapatnam

School code	Total number of children examined	Total number of children infected	Percentage of prevalence of diseases
School A	52	11	21
School B	119	21	17.6
School C	158	36	22.7
School D	84	17	20.2
School E	105	12	11.4
School F	82	7	8.5
School G	79	5	6.3
School H	121	19	15.7
School I	249	26	10.4
School J	336	34	10.1
School K	197	15	7.6
School L	278	21	7.5
School M	102	13	12.7
School N	124	19	15.3
School O	164	14	8.5
Total	2,250	288	12.8

Treatments: *df* = 2, SS = 181,894.011, MS = 90,947.006, *F* = 40.1019, *P* = 0.0000.

Error: *df* = 42, SS = 95,251.607, MS = 2,267.895.

Total *df* = 44, SS = 277,145.618.

Table 2: Gender-wise prevalence of enteric parasitic infections in children

School codes	Boys			Girls		
	No of children examined	No of children infected	Percentage of prevalence of diseases	No of children examined	No of children infected	Percentage of prevalence of diseases
School A	29	7	24	23	4	17.3
School B	54	15	27.7	65	6	9.2
School C	89	21	23.5	69	15	21.7
School D	31	7	22.5	53	10	18.8
School E	55	8	14.5	50	9	18
School F	49	5	10.2	33	6	18.1
School G	38	5	13.1	41	5	12.1
School H	47	7	14.8	74	12	16.2
School I	133	13	9.7	116	13	11.2
School J	174	19	10.9	162	15	9.2
School L	115	10	8.6	82	5	6.0
School M	122	6	4.9	156	18	11.5
School N	63	9	14.2	39	5	12.8
School O	78	11	14.1	46	8	17.3
School P	90	9	1.0	74	5	6.7
Total	1,167	152	13.0	1083	136	12.5

Treatments: *df* = 5, SS = 80,428.406, MS = 16,085.681, *F* = 26.1742, *P* = 0.0000.

Error: *df* = 84, SS = 51,623.260, MS = 614.563.

Total: *df* = 89, SS = 132,051.666.

significant difference prevails among the schools in the percentage of prevalence of enteric parasitic infection (*P* = 0.0000).

The enteric parasitic infection in context with gender is shown in Table 2. It was observed that the rates of prevalence of enteric parasitic infections among boys (13%) was slightly higher than girls (12.55%) in the sampled schools A, B, C, J, and L. However, the comparative prevalence of enteric parasitic infections among male and female students concluded that there is no significant difference on gender bias (*P* = 0.0000).

Table 3: Prevalence of protozoan enteric parasitic infections in children from the sampled schools

Protozoan enteric parasitic infections	Number of children infected	Percentage of prevalence of parasitic infections
E. histolytica	22	0.9
E. coli	35	1.5
E. nana	18	0.8
G. lamblia	12	0.5
B. hominis	56	2.5
Total	143	6.3

Treatments: *df* = 1, SS = 1,871.424, MS = 1,871.424, *F* = 12.2144, *P* = 0.1506.

Error: *df* = 8, SS = 1,225.712, MS = 153.214.

Total: *df* = 9, SS = 3,097.136.

Table 4: Prevalence of helminths infections in children from the sampled schools

Helminths infections	Number of children infected	Percentage of prevalence of parasitic infections
T. tricihura	12	0.5
T. solium	5	0.2
A. lumbricoides	7	0.3
F. hepatica	5	0.2
F. buski	7	0.3
Small intestine fluke	5	0.2
S. stercoralis	5	0.4
Hook worm	15	0.6
Total	61	2.7

Treatments: *df* = 1, SS = 212.431, MS = 212.431, *F* = 29.1475, *P* = 0.1565.

Error: *df* = 14, SS = 102.034, MS = 7.288.

Total: *df* = 15, SS = 314.464.

Table 5: Prevalence of multiple infections in children from the sampled schools

Multiple infections (combination of two or three infections)	Number of children infected	Percentage of prevalence of parasitic infections
G. lamblia	8	0.3
G. lamblia, E. nana, hook worm	8	0.3
E. histolytica, E. coli, B. hominis	7	0.3
T. trichura, hook worm, B. hominis	9	0.4
G. lamblia, E. coli, B. hominis	5	0.2
G. lamblia, E. coli, E. nana	5	0.2
G. lamblia, E. coli	6	0.2
G. lamblia, E. histolytica	11	1.5
G. lamblia, B. hominis	9	0.4
E. nana, E. coli	6	0.2
E. nana, B. hominis	5	0.2
E. histolytica, E. nana	5	0.2
Total	84	3.7

Treatments: *df* = 1, SS = 264.007, MS = 264.007, *F* = 127.7452, *P* = 0.1736.

Error: *df* = 22, SS = 45.467, MS = 2.067.

The mode and occurrence of enteric parasitic infections in children from 15 schools were analyzed according to the two categories: single infection [Tables 3,4] and multiple infections [Table 5]. There was a predominance in single infection (204 cases, *P* = 0.1506) in relation to multiple infections (84 cases, *P* = 0.1736). Of the 204 single infection cases, 143 pupils were infected with protozoa infection (*P* = 0.1506) and 61 pupils with helminths infections (*P* = 0.1565). The most frequent protozoa and helminths were *Blastocystis hominis* and hook worm, with the prevalence rates of 2.5% and 0.6%,

respectively. Others include *Entamoeba histolytica* (0.9%), *Entamoeba coli* (1.5%), *Giardia lamblia* (0.5%), *Endolimax nana* (0.8%), *T. tricihura* (0.5%), *Taenia solium* (0.2%), *A. lumbricoides* (0.3%), *Fasciola hepatica* (0.2%), *Fasciolopsis buski* (0.3%), small intestine fluke (0.2%), and *Strongyloides sterocoralis* (0.2%). Multiple infections were reported in 84 cases: triple infection in 34 cases and double infection in 42 cases with helminths and protozoa.

Discussion

The data from the sampled schools revealed that the pupils were more prevalent to enteric protozoan infections than helminths. There was no significant difference noticed between the boy and the girl children in the sampled schools. The most frequent protozoa and helminths noticed in our study were *B. hominis* and hook worm. Forty-two cases were reported with more than two cases of helminths and protozoan. Except five schools (schools G, L, K, F, and O), the sanitary conditions were completely neglected. This might be the reason for the parasitic and helminths infections.

Previously, the study[8] in Visakhapatnam noticed an overall prevalence rate of 82%. *A. lumbricoides* and hook worm were the most commonly observed parasitic infections with the prevalence rate of 75%. Moreover, the study also revealed that, of the 217 children, 177 children were infected with one or more parasitic infections. Another study in Visakhapatnam[9] observed that 92% of the sampled school children were infected with one or more soil-transmitted helminths. The most predominant parasites noticed in their study were *A. lumbricoides*, *T. trichiura*, and hook worm. In comparison with the previous studies, the prevalence ratio reduced significantly in this study. The parasites such as *A. lumbricoides* and hook worm were dominant in all the studies.

Study Limitations

This study conducted in 15 government-aided schools, which were established two decades back, presented the information on the prevalence of tropical parasitic infections in children. However, the study has not evaluated the role of specific factors that determine the prevalence, intensity, and aggregation of parasitic infections.

The possible reason for the prevalence of parasitic infections is lack of proper sanitary conditions and awareness among the children. The study concludes that periodic treatment should be given to the students once or twice a year.

Conclusion

The risk of parasitic infections was found in almost all the sampled schools. But, the intensity and type of infection varied from school to school. This study emphasizes that periodic treatment should be given to students once or twice a year. This intervention can reduce the morbidity of parasitic infections. Provision of health and hygiene components such as promotion of handwashing and improved sanitation can reduce the prevalence of parasitic infections.

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