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Original Article

Helminthic Infections in School Children in Puducherry, South India

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BACKGROUND/PURPOSE: Intestinal parasites are widely prevalent in developing countries, probably due to poor sanitation and inadequate personal hygiene. It is estimated that as much as 60% of the world's population is infected with intestinal parasites, which may play a significant role in morbidity due to intestinal infections. This study was designed to estimate the prevalence of helminthic infections among school children in Puducherry, South India.

METHODS: The prevalence of helminthic infections was studied in 1,172 children in public schools in Puducherry (Pondicherry), South India, between March and September 2006. The stools collected were concentrated using the formol–ether sedimentation technique, screened using conventional iodine and saline wet mounts, and examined by direct microscopy.

RESULTS: The prevalence of helminthic infection was found to be 34.56% in school children; *Ascaris lumbricoides* constituted 43.21% of total infections; *Ancylostoma duodenale* (hookworm), 28.89%; *Trichuris trichiura*, 10.87%; *Hymenolepis nana*, 7.66%; *Taenia* spp., 7.41%; and *Enterobius vermicularis*, 1.98%. Co-infections were also common; dual infections accounted for 8.40% and multiple infections for 2.47%, respectively, of total infection. The stool samples found to be positive for hookworm ova were further processed for culture using the Harada–Mori culture technique. Sixty-five (55.56%) hookworm ova-positive stools were found to be culture positive.

CONCLUSION: The infection prevalent in school children in this area is *Ascariasis*.

KEYWORDS: *Ascaris*, helminthic infection, hookworm, India, school children

Introduction

Intestinal parasites are widely prevalent in developing countries, probably due to poor sanitation and inadequate personal hygiene. It is estimated that as much as 60% of the world's population is infected with gut parasites, which may play a role in morbidity due to intestinal infections. Approximately 3.5 billion people are infected by intestinal parasites and around 450 million children are ill due to these infections.¹ In India, the overall prevalence rates range from 12.5% to 66%, with varying prevalence

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rates for individual parasites. About 50% of the urban population and 68% of the rural population in India is affected. High rates of infestation are seen in rural areas due to poor sanitation, contaminated water supplies and high population densities.² School children aged 5–10 years are at increased risk of helminthiasis. Helminthic infections are the main cause of loss of appetite, anemia, and malnutrition in children. The purpose of this epidemiological study was to determine the prevalence rate of intestinal helminthes in school children in the rural areas around Puducherry (Pondicherry), South India.

Methods

Data on the prevalence of helminthic diseases among school children are generally representative of the situation in the community as a whole. Therefore, our study focused on children (5–10 years of age) attending primary schools. They are the most suitable study group because schools are easily accessible, and disease occurrence is usually highest in this age group. The data collected on this age group may be used to assess the health of both children and the general community.³ We surveyed 1,172 school children from two public schools in Puducherry from March to September 2006. A detailed questionnaire was filled with the help of the children's parents. It contained four sections: (1) Sociodemographic data including age, gender, residence, education and occupation of parents, number of adults and children in the family and birth order of the child; (2) environmental factors including housing status (number of rooms and bathrooms) and water supply; (3) behavioral habits including type of toilet, hand washing (no washing/washing with only water/washing with soap); and (4) complaints including abdominal pain, lack of appetite, abdominal distention, habit of eating mud, perianal itching, teeth grinding, and history of parasitic infections.

To collect stools, children were given sterile containers the day before sampling along with comprehensive instructions. Stools were collected from the school and brought to the Department of Microbiology for further processing. Stool specimens were concentrated by formol-ether sedimentation.⁴ The concentrated stools were further processed by conventional iodine and saline wet mounting.⁵ Mounts were prepared by emulsifying a speck

of stool in a drop of iodine followed by a drop of saline. The mounts were screened under the microscope for the presence of helminth ova, and the prevalence rates of the different intestinal helminthes were estimated. Stools positive for hookworm ova were cultured using the Harada-Mori culture technique,⁶ in which approximately 0.5–1.0 g of stool was smeared on one end of a filter paper and placed carefully in a test tube containing water in such a way that the smeared area was clear of the water. One third of the filter paper was then dipped into the water in the test tube. The tube was then incubated at an ambient temperature of 26–28°C and kept under observation for 1 week. The cultured filariform larvae were concentrated by centrifugation, stained using Lugol's iodine, and observed under a microscope.

Results

The final study group comprised 1,172 children (674 males and 498 females) aged between 5 and 10 years. We collected specimens from these children and screened them for helminthic ova. The overall prevalence of helminth parasitic infection was 34.56% (405/1,172). At least one intestinal helminth was detected in 26.45% (310/1,172) of children and in 76.55% of the infected children. Dual helminthic infection was detected in 2.90% (34/1,172) of the total number of children, and in 8.40% (34/405) of the infected children. Triple infections were recorded in 0.85% (10/1,172) of the total number of children, and 2.47% (10/405) of the infected children (Table). The most common parasitic helminth was *A. lumbricoides* (43.21%; 175/405) followed by hookworm (28.89%; 117/405), *T. trichiura* (10.87%; 44/405), *Hymenolepis nana* (7.66%; 31/405), *Taenia* spp. (7.41%; 30/405) and *Enterobius vermicularis* (1.98%; 8/405). *A. lumbricoides* was found as a single infection as well as in association with other helminthes in mixed infections. Double infections included *A. lumbricoides*+hookworm (2.96%; 12/405), *A. lumbricoides*+*T. trichiura* (1.48%; 6/405), hookworm+*Taenia* spp. (1.48%; 6/405), hookworm+*T. trichiura* (0.99%; 4/405), *H. nana*+*T. trichiura* (0.99%; 4/405), and *A. lumbricoides*+*Taenia* spp. (0.49%; 2/405). Multiple infections included *A. lumbricoides*+*T. trichiura*+hookworm (0.99%; 4/405), *A. lumbricoides*+hookworm+*Taenia* spp. (0.49%; 2/405), *A. lumbricoides*+*T. trichiura*+*H. nana* (0.49%; 2/405) and *A. lumbricoides*+*H. nana*+*E. vermicularis* (0.49%; 2/405).

Table. Prevalence of intestinal helminthes in school children in Puducherry, South India and comparison of gender distribution^a

	Male (n=674)	Female (n=498)	Total (n=1,172)
Total children infected	210 (31.16)	195 (39.16)	405 (34.56)
Single infection ^b	166 (79.05)	144 (73.85)	310 (76.54)
<i>A. lumbricoides</i>	94 (44.76)	81 (41.54)	175 (43.21)
Hookworm	51 (24.29)	66 (33.85)	117 (28.89)
<i>T. trichiura</i>	27 (12.86)	17 (8.72)	44 (10.87)
<i>H. nana</i>	15 (7.14)	16 (8.21)	31 (7.66)
<i>Taenia</i> spp.	18 (8.57)	12 (6.15)	30 (7.41)
<i>E. vermicularis</i>	5 (2.38)	3 (1.54)	8 (1.98)
Dual infections ^b	18 (8.57)	16 (8.21)	34 (8.40)
<i>A. lumbricoides</i> +hookworm	8 (3.81)	4 (2.05)	12 (2.96)
<i>A. lumbricoides</i> + <i>T. trichiura</i>	3 (1.43)	3 (1.54)	6 (1.48)
<i>H. nana</i> + <i>T. trichiura</i>	2 (0.95)	2 (1.03)	4 (0.99)
Hookworm+ <i>Taenia</i> spp.	4 (1.90)	2 (1.03)	6 (1.48)
Hookworm+ <i>T. trichiura</i>	1 (0.48)	3 (1.54)	4 (0.99)
<i>A. lumbricoides</i> + <i>Taenia</i> spp.	0 (0)	2 (1.03)	2 (0.49)
Multiple infections ^b	3 (1.43)	7 (3.59)	10 (2.47)
<i>A. lumbricoides</i> + <i>T. trichiura</i> +hookworm	1 (0.48)	3 (1.54)	4 (0.99)
<i>A. lumbricoides</i> +hookworm+ <i>Taenia</i> spp.	1 (0.48)	1 (0.51)	2 (0.49)
<i>A. lumbricoides</i> + <i>T. trichiura</i> + <i>H. nana</i>	1 (0.48)	1 (0.51)	2 (0.49)
<i>A. lumbricoides</i> + <i>H. nana</i> + <i>E. vermicularis</i>	0 (0)	2 (1.03)	2 (0.49)

^aData presented as n (%); ^bpercentage of infection(s) were calculated by number of positive cases/total number of infected children.

A. lumbricoides showed the highest prevalence among both males (44.76%; 94/210) and females (41.54%; 81/195). Hookworm was more prevalent in females (33.85%; 66/195) as compared with males (24.29%; 51/210). Other helminthes had statistically similar prevalence rates in both genders. The stool samples positive for hookworm ova were cultured using the Harada-Mori culture technique⁶ and out of 117 positive specimens, 65 (55.56%) were culture-positive.

These results correlated with the clinical history taken at the time of sample collection, and most of the children infected with intestinal helminthes showed signs of abdominal pain, anemia, nail clubbing, loss of appetite and nail biting.

Discussion

Infestation by soil-transmitted helminthes is a serious public health problem in developing countries like India. It is a major cause of morbidity in school-age children, who have the highest burden of worm infestation. Some of the morbid conditions attributed to intestinal helminthiasis

are malnutrition, growth retardation, anemia, vitamin A deficiency, and impaired intellectual performance. Impairment of physical and mental development have also been identified as a deleterious effect of helminthic infection.⁷ As a result, there have been concerted efforts to control this group of diseases, especially among children who are the most vulnerable. However, knowing the prevalence of multiple infections will strengthen, or otherwise justify, the use of broad-spectrum anthelmintics in the prophylaxis and treatment of intestinal helminthes in children.⁸

Our results indicate that prevalence of helminthes infection in our area (34.56%) is in agreement with the studies conducted by Phathamvong in Vientiane Lao DPR (38.1%),⁹ Shrestha et al in Katmandu (42.5%),¹⁰ and Celik et al in Malatya (22.5%),¹¹ but lower than those reported by Le et al in rural Vietnam (92%),¹² Agbolade in Southwest Nigeria (66.2%),¹³ Dada-Adegbola et al in Africa (68.2%),⁸ Paul et al in Visakhapatnam, India (82%),¹⁴ and Naish et al (92.6%).¹⁵ However, our results are higher than those reported by Patel et al in Oman (9.4%),¹⁶ and Bansal et al in Chandigarh, North India (19.3%).¹⁷

We also found that 26.45% (310/1,172) of children were infected with at least one helminth, had dual infections in 2.90% (34/1,172), and multiple infections in 0.85% (10/1,172). The finding of Ascariasis as the most common helminthic infection is in agreement with the results of most previous studies.^{5,8,15}

In our study, the prevalence rate of *A. lumbricoides* was 43.21%, followed by hookworm (28.89%), *T. trichiura* (10.87%) and *H. nana* (7.66%). These results are lower than those reported in a study conducted in a South Indian village,¹⁵ but higher than those in a study conducted in a low socioeconomic area in Chandigarh, India.¹⁷ *A. lumbricoides* and hookworm were the most common dual infections observed in our study, which is similar to a study conducted in another rural community situated in Nigeria.⁸

Regarding dual infections, the combination of *A. lumbricoides* + hookworm had the highest prevalence (2.96%) followed by *A. lumbricoides* + *Taenia spp.* and hookworm + *Taenia spp.* (both 1.48%). Other researchers have reported similar results.^{9,11} The most frequent triple infections is *A. lumbricoides* + *T. trichiura* + hookworm (0.99%), which is in agreement with the report of Dada-Adegbola et al.⁸

A. lumbricoides was the most common helminthic parasite in both males (44.76%) and females (41.54%), followed by hookworm (24.29% in males; 33.85% in females). This may be due to the source of infection being present in the immediate area, to the frequent feco-oral spread of infection among school children, and to contamination of soil by human feces. In addition, a high degree of overcrowding and low socioeconomic level increases the susceptibility to helminthiasis. Other researchers have reported similar results.^{15,18} Hookworm infections were more prevalent in the females than males. No significant gender differences were found for other infections. These results are contrary to the studies conducted among children in Southern Sudan.¹⁹

The results of this study indicate that poor personal hygiene (such as not wearing shoes, no proper hand washing before and after eating, biting nails, improper toilet habits, poor socioeconomic conditions and a low level of education among parents) appear to be powerful determinants of infection. Implementation of short-term control measures like anti-microbial therapy, supplemented with long-term strategies like clean drinking water, adequate sanitation, and improvement in nutritional status and

health education programs, are needed to control these parasitic infections. Anthelmintic drugs were prescribed to those who were found to be positive for the helminthes. The parents of the infected school children were called for counseling and were educated about personal hygiene and the importance of washing hands, wearing shoes, and cleanliness of the household and surrounding areas. In conclusion, school health programmes including deworming and sanitation activities through the health education and improvement of sanitation conditions in the schools have a potential to better health and education for schoolchildren in this region.

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