Geographical location and age affects the incidence of parasitic infestations in school children

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ABSTRACT

Environmental factors affect the dissemination and distribution of intestinal parasites in human communities. To comprehend the prevalence of parasitic infestation and to examine whether geographical location and age also influence the prevalence of infection, fecal samples from 195 school children (rural = 95; male = 39; female = 56) (urban = 100; male = 60; female = 40) of five age groups ranging from 5 to 11 years in two different socio-economic zones (rural and urban) were screened for specific intestinal parasites using standard histological techniques. Percentage incidences of parasitic species found in fecal wet mounts and concentrates in rural children were Entamoeba coli (25.3%), Giardia lamblia (17.9%), Blastocystis hominis (14.7%), Entamoeba histolytica (4.2%), Iodamoeba butschlii (1.1%), Hymenolepis nana (1.1%) and Ascaris lumbricoides (1.1%). Whereas the percentage incidences among urban children were E. coli (26%), A. lumbricoides (21%), B. hominis (18%), G. lamblia (14%), T. trichiura (8%), I. butschlii (4%) and A. duodenale (1%). Such findings may be related to dietary differences, living conditions and the greater use of natural anti-helminthic medicinal plants in rural communities. These results are important for both epidemiological data collection and for correlating dietary differences to intestinal parasitic diseases. Aims: We chose to investigate whether geographical location and age affect the prevalence and distribution of intestinal parasites among school children from two separate regions (rural and urban) in areas surrounding, Chennai, Tamil Nadu, India. Setting and Design: A study of the prevalence of parasitic infestations was undertaken among primary school children, in rural and urban communities around Chennai, Tamil Nadu, India. Materials and Methods: Faecal sample collection, direct microscopic techniques, macroscopic examination and concentration techniques for identifying the parasites. Statistical analysis used: Percentage incidences of parasitic species found in faecal wet mounts and concentrates were done instead of statistical analyses. Results: Both macroscopic and microscopic examinations of faecal samples revealed that the overall percentage prevalence of parasitic species encountered in rural children were Entamoeba coli (25.3%), G. lamblia (17.9%), B. hominis (14.7%), Entamoeba histolytica (4.2%), I. butschlii (1.1%), H. nana (1.1%), A. lumbricoides (1.1%). The prevalence among urban children were E. coli (26%), A. lumbricoides (21%), B. hominis (18%), G. lamblia (14%), T. trichiura (8%), I. butschlii (4%) and A. duodenale (1%). Overall, comparative significant differences were noted between rural and urban children for E. histolytica (4.2 vs. 14%), G. lamblia (17.9 vs. 14%), A. lumbricoides (1.1 vs. 21%) and T. trichiura (0 vs. 8%), with the major difference being the much higher occurrence of A. lumbricoides and T. trichiura infections in urban children. Conclusions: One of the greatest challenges for healthcare professionals is the prevention and treatment of protozoal and helminthic parasitic infections. From our study we conclude that the prevalence of different pathogenic species of amoeba such as Entamoeba histolytica (4.2 vs. 0%) and G. lamblia (17.9 vs. 14%), (P value was equal to 1) was significantly higher among rural children compared to children from urban areas. In contrast, the prevalence of nematodes such as A. lumbricoides (21% vs. 1.1%), T. trichiura (8% vs. 0%) and A. duodenale (1%) was also significantly higher among rural children.

KEY WORDS: India, intestinal parasites, school children

INTRODUCTION

Over one quarter of the world’s population is most likely suffering from some form of parasitic infestation.[⁰] The prevalence of different parasitic diseases depends on environmental, social and economic factors.[¹]

Intestinal parasites can produce adverse effects on the growth and development of children, and impinge upon their nutritional status and morbidity rates.[²] In India, institutions such as schools, day-care centers, hospitals and healthcare clinics, however, are not in ideal positions to fully monitor the specific conditions that promote the appearance and spread of parasitic diseases within urban or rural populations, as these phenomena are determined by particular geographical and ecologic factors with a further contribution from the effects of the population explosion in many regions in this country.[³]

For this reason, we chose to investigate the precise nature of the environmental variables fostering the dissemination and distribution of intestinal parasites in rural [Figure 1] and urban communities
surrounding a representative city (Chennai, India) through examining the incidence of various intestinal parasite species within the primary school child populations from two separate regions of well-defined, but differing, socioeconomic status.

MATERIALS AND METHODS

Two schools were chosen on the basis of their geographical location and socioeconomic status. This study incorporated a total of 195 school children ranging in ages from 5 to 11 years. Of these, 100 children were from the urban setting (male = 60; female = 40) with the remaining 95 children from the rural community (male = 39; female = 56).

Rural areas—the children use the vast open surrounding fields for defecation.

Urban – The children use the same small areas repeatedly as there is an absence of regular toilets.

Faecal Sample Collection

Stool samples were collected from the children after procuring informed and written permission from the school and parental authorities. Other data (data regarding what food was consumed by the students, whether vegetarian or non-vegetarian; type of accommodation etc.) was acquired by verbal interview with the parents. The parents were also notified, in writing, of whether their child tested positive or negative for ova or cysts of specific parasite species. Individuals testing positive for presence of intestinal pathogenic parasites were offered treatment, which included appropriate antiparasitic drugs. Student demographic data was collated, de-identified and stored in a coded manner to ensure confidentiality. Stool samples were collected in standard, sterile fecal collection vessels.

This study was carried out after appropriate clearances from Research and Ethical committees were obtained from the institute where this study was carried out. No follow-up stool samples analysis was performed since it was beyond the scope of the project and also due to lack of funding.

Macroscopic Examination

Direct macroscopic examination of feces was performed to detect adult worms, segments of tapeworm, larvae, blood and mucus. The stool consistency (i.e. formed, soft, loose or watery) was then recorded. Color and odor of the stool were also recorded as these were additional diagnostic indicators of specific intestinal infections.

Microscopic Examination

Saline wet mounts of stool specimens were prepared to microscopically screen for worm ova or larvae, protozoal trophozoites and cysts, as well as reveal the presence of erythrocytes, leukocytes and any intestinal mucosal sloughing. Iodine wet mounts were also employed to stain glycogen granules and nuclei of specific parasite species and aid in the examination and classification of ova, cysts, trophozoites and adult worms.
Table 1: Table of the intestinal parasite species that were identified in children from the rural (a) and urban (b) areas

<table>
<thead>
<tr>
<th>Age</th>
<th>Entamoeba coli</th>
<th>Giardia lamblia</th>
<th>Blastocystis hominis</th>
<th>Entamoeba histolytica</th>
<th>Iodamoeba butschlii</th>
<th>Hymenolepis nana</th>
<th>Ascaris lumbricoides</th>
<th>Duodenalae</th>
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</thead>
<tbody>
<tr>
<td>Rural (a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>5–6 years</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>7–8 years</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>8–9 years</td>
<td>10</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
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<tr>
<td>9–10 years</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>10–11 years</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>17</td>
<td>14</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Overall percentage of experimental population positive/negative for specific parasite</td>
<td>25.3%</td>
<td>17.9%</td>
<td>14.7%</td>
<td>4.2%</td>
<td>1.1%</td>
<td>1.1%</td>
<td>1.1%</td>
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<tr>
<td>Urban (b)</td>
<td></td>
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<td></td>
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<tr>
<td>5–6 years</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<td>7–8 years</td>
<td>0</td>
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<td>3</td>
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<td>8–9 years</td>
<td>6</td>
<td>3</td>
<td>7</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>0</td>
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<td>1</td>
<td>4</td>
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<tr>
<td>10–11 years</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Total</td>
<td>26</td>
<td>14</td>
<td>18</td>
<td>14</td>
<td>8</td>
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<td>18%</td>
<td>14%</td>
<td>8%</td>
<td>4%</td>
<td>1%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Note: Some children were positive for more than one parasite species.

RESULTS

Fecal samples from 195 school children (rural = 95; male = 39; female = 56) (urban = 100; male = 60; female = 40) of five age groups varying from 5 to 11 years, in two socio-economic zones [Tables 1 and 2] were screened using saline and iodine wet mounts, a saturated saline concentration technique and light microscopy. As the lifestyle and habits of the students varied with age, they were segregated into age groups of 5–6; 7–8; 8–9; 9–10 and 10–11 years. Students below the age of 7 years had their health and hygiene needs met by either parents or guardians, whereas the older age groups were self-caring. Our data revealed a positive overall presence of parasites in rural and urban children of 62 and 54.7%, respectively. The gender-wise prevalence among the children showed that in the rural setting, 64.1% of male and 48% of female children tested positive for at least one parasitic infestation, whereas 65% of male and 57.5% of female children in the urban area were infested [Tables 1 and 2].

Both macroscopic and microscopic examinations [Figure 1] of fecal samples revealed that the overall percentage prevalence of parasite species encountered in rural children were Entamoeba coli (25.3%), Giardia lamblia (17.9%), Blastocystis hominis (14.7%), Entamoeba histolytica (4.2%), Iodamoeba butschlii (1.1%), Hymenolepis nana (1.1%), Ascaris lumbricoides (1.1%). The prevalence of parasite species in urban children were E. coli (26%), A. lumbricoides (21%), B. hominis (18%), G. lamblia (14%), T. trichiura (8%), I. butschlii (4%) and A. duodenale (1%). Overall, comparative significant differences were noted between rural and urban children for E. histolytica (4.2% vs. 0%), G. lamblia (17.9% vs. 14%), A. lumbricoides (1.1% vs. 21%) and T. trichiura (0% vs. 8%), with the major difference being the much higher occurrence of A. lumbricoides and T. trichiura infections in urban children.

DISCUSSION

Diarrhoeal disease is one of the greatest causes of childhood mortality and is responsible for over 2.2 million deaths of children under the age of five years in developing countries.[7] According to Lo and Walker,[8] diarrhoea is also the leading cause of infant morbidity with protracted cases resulting in malabsorption and malnutrition syndromes.[9] It is estimated that over 5 million people die from diarrhoea per annum, with 850 000 of these deaths occurring in India alone. Many of the diarrhoeal illnesses manifest from intestinal parasitic infestations.[10]

Our investigations are consistent with those of Fernandez et al.,[11] who also examined parasitic infestations in school children in India. They described a similar prevalence of parasitic species of G. lamblia but also reported on E. histolytica infection among urban school children, which we did not observe. We also did not find any H. nana or E. vermicularis infection in school children in the urban region.[11]

In the rural setting, our studies also revealed the percentage prevalence of G. lamblia and E. histolytica to be slightly lower than that mentioned in the study by Fernandez et al. Of greater significance was the fact that only one child in the rural setting had A. lumbricoides infestation and there were no T. trichiura and A. duodenale infestation observed.
Commensal organisms such as *Entamoeba coli* (25.3%), *B. hominis* (14.7%) and *I. butschlii* (1.1%) in the rural area, and *B. hominis* (18%) and *I. butschlii* (4%) in the urban areas were noted and appeared similar to previous studies. Moreover, Fernandez et al.\[11\] have reported that 91% of rural children and 33% of urban children were infested with at least one parasite, whereas our findings suggest 62 and 54.7%, respectively.

In the Philippines, Lee et al. reported the rate of parasitic infestation in urban areas was approximately 56% and in rural areas 92.3%.\[12\] They have also found infestation rates for *T. trichiura* (51%), *A. lumbricoides* (40%), Strongyloides species (23.4%), *I. butschlii* (15.6%), *Endolimax nana* (14.1%), *Entamoeba coli* (9.4%) and *G. lamblia* (7.8%) in inhabitants, but did not identify the geographical location. Moreover, they reported 33 cases with multiple infections (51.6%). Mixed infections with more than three parasite species (15 cases) occurred in children and adolescents living in rural areas. Their study suggested that helminthic infestations were prevalent among young children and adolescents in the Philippines.\[12\]

In contrast, our findings suggest that the occurrences of helminthic infestations in school children in rural India were significantly less than those in urban areas. Further investigations into diet, lifestyle and geographic location will enhance our understanding of infection type, and prevalence and assist in future endeavors regarding disease surveillance and childhood morbidity rates worldwide.

In rural areas, the school children use open fields for defecation, which is a common practice in India. As there is a lot of clear area, these children do not pick up the embryonated larvae, or filariform larvae and hence we do not see infestations like *A. lumbricoides* and *A. duodenale*. Unlike the rural area, there is an acute shortage of regular toilets in urban areas, as there is lack of space in these crowded urban surroundings. These children use the same areas on the road side for defecation, which is very close to where they live and hence they get re-infected with *A. lumbricoides*, *A. duodenale* and other helminthic worms. This could also be one reason for the high prevalence of *A. lumbricoides*, (21%) in the urban study group.

### CONCLUSION

In conclusion, one of the greatest challenges for healthcare professionals is the prevention and treatment of protozoal and helminthic parasitic infections. From our study we conclude that the prevalence of different pathogenic species of amoeba such as *Entamoeba histolytica* (4.2 vs. 0%), and *G. lamblia* (17.9 vs. 14%), \(P\) value was equal to 1) were significantly higher among rural children compared to children from urban areas.

In contrast, the prevalence of nematodes such as *A. lumbricoides* (21 vs. 1.1%), *T. trichiura* (8 vs. 0%) and *A. duodenale* (1%) were higher among rural children.

Our study, although a small one, in the field of surveillance of parasitic infestations, whether it be rural or urban, may assist others in the prevention and control of intestinal parasitic disease in children worldwide.

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