SOCIOECONOMIC AND BEHAVIORAL FACTORS AFFECTING THE PREVALENCE OF GEOHELMINTHS IN PRESCHOOL CHILDREN

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Abstract. The aim of this study was to examine the relationship between the prevalence of geohelminth infections in preschool children living in an urban slum area in Sri Lanka and parental education, socioeconomic status, the use of anthelmintics, and beliefs regarding these helminths. Between October 1992 and February 1993, stool samples were collected from preschool children (≤ 60 months of age) in the Mahaiyyawa area, Kandy, Sri Lanka, and examined using direct smears and a concentration technique. Stool samples which were found to be positive for helminth ova were also examined using the modified Kato-Katz technique. A pretested questionnaire was administered to the mothers or principal caretakers of the children from whom stool samples were obtained to assess parental education, socioeconomic status of the family and knowledge, attitudes and practices related to intestinal parasites, particularly geohelminths. Stool samples from 307 children were examined; 81 (26.4%) were positive for geohelminth ova. Roundworm infections predominated, and were seen in 73 of the 81 (90.1%), either alone or together with whipworm and/or hookworm infections. All infections were of mild to moderate intensity. Questionnaires were administered to the mothers/principal caretakers of 208 children. Mothers/caretakers of 91 children (45%) claimed that the child was on regular anthelmintics. As the educational level of the mother/caretaker improved, the prevalence of geohelminth infections in the children declined (chi-square for linear trend = 8.19, p = 0.004). However, there was no significant correlation between prevalence of infections and paternal educational levels. Prevalence also tended to increase as the socioeconomic class declined (chi-square for linear trend = 4.899, p = 0.026). Another finding of note in this study was the widespread ignorance and misconceptions regarding geohelminth infections among carers.

INTRODUCTION

The soil-transmitted helminths *Ascaris lumbricoides, Trichuris trichiura,* and the hookworms continue to be of importance in many tropical countries, including Sri Lanka, because of high prevalence rates (Bundy, 1994; Chan *et al* 1994a). At the same time, they are a much neglected group of infections: the availability of safe, cheap pan-anthelmintics and the resultant drop in prevalence has led to this complacence. The sector that is most affected is usually the poorest segment of the community and the associated morbidity is often covert and almost inextricably entangled with other factors linked with poverty.

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Many factors are known to influence the prevalence of these infections. Geographical and climatic factors are very important, because of the nature of their mode of transmission. Age is another factor that has been clearly shown to be related to the prevalence of geohelminth infections, either because of immunological factors, or age-related behavioral patterns. However, even within a given age group belonging to a single community living in a confined geographical area (thus living under similar environmental conditions), there can be considerable heterogeneity in the distribution of infections, especially with mild-moderated prevalence rates. While it is possible that this may be due to differences in the immune response, it is much more likely to be due to differences in behavior patterns, which are in turn affected by the socioeconomic status, education, traditional health-related practices, as well as the availability and use of health care facilities.

Both *A. lumbricoides* and *T. trichiura* infections have been shown to be aggregated in families (Chan

et al, 1994b). The prevalence of soil-transmitted helminth infections is also known to be much higher in the lower socio-economic classes than in the more affluent, with urban slums being particularly affected (Crompton and Savioli, 1993). In Malaysia, the degree of parental education has been shown to be related to the prevalence of geohelminths infections in preschool children (Kan *et al*, 1993). In Sri Lanka, however, apart from analysis of the association between prevalence and age, sex and area of residence where relevant, only one study has examined other socioeconomic and behavioral factors that may affect the prevalence of geohelminth infections (Ismail *et al*, 1989), and findings in one country, cannot always be extrapolated as being valid to another, even one in the same region.

The area in which this study was carried out is a typical urban slum: overcrowded conditions with an inadequate sewage system and water supply. Moreover, apart from the free availability of anthelmintics at a Municipal Clinic held once a week in the neighborhood, no sustained control measures had been implemented, nor had the extent of the problem of geohelminth infections in the community been assessed. Thus this study was carried out to establish the current prevalence of geohelminth infections among the preschool children in this area and to evaluate knowledge, attitudes and practices in the community with regard to geohelminthiases. This paper examines the relationship between prevalence and certain selected factors, namely, parental education, socioeconomic status, the use of anthelmintics, and beliefs regarding these helminths. The preschool age group was selected because geohelminthiases can pose serious problems in these children in terms of growth and development. Furthermore, promiscuous defecation is commonest among this age group and hence, if infected, they present the largest source of infection to the community.

MATERIALS AND METHODS

The study area (which is in Kandy, the capital of the Central Province of Sri Lanka) and the laboratory procedures used are described in an earlier paper (de Silva *et al*, 1994). The Model Tenements and Municipal Council Lines in Mahaiyyawa lie in about 4-5 acres of contiguous land within the Kandy Municipal Council (KMC) limits but function as two separate communities. The Lines were built by the Kandy Municipal Council to house it's laborers and even now, a large proportion of the occupants are unskilled manual laborers working for the KMC. The Model Tenements, on the other hand, are low cost housing units constructed by the Urban Development Authority and the occupants are a more socially heterogeneous group. The Model Tenements and the Lines together consist of about 700-800 housing units. In both areas the permanent houses are arranged in rows and are of cement and brick, with corrugated tin or tiled roofs. Many unauthorized temporary structures have also been put up in addition to the permanent structures. The compounds of some houses are cemented, but most consist of compacted earth. The water supply is through a mains system including roadside taps and tanks for public use supplied by the KMC. Water-sealed pour-flush latrines have been constructed by the KMC: the Lines are served by two complexes of approximately 25 latrines each, and two other smaller complexes, while on the Model Tenement side one outdoor latrine is shared by two-five households. However, many of the inhabitants, especially the children do not use these latrines, and feces are deposited in the open drains in the area. All preschool children ($\leq$ 60 months of age) in the area and their mothers, or in her absence, the person caring for the child on a long term basis, were considered eligible for inclusion in the study.

During the period October 1992-February 1993, stool samples were collected and examined as described earlier (de Silva *et al*, 1994) using direct smears in normal saline and the Ridley formol-ether concentration technique (Ridley and Hawgood, 1956; Allen and Ridley, 1970). Stool samples which were found to be positive for helminth ova by direct smear and/or formol-ether concentration, were also examined using the modified Kato-Katz technique (Katz *et al*, 1972; Suzuki and Sanbe, 1977). All children found to be positive for pathogenic protozoa or for geohelminths were given appropriate chemotherapy.

A questionnaire was devised to assess parental education, the socioeconomic status of the family and knowledge, attitudes and practices related to intestinal parasites, particularly geohelminths, among the mothers of preschool children in the area. The questionnaire was translated into Sinhalese and Tamil and pretested on about ten individuals. It was administered by the principal investigator and three other trained volunteers to

the mothers or principal caretakers of the children from whom stool samples were obtained.

Parental education was assessed by direct questioning regarding the highest grade attended at school. The economic status of the family was assessed on the observation of certain factors that were easily established, namely, the number of rooms in the house, the possession of a radio, television set, sewing machine, bicycle or motor vehicle and ownership of the house the family was living in (Central Bank of Ceylon, 1984). A scoring system was created based on these factors and each household was given an economic score, ranging from 0-20. Using this economic score, together with the child's father's occupation and his highest education achievement, the children were categorized as follows into one of five socioeconomic classes (Barker and Hall, 1991) for purposes of analysis.

Class I: those with fathers holding jobs which require a higher education, such as doctors, lawyers, engineers, etc, and an economic score of 19-20.

Class II: children with fathers who had attended school up to Grade 11 or 12, and who had an economic score of 12-18. Occupations such as bookkeepers, school teachers, etc.

Class III: children whose fathers had attended school upto Grades 6-10 and had an economic score of 9-11. Occupations such as petty trade, skilled labor and minor public servants.

Class IV: children whose fathers had only a primary education (Grade 1-5) and had an economic score of 5-8. Occupations such as waiters, street vendors, salesmen.

Class V: children whose fathers had had no formal education at all, and an economic score of 0-4. Mostly manual laborers.

Data were entered and analysed on Lotus 1-2-3 Version 2.1 and Epi Info Version 5.01b. Factors that could affect the prevalence of infection were considered in relation to the absence or presence of infection using the chi-square test or the chi-square test for linear trend. Where an expected figure in a cell was less than five, the Fisher exact test was used. For purposes of analysis, each child and his/her mother (or principal caretaker) was counted as a separate pair, even though there were a few instances where two or three children included in the study were of the same mother.

RESULTS

Prevalence of geohelminthiases

A total of 398 children ≤ 60 months of age were identified; stool samples were obtained from 307 (77% compliance). The mean age of these children was 28.8 months (SD 16.2) and 139 of them were males. 119 (38.7%) were from the Model Tenements while the rest were from the Municipal Council Lines. 71% of the children were Tamil, 20% Moslem and 9% Sinhalese. 81 samples (26.4%) were positive for geohelminth ova. Roundworm infections predominated, being seen in 73 of the 81 samples (90.1%), either alone or together with whipworm and/or hookworm infection (Table 1).

The roundworm egg counts varied from 130-9,953 epg feces, with 81% being < 5,000 epg feces. Whipworm egg counts ranged from 19-2,424 epg feces with 94% being < 1,000 epg feces. Hookworm egg counts ranged from 93-222 epg feces. Thus it appeared that most infections were mild, with a few of moderate intensity.

Questionnaires were administered to the mothers/principal caretakers of 208 of the children whose stools were examined. 65 (31.2%) of these children were from the Tenements and the rest (143) were from the Lines. The prevalence of geohelminth infections was significantly higher

Table 1

Prevalence of geohelminth infections in study population.

Geohelminth	count	(%)
Ascaris lumbricoides only	56	(18.2)
Trichuris trichiura only	08	(2.6)
A. lumbricoides, T. trichiura	12	(3.9)
A. lumbricoides, hookworm	03	(1.0)
A. lumbricoides, T. trichiura and hookworm	02	(0.7)
Negative for geohelminths	226	(73.6)
Total	307	(100.0)

among the children from the Lines (32.2%) than among the children from the Tenements (15.4%), (chi-square = 6.4, p = 0.011).

Maternal education

The educational level of the mothers/caretakers ranged from no formal schooling to secondary school level (General Certificate of Education, Ordinary or Advanced level). Those with no formal schooling at all accounted for 10.6% (22/208) of the overall group; all but one of them were from the Lines. When taken overall, 35 (16.8%) had only attended primary school up to Grades 1-3; 44 (21.2%) had gone up to Grade 4 or 5; 59 (28.4%) had gone up to Grade 6-8; and 46 (22.2%) had gone upto Grades 9-12. The schooling of the mothers from the Tenements was significantly better than those from the Lines (chi-square = 23.44, 4 dof, p = 0.001). As shown in Table 2, as the educational level of the mother improved, the prevalence of geohelminth infections in the children tended to decrease significantly (chi-square for linear trend = 8.19, p = 0.004). Among the children of mothers with primary schooling only, the prevalence among those in the Lines was significantly higher than in the Tenements (33/82 and 2/19 respectively, chi-square = 6.02, p = 0.01). Among the children of mothers with some secondary schooling, there was no significant difference between the prevalence rates in the Lines and the Model Tenements (13/60 and 8/45, respectively).

Paternal education

As with the mothers, the highest educational achievements of the fathers also ranged from no formal schooling to secondary school level and the fathers in the Tenements tended to be significantly better educated that their counterparts in the Lines (chi-square = 21.07, 4 dof, p = 0.0003). The prevalence of geohelminth infections when the children were categorized according to their father's education and the area of residence is shown in Table 3. Unlike with maternal education, however, the chi-square test for linear trend was not significant even when prevalence according to the father's level of education was considered separately for the Tenements and the Lines.

Socioeconomic class

There were no children of Socioeconomic class I, and only two who could be considered as being from Class II (both of them from the Tenements). There were 39, 106 and 61 children of Classes III, IV and V respectively. There was a significant difference between the Tenements and Lines in terms of socioeconomic class as well: the distribution in Socioeconomic Classes III, IV and V in the Tenements were 19, 37, and 7 respectively and in the Lines was 20, 69 and 54 (chi-square for linear trend = 21.7, p < 0.001). Table 4 shows the relationship between the socioeconomic class, the area of residence and the prevalence of geohelminths. Prevalence tended to increase significantly as the

Table 2

Prevalence of geohelminth infection according to maternal education and area of residence.

Level of schooling	Tenements		Lines		Total	
	+ve	-ve	+ve	-ve	+ve	-ve*
No schooling	0	01	11	10	11	11
Grades 1-3	0	03	11	21	11	24
Grades 4-5	02	13	11	18	13	31
Grades 6-8	05	18	08	28	13	46
Grades 9-12	03	19	05	19	08	38
Total	10	54	46	96	56	150

*chi-square for linear trend = 8.19, p = 0.004

Table 3

Prevalence of geohelminth infections in relation to educational level of father and area of residence.

Level of schooling	Tenements		Lines		Total	
	+ve	-ve	+ve	-ve	+ve	-ve
No schooling	0	01	08	06	08	07
Grades 1-3	01	02	04	09	05	11
Grades 4-5	0	07	11	22	11	29
Grades 6-8	02	16	12	35	14	51
Grades 9-12	07	29	11	25	18	54
Total	10	55	46	97	56	152

Table 4

Prevalence of geohelminth according to the area of residence and the socioeconomic status of the family.

Socioeconomic class	Tenements		Lines		Total	
	+ve	-ve	+ve	-ve	+ve	-ve*
Class I	0	0	0	0	0	0
Class II	0	02	0	0	0	02
Class III	04	15	04	16	08	31
Class IV	04	33	21	48	25	81
Class V	02	05	21	33	23	38
Total	10	55	46	97	123	153

*chi-square for linear trend = 4.899, p = 0.026

socioeconomic class declined in the overall study group: 20.5, 23.6 and 37.7% in Classes III, IV and V respectively (chi-square for linear trend = 4.899, p = 0.026). Among the children of Classes IV and V, the prevalence was significantly higher among those from the Lines than from the Tenements (42/123 and 6/44 resp, chi-square = 6.66, p = 0.009). Among children from the higher socioeconomic Classes (II and III) however, there was no difference in prevalence among children of the Lines and those of the Tenements (4/20 and 4/21 resp).

Use of anthelmintics

Treatment had been sought for 85 of the 106 (80.2%) children who had passed worms. Parents of 21 children with obvious evidence of infection (*ie* passage of worms) did not seek anthelmintic treatment though all of them were aware of the availability of drugs. Treatment was sought from a general practitioner in private practice for 53 children, from the state-run Kandy General Hospital for 15, and from the Municipal Council Clinic for eight. Anthelmintics had been obtained directly from a pharmacy for nine.

Mothers of 91children (45%) claimed that the child was on regular anthelmintics. Twenty of these children were ≤ 24 months of age (24% of the children of this age group in the study population). Of the older children, a much higher proportion (71/119, 60%) were said to be on regular anthelmintics. Most were given the anthelmintics as recommended by Western Medical Practitioners, but in the majority of cases, the mothers were unable to name the drug. Four children were given Ayurvedic or herbal preparations made at home. Among children ≥ 25 months of age, only 20/71 (28%) children on regular treatment were infected, compared with 17/48 (35%) who were not on regular treatment. This difference was not statistically significant. The mean intensity of infection was not significantly different either. As for treatment of children passing worms, regular anthelmintic treatment was obtained most often from a general practitioner (59/91). Treatment was given once in 6 months (38/91), once in 3 months (33/91) or once a year (17/91).

Beliefs regarding intestinal helminths

Most of the mothers (65%) could not name any worms, but of those who could, most had heard of roundworms (61/74), and to a lesser extent, hookworms (22/74). Mothers with some knowledge of the types of intestinal worms tended to be better educated than those who had no knowledge (chi-square for linear trend = 36.803, p < 0.001).

However, education did not necessarily have an influence on some false beliefs regarding worm infections. Eighty nine of the 208 (42.8%) mothers/principal caretakers believed that all children normally have worms in the intestine; 46 (22.1%) said that all children need not necessarily have worms; 73 (35.1%) said they did not know. Most (85.1%) thought that the presence of worms was harmful, two said that they did not cause any harm, but none believed that worms had any beneficial effect. Of those who said that worms were harmful, 103 (58.2%) said that infected children did not eat properly, 63 (35.2%) said that they suffer from abdominal pain, and a similar number (62) said that children become weak as a result.

When questioned on how they thought children acquire worm infections, 42% said that it was by eating sweets and 25% thought that it was contracted from other children; 27% said they did not know. None were aware of the relationship between contamination of soil with feces, and the spread of these helminth infections.

One hundred and three of the 208 (50.2%) mothers thought that it was possible to prevent children from getting worm infections; all of them said that it can be done through the use of drugs.

Three thought that it was not possible to prevent infection, and 97 (47.3%) were not sure. However, all those questioned said that if it was possible to prevent infection it was very important to do so.

DISCUSSION

Compared with many other urban slum areas, the prevalence of geohelminth infections among this population appears to be quite low: there was a moderately high prevalence of ascariasis with low prevalences of trichuriasis and hookworm infection. The intensity of infection was mild-moderate. It must be remembered, however, that even moderate intensities of infection may have important developmental conseqences in children (Bundy, 1994).

The higher prevalence of infection in the children living in the Lines is probably related to the fact that the inhabitants are mostly of the lowest socioeconomic class and have had only a minimal education. The finding that the prevalence of geohelminth infections was significantly related to the educational level of the mother but not to that of the father, may reflect the greater role that the mother plays in the care of the preschool child in this community. The effect of maternal education on prevalence was much more clearly seen in the Lines (where general sanitation was poorer) than in the Tenements. Kan *et al* (1993) found that the prevalence of soil-transmitted infections in preschool children in Malaysia was related to both maternal and paternal education. This highlights the point that some factors that affect prevalence may be applicable only to that particular society, thus making extrapolation from one situation to another inaccurate. In this community in Mahaiyyawa, better education of the girls in particular, would probably have a positive impact on the health of the children, with regard to infections with soil-transmitted helminthiases.

The finding that the prevalence of geohelminths decreases with increasing socioeconomic class is in agreement with many previously published reports (WHO, 1981; Crompton, 1986; Cooper, 1991; Hagel *et al*, 1993). Further analysis of the data using logistic regression with respect to these socioeconomic factors may have clarified the relative extents to which ethnic group, socioeconomic level, maternal and paternal education influence the prevalence of roundworm and whipworm infections among these preschool children, but the application of this technique was not possible because the number of children in some subgroups was too small. Similarly it was not possible to investigate the association between socioeconomic factors and intensity of infection because the great majority of infections in the study group were mild and the number of children with moderate or severe infections were too small for comparative analysis.

Mothers of 45% of the children claimed that the child was on regular anthelmintics; this rate was very low in the infants and rose to about 60% in the 3-5 years-old. However, despite this, neither the prevalence nor the intensity of roundworm infection was lower in the children said to be on regular anthelmintics compare to the children who were not. If anthelmintics are actually being used as claimed, at least the intensity of infection should be less in the treated group, as it has been shown that effective control measures bring about a significant decrease in the intensity of geohelminth infections before having a measurable impact on prevalence rates (Bundy *et al*, 1992).

Another notable fact that we found was that though anthelmintics were available free of cost from the Municipal Council Clinic (held weekly about half a kilometre away from the community) or the Kandy General Hospital (located about 3 km away), and the average economic status of the community was low, most of the inhabitants of the area preferred to obtain the services of a general practitioner. At the same time, a significant proportion of children who had passed worms were not given any anthelmintic treatment because the parents did not think it necessary, despite their knowledge of the free availability of anthelmintics. Also of note is the apparently widespread ignorance and misconceptions regarding these infections. If they are perceived as 'normal', it is evident that there will be no impetus to seek treatment, even for children who have been seen to pass worms.

The health of these preschool children, especially with regard to intestinal parasitoses, may be improved through the implementation of several measures both short-term and long-term. One measure that could be put into practice quickly and which would be of immediate benefit is the regular distribution of effective anthelmintics (mebendazole

or albendazole) to all infants over the age of six months and all preschool children, either on a door-to door basis by a Primary Health Care Worker or through the Child Welfare Clinic run by the Municipal Council. Although it will be more difficult to carry out, other important measures that should be implemented include improving sanitation (*eg* construction of latrines) and better education of females.

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