Urban helminthiasis in two socioeconomically distinct Costa Rican communities

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Abstract: A survey on the prevalence of *Ascaris lumbricoides, Trichuris trichiura* and *Hymenolepis nana* was conducted in two adjacent, but socioeconomically distinct, urban Costa Rican communities: a squatter settlement and a community with access to modern sewage facilities. The prevalence of these infections was significantly higher in the former. Although squatter children (1-14 years old) were more heavily infected with *A. lumbricoides* and *H. nana* than squatter adults, the same pattern was not observed for *T. trichiura*. The results suggest that local community-based helminthic parasite surveys may more accurately portray the actual health status of socioeconomically diverse urban populations.
Key words: *Ascaris, Trichiuris, Hymenolepis, Helminthiasis, communities.*

Intestinal parasitic infections continue to be a major medical and public health concern in developing countries in the tropics. This concern is due to the endemically high prevalence of the diseases and their deleterious effect on both the nutritional and immune status of infected individuals (World Health Organization 1981a). Although intestinal helminthiasis is usually a low grade infection, vast numbers of people are infected. The global level of parasitized people is in the hundreds of millions (World Health Organization 1981b).

The consequences of helminthic infections are not limited only to health and nutrition, but they also impinge upon the economy (Vanden-Bosschc 1984) and the quality of life in infected communities (World Health Organization 1987a). Although many developing nations have reduced the percentage of inhabitants suffering from endemic helminthiasis, repeated surveys (World Health Organization 1981c) in recent years have revealed that the number of infected people in developing nations remains the same due to the continued growth of underprivileged populations lacking basic sanitation facilities.

There is an unofficial consensus that the number of people living under marginal economic conditions in urban centers of Latin America is increasing (Khanna *et al.* 1984). However, few recent studies have documented this general impression. Although it was estimated that squatter settlements provide housing for between 10 and 20 percent of the population of many large cities in Latin America (Roberts 1979), the percentage has probably grown significantly in recent years due to a recession in the Latin Ameri-

can economy. As a consequence, urban unemployment has risen and the standard of living has fallen (Anonymous 1987).

The increased migration of people to urban centers has put stress on urban facilities and has intensified the housing scarcity. Consequently there has been an increase in squatter settlements lacking adequate sanitary facilities on the outskirts of the cities (Silva 1985). Furthermore, given that 65% of Latin Americans live in urban centers (Thompson 1985) it is clear that the number of people living under impoverished urban conditions in Latin American is significant. Studies have revealed that basic deficiencies in community sanitation compounded by low hygienic standards have contributed to the problem of soil-transmitted helminthic infections (Aggarwal *et al.* 1972, Bhandari *et al.* 1985).

Although the prevalence of soil-transmitted helminthic infections is much higher in lower socioeconomic classes, (Souza-Días 1981) relatively little is known about the socioeconomic factors that are responsible for the transmission of these infections. Parasitic disease studies predominantly focus on the biomedical aspects of disease and not on the important relationship between human behavior and the disease (Dunn 1979). In fact, most of the studies undertaken comparing the prevalence of helminthic infection in rural and urban communities have been chiefly concerned with such traditional social determinants as age and sex, (Embil *et al.* 1984. Mata *et al.* 1985. Kilpatrick *et al.* 1986) while very few have examined the prevalence of helminthiasis in different social classes between urban settings (Aggarwal *et al.* 1972, Neghme and Silva 1963). In particular, no study has compared the prevalence of soil- transmitted helminths in an urban squatter settlement with a neighboring community having modern sewage facilities.

As a developing Latin American nation, Costa Rica has made substantial progress in the area of public health (Mata *et al.* 1985). In 1980, the infant mortality rate (deaths of infants less than 1 year per 1000 live births) was 20.2 for Costa Rica compared to 42, 95 and 97 for El Salvador, Honduras, and Nicaragua, respectively (Wilkie and Lorey 1987). However, like most Latin American countries, Costa Rica has made significantly more progress in combating endemic public health problems in rural populations than in the growing urban marginal populations on the periphery of San José (Jaramillo *et al.* 1984).

The goal of the present survey was to determine whether three of the more common helminthic parasites in Costa Rica, *Ascaris lumbricoides, Trichuris trichiura* and *Hymenolepis nana,* (Mata *et al.* 1985) were more prevalent in a squatter settlement lacking basic sanitation facilities than in a nearby community having modern sewage facilities. It was expected that the prevalence of helminthic infection would be higher among squatter children (1-14 years) than among squatter adults (> 14 years) since the former are more likely to be exposed to feces-contaminated soil than are the latter.

MATERIAL AND METHODS

1. Study population

The survey was conducted between the end of March and the beginning of June, 1987. Two communities were included: a squatter community and a community with access to modern sewage facilities (Hatillo 3).

The squatter settlement is a typical urban, Costa Rican shantytown with substandard housing conditions. It is located approximately four km south of San José and approximately one km north of Hatillo 3, the second surveyed community. The shacks are of roofing metal and plywood with floors of wooden planks or earth. Although the quality of the water is considered adquate, the sewage facilities are completely deficient. Fecal contamination in the soil is rampant. Raw sewage is simply discarded into the gutters and the feces circulate throughout the community (Fig. 1). The community consists of 1,215 individuals living in 146 households on a plot of land approximately 10.000 m^2 (Alia Chavarría, Ministerio de Salud, San José, pers. com.). As a result, living conditions are severely poor.

Hatillo 3 was chosen for the study because of its proximity to the squatter settlement. Hatillo 3 constitutes one of the eight planned "model communities" collectively known as Hatillo proper. Between 1964-1971 the "Instituto Nacional de Vivienda y Urbanismo (INVU)" developed this bedroom community of San José. This planned community has a population of approximately 6,500 and a total of 1,164 modest single family cinder block dwellings. All of the families tested for intestinal helminthic parasites had access to modern sewage and water facilities.

Fig. 1. Typical latrine from the squatter settlement. The gutter (arrow) with raw sewage and the feces circulate throughout the community.

2. Specimen collection and laboratory technique

Individuals in 59 households in the squatter settlement and 46 households in Hatillo 3 were surveyed for intestinal parasites. The survey was conducted during the mornings in the squatter settlement and in the afternoons in Hatillo.

A thorough explanation of the study was given either to a child (age 1-14) or to an adult who took responsibility for the collection of fecal specimens from each member of the household. Disposable 105 ml plastic wide-mouth containers with snap-on tops and wooden tongue depressors were distributed to these persons.

A return visit was made on the following day. Since the participants in the study did not always have their specimens ready on the designated day of collection, it often required 2 or 3 consecutive days to collect the majority of the specimens from a single household. Typically 1-2 members of each household did not contribute specimens.

The specimens were fixed in 10% formalin, and then the number of eggs per gram of feces (NEPG) was calculated by the stoll method (Stoll 1923).

RESULTS

In Hatillo, 184 samples were analyzed to determine the prevalence and intensity of helminthic infection (NEPG). The population studied represents approximately 2.8% of the total population of Hatillo. In the squatter settlement, 360 samples were analyzed for NEPG, representing approximately 29.6% of the total population.

The overall prevalence of ascariasis in the squatter settlement was 15.0% while in Hatillo the prevalence was 7.6% (table 1). The prevalence of *A. lumbricoides* was approximately 21% and 6% among the children in the squatter settlement and Hatillo, respectively (table 1), and was significantly greater in the former than in the latter ($X^2 = 6.2$, $P < 0.01$, 1 df). No significant difference was found between adults in the two communities ($X^2 = 0.014$, $P > 0.9$; 1 df). In the squatter settlement, children were significantly more likely to be infected than were adults ($X^2 = 10.26$, $P < 0.01$, 1 df), although this was not the case in Hatillo $X^2 = 0.04$, $P > 0.5$; 1 df) (table 1).

The NEPG of *Ascaris* was significantly higher in the squatter settlement than in Hatillo ($X^2 = 10.06$, $P < 0.01$, Kolmogorov-Smirnov two samples test). In the squatter settlement 74% of those infected with *A. lumbricoides* had more than 100 NEPG while in Hatillo only 14% of the infected population exhibited 100 NEPG as maximun. Fifty-one percent of those infected in the squatter settlement had an NEPG higher than the maximum intensity (NEPG= 900) of infection found in Hatillo.

TABLE 1

Prevalence of intestinal helminths in the squatter settlement and Hatillo (%)

Parasite	Children (1-14 years)		Adults (15 or more years)	
	Squatter	Hatillo	Squatter	Hatillo
Ascaris	38 (21.0)	4 (6.0)	16 (8.9)	10 (8.6)
Trichuris	28 (15.5)	0	23 (12.8)	1 (0.8)
Hymenolepis	16 (8.8)	0	6 (3.4)	0
	N= 181	N= 67	N= 179	N= 117

The prevalence of trichuriasis in the squatter settlement was approximately 14.2% while in Hatillo it was approximately 0.5% (table 1). The squatter children were significantly more likely to be infected by *T. trichiura* than were the children of Hatillo ($X^2 = 11.67$, $P < 0.001$; 1 df). The same pattern was found among adults ($X^2 = 13.67$, $P < 0.001$; 1 df) (table 1). There was no significant difference between the prevalence of trichuriasis in adults and children in the squatter settlement ($X^2 = 0.49$, $P > 0.3$; 1 df) (table 1).

There were no cases of infection from *Hymenolepis nana* in Hatillo while the prevalence of hymenolepiasis was approximately 6.1% in the squatter settlement (table 1). Like ascariasis there was a significant difference in the prevalence of *H. nana* among children and adults in the squatter settlement ($X^2 = 4.73$, $P < 0.05$; 1 df) (table 1).

There was a significant difference between the two communities with respect to individuals experiencing any type of infection ($X^2 = 75.5$, $P < 0.001$; 1 df). Ninety-four percent of the individuals in Hatillo were uninfected by any of the three parasites tested, while 59% of the individuals in the squatter settlement were completely uninfected.

DISCUSSION

The hypothesis that inadequate sanitation conditions in the squatter settlement promote the transmission of helminthic parasites is supported by the significantly higher prevalence of *A. lumbricoides*, *T. trichiura* and *H. nana* in the squatter settlement than in Hatillo (table 1). Further support for this hypothesis is provided by the fact that squatter children were more infected with *A. lumbricoides* and *H. nana* than were squatter adults (table 1). In addition, the intensity of *A. lumbricoides*, as measured by NEPG, was significantly higher in the squatter settlement than in Hatillo.

High prevalence of *A. lumbricoides* and *T. trichiura* infections in urban Latin American communities have been associated with poor sanitary and living conditions (Neghme and Silva 1963). Although latrines were present in the squatter settlement, they were poorly constructed and did not provide proper containment of the feces, which are the main vehicle for the dissemination of ova (Fig. 1). As a result of sewage leakage, helminthic ova were probably highly distributed throughout the network of earthen gutters comprising the community's drainage system where they developed to the infective stage. The fact that the infestation rate in Hatillo was lower than in the squatter settlement suggests that inadequate sewage and sanitation facilities directly contribute to the higher prevalence of soil-transmitted helminthic infections (World Health Organization 1981d).

In the squatter settlement, a significantly higher prevalence of *A. lumbricoides* and *H. nana* occurred in children compared to adults. Squatter children are exposed to feces-contaminated soil to a greater extent than are adults, thereby increasing their risk of infection. Since the squatter children's play areas include the gutters, it is reasonable to assume that the children inadvertently ingest infective ova when placing contaminated objects or fingers in their mouths (geophagia). In communities with a high prevalence of soil-transmitted helminths, children who play with or handle soil are more prone to infection than are children who do not (Aggarwal *et al.* 1972). Although it is understandable that squatter children are at a higher risk of infection from *A. lumbricoides* than are squatter adults, it is unclear why the prevalence of ascariasis among adults from both communities was as high as it was, especially since adults are not only conferred with greater immunity to ascariasis (World Health Organization 1977b) but are less likely to ingest *Ascaris* ova. It is conceivable that ova-contaminated vegetables sold by local venders may play a role in elevating the prevalence of ascariasis.

As high an intensity of ascariasis infection in a community, as measured in NEPG, is associated with an elevated worm burden (Thein-Hlaing *et al.* 1984). Although unsanitary conditions are associated with a high prevalence of helminthic infection (Embil *et al.* 1984, Kilpatrick *et al.* 1986) no study has specifically examined the relationship between inadequate sanitary conditions and the intensiy of infection. In populations with a high prevalence of infection, a correspondingly high intensity of infection was also observed (Mata *et al.* 1985). This may indicate that a positive relationship may also exist between sanitary conditions and the intensity of helminthic infections. The significantly higher intensity of ascaris infections in the squatter settlemcnt compared to Hatillo suggests the important role that sewage contamination may play in the transmission of soil-transmitted helminthic infections.

Children typically are more parasitized by *T. trichiura* (Cohn and Sadun 1976) and *A. lumbricoides* (Arfaa 1984) than are adults. However, the present study reveals a different pattern. While the prevalence of *A. lumbricoides* was significantly higher in children than adults in the squatter settlement, the same pattern was not observed with *T. trichiura*. Given that less is known about the epidemiology of *T. trichiura* compared to *A. lumbricoides*, (Arfaa 1984) it is conceivable that another factor besides that of the geophagic tendency in children may account for the similar prevalences of trichuriasis among squatter children and adults.

The present study supports the untested hypothesis that disproportionately less public health progress has been made in squatter settlements than in communities with greater socioeconocmic stability (Jaramillo *et al.* 1984). Although urban populations in developing countries are comprised of extremely diverse socioeconomic communities, public health surveys concerning parasitic infections, typically disregard the role that socioeconomic conditions may play in the transmission of helminthic infections, by ignoring geographic boundaries that separate socioeconomically different urban communities. Instead, data from socioeconomically distinct, but geographically adjacent communities are tabulated together (Mata *et al.* 1985; Neghme and Silva 1963). Significant resolution is lost when data are analyzed in this way. For example, the prevalence of *T. trichiura* in the children of both communities, analized together, was 11.3%, and might lead to the erroneous conclusion that infection for this helminth is uniformly high in both communities. In fact, the actual prevalences among the squatter and Hatillo children were 15.5% and 0% respectively. Since squatter settlements typically represent relatively small pockets of underprivileged people within a larger urban environment, large-scale public health surveys will, most likely, underestimate the magnitude of the problems in these settlements. For this reason, public health attention may not be directed where it is needed most.

Although it is evident that public health standards for developing Latin American nations have been rising in recent years (Mata *et al.* 1985 and Wilkie and Lorey 1987) the present study suggests that less progress has been made in marginal urban communities than in communities that are socioeconomically more stable. Clearly, if the World Health Organization's goal for "Health for all by the year 2000" is to be realized, significantly more effort is needed to combat the threat of soil-transmitted helminths in urban squatter settlements in Latin America.

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RESUMEN

Se investigó la prevalencia de *Ascaris lumbricoides*, *Trichiuris trichiura* e *Hymenolepis nana* en dos comunidades adyacentes pero con nivel socioeconómico diferente, San José, Costa Rica. Se trató de un caserío precario con mala infraestructura sanitaria y un barrio con buenas condiciones higiénicas. El primero mostró una mayor prevalencia de las helmintiasis investigadas. El grupo etario de menores de 14 años del precario, fue más afectado por *A. lumbricoides* e *H. nana* que los adultos, patrón no observado con *T. trichiura*. Estos resultados indican la necesidad de incluir las condiciones socioeconómicas como parámetro de análisis, cuando se estudia la prevalencia de helmintiasis intestinales en comunidades urbanas, a fin de obtener un perfil de las parasitosis más realista.

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