

Prevalence and Intensity of Soil-transmitted Helminthiasis in the City of Portoviejo (Ecuador)

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*We studied the stool samples of 151 school children in a district of the city of Portoviejo (Ecuador) in order to determine the prevalence and intensity of soil-transmitted helminthiasis (STH) and their relationships with anthropometric indices. The samples were analyzed with the semiquantitative Kato-Katz technique and the intensity of infections was categorized as light, moderate or high according to the thresholds set by the World Health Organization. Prevalence of soil transmitted helminthiasis was 65% (92 out of 141 collected samples), *Ascaris lumbricoides* was the most common STH (63%) followed by *Trichuris trichiura* (10%) and hookworm (1.4%). Heavy intensity infections were found in 8.5% of the stool samples, with *T. trichiura* showing higher worm burdens than *A. lumbricoides*. Sixteen percent of the children were below the third percentile for weight (wasted), while 27% were below the third percentile for height (stunted). A significant relationship was found between the worm burden and the degree of stunting. This study suggests that the periodic administration of an antihelminthic drug should be targeted to preschool and school children to allow a normal growth spurt and prevent stunting.*

Key words: soil-transmitted helminthiasis - epidemiological survey - malnutrition - schoolchildren - Ecuador

It is estimated that more than 1 billion people in the world are infected by soil-transmitted helminths (STH) (*Ascaris lumbricoides*, *Trichuris trichiura* and hookworm) (Crompton 1999). These infections affect most frequently children in developing countries and are associated with poor growth, reduced physical activity and impaired learning ability (Stephenson et al. 1990, Nokes et al. 1992, Adams et al. 1994, Koroma et al. 1996, Stoltzfus et al. 1996). Infection can only be definitely controlled by improvement in sanitation and living conditions, but in the short term these measures can scarcely be implemented due to lack of resources.

Periodic treatment of the endemic population with a broad spectrum anti-helminthic drug has been advocated as a cheap and effective mean of reducing the worm burden and its related morbidity (Montresor et al. 1998). The World Health Organization (WHO) recommends a baseline survey in schoolchildren to determine the prevalence and intensity of infections (Montresor et al. 1998). Treat-

ment should then be given according to the results of the survey. The whole population should be treated in case of high prevalence and intensity, targeted treatment is preferred in case of high prevalence and low intensity, whilst case management is the option of choice in case of low prevalence and intensity.

Aims of the study were to compare the intensity of the infections with anthropometric indexes and to identify the recommended measures to control STH infections in an urban district of Portoviejo (Ecuador), characterized by poor living conditions and insufficient sanitary standards.

MATERIALS AND METHODS

The city of Portoviejo (about 200,000 inhabitants) is located in the coastal region of Manabí, Central Ecuador. The area is characterized by tropical climate with a rainy season lasting from November to April. The region of Manabí is very poor: 65% of the families live under the threshold of poverty (the total family income is barely sufficient to meet the basic feeding needs of its components) and 21% have the lowest income, inadequate to afford these needs. The National Health System does not provide reimbursement for medicines that are therefore purchased by families at their own expenses. Living conditions are particularly poor

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Received 22 February 2001
Accepted 16 July 2001

in the suburbs where people gather in overcrowded wooden huts completely devoid of basic sanitation and piped water supply.

A private Health Foundation located at the edge of one of these slums (district of Picoazà), with the aid of local (CA, TA and ID) and foreign doctors (PD, CJ) decided to start a deworming programme according to the guidelines of the WHO (Montresor et al. 1998) and with the supervision of one of its members (AM). In this district there are about 12,000 people and 1,600 schoolchildren attending eight primary schools. We randomly selected three schools and a sample of 151 children aged 7-11 years with the lottery method (Bennett et al. 1991). Preliminary meetings were held with the directors of the schools and representatives of the parents: the outline of the programme was explained and verbal consent was obtained from the families. The day before the survey the stool containers were distributed, the procedure of collection was clearly explained to the mothers and an educational intervention was accomplished by a trained nurse. Stool samples were collected in the mornings of three separate days and examined in the afternoons with the Kato-Katz method to quantitate the number of eggs per gram of feces (WHO 1994). In order to ensure proper identification of hookworm eggs, the preparation was read no later than 4 h after taking the samples. All the slides were read by one medical doctor specialized in parasitology and consistency of the readings was assured by second readings performed in 20% of the slides randomly selected. Intensity of infections for each worm was defined according to the thresholds proposed by the WHO Expert Committee in 1987.

The following data were collected for each child: weight, height, intensity of infection for *A. lumbricoides*, *T. trichiura* and hookworms.

Once the data were collected a single dose of mebendazole 500 mg was also given to all children of the three schools not enrolled in the study.

Anthropometric data and results of the stool examinations were analyzed according to the WHO guidelines (Montresor et al. 1998). Height and weight measurements were compared to a standard population of the same age by use of the Tanner's growth and weight charts corrected for the Latin population (Tanner & Whitehouse 1976). Statistical analysis was performed with the software package Data Analysis for Clinical Medicine (Chalmers 1988). The relationship between anthropometric data and worm burden was studied by means of linear regression analysis (Pearson's coefficient).

RESULTS

One hundred fifty one school children (72 males and 79 females) were selected for the survey. Mean

age of the children was 8.9 years \pm 1.9 SD, 59 were selected from school A, 48 from school B and 44 from school C. One hundred forty one stool samples were collected (93% returning rate). Ninety two out of 141 children (65%) were infected with soil transmitted helminths, 33 (23%) by other worms or parasites (2 *Strongyloides stercoralis* larvae, 5 *Enterobius vermicularis*, 12 *E. coli*, 25 *E. histolytica/dispar*, 9 *Giardia lamblia* and 1 *Hymenolepis nana*). Only 16 (11%) stool samples did not contain parasites. Twelve children (8.5%) were heavily infected by one or more soil transmitted helminths, while 12 had double infections and 1 a triple infection. Less than 5% discrepancy was observed between the two readers on the 20% of the slides submitted to the quality control.

Table I shows the prevalence and intensity of infections for each species of worm. There were differences both in prevalence and in intensity of infections among the three schools: 80% and 62% of the children from school A and B were infected (13% and 12% with high intensity), while 22% only of the children from school C were infected (none with high intensity).

TABLE I
Prevalence and intensity of infections

Worm	Prevalence	Mean egg (\pm SE)	High intensity
<i>Ascaris lumbricoides</i>	89/141 (63%)	13217 (\pm 1540)	7 (7.8%)
<i>Trichuris trichiura</i>	15/141 (10.6%)	7168 (\pm 1074)	5 (33%)
Hookworm	2/141 (1.4%)	4800 (\pm 960)	2 (100%)

Anthropometric measurements showed that 22 (15.6%) children were below the third percentile for weight (wasted) and 38 (27%) were below the third percentile of height (stunted). Table II shows the relationship between the intensity of infections and the degree of malnutrition. No relationship was found between intensity of infections and wasting, while children with high intensity of infections were more stunted than the other children. Linear regression analysis (Fig. 1) confirmed a significant relationship ($p < 0.05$) between total worm burden, *A. lumbricoides* burden and degree of stunting, while no relationship could be found with wasting (Fig. 2). No analysis was made for *T. trichiura* and hookworm burdens because of the small size of the infected population.

TABLE II
Relationship between intensity of infections and degree of malnutrition

	Soil-transmitted helminths				
	High intensity (12)	Middle intensity (62)	Low intensity (18)	Other parasites (33)	Normal stools (16)
< 3d centile of weight	2(17%)	8(13%)	3(17%)	6(18%)	3(19%)
< 3d centile of height	5(42%)	18(29%)	5(28%)	6(18%)	4(25%)

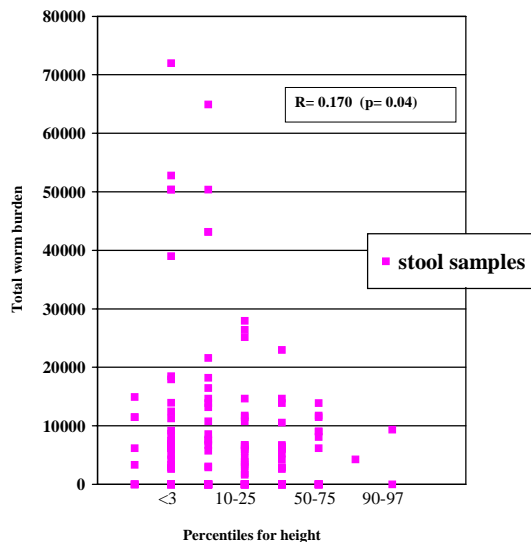


Fig 1: relationship between intensity of infections and degree of stunting (total worm burden is expressed as number of eggs/g of faeces).

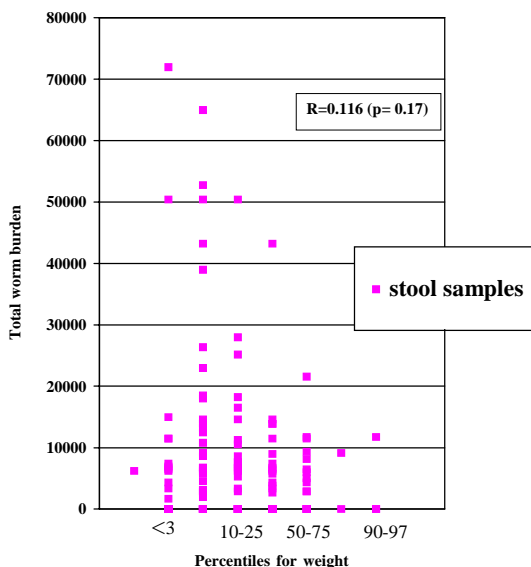


Fig 2: relationship between intensity of infections and degree of wasting (total worm burden is expressed as number of eggs/g of faeces).

DISCUSSION

The majority of the studies on the prevalence of STH have been performed in Africa and Asia, due to their wide diffusion in these continents. Among the few studies reported from South America are the recent epidemiological surveys conducted by Scolari et al. (2000) and Rocha et al. (2000) in addition to earlier studies performed in Chile and Brazil in the late seventies (Puga et al. 1980, Dias 1981, Schenone et al. 1981). The only data from the Andean countries are derived from a school based control program in an indigenous rural community of northern Ecuador (San Sebastian & Santi 2000). No data are available from the overcrowded urban settings of the coastal region of Ecuador where the problem of intestinal helminths is nevertheless considered an important issue by local health authorities.

The majority of the infections found in our survey were caused by *A. lumbricoides* while the prevalence of hookworms was very low reflecting the overcrowded urban setting where we collected the data.

On the basis of these results and according to the guidelines of the WHO we classified the community as at medium risk for STH and started a periodic treatment targeted to all the children and women of childbearing age. The overall prevalence and the percentage of high intensity infections found in our survey may however have been underestimated because the samples were taken in the middle of the dry season when the transmission is lower. In addition some of the school children may have recently received antihelminthic treatment in the county hospital or in some health clinic located in the city center and this might explain why children of school C which is nearer to the city center were found to be less infected than the others. Moreover in Ecuador occasional campaigns against intestinal parasites have started when funds were available and one of these was underway when we conducted the survey. In these programmes an antihelminthic drug is generally made available to the families demanding it in few health centers but supplies quickly run out and the people generally lack confidence on these

measures. These interfering factors must be taken into account when performing epidemiological surveys in South America and may lead either to underestimation of the risk or to falsely unequal distribution of these infections in otherwise homogeneous areas.

In our study we found a statistical significant correlation between total worm burden and degree of stunting, while no correlation was found with wasting. This could be explained by the fact that underweight represents a state of acute malnutrition that can be corrected by food while stunting is an index of chronic malnutrition. Lack of adequate nutrients caused by high intensity infections in a critical period can prevent the normal growth spurt in pre pubertal and pubertal children. The subsequent treatment of these infections and the normalization of the nutritional state cannot induce a catch up growth to correct for the deficit by that time established. The mechanism of stunting in chronic nematode infection is not known but could be mediated by a decreased spontaneous growth hormone (GH) secretion caused by poor nutritional state. Suboptimal nutrition can decrease spontaneous overnight GH secretion and blunt the GH response to GH releasing hormone (Abdenur et al. 1992). These abnormalities may represent compensatory mechanisms to energy restriction and may partly subside with the onset of puberty (Abdenur et al. 1992). Another contributing factor to growth failure is the adverse emotional and social environment existing in families with the highest worm burdens and living in very miserable conditions (Stanhope 1994).

While roughly one third of the children were found below the third percentile for height only 15% were found below the third percentile for weight. Moreover no relationship was found between degree of wasting and worm burden. This could be explained by the fact that in Ecuador a government funded programme of free school meals is operating. All the children attending our schools were receiving a high calorie, protein rich lunch and this could have prevented their starving in spite of concomitant moderate or severe nematode infections.

In conclusion our survey shows that data on prevalence of soil transmitted infections must be interpreted with caution in a South American urban setting because other control programmes and health care facilities are operating already, although largely ineffective. The most serious morbidity to be prevented is stunting and a regular, well planned treatment of pre-school and school children is to be recommended. The most vulnerable children are those not attending school or in pre-school years when a statural deficit is more likely to set in. The

results of our survey classify this community as at medium risk for STH according to the WHO guidelines (Montresor et al. 1998). We therefore started a house by house distribution of mebendazole to all women of childbearing age, pre-school and school-age children with educational interventions accomplished by volunteers of the health foundation and by medical students of the nearby university. Future treatments will be organized every 6 months and a second survey will be repeated in the same schools 3 years after the start of the drug distribution. The first aim of this programme is the reduction or disappearance of the proportion of highly infected children because this will be accompanied by decreased morbidity. If a significant reduction of these infections will be found on the second survey the distribution of mebendazole will proceed indefinitely or at least until the living conditions of the district are ameliorated. The programme was approved by the local Health Authority and is funded by an Italian partner Charity Association.

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