

INTESTINAL HELMINTH INFECTION IN AN ETHNIC MINORITY COMMUNE IN SOUTHERN VIETNAM

Le Q Hung^{1,2}, Peter J de Vries¹, Phan T Giao^{1,2}, Tran Q Binh², Nguyen V Nam³ and Piet A Kager¹

¹Division of Infectious Diseases, Tropical Medicine and AIDS, Academic Medical Center, Amsterdam, The Netherlands; ²Department of Tropical Diseases, Cho Ray Hospital, Ho Chi Minh City; ³Center for Malaria and Goiter Control, Phan Thiet, Binh Thuan Province, Vietnam

Abstract. A program to control intestinal helminth infections, based on stool surveys, mass treatment of children below 17 years, improvement of sanitation and health education was performed between 1997 and 1999 in Phan Tien, an ethnic minority community in mountainous southern Vietnam. Before intervention, 28.6% of children excreted eggs of at least one parasite, hookworm being the most common (23%), followed by *Trichuris trichiura* (1.9%), *Hymenolepis nana* (1.9%), *Enterobius vermicularis* (0.9%), *Ascaris lumbricoides* (0.5%), and multiple kinds of helminthes (0.5%). *Strongyloides stercoralis* was never detected. Poor sanitation and personal hygiene, and walking barefoot were considered the main risk factors for intestinal helminth infections. The success of 400 mg albendazole single dose mass treatment was initially frustrated by the poor quality of the drug formulation used, only containing half of the indicated amount of albendazole. Using another formulation quickly reduced the hookworm infection rate. Praziquantel was used to treat *H. nana* infections. After three years of intervention, intestinal helminth infections were reduced to 3.3% ($p < 0.0001$). We conclude that interventions combining health education, improvement of sanitation and mass treatment effectively control intestinal helminth infections, but the quality of the drugs used is an important factor.

INTRODUCTION

The successful malaria control program, initiated in 1994 in Phan Tien, a mountainous ethnic minority commune in southern Vietnam, did not reduce the prevalence of anemia in children (15%) as expected, suggesting another important cause of anemia (Hung *et al*, 2002). Intestinal helminth infections (IHI) are very common in the remote rural areas of Vietnam, associated with poor living conditions, poor sanitation, and lack of knowledge. IHI are an important cause of anemia, especially among school-age children and adolescents, who are more frequently infected and with higher parasite densities than adults (Stephenson, 1987).

Severe complications of IHI, such as severe anemia, bowel obstruction, bile duct infection, pancreatic duct infection and pancreatitis have been reported (Chen and Bo, 1997; Sandouk *et*

al, 1997) but usually IHI evolves slowly and gradually and remains asymptomatic or mildly symptomatic. Consequently, the detection and treatment of IHI are often neglected, giving way to a large burden of silent infection, especially in children. This may result in chronic anemia, reduced physical fitness and activity, impaired school performance, increased susceptibility to infection, and retarded growth in children (Dallman *et al*, 1980; Stephenson, 1987; Pollitt *et al*, 1989; Soewondo, 1995).

To assess the prevalences of infection by the different intestinal helminthes in Phan Tien, and to determine the appropriate interventions, repeated surveys were conducted from 1997 onwards.

MATERIALS AND METHODS

Population and study site

Phan Tien, an ethnic minority community, is situated in Bac Binh District, in the mountainous part of Binh Thuan Province, in southern Vietnam. In three years (April 1997-December

Correspondence: Dr Le Quoc Hung, Department of Tropical Diseases, Cho Ray Hospital, 201B Nguyen Chi Thanh Street, District 5, Ho Chi Minh City, Vietnam.
E-mail: lequochung@saigonnet.vn

ber 1999) the population increased from 907 to 1,083 subjects, by immigration and a high birth rate (3.2% per year), approximately half of the population being younger than 15 years. Subsistence agriculture and forest work, such as logging wood, was the main source of income of this commune. There was no health care facility before 1994 and no electricity before 2000.

Houses in Phan Tien are mainly made of clay walls and thatched roofs, without toilets or bathrooms. Animals and human excrements were disseminated in and around the village. Walking barefoot was common in Phan Tien, especially for infants and young children.

People and cattle shared a small river surrounding the village as their water source for consumption, washing and agricultural irrigation. The capacity of three wells, drilled in 1994 with the aid of UNICEF, was insufficient. Two of them broke down in 1996 so that many inhabitants kept consuming river water. The rainy season runs from late April through November, followed by a dry season during which the river drops to very low levels and the water becomes turbid. The ambient temperature ranges from 20° to 35°C and humidity is high.

This study comprised annually repeated stool examinations of all children younger than 17 years in Phan Tien, during an intervention program from April 1997 to December 1999. There were no exclusion criteria.

Feces examination surveys

The feces examination surveys were synchronized with malaria surveys at the end of the rainy season, but in 1997 two surveys were done, in April, at the end of the dry season, and in December, at the end of the wet season. Empty plastic containers were distributed to families with children of pre-school age. The older children received the containers at school. By checking the population registration it was ensured that all children received a container and were instructed to return a fresh stool specimen. Fresh stool samples were immediately examined by the Willis and Kato-Katz thick smear techniques (Beaver *et al*, 1984; WHO, 1992). The agar plate method was used to detect *Strongyloides stercoralis* (Arakaki *et al*, 1990). Any in-

testinal helminth infection was specified by infecting species.

Interventions

Water, sanitation and health education. In 1997, after the first survey, a safe water supply program was initiated, providing new wells as well as fixing the old wells so that 8 functioning wells were available, enough to supply the complete population with clean water. At the same time, five toilets and bathrooms were built in public places like the health post, school and office of the people's committee, as examples to be imitated by the families of Phan Tien.

Health education was done throughout the surveys with information on the benefits of wearing sandals/shoes, hand washing before meals, using clean water, maintenance of the household environment and safe storage of food. This program was practiced by teachers in the primary school, during meetings of the women's union and by the local medical staff. In addition, health personnel visited families of infected members at home. Sandals/shoes were supplied free of charge to all subjects during the surveys in December 1997 and 1998.

Medical mass treatment. Mass treatment aimed at administration of albendazole to each individual of the population of Phan Tien present at the time of the survey always included 100% of the schoolchildren. During the first mass treatment, given after the first survey in April 1997, albendazole (two tablets of 200 mg) from a local pharmaceutical company was used. The contents of the albendazole tablets were examined by standard High Performance Liquid Chromatography (HPLC) when the first mass treatment did not exerted any effect on the IHI rate. In the mass treatment campaigns of December 1997 and September 1998 a Korean product (a single tablet of 400 mg albendazole, Sudo Pharm INDCO) was used.

Hymenolepis nana infections were treated with praziquantel (50 mg/kg) during the surveys of 1998 and 1999.

Data analysis

A full registration of all inhabitants was kept and updated during each survey. The results of

each individual were entered in an electronic data base and analyzed with SPSS (version 11, SPSS Inc, Chicago, Ill). The results were expressed as a proportion (p) of the population sample studied (n); 95% confidence interval (95% CI) of the proportion was calculated with a correction for a finite total population (N) according to:

$$SE = \sqrt{p \cdot (1-p)/n} \cdot \sqrt{(N-n)/N}; (95\%CI=p \pm 1.96 \cdot SE)$$

The studied children was divided into three age groups: ≤ 5 years, 6-10 years, and 11-16 years. The Chi-square test was used to compare the rate of IHI in different surveys and different age groups. Statistical significance was accepted at a p-value < 0.05 .

RESULTS

During the first three surveys approximately 43.4, 49.7, and 38% of the children returned the container with a fresh stool sample for examination, respectively. In the last survey, when the rate of IHI had significantly dropped, only 122 (23.5%) fecal sample were collected. In all the surveys, the response rate among the children 6-10 years was the highest (from 36.1% to 60.8%).

Before intervention, in the first survey, April 1997, 28.6% (95% CI: 24.1 to 33.2) of children excreted eggs of at least one parasite, hookworm being the most common (23.0%; 95% CI: 18.8 to 27.3), followed by *Trichuris trichiura* (1.9%; 0.5 to 3.2%), *Hymenolepis nana* (1.9%; 95% CI: 0.5 to 3.2%), *Enterobius vermicularis* (0.9%; 95% CI: 0 to 1.9), *Ascaris lumbricoides* (0.5%; 95% CI: -0.2 to 1.2), and multiple types of helminthes (0.5%; 95% CI: -0.2 to 1.2). *Strongyloides stercoralis* was never found.

Hookworm also presented in most of the multiple helminthes infection cases. The infection rate was significantly more prevalent in children aged 6 - 10 years than in other ages (data not given) in the first two surveys (Fig 2). The IHI were slightly more prevalent in girls than boys in the two first surveys but this difference did not reach statistical significance.

As a result of health education, people began boiling their drinking water and some families built toilets in their compounds. People in-

creasingly used sandals and shoes, stimulated by the free distribution of sandals. In general, the sanitation in Phan Tien improved.

The quality of the albendazole used in the first mass treatment campaign was checked when no reduction in IHI was observed in the second survey (26.6%; 95% CI: 22.7 to 30.6). The albendazole formulation was examined for its content by standard analytical techniques, including high performance liquid chromatogra-

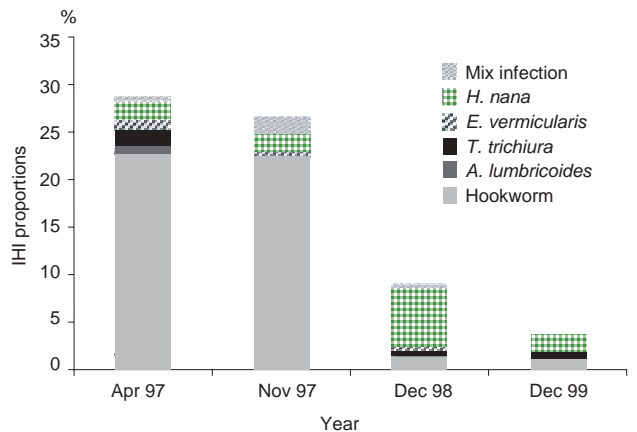


Fig 1—The proportions of intestinal helminthic infections in the children below 17 years in Phan Tien, in feces examination surveys from April 1997 to December 1999.

IHIs: Intestinal helminth infections

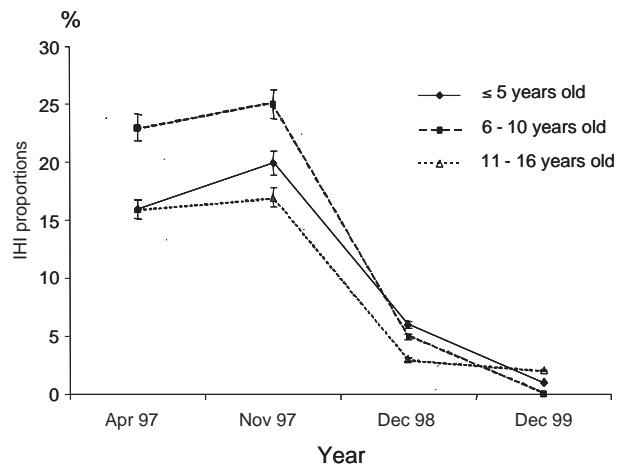


Fig 2—The intestinal helminthic infection rates of the children of Phan Tien, stratified by age groups.

IHI: Intestinal helminth infections

phy (HPLC), by the Department of Clinical Pharmacology in the Academic Medical Center in Amsterdam. The albendazole tablets contained less than half of what they should. In December 1997, 65.7% of the entire population received albendazole from the other manufacturer, and 51.4% in September 1998 (100% of all school-children on both occasions). Thereafter, the IHI rate declined rapidly, as is shown in Fig 1.

During the survey of November 1998 the IHI rate had decreased to 8.7% (95% CI: 5.6 to 11.8; $p < 0.0001$), but the infection rate for *H. nana* remained stable at 6.2% (95% CI: 3.5 to 8.8) until praziquantel was given to the infected subjects in December 1998. In December 1999 this decreased to 1.6% (95% CI: -0.3 to 3.6) in 1999. The overall IHI rate decreased to 3.3% (95% CI: 0.5 to 6.0) after three years of intervention ($\chi^2 = 20.81$, $p < 0.0001$).

DISCUSSION

A high prevalence of parasitic intestinal infections was found in children in Phan Tien, related to low standards of sanitation and walking barefoot. The highest prevalence of IHI was found in children from 6 to 10 years old, because they often play outside. Younger children are looked after more carefully by their parents and older children play less and may have more knowledge of personal hygiene.

Surprisingly, *Ascaris lumbricoides*, which is the most frequently found worm in other areas in Vietnam (Nguyen and Hoang, 2002) and worldwide (Hadju *et al*, 1995; Chai and Hongvongthong, 1998; Lee *et al*, 2002; Waikagul *et al*, 2002), was very rare in this population. This is probably explained by the habit of the ethnic minority population of Phan Tien of not cultivating vegetables which are eaten uncooked, such as lettuce, not eating raw, uncooked food and not using human excreta in agriculture.

After the first half year of interventions, the IHI prevalence had not changed. This raised a suspicion regarding the quality of the albendazole tablets made by a local pharmaceutical company. Although a compensatory increase during the rainy season could not be excluded, the first survey was performed at the end

of the dry season and the second after the rainy season, we considered the ecological conditions in Phan Tien suitable for stable soil transmission of hookworms throughout the year. It was confirmed that the tablets contained only half of the indicated dose, and when another formulation was used, the IHI rate declined rapidly. Therefore, we conclude that the lack of any effect on the prevalence of intestinal helminth infections was due to a sub-therapeutic dose of albendazole.

Mass treatment is very important for a rapid elimination of intestinal helminth infections, while health education and sanitation play a role in preventing re-infection. A previous study in northern Vietnam was exemplary: after 5 years of intervention with health education and improving personal and environmental hygiene, but without anthelmintic treatment, only a moderate decrease in *A. lumbricoides* and hookworm infections was observed (Hoang *et al*, 2001). In our study, mass treatment was not continued after the third survey in November 1998, and the IHI rate did not increase in 1999. This is consistent with the preventive role of hygienic interventions.

Therefore, mass treatment with albendazole is an essential tool for the rapid reduction of intestinal helminth infections, while other interventions, such as health education, improvement of environmental sanitation and supplying safe water, are necessary to prevent reinfection.

Albendazole is a broad-spectrum anthelmintic drug. Several community based trials have shown albendazole to be safe and effective in eradicating many parasites, but the dosing regimens applied in mass treatment campaigns have varied from a single 400 mg dose to 2,000 mg divided over five days, with subsequently variable success rates (Stephenson *et al*, 1989; Nahmais *et al*, 1991; Muenning *et al*, 1999; Paul *et al*, 1999; Oyewole *et al*, 2002). In this study, the single 400 mg albendazole dose in the second formulation was highly effective, whereas the first formulation was not. This shows that the success of mass treatment campaigns depends greatly on the quality of the formulation used. This is an important aspect to take into the total account of cost and effort invested in the control of intestinal helminth infections.

Many previous studies have shown that chemotherapy with broad-spectrum antihelminthic drugs is one of the most important strategies in helminthic control programs. Both mass treatment and selective or targeted treatment after mass screening can be applied (WHO, 1985; Bundy, 1990; Bundy *et al*, 1990; Savioli *et al*, 1992). Selective or targeted treatment may be most effective for the control of morbidity if a highly exposed group can be identified (Anderson and Medley, 1985). However, this requires mass screening first with an expert medical staff, which is not available everywhere, particularly not in remote areas in developing countries. Mass treatment can be guided by primary screening or it can also be based on extrapolating the results of helminthic surveys in similar communities. The advantage of mass treatment is that teachers, mothers and other non-health-professionals can distribute anthelmintic drugs efficiently to school age children with minimal training (Bundy and de Silva, 1998; Crompton *et al*, 2003). This saves time, human resources and finances. In this study we show that mass treatment, focusing on schoolchildren, is effective, even when coverage of the entire population is only between 50 and 60%.

Praziquantel, at a dose of 50 mg/kg of body weight (Montreson *et al*, 2001) was effective in eliminating *H. nana*. In this study we administered praziquantel only to those subjects who were infected with *H. nana* but Nahmias *et al* (1991) showed that combining a single dose of albendazole 400 mg with praziquantel (40 mg/kg body weight) in their mass treatment campaigns eradicated approximately 85% of all intestinal helminth infections. In that study, the high rates of hymenolepiasis and schistosomiasis justified the use of praziquantel for mass treatment. The current price of an albendazole 400 mg tablet is around US\$ 0.20; a praziquantel 600 mg tablet costs around US\$ 0.1. A combined regimen can be cost-effective for deworming campaigns without stool examination, especially in areas with multiple helminthic infections.

The impact of intestinal helminth infections on human health, especially in children, is well recognized. The findings in this study are most likely representative of most other ethnic minor-

ity communes in the remote areas of Vietnam. Because mass treatment of IHI with albendazole is cheap and can reduce IHI quickly over a short period of time, we suggest that this can be organized through the logistics of the malaria control program in Vietnam, which is free of charge to vulnerable and poor populations (Hung *et al*, 2002).

In conclusion, an ethnic minority commune in a mountainous area in southern Vietnam, a high prevalence of intestinal helminth infections was found. Interventions with repeated albendazole mass treatment, health education and improvement of environmental hygiene and supply of clean water were initially frustrated by poor quality of the albendazole formulation used. Replacement quickly led to a significant reduction of the IHI rate. This method can be used for other areas with similar conditions.

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