



Ascaris lumbricoides and *Trichuris trichiura* infections associated with wastewater and human excreta use in agriculture in Vietnam

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ABSTRACT

Background: We assessed the risk of helminth infections in association with the use of wastewater and excreta in agriculture in Hanam province, northern Vietnam. In two cross-sectional surveys, we obtained samples from 1,425 individuals from 453 randomly selected households. Kato-Katz thick smear and formalin-ether concentration techniques were used for helminth diagnosis in two stool samples per person. Socio-demographic and water, sanitation and hygiene related characteristics, including exposure to human and animal excreta and household wastewater management, were assessed with a questionnaire.

Results: Overall 47% of study participants were infected with any helminth (*Ascaris lumbricoides* 24%, *Trichuris trichiura* 40% and hookworm 2%). Infections with intestinal protozoa were rare (i.e. *Entamoeba histolytica* 6%, *Entamoeba coli* 2%, *Giardia lamblia* 2%, *Cryptosporidium parvum* 5% and *Cyclospora cayetanensis* 1%). People having close contact with polluted Nhue River water had a higher risk of helminth infections (odds ratio [OR] = 1.5, 95% confidence interval [CI] 1.1–2.2) and *A. lumbricoides* (OR = 2.1, 95% CI 1.4–3.2), compared with those without contact. The use of human excreta for application in the field had an increased risk for a *T. trichiura* infection (OR = 1.5, 95% CI 1.0–2.3). In contrast, tap water use in households was a protective factor against any helminth infection (i.e. *T. trichiura* OR = 0.6, 95% CI 0.4–0.9). Prevalences increased with age and males had generally lower prevalences (OR = 0.8, 95% CI 0.6–1.0), participants performing agricultural (OR = 1.5, 95% CI 1.1–2.1) and having a low educational level (OR = 1.7, 95% CI 1.2–2.4) were significantly associated with helminth infections. None of the factors related to household's sanitary condition, type of latrine, household's SES, use of animal excreta, and personal hygiene practices were statistically significant associated with helminth infection.

Conclusions: Our study suggests that in agricultural settings, direct contact with water from Nhue River and the use of human excreta as fertiliser in the fields are important risk factors for helminth infection. Daily use of clean water is likely to reduce the risk of worm infection. Deworming policies and national programs should give more attention to these agricultural at risk populations.

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1. Introduction

In agricultural production the use of wastewater and excreta is a widespread practice with a long tradition in many countries around the world [1], in particular in China, South and South East Asia as well as various settings in Africa [2–4]. The sources of irrigation water in Vietnam vary from fresh water and wastewater to ground water [5]. Nearly all rural households in north and central regions of

Vietnam use excreta as fertiliser in agriculture [6]. Wastewater and excreta have many benefits for agricultural users such as valuable and reliable water resources and nutrients, but they may have negative impacts on human health [7–9]. Most common health risks related with wastewater and excreta use are diarrhoeal diseases and soil-transmitted helminthiasis (STH) [9,10].

STH are common worldwide with more than a billion people infected [11,12]. Estimates suggest that *Ascaris lumbricoides* infects over 1 billion people, *Trichuris trichiura* 795 million, and hookworms (*Ancylostoma duodenale* and *Necator americanus*) 740 million [13]. In tropical and sub-tropical countries, distribution of STH is linked with the lack of sanitation and poverty [14,15]. In Vietnam, estimated 39.9 million (44.4%) people are infected with *A. lumbricoides*; 17.6 million (23.1%) with *T. trichiura* [16,17], and 19.8 million (22.1%) with

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hookworm [17]. High prevalence of helminth infection is found in rural areas of northern Vietnam, which is possibly related with the common use of excreta as fertiliser in the fields [18–23]; and also associated with the high population density, differences in climatic condition and humidity [24].

Prevalence of and risk factors for helminth infections have been studied in Vietnam [18,19,23,25–29]. However, only a few studies focused on the relationship between helminth infection and exposure to wastewater such as handling practices and use of wastewater and excreta in agriculture, environmental factors, and personal hygiene practices.

This study aimed at determining the prevalence of helminth infections among people living in an agricultural community, where an intensively polluted river (i.e. Nhue River) is used to irrigate fields and where human and animal excreta serve as fertiliser in agriculture and fish breeding. The main focus of the study was relative contribution of exposure to wastewater and excreta to helminth infections. Two cross-sectional studies were performed in these agricultural communities.

2. Material and methods

2.1. Study area

The study was carried out in Nhat Tan and Hoang Tay communes in Kim Bang district, Hanam province (20.32° N, 105.54° E), northern Vietnam, situated about 60 km south of Hanoi (Fig. 1). Nhat Tan and Hoang Tay communes count 10,500 (2700 households) and 5500 (1500 households) inhabitants, respectively. Most households have livestock in their compounds. The residential areas are in the vicinity of fields used for rice cultivation, vegetable planting and fish breeding. The rice fields and local ponds cover about 50% of the surface. The two communes border on the Nhue River. Hanoi City's wastewater from households, industry and other sources such as hospitals is directly and untreated discharged into the river [30]. The Nhue River water is used for crop irrigation and to feed fishponds. Several

pump stations located along the river and a system of open and closed canals distribute the water to fields and fish ponds. Wastewater from household (grey water from kitchens and bathrooms, and effluent from septic tanks and sanitation facilities) is directly discharged into the small irrigation canals.

The area has two main rice production cycles per year, one called “spring season” from January to June and the other “autumn season” from July to October. Human and animal excreta are used as fertiliser in Hanam as in many other places in northern and central Vietnam. In general, excreta from double or single vault latrines are not or partially composted. Personal protective measures to prevent contamination are often lacking.

2.2. Study design

Two cross-sectional surveys were carried out in the rainy season from July to October 2008 and in the dry season from April to June 2009. A total of 15 villages in Nhat Tan and 10 villages in Hoang Tay communes were selected to participate in the study. For each cross-sectional survey, 270 households were randomly selected from all 4282 household on the list provided by the Communal People's Committee. None of the household was selected twice. The sample size was calculated based on an 80% expected proportion of household use of wastewater in agriculture, a precision of 5% and a 95% confidence level. All household members above 12 months of age were eligible.

2.3. Data collection

Questionnaires on household and personal level with five sections were administered to all households members: (i) general demographic information and socio-economic status (SES): age, sex, educational level, occupation, household's economic status were assessed with a list of indicators which included surface of household's rice field and fish ponds, number of animals (pig, chickens, ducks, buffalos, cows, dogs and cats), housing characteristics (building materials, number of

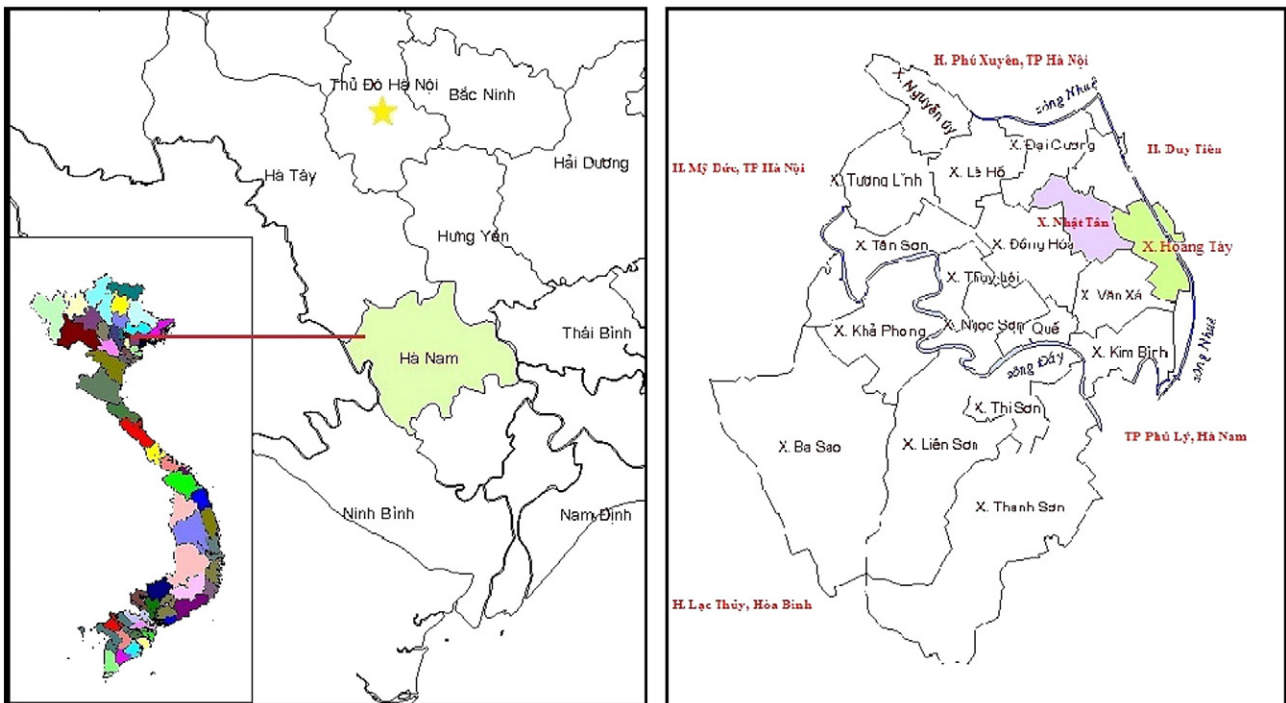


Fig. 1. Map of the study sites in Hoang Tay and Nhat Tan communes, Hanam province, northern Vietnam.

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