



Transmission of helminth eggs through hands in a high-risk community

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Background: The role that hands play in the transmission of *Ascaris* is not well understood.

Methods: A newly developed method to quantify the presence helminth eggs on hands was tested among a group of farmers in Vietnam. High turbidity in hand rinse samples meant that the adopted sugar solution had to be replaced by zinc sulphate as a flotation solution.

Results: The survey found 34% (31/90) of study participant hands were positive for helminth eggs, though concentrations were low and ranged from 0–10 eggs/2 hands. The use of fresh excreta in agriculture was the only variable that showed an association with the concentrations of eggs found on hands.

Conclusions: The results highlight the need to promote handwashing with soap to prevent the transmission of soil-transmitted helminth infections.

Keywords: Hand hygiene, Helminths, Transmission, Vietnam

Introduction

Ascariasis is a faecal-oral infection with multiple transmission routes. Produce, soil, fomites, flies and hands have all been implicated in their transmission. The relative importance of these different routes will vary from place to place, but in general is poorly understood. For example, the role of hands in transmission and the impact of handwashing with soap on the risk of *Ascaris lumbricoides* is unclear as few studies have tried to quantify the number of eggs on hands, while evidence on the impact of handwashing with soap on Ascariasis remain inconclusive.¹

This study aimed to field test a newly developed method to quantify the number of soil-transmitted helminth (STH) eggs on hands that was found to have a high (>95%) recovery under laboratory conditions.² A secondary objective was to identify key risk factors that were associated with the presence and concentration of eggs found on hands.

Methods

In a 6-week period from June to August 2013, the hands of 90 study participants in rural Vietnam were washed and analysed for the presence of helminth eggs using a standardised method. Study participants were selected through convenience sampling by visiting agricultural fields and farmsteads in two communes in Ha Nam province, approximately 70 km south of Hanoi, Vietnam. A survey into STH prevalence in a neighbouring province found over 70% of the study population to be positive for at least

one STH infection.³ The study was explained to study participants by the community healthcare worker in each of the participating communes and informed written consent was provided by every study participant. Following consent hand rinse samples were taken, between 8 and 11 am, from the left and right hands of each participant. A questionnaire exploring potential risks factors, including access to water, sanitation, hygiene, socio-economic status and agricultural practices was also completed.

Hand rinse analysis

Each hand was placed inside a polyethylene bag (sized 17 by 25 cm) with a zip lock to which 40 ml of anionic detergent 7× (1%) solution was added. Hands were then massaged through the bag for approximately 30 s. Bags were then sealed and placed in a cool box. Samples were prepared, upon return to Hanoi, approximately 3–4 hours later. Samples were decanted from the rinsing bags into 50 ml falcon tubes and centrifuged at 253 g for 7 min. The supernatant was then removed and 5 ml of sugar salt flotation solution (density 1.37) was added. The method was pre-tested and when a large proportion of the rinse samples showed a high turbidity, an additional 10 ml of flotation solution was added. When turbidity did not improve the solution was changed and standardised at 15 ml of zinc sulphate (density 1.18), as used by the modified Bailingier method for the recovery of helminth eggs from wastewater.⁴ Three samples per hand were analysed for the presence of helminth eggs using light microscopy and McMaster slides.

Data analysis

The presence and concentrations of helminth eggs on hands and the potential risk factors were explored using the statistical software package R 3.0.1 GUI 1.61 Snow Leopard (R Foundation for Statistical Computing, Vienna, Austria). Generalised linear models (GLM) were performed on questionnaire variables against the presence and concentration of eggs. Where data was not normally distributed Poisson errors were run with GLM. Linear regression was used to analyse continuous variables.

Results

Both hands of the 90 study participants were washed and analysed for the presence of helminth eggs. A total of 37 hands (20.5%; 37/180) and 31 (34%; 31/90) study participants were found to be positive for helminths, with 6 people having both hands positive for helminth eggs. Helminth egg concentrations ranged from 0 to 7 eggs per hand, and 0 to 10 eggs per individual, with the large majority (70%; 63/70) of positive hands found to contain only a single egg. The geometric mean was found to be 0.2 eggs/hand and 0.4 eggs/person, respectively. No significant difference in egg concentrations on hands was detected between the dominant and non-dominant hand.

Ascaris spp. (24/180; 13.3%) was the egg most commonly found on hands, followed by *Trichuris spp.* (10/180; 5.6%), hookworm (5/180; 2.8%) and *Taenia spp.* (1/180; 0.6%). Concentrations for *Ascaris* ranged from 0 to 9 eggs per hand, with a geometric mean of 0.13 eggs/hand. For *Trichuris spp.*, concentrations ranged from 0 to 3 eggs/hand, with a geometric mean of 0.05 eggs/hand. All five positive hand rinse samples for hookworm and the one for *Taenia spp.* contained a single egg.

Risk factors

The average age of the study participants was 48 years and over 80% were female. However, neither age nor sex showed a greater association with the presence of helminth eggs on hands.

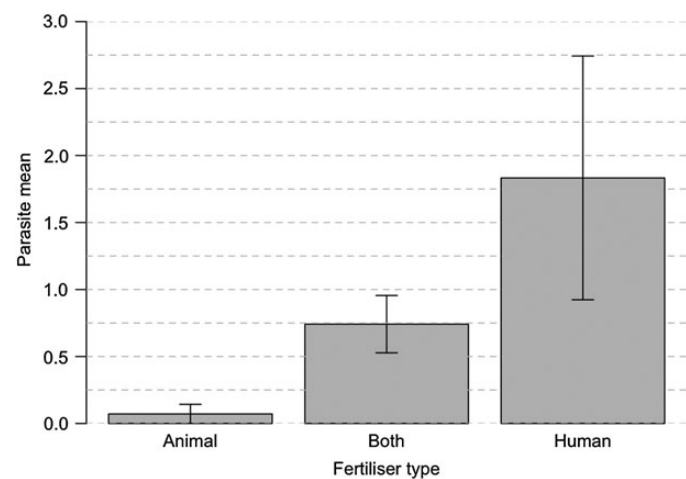


Figure 1. Helminth egg concentrations found on hands (eggs/2 hands) for type of fertilizer used in agriculture.

All study participants had an involvement in agriculture and all grew rice as the principle crop. Neither land and animal ownership, nor type of crops grown was associated with helminth contamination on hands. The only agricultural activity that showed a borderline association ($p < 0.05$) with helminth eggs on hands was the use of human excreta in agriculture (Figure 1).

Household size, number of children and type of water supply showed no association. While almost all households had a private latrine, many admitted that they practice open defecation while working in their fields. Self-reported handwashing with soap was low (29%; 26/90) and showed no association with either the presence or concentration of helminth eggs on hands.

Discussion

The main aim of this survey was to test the newly developed hand rinse method for the detection of helminth eggs on hands under field-conditions, away from the controlled conditions within the laboratory. The hand rinse method was developed and tested by seeding hands with a high number of freshly shed *Ascaris suum* eggs (1000 eggs). Under field-conditions, it was able to detect low concentrations of *Ascaris spp.*, *Trichuris spp.*, hookworm and *Taenia spp.* eggs on hands. The only adaptation that we made to the method used in the laboratory was that 15 ml of zinc sulphate was added to the centrifuged sample, as opposed to the sugar solution. This was because dirt on washed hands had made the hand rinse samples more turbid, thus making eggs more difficult to identify.

Farmers in northern Vietnam were selected as past studies on helminth infections had shown that high burdens of infection were due to the common use of fresh excreta in agriculture.⁵ The use of excreta was the only significant factor associated with helminth eggs on hands, though given the limited sample size of this survey, it is impossible to draw conclusions regarding the lack of association with known risks factors for helminth infections like open defecation, lack of hygiene and poor socio-economic status. This survey found a high proportion (34%) of farmers in rural areas of North Vietnam with helminth eggs on their hands. Few studies have looked at the role of hands in the transmission of *Ascaris* and to our knowledge only a study conducted in Tajikistan reported the prevalence of eggs on hands. This study found an even higher prevalence of helminth eggs on hands, with 48% of children aged 1 to 8 years were found positive for eggs on their hands.⁶ However, this study did not specify the concentration or types of helminths.

Our study had limitations in that the relatively small size did not allow us to explore in-depth what other risk factors might be associated with contaminated hands, and further travel time to the laboratory did not allow us to sample at different times of day, which is likely also associated with levels of hand contamination.

A single helminth egg could in principle cause an infection or could add to a higher intensity of infection. Therefore, the concentrations found on farmers' hands, in our study, pose a serious risk to both farmers and their family's health. The use of fresh excreta in agriculture in China and Vietnam is an ancient and widespread practice that provides a cheap and sought-after fertilizer.⁷ It is a practice that is unlikely to disappear anytime soon and these

results stress the need for risk-mitigation interventions. The role that improved hygiene and handwashing with soap could play in the control of helminth infections and transmission should be further investigated.

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Authors' contributions: FG, VAN and JHJE designed the study; AJ developed and tested the method; FG and HAD collected and analysed the data; FG, AJ, VAN, HAD and JHJE were involved in writing the paper. All authors have read and approved the final manuscript. JHJE is the guarantor of the paper.

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