University of Wollongong
Research Online

Faculty of Social Sciences - Papers (Archive) Faculty of Arts, Social Sciences & Humanities

2016

Evaluation of a broadly-based control model of fascioliasis (liver fluke) in central Vietnam

T M. Quy
Institute of Malariology-Parasitology and Entomology

Heather Yeatman
University of Wollongong, hyeatman@uow.edu.au

Follow this and additional works at: https://ro.uow.edu.au/sspapers

Part of the Education Commons, and the Social and Behavioral Sciences Commons

Research Online is the open access institutional repository for the University of Wollongong. For further information contact the UOW Library: research-pubs@uow.edu.au

Evaluation of a broadly-based control model of fascioliasis (liver fluke) in central Vietnam

Abstract

Fascioliasis (liver fluke) has raised significant public health concerns in the 15 regional provinces of Central Vietnam. However, comprehensive strategies for fascioliasis control are not in place with reliance on chemotherapy as the main control measure. This study implemented a broadly-based control model comprising of five main components: vector control, health education, improvement of local health systems, involvement of concerned bodies, and chemotherapy. Following the intervention, significant reductions in seroprevalence (4.2% vs. 8.8%, p<0.05) was found in the Intervention 1 commune (broadly-based model), but not in the Intervention 2 commune (model comprising of human chemotherapy and animal chemoprevention) or the Control commune (Control commune, human chemotherapy only). Improvements in knowledge and practice of fascioliasis control were found in the intervention communes 1 and 2, although there remained significant differences in the levels of awareness in these two cohorts (80.2% vs. 37.5% respectively, p <0.017). Considerable changes in practices were found in the Intervention 1 commune with all poor practice items reduced significantly in comparison with the baseline level (p<0.017). Findings in this study also supported the effectiveness of the recommended chemotherapy (triclabendazole 250mg, 10mg/kg body weight) for selective treatment of fascioliasis. Having established the effectiveness of the broadly-based control model, it is important to explore the factors that enable, or act to impede, the implementation of a broadly based control model.

Keywords

broadly, control, model, fascioliasis, evaluation, liver, vietnam, fluke, central

Disciplines

Education | Social and Behavioral Sciences

Publication Details

Quy, T. M. & Yeatman, H. (2016). Evaluation of a broadly-based control model of fascioliasis (liver fluke) in central Vietnam. Vietnam Journal of Public Health, 4 (1), 40-52.

This journal article is available at Research Online: https://ro.uow.edu.au/sspapers/2406

ORIGINAL RESEARCH

EVALUATION OF A BROADLY-BASED CONTROL MODEL OF FASCIOLIASIS (LIVER FLUKE) IN CENTRAL VIETNAM

Tran Minh Quy[1*], Heather Yeatman[2, 3]

ABSTRACT

Fascioliasis (liver fluke) has raised significant public health concerns in the 15 regional provinces of Central Vietnam. However, comprehensive strategies for fascioliasis control are not in place with reliance on chemotherapy as the main control measure. This study implemented a broadly-based control model comprising of five main components: vector control, health education, improvement of local health systems, involvement of concerned bodies, and chemotherapy. Following the intervention, significant reductions in seroprevalence (4.2% vs. 8.8%, p<0.05) was found in the Intervention 1 commune (broadly-based model), but not in the Intervention 2 commune (model comprising of human chemotherapy and animal chemoprevention) or the Control commune (Control commune, human chemotherapy only). Improvements in knowledge and practice of fascioliasis control were found in the intervention communes 1 and 2, although there remained significant differences in the levels of awareness in these two cohorts (80.2% vs. 37.5% respectively, p <0.017). Considerable changes in practices were found in the Intervention 1 commune with all poor practice items reduced significantly in comparison with the baseline level (p<0.017). Findings in this study also supported the effectiveness of the recommended chemotherapy (triclabendazole 250mg, 10mg/kg body weight) for selective treatment of fascioliasis. Having established the effectiveness of the broadly-based control model, it is important to explore the factors that enable, or act to impede, the implementation of a broadly based control model.

***Keywords**: broadly-based; Central Vietnam, chemotherapy; control; fascioliasis; risk factors; seroprevalence*

1 Tran Minh Quy, Institute of Malariology-Parasitology and Entomology, Quy Nhon, Vietnam

2 Public & Population Health, Public Health Association of Australia

3 School of Health & Society, University of Wollongong, Australia

* **Corresponding author:** Tran Minh Quy, Institute of Malariology-Parasitology and Entomology, Quy Nhon, Vietnam.
Email: tminhquy@yahoo.com

INTRODUCTION

Fascioliasis (liver fluke) is listed as one of the most important parasitic infections in humans and animals in the developing world, posing a considerable burden to human public health and veterinary health globally[1]. In Vietnam, the prevalence of fascioliasis has increased rapidly since the beginning of the 21st century and it has become a zoonosis of great public health importance, with Central Vietnam being most severely hit by the disease[2].

Baseline surveys of three adult cohorts in two central provinces of Vietnam indicated that fascioliasis was prevalent at high levels and that the communities were mainly ignorant of the disease and how to prevent infection[3]. The surveys reported the overall prevalence of fascioliasis as 7.75% of the study population, a higher rate than reported in previous studies. In addition, knowledge of fascioliasis in the study population was low and their long-existing practices of living and raising animals exposed them to potential fascioliasis infection.

To date, strategies for fascioliasis control rely on chemotherapy with triclabendazole (TCZ), recommended by the WHO as the drug of choice for the treatment of both acute and chronic fascioliasis in humans[4]. However, TCZ resistance has been reported in animals and in humans[5]. Although alternative fascioliasis control measures are recommended elsewhere, no typical example has been proven to be effective in practice[6,7]. Furthermore, various models of food-borne trematode infection control have been introduced and tested for their effectiveness but none of them are complete and applicable to all situations[8].

A broadly-based intervention model (Figure 1), selectively adapted from the trial control model of fascioliasis by Nguyen et al.[8] and the intervention model by Molyneux[9], was implemented to control fascioliasis in Central Vietnam. It comprised of five main components: vector control, health education, improvement of local health systems, involvement of concerned bodies, and chemotherapy. The effectiveness of the new model was evaluated following implementation.

MATERIALS AND METHODS

Implementation of the broadly-based control model of fascioliasis in Central Vietnam.

The intervention measures were undertaken from June to December 2013 in Nhon Hau and Nhon Thanh communes (An Nhon town-Binh Dinh province) and Tinh Giang commune (Son Tinh district-Quang Ngai province) in Central Vietnam, previously selected for baseline surveys[3]. The selection of the actual communes in the two different provinces was based on the convenience of accessibility (transports, health system facilities, and engagement of local authority), and site distance (control commune away from the influences of the intervention communes). Intentionally, the Intervention 1 commune received all of the broadly-based intervention measures of fascioliasis control, including chemotherapy, improvement of the health system activities, health education, co-ordination of related bodies, and vector control. The Intervention 2 commune received chemotherapy for humans and animals. Human chemotherapy was the only control measure applied to the control community.

Chemotherapy/chemoprevention

Chemotherapy with triclabendazole (TCZ) 250 mg was applied to 125 (100%) seropositive human cases of fascioliasis in the three studied communes and manifestations of signs and symptoms were recorded. The infected participants were monitored over seven days post-treatment to record and manage any side effects: at Day 1 (one day after treatment) and Day 7 (seven days after treatment)[4]. They then had their blood re-examined after 6 months (in November, 2013) and 12 months (in April, 2014), with repeat treatment if their results remained positive to fascioliasis. Animal chemoprevention was applied in the Intervention 1 and 2 communes, together with vitamins and other supplementary medication to increase the cattle's immunity and to fight against diseases.

Improvement of quality of health care network

Training courses were given to local health staff and other involved stakeholders in the Intervention 1 commune to improve their skills and knowledge of fascioliasis control activities. In addition, the participants were trained in techniques of health education and promotion such as group communication, household visits, informal communication at other events, and strategies to incorporate health communication in other communal health meetings. The training was followed by monitoring and evaluation trips by the researcher on a monthly basis to the villages to observe the stakeholders fascioliasis control activities. Feedback on the fascioliasis control activities was communicated back to the village health volunteers to aid improvement.

Health education

Health communication activities were conducted separately in school and community locations. At the communal Secondary Schoo[l], the "message about fascioliasis control", which contained information on the causes of, damage caused by and control measures for fascioliasis, was regularly read by the headmaster of the school at the Monday flag salute. The homeroom teachers also updated the students' awareness during the common weekend class periods. Leaflets containing reminders such as "do not eat raw vegetables", or "do not drink freshwater from rivers or canals", "drink boiled water", and "wash hands before meals or after toileting" were distributed to students for health education at their homes.

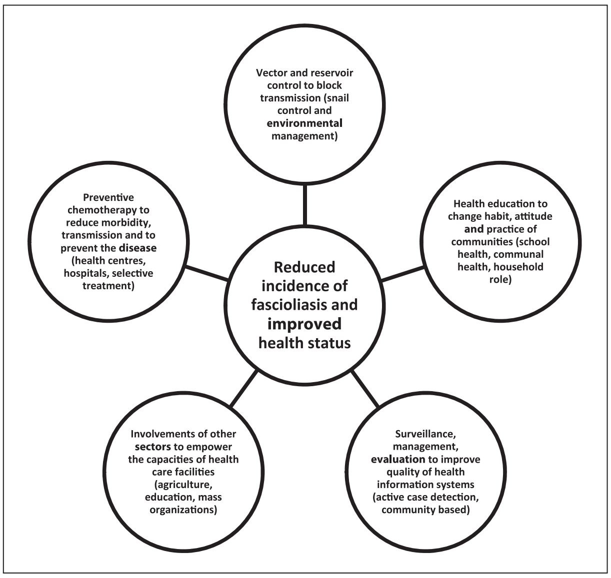

Figure 1. Components of interventions against fascioliasis, adapted from Control of human parasitic diseases: context and overview[9]

At the community level, weekly household visits were regularly conducted by village health volunteers, together with community meetings by teams of representatives from the communal local authorities, health, veterinary, educational, and social organizations. Billboards depicting the problems of fascioliasis and appropriate control measures were erected in front of the communal health station, village administration offices and markets to draw the attention of the community. Finally, information about fascioliasis control was read twice on the broadcasting systems installed in every village, which aimed to gain the community's attention.

Involvement of concerned sectors

Multidisciplinary collaborations among the health, agricultural and educational sectors, under the overall leadership of the local authority, were implemented to empower the capacity of the broader local health network. The aim of this collaborative approach was to increase awareness of the stakeholders, as well as the affected populations, of the disease burden. Human and veterinary public health intervention measures conducted by the health and agricultural sectors included health education campaigns, household visits, and community meetings, as previously described. Mutual commitments between the health and education sectors facilitated stronger involvement of the school-teachers and students in the fascioliasis control activities, resulting in jointly conducted environmental cleaning activities such as collecting animal waste and garbage, cleaning streams and canals, and releasing fish into water sources for killing snails.

Intersectoral efforts included the participation of the local authority and other related bodies such as the social-cultural sector and social organizations. The engagement of the communal people's committee representatives with their important 'gate-keeping' roles facilitated and increased public awareness of fascioliasis. Members of the communal and village women's associations participated in the fascioliasis education program, alongside undertaking their other responsibilities for maternal health promotion and family planning. This strategy aimed to increase women's awareness of fascioliasis and promote the practises of safe vegetable treatment and food preparation to avoid infection of Fasciola.

Vector control

Combined grazing, feeding and environmental management activities, which served as the vector and reservoir control measures were undertaken to reduce the risks of animal fascioliasis infection. Free grazing husbandry was practised by most cattle raising households in Central Vietnam. Animal health education was implemented monthly by veterinary staff to encourage farmers to practise zero-grazing, which provided a steady and important source of income to the smallholders, through increased milk productivity and avoidance of diseases from the outside environment. Farmers were instructed on good nutrition for their cattle, and advised to regularly clean animal shelters to minimise the effects of lameness and leg injury that can result from increased shelter-based husbandry. Farmers were also encouraged to construct sanitary drenches close to cattle shelters to store and decompose the dung and waste from animals, in order to prevent the transmission of eggs to proximal areas.

Regular de-worming of cattle is the best of the animal husbandry solutions for controlling fascioliasis. Between July and August (before the rainy season in Central Vietnam, which starts from September)[10], about 650/1,621 (40.1%) cattle in 210/534 (39.3%) cattle-raising households in the Intervention 1 commune, and 469/1,398 (33.5%) cattle in 189/561 (33.7%) households in Intervention 2 commune were de-wormed with Dertyl B 300mg, 6mg/kg body weight, a commonly-used anthelminthic drug proposed for prophylaxis of animal fascioliasis in Central Vietnam[11].

Data collection and analysis

The follow-up study was undertaken in Nhon Hau and Nhon Thanh communes (An Nhon town-Binh Dinh province) and Tinh Giang commune (Son Tinh district-Quang Ngai province) in Central Vietnam between October and December 2013. Results were compared with those in the previous surveys to assess the outcomes of the intervention. Similar to the baseline surveys[3], a cross-sectional descriptive design comprising human blood survey and knowledge, attitudes and practices (KAP) survey was applied in this study. In each commune, randomly-selected 500 adults (aged from 18 years old) had their blood samples examined (ELISA) and 600 randomly selected adults (household representatives) were involved in the KAP survey on fascioliasis.

The seroprevalence of fascioliasis in three communities was determined by laboratory-based blood ELISA and comparing the eosinophilia counts with the guidelines of diagnosis and treatment of fascioliasis by the Ministry of Health, Vietnam[12]. Determining the prevalence of fascioliasis in the community settings can be based on either of two main diagnostic methods: the classical coprology and serology[4]. In this study, serological ELISA (Enzyme-Linked Immunosorbent Assay) was used to indirectly detect the antibodies specific to *Fasciola spp.* (IgG) in human sera. This study used the test kits (FASCELISA), specific for *F.gigantica* infection, which were produced and distributed by the Viet Sinh Chemical Producing & Trading Co., Ltd (formerly the Faculty of Pharmacy-Ho chi minh City University of Medicine and Pharmacy-Vietnam). The test kits were previously proven to have high sensitivity and specificity[13], and the protocol had been approved for use by the Ministry of Health.

The blood samples were used for ELISA to identify if a person was infected with fascioliasis and for eosinophilia evaluation as a supplementary indicator of positive case[12]. The results of the assays were calculated by dividing the optical density (OD) reading of each sample well of the plate by the cut-off value (determined by the mean OD negative controls plus 3 standard deviations). Any result from 1.0 was considered positive, and results less than 1.0 were recorded as negative[13].

RESULTS

Prevalence of fascioliasis in the studied cohorts after intervention – compared with the baseline level.

The findings of ELISA blood surveys in three communes after the implementation of the broadly-based control model of fascioliasis (from June to December 2013 and April 2014 for chemotherapy) were compared with those in the previous surveys to assess the outcomes of the intervention. The seroprevalence in the three cohorts were 4.2% in the Intervention 1 commune (broadly-based model), 5.4% in the Intervention 2 commune (model comprising human chemotherapy and animal chemoprevention) and 6.4% in the Control commune (Control commune, human chemotherapy only). In comparison with the baseline surveys, a significant difference ($p<0.05$) in infection prevalence was found in the Intervention 1 commune, which received the broadly-based control model for fascioliasis, while the differences were not significant in the two other communes ($p>0.05$).

Similar to the baseline surveys, more females than males attended the follow-up blood tests, but the infection rates were not significantly different between the two genders in the three cohorts. However, compared with the baseline surveys, significant reductions ($p<0.05$) were reported in women of the Intervention 1 commune and men from the Intervention 2 commune, the two communes applying more intervention measures in comparison with the Control commune. No significant difference based on gender ($p>0.05$) was found among the combined three cohorts post intervention compared with baseline.

Differences in fascioliasis seroprevalence were also found with regard to certain age ranges. A significantly decreased ($p<0.05$) prevalence of infection was displayed in participants aged from 40-49 years in the two Intervention communes, and from 50-59 years in the Intervention 1 commune. Non-significant increases in infection were found among participants aged from 18-29 years.

With regard to educational levels, the only significant change in infection rates was found in the Intervention 1 commune, where the number of infected people with lower educational backgrounds was reduced by more than half ($p<0.05$). No significant differences were found in the prevalence among the groups with higher educational backgrounds, or in the overall prevalence by educational background in each of compared communes.

Compared with the baseline survey, the follow-up prevalence of fascioliasis was significantly reduced by more than half ($p<0.05$) in Intervention 1 farmers, while no significant differences for farmers infected with the disease were found in the other two communes ($p>0.05$). Farmers remained the group with the highest proportion of fascioliasis infection cases, but no significant differences ($p>0.05$) were found in comparison with other occupational groups.

Effectiveness of chemotherapy on seropositive cases of fascioliasis

Overall, the serological ELISA results showed a reduction over the 12 months of follow-ups, which correlated with the decreased eosinophilia in the seropositive participants of fascioliasis (Table 1).

In the baseline blood survey, the serological ELISA results following the treatment with triclabendazole (at 10mg/kg of body weight) were significantly reduced after six months and twelve months among seropositive participants in all three communes. Similarly, the follow-up surveys indicated the same results as significant reductions were shown in the ELISA antibodies of the treated seropositive participants after 6 months (December 2013) and after one year (April 2014) from the start of the chemotherapy (June 2013). This is an important result that might linked to other interrelated intervention measures in the model (Figure 1) concurrently conducted to prevent the reinfection of fascioliasis. The significantly reduced ELISA antibodies also correlated with decreased eosinophilia among the seropositive participants receiving the treatment of the medication, which were also significantly different after one year following the chemotherapy with triclabendazole. All of the initially seropositive participants were diagnosed as negative at follow up, which

Table 1 Changed seroprevalence and laboratory examination of fascioliasis in three cohorts after the implementation of intervention measures

Characteristics	Intervention 1 commune			Intervention 2 commune			Control commune		
	Baseline	Follow-up	p	Baseline	Follow-up	p	Baseline	Follow-up	p
	Number/total (%)	Number/total (%)		Number/total (%)	Number/total (%)		Number/total (%)	Number/total (%)	
Infected cases	47/535 (8.8)	21/500 (4.2)	<0.05	44/522 (8.4)	27/500 (5.4)	NS	34/555 (6.1)	32/500 (6.4)	NS
Gender									
Males	15/180 (8.3)	7/169 (4.1)	NS	21/216 (9.7)	7/168 (4.2)	<0.05	16/221 (7.2)	15/209 (7.2)	NS
Females	32/357 (9.0)	14/331 (4.2)	<0.05	23/306 (7.5)	20/332 (6.0)	NS	18/334 (5.4)	17/291 (5.8)	NS
Age (mean±SD)	(47.7±12.1)	(45.4±10.9)		(44.8±12.5)	(43.7±11.4)		(46.2±13.2)	(45.2±12.7)	
40-49 years	13/152 (8.6)	4/159 (2.5)	<0.05	20/120 (16.7)	8/172 (4.7)	<0.05	9/141 (6.4)	7/147 (4.8)	NS
50-59 years	18/148 (12.2)	8/147 (5.4)	<0.05	9/157 (5.7)	7/114 (6.1)	NS	11/145 (7.6)	8/120 (6.7)	NS
Education level									
Secondary & under	42/417 (10.1)	17/407 (4.2)	<0.05	34/365 (9.4)	20/366 (5.5)	NS	25/402 (6.2)	24/375 (6.4)	NS
High school & above	5/118 (4.2)	4/93 (4.3)	NS	10/157 (6.4)	7/134 (5.2)	NS	9/153 (5.9)	8/125 (6.4)	NS
Occupation									
Farmers	34/342 (9.9)	18/430 (4.2)	<0.05	31/313 (9.9)	24/400 (6.0)	NS	20/300 (6.7)	24/353 (6.8)	NS
Others	13/193 (6.7)	3/70 (4.3)	NS	13/209 (6.2)	4/100 (4.0)	NS	14/255 (5.5)	8/147 (5.4)	NS

Characteristics	Baseline survey (n=125)			Follow-up survey (n=80)		
	Before treatment	After 6 months	After one year	Before treatment	After 6 months	After one year
Ab-ELISA (+)	125 (100%)	9 (-92.8%)	0 (-100%)	80	13 (-85.0%)	0 (-100%)
Mean (SD) *SE Mean*	1.1(0.1) 0.01	0.59 (0.26) 0.02	0.22(0.12) 0.01	1.14 (0.14) 0.02	0.72 (0.22) 0.03	0.36 (0.11) 0.01
t-test, p^2		t: 25.6, p <0.001	t: 19.6, p<0.001		t: 29.2, p<0.001	t: 29.1, p<0.001
Eosinophilia (≥8.0%)	70 (56.0%)	17 (13.6%)	0	52 (65.0)	17 (21.25%)	0
Mean (SD)	8.19 (3.33)	3.84 (2.52)	2.64 (1.54)	9.33 (3.96)	6.03 (2.51)	3.35 (1.66)
SE Mean	0.37	0.28	0.17	0.44	0.28	0.19
t-test, p^1		t: 13.6, p <0.001	t: 15.4, p<0.001		t: 21.5, p <0.001	t:18.0, p<0.001

1 In this table, some values less than 5 were calculated using the Fisher's exact test

2 t-test, p for trends: after 6 months and one year following treatment

demonstrated the efficacy of the currently-used medication for fascioliasis treatment.

Changed perception and control practice of fascioliasis among the three cohorts under study after intervention

Following the implementation of the intervention measures applied differently in the three cohorts, significant increases (p<0.01) in the overall knowledge were indicated in Intervention 1 commune and Intervention 2 commune, compared with the respective baseline levels; whereas no significant difference (p>0.017) was found for the Control commune (Table 2). Across the communes, the proportions of participants from Intervention 2 commune and the Control commune being aware of fascioliasis increased compared with the baseline level, but they still scored less than 50.0% and were significantly lower compared with those in the main Intervention 1 commune (p<0.01).

Participants in Intervention 1 commune showed extensive understanding of fascioliasis transmission routes (p<0.01). In the other two communes participants demonstrated not significant changes (p>0.017) in their knowledge of how fascioliasis was transmitted, except for the significant improvement of Intervention 2 commune participants' awareness in identifying unwashed vegetable consumption as a cause of fascioliasis infection (p<0.01).

Similar findings were also made in the changed knowledge of the three cohorts, with significant improvement in knowledge of the participants of Intervention 1 commune who correctly described the signs and symptoms of fascioliasis and affirmed that the disease was controllable and curable (p<0.01). No significant increases of the cohorts in the two other communes were found in the responses to the same questions (p>0.017).

The changes in practice of the participants following the implementation of the intervention measures against fascioliasis are presented in Table 2. In the Intervention 1 commune all poor practice items reduced significantly in comparison with the baseline level (p<0.017). In the other two cohorts, the only changed behaviour was a reduction in the number of participants reporting that they drank improperly boiled water (p<0.017).

In summary, significant differences (p<0.01) were clearly indicated among the participants from Intervention 1 commune compared with those of the two other communes regarding their knowledge of the causes of fascioliasis, its signs and symptoms, and whether it was controllable and curable. In addition, higher proportions of participants from the Intervention 2 commune compared with the Control commune showed their adequate knowledge that there were fascioliasis risks from eating raw vegetables, and believed the disease was controllable; and these differences were significant (p<0.017). These could lead to positive changes in control practice of the communes with intensified or proper intervention of the disease (Table 2).

DISCUSSION

Overall, the components of the model were implemented as designed. The Intervention 1 commune received all the components of the intervention model with some modifications; the Intervention 2 commune received the chemotherapy for human and animal de-worming activities only; and only case treatment of human fascioliasis was applied to the Control commune.

Reduced seroprevalence of fascioliasis in the Intervention commune 1 (receiving broadly-based control intervention of fascioliasis control model)

In the Intervention 1 commune, the seroprevalence of fascioliasis reduced markedly compared with the baseline survey. It reduced, but not significantly, in the Intervention 2 commune and increased in the Control commune. These results most likely reflect the different levels of intervention applied in the three communes under study.

Table 2 Description of cohorts' knowledge and practice of fascioliasis after intervention measures, compared with baseline level

Item	Intervention 1 commune[a]			Intervention 2 commune[b]			Control commune[c]		
	Baseline number (%)	Follow-up number (%)	p	Baseline number (%)	Follow-up number (%)	p	Baseline number (%)	Follow-up number (%)	p
Know about fascioliasis[3]	N=600 276 (46.0)	N=600 481 (80.2)	<0.017	N=600 148 (24.6)	N=600 225 (37.5)	<0.017	N=600 224 (37.3)	N=600 219 (36.5)	NS
Know transmission routes	N=276	N=481		N=148	N=225		N=224	N=219	
Eat unwashed veggies	173 (62.7)	410 (85.3)	<0.017	91 (61.5)	173 (79.1)	<0.017	141 (62.9)	143 (65.3)	NS
Drink impure water	165 (59.8)	421 (87.5)	<0.017	95 (64.2)	152 (67.5)	NS	129 (57.6)	126 (57.5)	NS
Know signs & symptoms	121 (43.8)	424 (88.1)	<0.017	56 (37.8)	111 (49.3)	NS	102 (45.5)	105 (48.1)	NS
Know it is controllable[4]	144 (52.2)	404 (84.1)	<0.017	81 (54.7)	144 (64.1)	NS	111 (49.6)	97 (44.1)	NS
Know it is curable	145 (52.5)	402 (83.6)	<0.017	59 (40.0)	115 (51.1)	NS	97 (43.3)	117 (53.4)	NS
Eat improperly washed vegetables[5]	169 (28.2)	114 (19.0)	<0.017	197 (32.8)	166 (27.7)	NS	203 (33.8)	182 (30.3)	NS
Drink improperly boiled water	141 (23.5)	44 (7.3)	<0.017	255 (42.5)	178 (29.7)	<0.017	220 (36.7)	156 (26.0)	<0.017
Do not own household toilets	104 (17.3)	41 (6.8)	<0.017	85 (14.2)	90 (15.0)	NS	123 (20.5)	89 (14.8)	NS
Outdoor defecation	65/104 (62.5)	16/41 (39.0)	<0.017	66/85 (77.6)	68/90 (75.6)	NS	90/123 (73.2)	54/89 (60.7)	NS

3 Significant differences found all compared follow-up values between a and b (p<0.017); and a and c (p<0.017)
4 Significant difference in compared follow-up value between b and c (p<0.017)
5 Significant differences in the follow-up values between a and b, and a and c (p<0.017)

Other studies conducted previously in the region also reported significant reductions in fascioliasis prevalence[8,14-16], but the reduced prevalence of infection in the intervention communes found in this study was greater. This could be as a result of the different sampling methods employed for the study. The previous studies recruited the same participants to be involved at the beginning and end of the study, whereas in this community study different sample cohorts were recruited for the two stages of the study. In addition, the larger sample size in this study had greater statistical power, and was likely to reflect a more valid report of the disease prevalence than in other studies.

The diagnosis of fascioliasis in this study was based only on serology only (detection of antibodies rather than the manual coprological (stool) tests to identity the infection of fascioliasis in the human antibody because of its higher specificity and sensitivity. However, serological results may detect past infections, as the fluke antibodies may remain in the human body for a long period post-treatment and even after the elimination of the flukes from the recipient's body, which affected the validity of the tests[17]. In addition, it should be noted that limited commercial supplies of test kits, issues of specific antigens, test procedures, and lack of a validated optimal test system may challenge the serological diagnosis in many areas in which the disease is endemic, including Vietnam[18].

Effectiveness of chemotherapy for fascioliasis control

Among the interrelated factors involved in the model, detection and chemotherapy were important in the reduced prevalence of fascioliasis. The cure rates of the disease for all seropositive cases from two blood surveys after 6 months were 92.8% and 85.0% respectively, and 100% after 12 months. These findings support the effectiveness of the recommended chemotherapy (triclabendazole 250mg, 10mg/kg body weight) for selective treatment[12]. Previous studies[14,19] also reported evidence that this medication was still highly effective in fascioliasis treatment in Vietnam (with 95.0-100% cure rates), while the resistance of the parasites to the drug has been identified in other countries[5,20-22]. These results reinforce the importance of intensified detection and prompt treatment of fascioliasis in the community with moderate prevalence of the disease, hence supporting selected treatment as a cost-effective measure compared with mass drug administration[23].

The findings in our study also indicated significant reduction of eosinophilia in seropositive participants after 6 months and one year following the treatment of fascioliasis. These results were also consistent with previous studies in the region[15,19]. Elevated eosinophils are considered to be a diagnostic marker of possible fascioliasis infection[24,25] and their reduction reflects successful treatment of the disease[12].

Changes in perception of risks and practice associated with fascioliasis infection in three cohorts.

Compared with the baseline level, significant improvements in knowledge of fascioliasis were found in the intervention communes 1 and 2, although the disparity of the awareness between these two cohorts was great. In the Intervention 1 commune, the higher rates of knowledge were likely to reflect the more intensive educational activities undertaken. Similar results have been reported in previous studies, with variances of knowledge ranging from 57.0% to 99.0%[8,19,26,27].

The cohorts in this study performed differently in their practices to reduce the risks of fascioliasis infection. Although significant reductions were reported in all three cohorts related to drinking improperly boiled water, most changes were noticed in the Intervention 1 commune, with improvements found in all surveyed practices. In the Intervention 1 commune, the reduced proportion of respondents drinking improperly boiled water (7.3%) was higher than some studies previously conducted in Central Vietnam, such as reductions of 1.2%[19] and 2.6%[14] in Quang Nam province; but lower than 34.0% reduction reported in a study conducted in Binh Dinh province[8]. In addition, the proportion of participants in the commune reportedly eating improperly washed vegetables was lower than those in other studies [8,19].

The health education campaigns in Intervention 1 commune appeared to effectively achieve the desired outcomes, as more people accepted the practice of washing vegetables under running tap water, or dipping vegetables in water containing non-toxic chemicals or salt for minimum periods of time. This practice of the safer treatment of vegetables has also been reported in other studies[19,27], and could be considered to be a more appropriate household practice than destroying the infected vegetation areas, as had been conducted in some countries[28].

This study clearly demonstrated that a full range of control measures resulted in raised awareness of fascioliasis in the community. Limited changes were found in the knowledge and practice of the cohorts where minimal control measures were implemented, except for "eating unwashed vegetables" as one transmission route of fascioliasis, indicated by participants of the Intervention 2 commune (Table 2). This change may have resulted from education about reducing the risks of fascioliasis infection associated with the de-worming activities conducted by local veterinary staff. However, eating unwashed vegetables is not the only transmission route of fascioliasis; other transmission routes include drinking impure water, as has been identified in other documents[29,30].

Sanitation is an important consideration for fascioliasis control. Significantly fewer participants reported having no household toilets in the Intervention 1 commune, with no significant changes in the other communes (Table 2). In addition, a significant difference was also found in the Intervention 1 commune in relation to a reduction in the number of respondents in the non-toilet households (39.0%) reporting they defecated in public places. These two actions would both reduce the risks of fascioliasis transmission among the community and this was confirmed by the finding of a lower prevalence of fascioliasis following intervention.

Outdoor defecation, commonly practised in the absence of adequate latrine facilities, facilitates human transmission of fascioliasis[31,32]. In a survey conducted of Binh Dinh in Central Vietnam by Nguyen, 33.8% of respondents reported defecating into the rice fields or sandbanks as they did not own household toilets, and this was associated with a higher prevalence of fascioliasis (6.5%) in that study[8]. The results of the current study support the importance of encouraging the intensive use of public toilets as an effective strategy to reduce fascioliasis infection.

CONCLUSIONS

With full intervention measures applied, the Intervention 1 commune was found to have a significantly reduced prevalence of fascioliasis, and significantly increased awareness of, and practices against the disease transmission compared with the baseline stage. Across the communes, significant differences in the levels of change were found between the Intervention 1 commune and the other two communes for most of the indicators. The post intervention changes provide strong support for the effectiveness of a broadly based control model to reduce infection from fascioliasis. Although broadly-based control model was proven effective, it is important to explore the factors that enable, or act to impede, the implementation of such a control model.

DECLARATION OF CONFLICTING INTERESTS

The authors declare that they have no competing interest.

REFERENCES

1. Mas-Coma S. Epidemiology of fascioliasis in human endemic areas. Journal of Helminthology. 2005a;79(3):207-216.

2. Trieu NT. Annual workshop reviewing control activities of malaria, parasitic and vector-borne diseases in Central Vietnam in 2010: Institute of Malariology-Parasitology and Entomology, Quy Nhon; 2011:7.

3. Quy TM, Yeatman H, Flood V, Chuong NC. Prevalence and risks of fascioliasis among adult cohorts in Binh Dinh and Quang Ngai provinces-central Viet Nam. Vietnam Journal of Public Health. 2015;3(1):46-61.

4. WHO. Report of the WHO Informal Meeting on use of triclabendazole in fascioliasis control. 2007b.

5. Ortiz P, Scarcella S, Cerna C, et al. Resistance of Fasciola hepatica against Triclabendazole in cattle in Cajamarca (Peru): A clinical trial and an in vivo efficacy test in sheep. Veterinary Parasitology. Jul 2013;195(1-2):118-121.

6. Nithiuthai S, Anantaphruti MT, Waikagul J, Gajadhar A. Waterborne zoonotic helminthiases. Veterinary parasitology. 2004;126(1):167-193.

7. Saba R, Korkmaz M. Human fascioliasis. Clinical Microbiology Newsletter. 2005;27(4):27-34.

8. Nguyen VC, Nguyen VK, Bui VT, Tran MQ. Trial model of fascioliasis control in two communes of Phu Cat district, Binh Dinh province, Vietnam. Journal of Practical Medicine. 2011;796:152-156.

9. Molyneux DH. Control of human parasitic diseases: Context and overview. Vol 61. SAN DIEGO: ELSEVIER ACADEMIC PRESS INC; 2006:1-45.

10. GSO. Mean population by gender and urban/rural areas. 2014; http://www.gso.gov.vn/default.aspx?tabid=387&idmid=3&ItemID=15570. Accessed Dec.10, 2014.

11. Nguyen VQ, Tran TLH, Le PB, Truong THY, Ngo NY. Animal infection of fasioliasis in Binh Dinh province and preventive and control measures Journal of Science and Technology, Department of Science and Technology. 2010.

12. MOH. Guidelines on diagnosis and treatment of fascioliasis in humans. In: Departmen of Treatment, ed. Hanoi: Ministry of Health; 2006.

13. Tran VH, Tran TKD. Test kits for diagnoses of parasitological diseases. Journal of Practical Medicine, MOH, Viet Nam. 2004;447:112-116.

14. Nguyen KL. Study on some characteristics of fascioliasis (Fasciola spp.) and effectiveness of intervention measures in Dai Loc district, Quang Nam province. Ha Noi, Vietnam Military Medical University; 2010.

15. Nguyen TH. Study on some characteristics and treatment effectiveness of fascioliasis with triclabendazole in Tinh Ky and Nghia Son communes, Quang Ngai province. Ha Noi, National Institute of Malariology-Parasitology and Entomology; 2012.

16. Nguyen VV, Nguyen MH, Le XH, Nguyen TT. Infections of fascioliasis among the high-risk communities of Quang Nam province. Jounal of Malaria, Parasitic and Entomological control. 2011;3:92-98.

17. Apt W, Aguilera X, Vega F. Treatment of human chronic fascioliasis with triclabendazole: drug efficacy and serologic response. Am. J. Trop. Med. Hyg. 1995;52:532-535.

18. Espinoza JR, Huaman MC, Bargues MD, et al. Evaluation of FAS2-ELISA for the serological detection of Fasciola Hepatica infection in humans American Journal of Tropical Medicine and Hygiene. 2007;76(5):977-982.

19. Nguyen VV. Study on human fascioliasis and effectiveness of intervention measures in a community of Quang Nam during 2009-2011. Ha Noi: Parasitology Department, National Institute of Malariology-Parasitology and Entomology; 2012.

20. Winkelhagen AJ, Mank T, de Vries P, Soetekouw R. Apparent Triclabendazole-resistant Human Fasciola hepatica infection, the Netherlands. Emerging Infectious Diseases-CDC. 2012;18(6):1028-1029.

21. Fairweather I. Triclabendazole progress report, 2005-2009: an advancement of learning? Journal of Helminthology. 2009;83(2):139-150.

22. Olaechea F, Lovera V, Larroza M, Raffo F, Cabrera R. Resistance of Fasciola hepatica against triclabendazole in cattle in Patagonia (Argentina). Veterinary Parasitology. 2011;178(3-4):364-366.

23. Nguyen TGT. Zoonotic fascioliasis in Vietnam: molecular identification and geographical distribution: Department of Virology, Parasitology and Immunology-Faculty of Veterinary Medicine, Ghent University, Ghent Univerisity-Belgium; 2012.

24. Nguyen VC, Trieu NT, Nguyen VK, Bui VT. Study on some epidemiological characteristics of fasioliasis in some study sites of Central Vietnam. Monograph of Scientific research studies. 2007:410-416.

25. Curtale F, Mas-Coma S, El Wahab Hassanein YA, Barduagni P, Pezzotti P, Savioli L. Clinical signs and household characteristics associated with human fascioliasis among rural population in Egypt: A case-control study. Parassitologia. 2003;45(1):5-11.

26. Nguyen KL, Do NA, Nguyen NS. Identification of fascioliasis infection in cattle and risk factors of human transmission in Dai Loc district-Quang Nam province. Jounal of Malaria, Parasitic and Entomological control-National Institute of Malariology-Parasitology and Entomology. 2011;3:76-82.

27. Dang TCT, Nguyen XT, Nguyen MH, Trieu NT. Epidemiological charateristics and control measures of fascioliasis in Vietnam Hanoi: Ministry of Health;2011.

28. Rojas L, Vazquez A, Domenech I, Robertson LJ. Fascioliasis: can Cuba conquer this emerging parasitosis? Trends in parasitology. 2010;26(1):26-34.

29. Chen J-X, Guo Y-H, Chen M-X, et al. An Outbreak of Human Fascioliasis gigantica in Southwest China. . PLoS ONE. 2013;8(8).

30. Keiser J, Utzinger I. Food-borne trematodiasis. Clinical Miriobiological Review. 2009;22:466-483.

31. Agnamey P, Fortes-Lopes E, Raccurt CP, Boncy J, Totet A. Cross-sectional serological survey of human fascioliasis in haiti. Journal of parasitology research. 2012;2012(Journal Article):751951-751953.

32. Mas-Coma S, Esteban JG, Bargues MD. Epidemiology of human fascioliasis: a review and proposed new classification. Bulletin of the World Health Organization. 1999a;77:340-346.