Acta Tropica 141 (2015) 361–367

Contents lists available at ScienceDirect

Acta Tropica

journal homepage: www.elsevier.com/locate/actatropica

Toward integrated opisthorchiasis control in northeast Thailand: The Lawa project

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ARTICLE INFO

Article history:
Available online 4 August 2014

Keywords:
Opisthorchis viverrini
Integrated control
Ecosystems health
Lawa model
Thailand

ABSTRACT

Human liver fluke, *Opisthorchis viverrini*, a food-borne trematode is a significant public health problem in Southeast Asia, particularly in Thailand. Despite a long history of control programmes in Thailand and a nationwide reduction, *O. viverrini* infection prevalence remains high in the northeastern provinces. Therefore, a new strategy for controlling the liver fluke infection using the EcoHealth/One Health approach was introduced into the Lawa Lake area in Khon Kaen province where the liver fluke is endemic. A programme has been carried using anthelminthic treatment, novel intensive health education methods both in the communities and in schools, ecosystem monitoring and active community participation. As a result, the infection rate in the more than 10 villages surrounding the lake has declined to approximate one third of the average of 50% as estimated by a baseline survey. Strikingly, the Cyprinoid fish species in the lake, which are the intermediate host, now showed less than 1% prevalence compared to a maximum of 70% at baseline. This liver fluke control programme, named "Lawa model," is now recognised nationally and internationally, and being expanding to other parts of Thailand and neighbouring Mekong countries. Challenges to *O. viverrini* disease control, and lessons learned in developing an integrative control programme using a community-based, ecosystem approach, and scaling-up regionally based on Lawa as a model are described.

1. Introduction

The human liver fluke, *Opisthorchis viverrini* remains an important public health problem in many parts of Southeast Asia, particularly in the Lower Mekong Basin, including Thailand, the Lao People's Democratic Republic (Lao PDR), Cambodia and central/south Vietnam (Sripa et al., 2010; Sithithaworn et al., 2012). *O. viverrini* is acquired by eating traditional fish preparations in which the infective stage often remains viable.

Infection by this food-borne trematode can lead to hepatobiliary disease including hepatomegaly, cholangitis, cholecystitis, fibrosis of the periportal system, and gallstone (Sripa et al., 2010). Moreover, *O. viverrini* has been classified as a Group 1 carcinogens (metazoan parasites that are carcinogenic to humans) by the International Agency for Research on Cancer, World Health Organization (WHO) (Bouvard et al., 2009; IARC, 2012) since it is the major aetiological agent of bile duct cancer, cholangiocarcinoma (CCA) (Sripa et al., 2007, 2012). As a result of this liver fluke, Khon Kaen Province of north-eastern Thailand has the highest incidence of this type of primary liver cancer in the world (Vatanasapt et al., 1990; Shin et al., 2010).

The first report of high prevalence of *O. viverrini* infection, which reaches 100% in certain villages of north-eastern Thailand, was done by Sadun (1955). Almost 30 years later, a similar near 100% prevalence and high intensity infection of *O. viverrini* was reported in the Chonnabot District of Khon Kaen Province, confirming Khon Kaen to be one of the hotspots of liver fluke infection (Upatham et al., 1982, 1984). The first nationwide survey (1980–1981)

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http://dx.doi.org/10.1016/j.actatropica.2014.07.017
0001-706X/

revealed an overall prevalence of *O. viverrini* infection of 14%; with the highest prevalence in the northeast (34.6%) followed by the central part of the country (6.3%), then the north (5.6%) and the south (0.01%) (Jongsuksuntigul and Imsomboon, 2003).

Following a period of intensive and continuous control programmes and public health service activities, along with a significant demographic shift from traditional agriculture to modern urban-industrial life, the average national prevalence of this infection declined to 9.4% in the year 2000 (Jongsuksuntigul and Imsomboon, 2003) reaching 8.7% by the end of the decade (Sithithaworn et al., 2012). Based on national survey data in 2009, *O. viverrini* infection prevalence in Thailand still high, particularly in the North and north-eastern regions, with the total number of *Opisthorchis*-infected cases estimated to exceed 6 million, an assessment highly likely to be a gross underestimate (Andrews et al., 2008).

In spite of the recent apparent overall reduction in prevalence data indicate a reversal in some areas as well as numerous pockets, particularly in the north-eastern provinces, where prevalence remains as high as 50% (Sithithaworn et al., 2012). Clearly, the positive outcomes from previous control programmes were not sustainable. It seems that they failed to infuse a long-term affect in many communities, or other unidentified social or ecological influences on *O. viverrini* transmission dynamics are at work. As this became realized closer examination including more detailed studies began to suggest factors that might responsible for the intransigence of the *O. viverrini* infection rates.

What has emerged is the need for new ways of thinking about this disease and its control. For example, like that suggested for other neglected tropical diseases (NTDs) elsewhere, a multi-sectoral, multidisciplinary control efforts is required (e.g., Ehrenberg and Ault, 2005), and helminths generally (Gazzinelli et al., 2012). This is found to reflect zoonotic NTDs in particular, which are especially problematic in light of their complex life cycles, multiple determinants and limited funding (IOM, 2011). The recent designation including of persistent helminth diseases as simultaneously "diseases of environmental, agriculture and poverty" included pointing to the need new, systems oriented approaches such as "one health" or "ecohealth" (WHO, 2013).

What all these approaches have in common is integrated intervention methods developed based in integrative, transdisciplinary research using an "ecosystem approach to health (Charron, 2012; Forget and Lebel, 2001; Parkes et al., 2005; Wilcox et al., 2012). The resulting integrated control methods necessitate the combining of technologies and expertise from different fields beyond biomedicine or conventional public health, including that from social, environmental and ecological sciences.

Unfortunately, in our experience, neither explicit guidelines nor examples exist of procedurally how to develop such an integrated control strategy. Among other challenges this requires overcoming barriers to collaboration between academic scientists from multiple disciplines, not to mention with and local communities and other stakeholders; i.e., expanding a project beyond interdisciplinary to transdisciplinary. In this paper we trace the history of the efforts to control *O. viverrini* infection in Thailand, identify the likely barriers to sustainable control, describe an evolving integrative programme for *O. viverrini* research and control and the lessons learned.

2. Opisthorchiasis control in Thailand: a success story?

2.1. History

Opisthorchiasis control in Thailand spans more than 50 years and can be roughly divided into three phases.

First phase: During the period from 1950 to 1958 the Department of Health, Ministry of Public Health, Thailand established Helminthiasis Control Units in five provinces with the support of USAID. These provinces were Nakorn Ratchasima, Udon Thani, Skol Nakorn, Ubon Ratchathani (in north-eastern Thailand) and Songkhla (in the South) (Jongsuksuntigul and Imsomboon, 2003). Following a decline in USAID support in 1958, the helminthiasis control activities were integrated into the national Rural Health Development Project (1967–1974). An Opisthorchiasis Control Unit was established in Sakol Nakorn Province in the Northeast to implement these control activities. The Unit focused mainly on health education at the community level, utilizing a variety of strategies such as demonstrations of how to prepare cooked fish, distribution of low-cost cooking pots, etc. Following the termination of the Rural Health Development Project in 1974, health education on liver fluke infection and "safe cooking" was the only approach used for opisthorchiasis control.

Second phase: After the introduction of the anthelmintic praziquantel in Thailand in the early 1980s, a joint field trial organized by Mahidol University and the Helminthiasis Section of the Department of Communicable Disease Control, Ministry of Public Health, was conducted in north-eastern Thailand (Jongsuksuntigul and Imsomboon, 2003). During the 1984–1987 period, the Department of Communicable Disease Control organized opisthorchiasis treatment units in four provinces in the Northeast: Khon Kaen, Roi-Et, Sakol Nakorn and Ubon Ratchathani. A region-wide line of attack against the disease was started in 1987 with the inclusion of an opisthorchiasis control programme included as part of the Sixth Five-year National Public Health Development Plan (1987–1991), under the auspices of the Department of Communicable Disease Control. In addition, the German Society for International Cooperation (GTZ) provided technical and partial operational support for the Project for Promotion of Community Health through Parasite Control in seven north-eastern provinces (from 1989 to 1992). During this period, a total of 7,077,875 individuals were examined and 2,306,104 positive cases treated. The Seventh National Health Development Plan (1992–1996) extended the Opisthorchiasis Control Programme to an additional 17 provinces in northern Thailand and six provinces in the centre of the country. With the Eighth National Health Plan (1997–2001), the opisthorchiasis control programme was integrated into the Nationwide Disease Control Aims, with the objective of reducing the prevalence of *O. viverrini* infection to below 10%. Many campaigns against the consumption of "raw fish" were organized by different governmental and non-government organizations. During this period (1981–2001) the level of *O. viverrini* infection prevalence fell from 34.6% to 15.7% in the Northeast to an overall national prevalence of 9.4% (Jongsuksuntigul and Imsomboon, 2003).

Third phase: After 2000, the National Opisthorchiasis Control Programme activities subsided after the Asian Economic crisis, due to a reduction in government funding and a diversion of resources to other health priorities. The most recent data from the National Helminthic Survey showed an overall *O. viverrini* infection prevalence of 8.7%, with the highest level in the Northeast (16.6%), followed by the North (10.0%), the Centre (1.3%) and the South (0.1%) (Sithithaworn et al., 2012). Indeed, the prevalence in 2009 in the northeastern provinces was similar or even higher than that of the previous survey 10 years before in 2001 (15.7%).

Even more alarming, although the average prevalence nationally shows an overall declining trend, reliably estimated *Opisthorchis* infection rates as high as 85% were still being reported for some villages in the Northeast in the 2009 National Survey (Sithithaworn et al., 2012) – similar to that reported 60 years ago! Moreover, the age-standardized incidence rate (ASR) of CCA is still high with average of 44.3 per 100,000 for male in Khon Kaen province, northeast Thailand (Kamsa-ard et al., 2011).