Acta Tropica xxx (2013) xxx–xxx

Contents lists available at ScienceDirect

Acta Tropica

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

Potential schistosomiasis foci in China: A prospective study for schistosomiasis surveillance and response

Ying-Jun Qian[a], Shi-Zhu Li[a,1], Jing Xu[a], Kun Yang[b], Yi-Xin Huang[b], Zhi-Guo Cao[c], Feng Miu[d], Hui Dang[a], Li-Juan Zhang[a], Li Zhang[a], Qiang Wang[a], Robert Bergquist[e], Xiao-Nong Zhou[a,*]

[a] National Institute of Parasitic Diseases, Chinese Center for Disease Control and Prevention, Key Laboratory of Parasite and Vector Biology, Ministry of Health, Shanghai 200025, China
[b] Jiangsu Institute of Schistosomiasis, Wuxi, Jiangsu, China
[c] Anhui Provincial Institute of Parasitic Diseases, Wuhu, Anhui, China
[d] Shandong Institute of Parasitic Diseases, Jining, Shandong, China
[e] Ingerod 407, Brastad, Sweden

ARTICLE INFO

Article history:
Received 3 April 2013
Received in revised form 23 July 2013
Accepted 26 August 2013
Available online xxx

Keywords:
Schistosomiasis
Risk
New foci
Climate change
Surveillance and response
PR China

ABSTRACT

Schistosomiasis japonica was endemic in 12 provinces (including municipalities and autonomous regions) in the People's Republic of China (PR China). Despite the tremendous decrease of schistosomiasis incidence after almost 60 years of control, the distribution of snail-breeding sites has not been reduced significantly. In order to verify current transmission risks and identify the potential establishment of new foci of schistosomiasis driven by environmental changes, we conducted surveillance in selected risk areas of three provinces: Jiangsu, Anhui and Shandong from 2008 to 2010 in addition to routine snail surveillance. We investigated populations and possible reservoirs in sentinel sites and report that the total number of new acute cases did not diminish further in spite of ongoing control activities. In Anhui Province the local count compared to the national count was 43% (19/44) in 2008, 33% (25/75) in 2009 and 40% (17/42) in 2010. In all, 31.58 km^2 areas of snail breeding sites were newly detected nationwide through the year 2008–2010, of which the proportion of Anhui was 42% (5.03/11.98) in 2008, 95% (8.39/8.79) in 2009 and 79% (8.52/10.81) in 2010. Sentinel surveillance showed eight, nine and five confirmed cases of acute schistosomiasis in mobile populations (fishermen, migrant workers) in 2008, 2009 and 2010, respectively. All these cases were detected in Chaohu County, which must therefore be deemed an area at risk. We conclude that continuous surveillance with an emphasis on snails must be enhanced in potential risk areas in PR China.

1. Introduction

Schistosomiasis japonica continues to be a public health problem in the People's Republic of China (PR China). Thanks to political commitment and strong control efforts in the past, the endemic areas have been greatly reduced. Indeed, the lowest levels of infection in both human and cattle in history have been reached in the last decade (Li et al., 2009b; Utzinger et al., 2005; Wang et al., 2008; Zheng et al., 2012b; Zhou et al., 2005). Based on the "National Criteria for Control and Elimination of Schistosomiasis", jointly issued in 2006 by the General Administration of Quality Supervision, Inspection and Quarantine of PR China and the Standardization Administration of PR China (Zhang et al., 2007), transmission has been interrupted in five provinces, i.e. Shanghai (1985), Guangdong (1985), Guangxi (1988), Fujian (1987), Zhejiang (1995) and controlled in three: Sichuan (2008), Yunnan (2009) and Jiangsu (2010) (Deng et al., 2007; Jiang et al., 2007; Li et al., 2009a; Wen et al., 2006; Zhang et al., 2009; Zhou et al., 2012). However, some areas related to marshes and lakes in Anhui, Jiangxi, Hubei and Hunan provinces remain endemic (Zheng et al., 2012b; Zhou et al., 2012) (Fig. 1). Of all 454 previously endemic counties (including districts and cities), 60% (274) achieved the criterion of transmission interruption, with 23% (103) reaching transmission control and 17% (77) morbidity control. The number of patients was reduced by 30.5% from 412,927 in 2008 to 286,836 in 2011. By the end of 2011, only three local acute cases were reported. Compared to 57 reports in 2008, a reduction of 95% was achieved. A total number of 5146 infected cattle was reported in 2011 with an incidence rate of 0.7% against 9988 with 1.3% new infections in 2008. Nevertheless, a total of 1637 km^2 of

* Corresponding author at: National Institute of Parasitic Diseases, Shanghai 200025, China. Tel.: +86 021 64746458; fax: +86 021 64746458.
E-mail addresses: xiaonongzhou1962@gmail.com, ipdzhouxn@sh163.net (X.-N. Zhou).
[1] Co-first author.

0001-706X/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.actatropica.2013.08.017

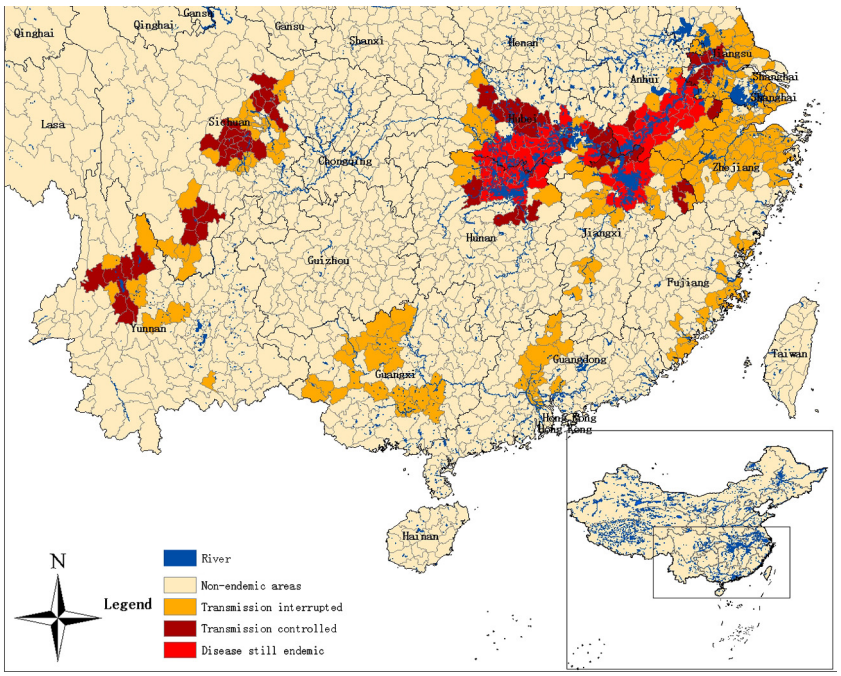

Fig. 1. Geographic distribution of schistosomiasis japonica based on the catalogues of the control programme in PR China in 2011.

snail breeding sites was surveyed in 2011, of which 12 km^2 were found to be newly infested. These numbers are close to that of in 2008 (1484 and 12 km^2), respectively (Zheng et al., 2012b).

In 2004, PR China upgraded schistosomiasis control together with the control of HIV/AIDS and tuberculosis to the highest priority level for communicable diseases (Engels et al., 2005; Zhou et al., 2012). Since then, fighting schistosomiasis has received unprecedented investments from the Government. The State Council issued the medium and long-term (2004–2015 in total) plan for prevention and control of schistosomiasis marking the shift from morbidity control to an integrated control strategy (Collins et al., 2012; Lin et al., 2007; Wang et al., 2008, 2009). Under the leadership of the Ministry of Health (MOH), interventions were put in place by removing cattle from the snail-infested areas, providing farmers with mechanized farm equipments, institution of environmental management geared at snail elimination, improving sanitation and access to clean water, providing boats with faecal containers among the major mobile population and strengthening surveillance and case management and implementing an intensive health education programme. Apart from the MOH, this new strategy involves a number of governmental sectors such as those dealing with agriculture, forestry, water conservancy, environment, education and others as needed (Yu et al., 2006). This approach proved successful and has added value beyond control of schistosomiasis, e.g. concomitant reduction of the prevalence of soil-transmitted helminth infections was also observed (Li et al., 2009b, 2012; Wang et al., 2009; Zheng, 2009).

Although great progress of schistosomiasis control was made in the past decades (Zheng et al., 2012b; Zhou et al., 2005), the potential risk of re-emerging transmission in controlled areas, or the appearance of new foci in sensitive areas, was recognized (Wang et al., 2004; Wu et al., 2005, 2008; Xu et al., 2011; Zheng et al., 2012a). In some areas, where transmission had been interrupted or was already well-controlled, progress levelled off resulting in enlarged snail-infested areas here and there (Huang et al., 1992; Wang et al., 2011; Xu et al., 2011). Following increases in snail densities and infection rates, re-emergence of schistosomiasis was reported with new infected cases attributable to environmental and social changes (Chen, 2005; Wang et al., 2004).

A recent discussion at the World Health Organization (WHO) indicates that a 2 °C temperature rise in PR China would result in the potential increase of 50–100% of the geographic distribution of snails (WHO, 2011a). Hence, the potential transmission of schistosomiasis in previously non-endemic areas would endanger the lives of tens of millions of people. Different mathematical models show that schistosomiasis is likely to extend northward due to the potential expansion of snail habitats (Liao, 2011; Yang et al., 2006a, 2006b; Yu et al., 2004; Zhou et al., 2008). This increase of endemic areas would primarily strike the provinces of Anhui and Jiangsu as well as the southern parts of Shandong and Henan. Water resource developments, i.e. the South-to-North Water Diversion Project (SNWDP) and the Three Gorges Dam (TGD), pose an additional challenge for the control of schistosomiasis (Wang et al., 2007; Yang et al., 2006b; Zhou et al., 2003), as seen in a potential scenario supported by snail experiments in Shandong and Jiangsu (Cao et al., 2007; Wang et al., 2010; Zheng et al., 2009). The 0–1 °C January isotherm, considered as the geographic limit for *Schistosoma japonicum* transmission as reflected by the temperature limit for snail survival, shifted from 33°15′ N to 33°41′ N, expanding the potential transmission area by 41,335 km^2 (Yang et al., 2005). A recent study of the impact of climate change on schistosomiasis predicts that schistosomiasis would potentially extend far northward already by the 2030s and more so in the 2050s and thus include the southern parts of the Shandong and Henan provinces (Zhou et al., 2008). Apart from the environmental impacts, another concern of schistosomiasis rebound is population movement that may transfer the disease from endemic areas to non-endemic places. In particular, those dealing with fishery, on-water construction, and boat dwellers are high-risk population due to the nature of their work (Liang et al., 2008).

Given the risks of increase of snail breeding sites as well as rebound of schistosomiasis, it is time to identify the high-risk areas in the context of a changing environment. According to the findings and the current surveillance system for schistosomiasis in China, we selected several high-risk areas to carry out on-site monitoring

Please cite this article in press as: Qian, Y.-J., et al., Potential schistosomiasis foci in China: A prospective study for schistosomiasis surveillance and response. Acta Trop. (2013), http://dx.doi.org/10.1016/j.actatropica.2013.08.017