# Towards elimination of soil-transmitted helminthiasis in China

Men-Bao Qian,[a,b] Jürg Utzinger,[c,d] Shi-Zhu Li,[a,b] Antonio Montresor,[e] and Xiao-Nong Zhou [a,b]*

[a]National Institute of Parasitic Diseases, Chinese Center for Disease Control and Prevention (Chinese Center for Tropical Diseases Research), NHC Key Laboratory of Parasite and Vector Biology, WHO Collaborating Centre for Tropical Diseases, National Center for International Research on Tropical Diseases, Shanghai, China
[b]School of Global Health, Chinese Center for Tropical Diseases Research, Shanghai Jiao Tong University School of Medicine, Shanghai, China
[c]Swiss Tropical and Public Health Institute, Basel, Switzerland
[d]University of Basel, Basel, Switzerland
[e]Department of Control of Neglected Tropical Diseases, World Health Organization, Geneva, Switzerland

**The Lancet Regional Health - Western Pacific 2022;22: 100455**
Published online 12 April 2022
https://doi.org/10.1016/j.lanwpc.2022.100455

Soil-transmitted helminth infection are caused by a group of parasitic worms, including hookworm (*Ancylostoma duodenale* and *Necator americanus*), roundworm (*Ascaris lumbricoides*), and whipworm (*Trichuris trichiura*).[1] In 2019, the estimated global burden of soil-transmitted helminth infection was 1.97 million disability-adjusted life years; a marked reduction compared to 1990.[2] Soil-transmitted helminths mainly affect poor and marginalized communities in low- and middle-income countries. The World Health Organization (WHO)'s road map for neglected tropical diseases 2021-2030 targets elimination of soil-transmitted helminthiasis as a public health problem in 60%, 70%, and 96% of countries by 2023, 2025, and 2030, respectively.[3] Elimination as a public health problem is defined as <2% proportion of soil-transmitted helminth infection of moderate and heavy intensity.

In China, soil-transmitted helminth infections were very common in the early 1990s, but the situation has much improved over the past decades. Figure 1 summarizes data obtained from three national surveys conducted in 1988–1992, 2001–2004, and 2014–2015, respectively.[4–6] Indeed, while more than 50% of people were thought to be infected with any soil-transmitted helminth species in the early 1990s,[4] sustained social and economic development, coupled with poverty alleviation, improved access to water, sanitation, and hygiene (WASH), and periodic deworming campaigns, resulted in strong declines. In the early 2000s, the prevalence of infection was reduced to 19.6%, and further dropped to 4.5% in 2015.[5,6] The prevalence of ascariasis, trichuriasis, and hookworm diseases was 1.4%, 1.0%, and 2.6% with a relatively small proportion of moderate or heavy infections (12-30%).[6] The population with soil-transmitted helminth infection decreased by over 95% in China over the past 25 years.

According to the aforementioned WHO definition, soil-transmitted helminthiasis had already been eliminated as a public health problem in China in 2015, because the proportion of moderate and heavy infections fell even below 1%.[6] Hence, should a more ambitious target be set for elimination, or transmission interruption, of soil-transmitted helminthiasis in China, which is not yet considered in the current programme? A programme on elimination will set a definite goal and push the further progress of soil-transmitted helminthiasis control. This will promote the access to universal health for all. To address this issue, it is also useful to provide a historic account, look into other parasitic diseases, and consider contextual factors. In 1956, hookworm – along with lymphatic filariasis, malaria, schistosomiasis, and leishmaniasis – was one of five parasitic diseases targeted for elimination, because they caused high disease burden and hindered social and economic development.[7] Subsequently, the Chinese government exhibited political will and provided financial and technical support to eliminate these diseases. In 2007, elimination of lymphatic filariasis as a public health problem was achieved, followed by malaria elimination in 2021.[7] In parallel, in 2020, China announced elimination of poverty at the national level. Surveillance data suggest that soil-transmitted helminth infection further declined since 2016.[8] Against this background, it is reasonable to put forth ambitious targets for achieving elimination of soil-transmitted helminthiasis in China.

There are three main challenges to initiate the national elimination programme for soil-transmitted helminth infection. First, technical guidelines are needed for the era of post-elimination as a public health problem in soil-transmitted helminthiasis. The criteria

*Corresponding author at: National Institute of Parasitic Diseases, Chinese Center for Disease Control and Prevention (Chinese Center for Tropical Diseases Research), NHC Key Laboratory of Parasite and Vector Biology, WHO Collaborating Center for Tropical Diseases, National Center for International Research on Tropical Diseases, Shanghai, China.
*E-mail address:* zhouxn1@chinacdc.cn (X.-N. Zhou).

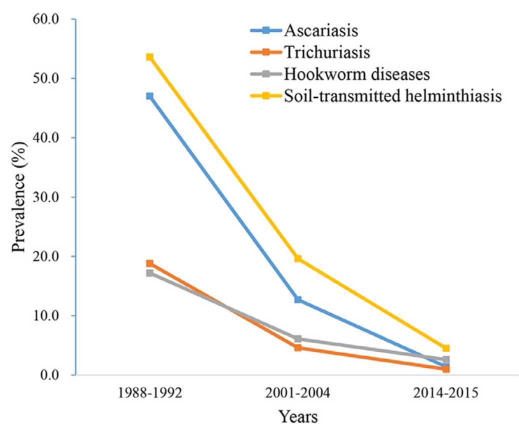


**Figure 1.** Prevalence of soil-transmitted helminthiasis in China in three national surveys.

for transmission control and interruption of soil-transmitted helminthiasis were issued in China in 2018, in which a threshold of 1% in total prevalence including all intensity of infection in three species of helminths as transmission control, and 0.1% as transmission interruption for three consecutive years at county level was required.[9] Particularly the threshold of transmission interruption needs further evidence and a feasible scheme for measurement. Many factors need to be considered, including helminth species, movement of people, social-ecological contexts, control interventions, among others. Recent studies modelled the breakpoint of transmission through mass drug administration in soil-transmitted helminthiasis, especially hookworm diseases.[10,11] Such methodology is worthwhile to be applied, which combined with field evidence might inform the definition of what conditions should be used for interrupting transmission of soil-transmitted helminth infection in different settings.

Second, although the overall elimination as a public health problem defined by WHO guideline, soil-transmitted helminthiasis distributes unequally in China, with local hot-spots in southwestern and central China. Thus, risk maps that integrate the latest available demographic, ecological, parasitological and socioeconomic data are needed to guide implementation of further control and transmission interruption of soil-transmitted helminth infection, similar to approaches done for schistosomiasis in Africa.[12] Maps should be at high resolution (e.g. village level or 5 × 5 km) and updated annually, which will support the surveillance of the elimination programme precisionally. Nowadays, China establishes a large surveillance system for soil-transmitted helminthiasis, covering approximately 400,000 people in 400 counties.[8] Spatiotemporal modelling should be applied, linked to the surveillance data, remotely sensed environmental data and routine demographic and socioeconomic data. Additionally, transmission dynamic models could guide policymakers to establish a definitive roadmap for transmission interruption and pre-defined criteria for verification.

Third, low prevalence and intensity of infection in the era of transmission interruption requires highly sensitive diagnostic techniques. Detection of helminth eggs in faeces by traditional and widely used techniques (e.g., Kato-Katz thick smear method) plays an important role when the goal is morbidity control, but they are less useful when the target is interruption of transmission. Indeed, many studies have shown the low sensitivity of the Kato-Katz technique in low-endemicity settings.[13] Molecular techniques (e.g., qPCR) significantly increase the sensitivity,[13] but such techniques still need validation in real-world settings that are characterized by low prevalence and intensity of infection. The feasibility and accessibility also need to be considered, and thus the improvement of such techniques is also expected. If traditional method is still applied, the impact of diagnosis performance should be considered as an important determinant in set of the threshold mentioned above.

The observed decrease of soil-transmitted helminth infection in China over the past 30 years not only promotes the wellbeing of Chinese, but also contributes to the global disease elimination agenda.[14] Indeed, the era of post-elimination of soil-transmitted helminthiasis as a public health problem in China provides an opportunity to explore the elimination of these parasitic diseases. Evidence-based guidelines, clear criteria, and techniques could be established. The lessons learned will be useful for other endemic countries. A successful example in China might encourage global ambition to eliminate soil-transmitted helminthiasis elsewhere.

## Author contributions

Men-Bao Qian did literature search, data collection, data interpretation, and writing. Jürg Utzinger, Shi-Zhu Li, Antonio Montresor, and Xiao-Nong Zhou did data interpretation, and writing.

## Declaration of interests

All authors declared no conflict of interests. The article represents the authors' personal view.

## Acknowledgements/Funding

No funds received for this study.

### References

1 Jourdan PM, Lamberton PHL, Fenwick A, Addiss DG. Soil-transmitted helminth infections. *Lancet*. 2018;391:252–265.

2 GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet*. 2020;396:1204–1222.

3 World Health Organization. *Ending the Neglect to attain the Sustainable Development Goals: a Road Map for Neglected Tropical Diseases 2021–2030*. Geneva: World Health Organization; 2020.

4 Xu LQ, Yu SH, Jiang ZX, et al. Soil-transmitted helminthiases: nationwide survey in China. *Bull World Health Organ*. 1995;73:507–513.
5 Coordinating Office of the National Survey on the Important Human Parasitic Diseases. A national survey on current status of the important parasitic diseases in human population. *Chin J Parasitol Parasit Dis*. 2005;23:332–340. (in Chinese).
6 Chen YD, Qian MB, Zhu HH, et al. Soil-transmitted helminthiasis in China: a national survey in 2014-2015. *PLoS Negl Trop Dis*. 2021;15:e0009710.
7 Qian MB, Li SZ, Zhou XN. After malaria: which parasitic disease will China eliminate next? *Nature*. 2021;596:189.
8 Zhu HH, Huang JL, Chen YD, et al. Analysis on endemic status of soil-transmitted nematode infection in China in 2019. *Chin J Parasitol Parasit Dis*. 2021;39:666–673. (in Chinese).
9 National Health Commission of People's Republic of China. *Criteria for Transmission Control and Interruption of Soil-Transmitted Nematodiasis (WS/T 629—2018)*. National Health Commission of People's Republic of China; 2018. (in Chinese).
10 Ásbjörnsdóttir KH, Means AR, Werkman M, Walson JL. Prospects for elimination of soil-transmitted helminths. *Curr Opin Infect Dis*. 2017;30:482–488.
11 Truscott JE, Werkman M, Wright JE, et al. Identifying optimal threshold statistics for elimination of hookworm using a stochastic simulation model. *Parasit Vectors*. 2017;10:321.
12 Kokaliaris C, Garba A, Matuska M, et al. Effect of preventive chemotherapy with praziquantel on schistosomiasis among school-aged children in sub-Saharan Africa: a spatiotemporal modelling study. *Lancet Infect Dis*. 2022;22:136–149.
13 Papaiakovou M, Littlewood DTJ, Gasser RB, Anderson RM. How qPCR complements the WHO roadmap (2021-2030) for soil-transmitted helminths. *Trends Parasitol*. 2021;37:698–708.
14 Hotez PJ. Whatever happened to China's neglected tropical diseases? *Infect Dis Poverty*. 2019;8:85.