The Use of GIS and Remote Sensing in Schistosomiasis Control in China

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Despite considerable achievements in the control of schistosomiasis in China, it remains one of the country’s most serious public health problems. Geographic information systems and remote sensing provide new tools for better understanding the spatial epidemiology of disease transmission. We present applications of these technologies at both the regional and local scale. At the regional scale, we compare remote sensing approaches for mapping snail intermediate host habitat in the mountainous environment and the flood basins of the upper and lower Yangtze River, respectively. At the local scale,
we present the use of global positioning systems and geocoding of routinely collected field data. High-resolution IKONOS imagery is used to identify landscape characteristics associated with disease transmission at the village level. We conclude with a discussion of the implications of these technologies for improved disease control.

INTRODUCTION

Schistosomiasis has existed in China for over 2,100 years, and remains one of country’s most serious public health problems (Chen & Zheng, 1999). Nearly one million Chinese are infected with schistosomiasis. Despite great success in eradicating the disease in some areas, schistosomiasis remains endemic in 118 counties in seven provinces, placing an estimated 40 million at risk of infection.

The disease is caused by infection by the *Schistosoma japonicum* parasite (Webbe, Sturrock & Jordan, 1993). Humans and other animals become infected via contact with contaminated water. In rural China, such water contact for humans is inevitable for those involved in irrigated agriculture, fishing, cattle grazing, and domestic duties, such as washing. Children who often play in water are also at risk of infection.

The lifecycle of *S. japonicum* begins with the maturation of the parasite into adult worms in the blood vessels of the animal host. These worms, called schistosomes, sexually pair and lay eggs, which are excreted from the host in feces. This is different from *S. haematobium*, in which eggs are excreted in the urine of the infected host. In the absence of waste treatment, these eggs are released back into the environment. The problem is compounded by the use of human and animal excrement as fertilizer in agricultural areas. A new form of the parasite, miracidia hatch from the eggs when they become exposed to freshwater. These free-swimming miracidia must infect an appropriate snail in which to develop. In China, the amphibious *Oncomelania hupensis* snail serves as the intermediate host for the parasite. After a period of asexual reproduction, free-swimming larvae called cercariae leave the snail and are transported in water where they come into contact with animal hosts. Cercaria can penetrate the intact skin of the host, thus infecting them and continuing the lifecycle.

Spatial relationships between the parasite, snail and human (and other animal hosts) habitats are strong determinants of disease risk. For humans, two processes are driven by spatial factors: the infection process, which is determined in part by where contact with contaminated water occurs, and the process of egg dispersion, in which the spread of parasitic eggs is related to human activity such as the geographic distribution of land-use and stool fertilizer use. Snails are also affected
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