

Abstract

Thermal/cool spring tubs have become a popular means of recreation. Indeed, it has been reported that many people in Taiwan have purchased spring tubs since 1990. Human contact with aquatic environments can clearly introduce bacterial, viral, and protozoan parasites. The concentration and persistence of these organisms in spring tubs are subject to a number of complex factors. Numerous reports of illnesses related to spring tub use suggest the necessity for continued vigilance over maintenance practices. Contamination of thermal/cool spring tub water during high pathogen loading events (e.g., excessive bather loading, or an accidental fecal release) can temporarily compromise the ability of the system to remove pathogenic organisms. Contact with this contaminated water can result in skin, ear, or eye infections and, if the water is ingested, can lead to gastrointestinal illness. Therefore, it is important to realize the water quality and management of Taiwan spring tubs.

In this study, we gathered data on factors potentially associated with the pathogen's distribution, including environment, facility operation and physical and microbiological water quality parameters. The detecting methods for microbiological parameters are according to the standard method published by Environmental Analysis Laboratory of Taiwan EPA. The pathogenic microorganisms detected in this study including *Cryptosporidium*, *Legionella*, enteroviruses and hepatitis A virus. The detection method for *Cryptosporidium* is modified from the Method 1623 of USEPA, and the other pathogens in this study are all detected by PCR and identified by DNA sequencing analysis.

In the collected 30 spring water samples, *Cryptosporidium* was detected in 1 (3.3%), *Legionella* was detected in 4 (13.3%), enteroviruses was detected in 15 (50.0%) and none of samples were detected with hepatitis A virus. Four *Legionella* species and two enteroviruses species varied in their distribution. The detected *Legionella* was *L. pneumophila* serogroup 1, *L. oakridgenesis*, *L. dumoffii*, and unculture *Legionella* species. They were all detected once. The most detected enterovirus was Coxsackie A2 and the EV 71 was detected once. *Legionella* species were easily found in water temperatures ranging from 35°C to 45°C. Optimal pH appeared to be between 7.0 and 11.0. Enteroviruses were distributed in various water temperatures and pH ranges. Results of this survey confirm the ubiquity of *Legionella* and enteroviruses in Taiwan spring recreation areas. These pathogens should be considered a potential public health threat in the spring recreation areas of Taiwan. Proper maintenance of spring tubs is essential in the control of microbial disease. In recognition of potential illnesses associated with the use of spring tubs, to develop guidelines then minimize the risk is needed.

Keywords: Thermal/cool spring, Microorganism indicators, *Cryptosporidium*, *Legionella*, enteroviruses, hepatitis A virus