Environ Sci Pollut Res
DOI 10.1007/s11356-013-1925-1

RESEARCH ARTICLE

Aquatic biomonitoring of *Giardia* cysts and *Cryptosporidium* oocysts in peninsular Malaysia

Soo Ching Lee · Romano Ngui · Tiong Kai Tan · Muhammad Aidil Roslan · Init Ithoi · Yvonne AL Lim

Received: 4 April 2013 / Accepted: 10 June 2013

Abstract An aquatic biomonitoring of *Giardia* cysts and *Cryptosporidium* oocysts in river water corresponding to five villages situated in three states in peninsular Malaysia was determined. There were 51.3 % (20/39) and 23.1 % (9/39) samples positive for *Giardia* and *Cryptosporidium* (oo)cysts, respectively. Overall mean concentration between villages for *Giardia* cysts ranged from 0.10 to 25.80 cysts/l whilst *Cryptosporidium* oocysts ranged from 0.10 to 0.90 oocysts/l. Detailed results of the river samples from five villages indicated that Kuala Pangsun 100 % (9/9), Kemensah 77.8 % (7/9), Pos Piah 33.3 % (3/9) and Paya Lebar 33.3 % (1/3) were contaminated with *Giardia* cysts whilst *Cryptosporidium* (oo)cysts were only detected in Kemensah (100 %; 9/9) and Kuala Pangsun (66.6 %; 6/9). However, the water samples from Bentong were all negative for these waterborne parasites. Samples were collected from lower point, midpoint and upper point. Midpoint refers to the section of the river where the studied communities are highly populated. Meanwhile, the position of the lower point is at least 2 km southward of the midpoint and upper point is at least 2 km northward of the midpoint. The highest mean concentration for (oo)cysts was found at the lower points [3.15±6.09 (oo)cysts/l], followed by midpoints [0.66±1.10 (oo)cysts/l] and upper points [0.66±0.92 (oo)cysts/l]. The mean concentration of *Giardia* cysts was highest at Kuala Pangsun (i.e. 5.97±7.0 cysts/l), followed by Kemensah (0.83±0.81 cysts/l), Pos Piah (0.20±0.35 cysts/l) and Paya Lebar (0.10±0.19 cysts/l). On the other hand, the mean concentration of *Cryptosporidium* oocysts was higher at Kemensah (0.31±0.19 cysts/l) compared to Kuala Pangsun (0.03±0.03cysts/l). All the physical and chemical parameters did not show significant correlation with both protozoa. In future, viability status and molecular characterisation of *Giardia* and *Cryptosporidium* should be applied to identify species and genotypes/subgenotypes for better understanding of the epidemiology of these waterborne parasites.

Keywords Biomonitoring · *Giardia* · *Cryptosporidium* · River water · Riverine indigenous communities

Introduction

The paucity of safe water and proper sanitation can cause severe impact on the well-being and wholesome development of human health. This is evident as approximately 1.8 million child deaths occur each year due to waterborne and water-related diseases, which translates to 4,900 deaths each day due to diarrhoea (Human Development Reports 2006). Recently, the World Health Organization postulated that improvement of water, sanitation and hygiene are able to prevent at least 9.1 % of the global disease burden (in disability-adjusted life years), or 6.3 % of deaths (Prüss-Üstün et al. 2008).

The repercussion of waterborne transmission can be massive and costly as illustrated in the largest waterborne *Cryptosporidium* outbreak, which occurred in Milwaukee, USA, in the early spring of 1993. With an estimated 1.5 million consumers exposed to *Cryptosporidium* contamination of the public water supply, 403,000 became ill and 104 died (Mac Kenzie et al. 1994). This translated to an economic cost of outbreak-associated illness to approximately $96.2 million (Corso et al. 2003). In areas where intestinal parasitic infections are highly endemic such as Malaysia (Norhayati et al. 2003), prevailing conditions of scarcity of water supply and improper sanitation provide conditions which are conducive for the transmission of diseases especially via contaminated water.

Responsible editor: Philippe Garrigues

S. C. Lee · R. Ngui · T. K. Tan · M. A. Roslan · I. Ithoi · Y. A. Lim (✉)
Department of Parasitology, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, Malaysia
e-mail: limailian@um.edu.my

Published online: 21 June 2013