

Makalah **AKADEMIA**

PARASITES IN WATER RESERVOIR

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Have you ever wondered, how much water is there on, in and above the Earth? About 71 percent of the Earth's surface is water-covered, roughly 97 percent found in the oceans (not suitable for drinking, agricultural and industrial purposes) and 3 percent is freshwater (CCAO, 2020). Freshwater resources, such as rainwater that falls from the sky and flows into streams, rivers, lakes and groundwater provide humankind and animals with water they require on a daily basis. Not only that, water is also vital for the life and survival of all plants. The "6th Sustainable Development Goals: *To ensure access to water and sanitation for all*" reflecting how important clean water is. According to the United Nations, approximately 2.2 billion people in the world do not have access to clean drinking water, including 785 million who do not have access to basic drinking water. Millions of people will continue to die each year from water-related diseases such as malaria and diarrhoea unless infrastructure and management improve. The Association of Academies and Societies of Science in Asia (AASSA) vice president Prof Datuk Dr Khairul Anuar Abdullah said that the presence of parasites in both untreated and treated water supply in Southeast Asian countries can be a potential risk for disease transmission (BERNAMA, 2018).

Parasite is an organism that lives on or in another organism, reproducing at a faster rate and causing detrimental effects to its host. Without a host, parasites cannot survive, reproduce and replicate as they need the host's nutrients to fuel its life cycle (Brazier, 2018). Parasites are small, sneaky and they can spread disease on living organisms.

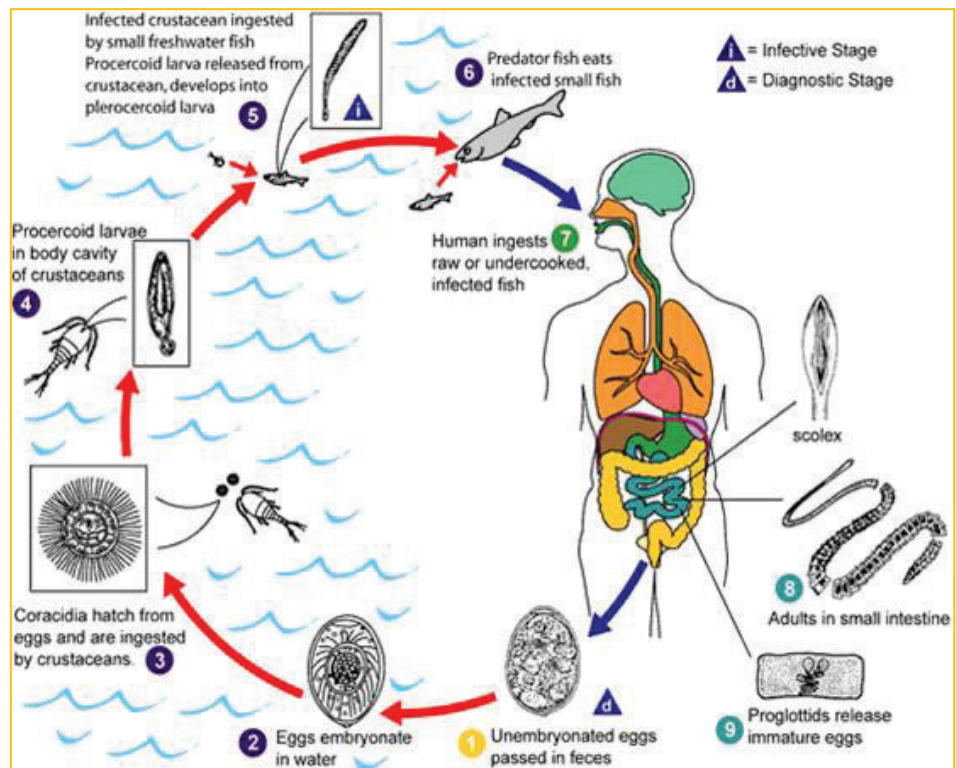
“Some of them use water as a vehicle for transmission to their intermediate or definitive host (Zhou,2012). Aquatic animals such as frog, fish and snail are the most common intermediate hosts for parasites. Let's meet some of the parasite representatives!”

HELMINTH PARASITE

Helminths are worm-like parasites. They are large, multicellular invertebrates that can be seen with naked eye in their adult stages. The helminths include Platyhelminths or flatworms (trematodes and cestodes), Acanthocephalins or thorny-headed worms and nematodes or roundworms (Actor, 2012; Blanchard and Rusell, 2012). This parasite is transmitted to human in many different strategies, and the simplest one, by accidental ingestion or direct contact with infective egg-contaminated water (Bobbi, 2015). In several cases, infection requires an intermediate host vector such as snail, frog and fish. These hosts contain the infective egg or larvae and are taken in when human eats that host. Parasite eggs are very virulent and resistant to disinfection (WHO,2012).

TRANSMISSION OF HELMINTH'S EGGS

Water-transmitted helminths live in the human intestine and their eggs are passed in the feces of infected host. As the host defecates near the water resources such as river or stream, the eggs are released and embryonate in the water. Coracidia escapes from the egg and is ingested by a small aquatic crustacean and develops into a proceroid larva. When the first intermediate host (crustacean) is eaten by a second intermediate host, normally a small fish, the larvae invade the internal cavity of the host and manifest as plerocercoid larvae.



Life cycle of helminths. Source: Actor, 2012.

This larva is contagious and transmittable to humans; humans become infected as they ingest a fish with plerocercoid larvae, mature and turn into adult worms in small intestines.

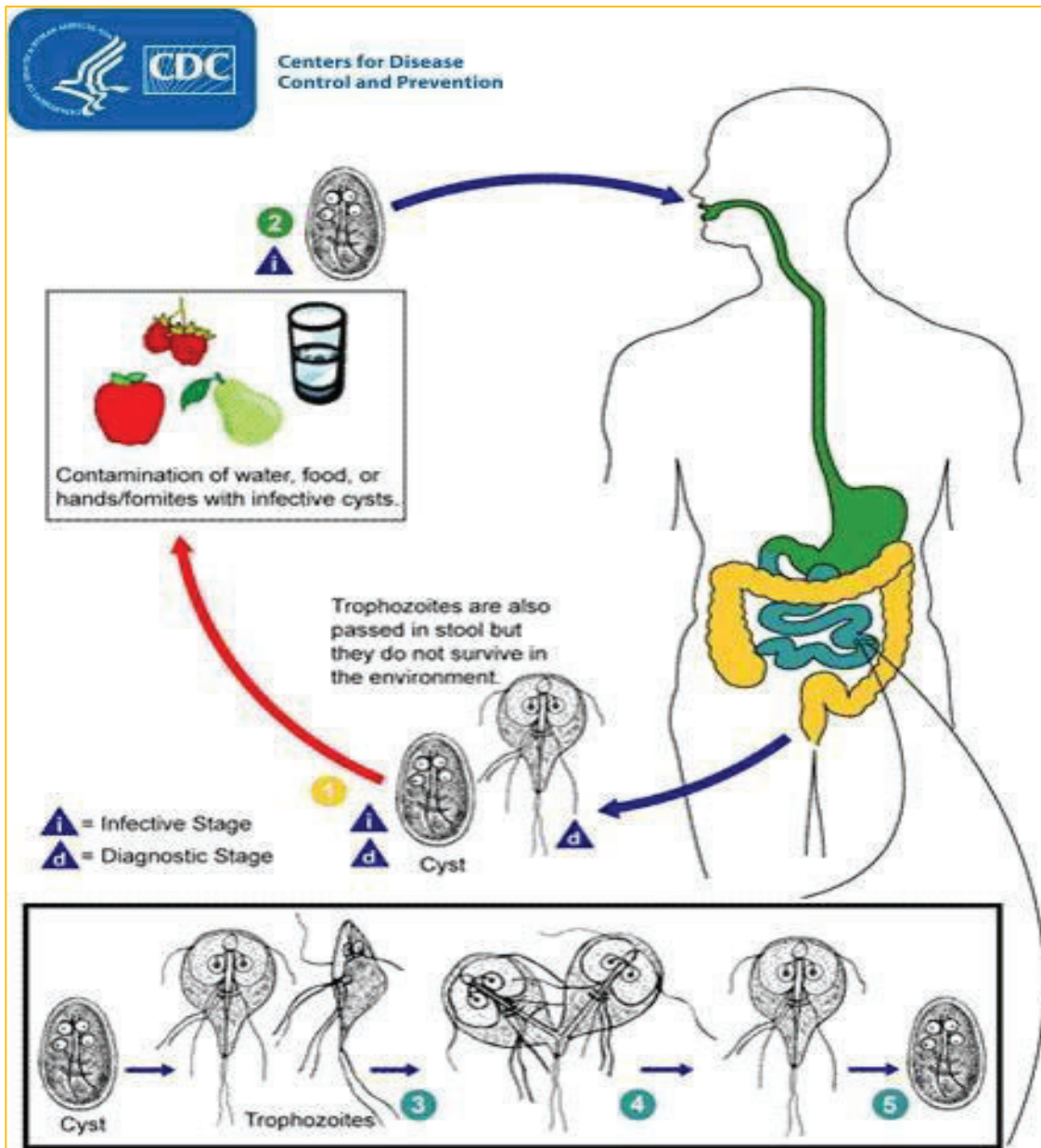
PROTOZOA PARASITES

Protozoa are microscopic, unicellular organisms. Most of them are free living, however, they can multiply in living organisms such as humans and can be transmitted from one person to another. By that, they can be categorized as pathogenic and non-pathogenic organisms (Lynne 2017). This holozoic organism favours moist habitats such as fresh water, marine environments and even in the soil (Saari, 2019). Protozoa are grouped into different groups based on their mode of movements; sporozoa (*Plasmodium*), flagellates or mastigophora (*Giardia*), amoeba (*Entamoeba*) and ciliates (*Balantidium*). Infections caused by protozoa can be spread through faecal-oral (through ingestion of cyst in contaminated food or water), vector-borne and person to person contact (CDC, 2020).

Ahmad *et al.* (1997) mentioned that *Cryptosporidium* sp. and *Giardia* sp. are the common protozoa parasites which cause waterborne disease in Malaysia. This statement can be supported by several studies which revealed in 174 rivers studied in Malaysia are contaminated by *Giardia* and *Cryptosporidium* cysts (Lim *et al.*, 2008) and two sampling rivers in Selangor contained the oocyst of these parasites (Azman *et al.*, 2009). As indicated by Esch (2013), protozoa cyst and oocyst demonstrated a high level of tolerance and adaptation to low temperature.

TRANSMISSION OF PROTOZOA

Both cyst and oocyst of protozoa can cause diseases when swallowed in their infective stage of their life cycle. Infection started when a person unintentionally ingested a cyst or oocyst from fecally contaminated food, water or hands. As the cyst or oocyst enters the human small intestine, each cyst releases two trophozoites.



Each cyst releases two trophozoites via a process known as excystation.
Source: cdc.com

These trophozoites replicate by longitudinal binary fission and stay in the small intestine, where they can be free or attached to the mucosa. As they travelled to the colon, trophozoites transformed back into cyst form and released through feces.



CASES AND SYMPTOMS

Water-borne diseases are generally caused by pathogenic microbes such as bacteria, virus, protozoa or helminth, spread through contaminated water with infected human, domestic and wild animal feces. The dissemination of these pathogens occurs while directly or indirectly contacted with the water for drinking, food preparation and recreational activities. Cases are also associated with consuming raw or undercooked seafood such as fish, crustaceans, snails and even vegetables. The information (Table 1) indicated a few cases which are well documented about water-borne disease caused by parasitic microorganisms.

Other than that, farmers and plantation workers are also exposed to parasitic infection during harvesting and packaging fruits or vegetables which are irrigated and washed with contaminated water (Budu et al., 2012). This statement was supported by Jimenez and Asano (2008) which claimed that about 20 million hectares of cropland are irrigated with contaminated water. In addition, the lack of appropriate safe water supply and sanitation infrastructure is the leading cause of illness and mortality in most developing countries.

Water-borne diseases are still prevalent, particularly in rural areas, because the majority of them relied on open wells, streams and rivers for freshwater resources to drink or bathing (Wynwood et al., 2014). Lack of information, understanding and awareness also contributes to waterborne disease cases in rural areas (Chaisiri et al., 2019). While dysentery and vomiting are the most commonly recorded symptoms, water-borne diseases can also cause respiratory infections, neurological and gastrointestinal illness, skin rashes and sepsis (CDC,2020).

Prevention and Precaution measurement

Water is our most precious global resource. Without water, all living things in this world would die. Hence, access to clean and safe water, proper sanitation, and enhanced hygiene are vital to preserving human health and life. To ensure a continuous supply of healthy water, future initiatives must focus on catchment management through education and improved waste/wastewater technologies.



Table 1: Researches on parasites in water

No.	Activity	Causal parasitic organism	Reference
1	Consumption of raw fish	<i>Kudia septempunctata</i> (myxozoan) <i>Cryptosporidium parvum</i> (protozoan) <i>Anisakis</i> (nematode)	Kawai et al., (2012) Palmer (2002) Machi et al., (1997); Muraoka et al., (1996)
2	Consumption of raw fruits and vegetables	<i>Giardia intestinalis</i> (protozoan)	Mintz et al., (1993); Porter et al., (1990)
3	Swimming	<i>Leptospira</i> sp. (bacteria) <i>Trichuris trichiura</i> (parasitic worm)	Garba et al., (2018) Actor (2012)