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FISH BORNE HELMINTHIC ZOONOSES

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Introduction

Humans suffer from numerous parasitic foodborne zoonoses from fish when they take fish as their food, many of which are caused by helminths. Some of the helminthes zoonoses of concern are transmitted from fish, freshwater, brackish and marine. In the past, these diseases were limited to populations living in low- and middle-income countries, but the geographical limits and populations at risk are expanding and changing because of growing international markets, improved transportation systems, and demog raphic changes (such as population movements). World Health Organization (1995) has estimated that the number of people currently infected with fish-borne trematodes exceeds 18 million, but number of people at risk in world, including those in developed countries, is estimated to be 50 million. The recognition of the public health significance of those zoonoses has increased the heed to explore their links to poverty, cultural traditions, environmental degradation, and the lack of tools for control (World Health Organization, 2004). National public health systems have done very little on fish-borne parasitic zoonoses principally due to none priority in the national public health systems. Resources to fish-borne parasitic zoonoses are generally handicapped by the lack of good data on health and economic impacts. The population of fish eating masses is so significant that the problem of fish zoonoses health significances, economics and designing prevention and control programs requires serious attention by policy makers and scientist. Compared with other well-studied parasitic diseases, fish-borne parasitic zoonoses have been public health orphans in the world of research funding, due in no small measure to insufficient appreciation of a crucial fact that most of them exist as a complex of parasite species whose transmission is often dependent

on well-entrenched human behaviors. Because the modes of human infection are so similar, collectively these zoonoses may in many locations have a much greater aggregate effect than other parasitic diseases. The difficulties of diagnosis, the complexities of human cultural behaviors and the poor understanding of potential economic costs have made this field daunting, obscure and, unattractive to investigators. However, the challenge of developing a prevention and control strategy keeping strong cultural and agricultural traditions in mind provide food for thought to researchers.

Potential fish-borne zoonoses seem to be same as meat-borne zoonoses such as trichinellosis and cysticercosis, far fewer are acquainted with fish-borne parasitic zoonoses like opisthorchiasis, intestinal trematodiasis, anisakiasis or diphyllobothriasis. Nevertheless, fish for these zoonoses are contributing larger share. Some most significant (World Health Organization, 1995) diseases, occurring in various regions are being discussed here.

Trematods

Liver flukes

The liver flukes are a closely related group of trematodes belonging to the family *Opisthorchiidae*. Liver flukes have long been known to cause serious disease in fish as well as human. Cholangitis, choledocholithiasis, pancreatitis, and cholangiocarcinoma are the major clinical problems, associated with the long chronic pattern of these infections. The extent of the problem is difficult to assess due to the lack of comprehensive epidemiological studies. There is evidence that the greatest risk factor for humans, the consumption of raw or improperly cooked or processed fish, is increasing in some regions, facilitated by population migrations and aggravated by commercial activities (World Health Organization, 2004). The causative agents of human infections include *Clonorchis sinensis* in East and Southeast Asia, *Opisthorchis viverrini* in Southeast Asia, *Opisthorchis felineus* in Russia and Eastern Europe and *Metorchis conjunctus* in North America. A total of 26 million people around the world are estimated to be infected with these liver flukes (World Health Organization, 2011).

The intestinal flukes

1. Heterophyids

These minute intestinal flukes of the family Heterophyidae are parasites of birds and mammals. A large number of species have been reported from humans, among which *Metagonimus yokogawai* and *Heterophyes* are generally considered the most important (Yu and Mott, 1994). However, lot many heterophyid species are zoonotic (about 35 species) with similar transmission patterns, as well as a very significant food safety and quality problem, but none has attracted the interest of international agencies until recently. The importance of these flukes are being increasingly understood through recent studies conducted at Philippines (Belizario *et al*., 2001), at Thailand on *Haplorchis taichui* (Sukontason *et al*., 2001) and from Korea on several species including Heterophyes nocens and Metagonimus spp. (Chai and Lee, 1991, 2002). Although generally liver flukes are not considered of significant clinical important, several heterophyid species, including *Stellantchasmus falcatus*, *Haplorchis* and *Procerovum* spp., can cause significant pathology, often fatal, in the heart, brain, and spinal cord of humans (World Health Organization, 1995). The exact mechanisms of pathogenesis responsible are not clear but may be related to invasion of the circulatory system by worm eggs. Disease is usually related to worm burdens, which in some cases can be very heavy (MacLean *et al*., 1999). Another very important issue related to heterophyids is the difficulty of differentiating the eggs from those of the liver flukes in human fecal examinations, which may cause inaccurate estimates of the prevalence of both trematode groups (Chai and Lee, 2002). New diagnostic techniques including PCR are needed to improve specific diagnosis of these flukes.

2. Echinostomes

Trematodes of the family Echinostomatidae are intestinal parasites of birds and mammals. At least 30 genera and more than 200 species are known; about 15 species infect humans (Huffman and Fried, 1990). There are 11 reported fish-borne echinostome species of which *Echinostoma hortense* and *Echinochasmus japonicus* are the most important (Chai and Lee, 2002). Most human echinostome infections have been reported from Asia and the Western Pacific, but infections probably occur also in Africa (Yu and Mott, 1994). The disease is generally mild, but ulcerations and bleeding in the stomach or duodenum may occur, as in *E. hortense* infection (Chai et al., 1994b).

3. *Nanophyetus salmincola*

Nanophyetus salmincola belongs to the *Nanophyetidae* which infects various mammals including humans, dog, cat, raccoon, and fox, and of birds (Beaver *et al*., 1984). It is minute, pyriform, and possesses two large testes in the posterior half of the body. Its snail host is *Oxytrema silicula* and the second hosts are salmonid (trout, salmon) and non-salmonid fish (Millemann and Knapp, 1970). Nanophyetiasis is endemic in the far-eastern part of Russia including Amur and Ussuri valleys of Khabarovsk territory and north Sakhalin (Yu and Mott, 1994). In local ethnic minorities, the prevalence is 20%, and reaches up to 60% in some localities. In the USA, 20 human cases have been reported since 1974 (Eastburn *et al*., 1987). Infected people may experience mild diarrhea, abdominal discomfort, and eosinophilia. In animals such as dogs, foxes, and coyotes, however, the fluke has been shown to be the vector of a rickettsia, *Neorickettsia helmintheca*, which causes a serious and often fatal systemic infection known as 'salmon poisoning', which has not been reported in humans. Another species, *Nanophyetus schikhobalowi*, described from natives of far-eastern Siberia, is regarded as a subspecies, *N. salmincola schikhobalowi*; the major difference from *N. salmincola* is that this subspecies is apparently not a vector for the rickettsial organism (Millemann and Knapp, 1970).

CESTODE

Diphyllobothriasis

This is the most important fish-borne zoonosis caused by a cestode (tapeworm) parasite. Species of the genus *Diphyllobothrium* (Order *Pseudophyllidae*, Family *Diphyllobothriidae*) are responsible for most reported cestode infections in humans. The zoonosis occurs most commonly in countries where it is a frequent practice to consume raw or marinated fish. At least 13 of about 50 species of *Diphyllobothrium* have been reported from humans. All are gastrointestinal parasites as adults in a variety of piscivorous birds and mammals. The intermediate hosts include both freshwater and marine fish, especially anadromous species. Although not generally considered a serious zoonosis, there are indications that its frequency and distribution is increasing in some regions, probably because of social and economic change. Even where it may be declining in humans, the cestode is widely distributed in the wild among fish, wild mammal and bird hosts, a significant zoonotic reservoir (Dick *et al*., 2001).

Nematode

Anisakiasis

Anisakiasis (anisakidosis) refers to infection of people with larval stages of nematodes belonging to the families, *Anisakidae* or *Raphidascarididae*. Although cases of human infection have been reported with worms from a number of species within these families (Beaver *et al*., 1984; Smith and Wootten, 1987; Bouree *et al*., 1995), the two genera most often associated with anisakiasis are *Anisakis* and *Pseudoterranova*. Anisakiasis occurs when people ingest third stage larvae found in the viscera or muscle of a wide range of fish and cephalopod mollusc species. Humans are accidental hosts in the life cycle, and the parasites almost never develop further within the human gastrointestinal tract. Nevertheless, anisakiasis is a serious zoonotic disease, and there has been a dramatic increase in its reported prevalence throughout the world in the last two decades.

Tables

1. Species of liver flukes reported from humans

Species	Molluscan and piscine hosts	Other definitive hosts
Clonorchis sinensis	Freshwater Snails and fish	Dogs, cats, rats, pigs, badgers, weasels, camels Buffaloes
Opisthorchis viverrini	Freshwater Snails and fish	Dogs, cats, rats, pigs
Opisthorchis felineus	Freshwater Snails and fish	Dogs, foxes, cats, rats, pigs, rabbits, seals, lions, wolverines, martens, polecats
Metorchis conjunctus	Freshwater Snails and fish	Dogs, cats, wolves, foxes, coyotes, raccoons, muskrats, minks, fishers

2. Important heterophyid species reported from humans

Species	Molluscan and piscine hosts	Other definitive hosts
Metagonimus yokogawai	Freshwater snails and fish	Dogs, cats, rats
Metagonimus takahashii	Freshwater snails and fish	(experimentally) mice, Dogs
Metagonimus miyatai	Freshwater snails and fish	(experimentally) mice, rats, hamsters, dogs
Heterophyes heterophyes	Brackish water snails and fish	Cats, dogs, foxes, wolves Pelicans
Heterophyes nocens	Brackish water snails and fish	Cats
Haplorchis taichui	Freshwater snails and fish	Cats, dogs, foxes egret
Haplorchis pumilio	Freshwater snails and fish	Cats, dogs, foxes, wolves Pelicans
Haplorchis yokogawai	Freshwater snails and fish	Cats, dogs, egret
Pygidiopsis summa	Brackish water snails and fish	Cats

3. Important fish-borne echinostome species reported from humans

Species	Piscine hosts	Other definitive hosts
Echinostoma hortense	Freshwater snail and fish	Rats, dogs, cats, mice
Echinochasmus japonicus	Freshwater snail and fish	Chickens, ducks
Echinochasmus perfoliatus	Freshwater snail and fish	Foxes, rats, wild boars, dogs
Echinochasmus liliputanus	Freshwater snail and fish	Dogs, cats, badgers, foxes, raccoons
Echinochasmus fujianensis	Freshwater snail and fish	Dogs, cats, pigs, rats

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