CURRENT STATUS OF FOOD-BORNE PARASITIC ZOONOSES IN JAPAN

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Abstract. Progress in public sanitation over the past four decades has greatly decreased the prevalence of soil-transmitted gastrointestinal parasites in Japan. Although food-borne zoonotic parasites also show a similar trend, there continues to be a steady flow of patients infected with the latter parasites. This stems from the traditional popularity among the Japanese of eating raw food, coupled with an increasing fondness for rare delicacies, overseas travel, and consumption of exotic food. These factors have given rise to many reports of anisakiasis, angiostrongyliasis, trichinellosis, capillariasis, gnathostomiasis, paragonimiasis, sparganosis, etc. Food-borne parasitic zoonoses in Japan can be roughly divided into three categories according to the type of food consumed, namely, livestock meat, wild game meat, and aquatic food. The current status of these diseases, including a discussion of the retro- and prospective trends are presented.

INTRODUCTION

The prevalence of soil-transmitted gastrointestinal (GI) parasites in the Japanese population has greatly decreased over the past 40 years because of progress made in public sanitation. Food-borne zoonotic parasites show a similar trend. This has led many people to believe that the problem of human parasitic infection no longer exists in Japan. Nevertheless, the tradition of eating raw food, fondness for rare delicacies, and increased overseas travel among the Japanese today has given rise to greater opportunities for consuming exotic food, which has resulted in increased reports of certain food-borne parasitic infections. In fact, the number of Japanese travelling abroad is estimated to be more than 10 million this year.

In the 1920s, 70% of the total inhabited area in Japan was farmland and classified as rural. There was a high prevalence of GI parasitic infections with ascarids and hookworms among the Japanese population because human waste was used as manure. The prevalence of soil-transmitted parasites can, to a certain extent, be considered an environmental barometer for monitoring the hygienic level of society or community. The Japanese government addressed this problem by conducting its first ever GI parasitological survey in seven villages from 1918 through 1923. The results showed that 86.7% of the those surveyed were infected with GI parasites, a number which is much higher than reported for today's developing countries. This led to the enactment of the Parasitic Diseases Prevention Ordinance in 1932 and the implementation of a policy to eradicate parasites on a national scale. Before 1943, the percentage of positive cases had decreased conspicuously but rose again immediately after World War II (1946-1959) because of the devastation and hardship that followed. However, the government, with help from the private sector, succeeded in continuing the eradication campaign and there was a rapid decrease in the prevalence of GI parasitic infection among the Japanese since then. According to data from the Japan Parasite Prevention Agency, the prevalence of GI parasites among the Japanese in 1987 was 0.23%, and the breakdown of that number is 0.15% in children below the age of 12, and 1.67% in adults.

Adults tend to have a higher chance of being infected because of traditional Japanese eating habits. Most of the food-borne parasitic zoonoses in Japan can be roughly divided into three categories, according to the type of food consumed, namely, livestock meat, wild game meat, and aquatic food. A discussion of the current status

and future trends of these diseases, and foreseeable problems that might arise in conjunction with the lifting of the trade barriers in Japan is presented here.

LIVESTOCK MEAT

Importation of livestock or meat into Japan was only permitted after 1955 and from then on there was a gradual but steady increase. As of April 1991, with the introduction of the free trade system for meat, all the present tariffs on the importation of livestock and meat into Japan will be lifted, and the influx of various infectious diseases into Japan is predicted.

Since animal quarantine in Japan is governed by the Livestock Infectious Disease Ordinance which does not specially identify any parasitic disease, it is difficult to implement any prophylactic measures against imported livestock with parasitic infections under this legislation. However, when imported livestock earmarked for human consumption is slaughtered, jurisdiction falls under the Domestic Animal Slaughterhouse Ordinance. This ordinance states that all livestock to be slaughtered for human consumption must undergo ante- as well as post-mortem inspection for a list of diseases which includes cysticercosis, trichinellosis and toxoplasmosis. The prevalence of *Cysticercus bovis* in local cattle monitored at the slaughterehouse is shown in Table 1. Until the mid 1960s, the prevalence of *C. bovis*-infected cattle was approximately 0.1% but dropped to 0.001% in the 1980s despite an increase in the number of cattle slaughtered. This translates to a greatly reduced chance for the consumers to get infected with *Taenia saginata.*

Cysticercus cellulosae infection in pigs was reported in Okinawa (Ohasi, 1939). However, improvements in pig management after World War II, and an increase in the awareness of hygiene among the people have resulted in not a single case of cysticercosis being reported from any local pig since the late 1960s. Between December 1963 and September 1964, 1.35% of about 6,000 pigs imported from South Korea were found to be infected with *C. cellulosae* (Table 2). The percentage of infected pigs reflects the prevalence of cysticercosis in pigs in South Korea during that period.

Although an average of 24% of pigs throughout Japan were found to be serologically positive for *Toxoplasma gondii* antibodies between 1954 and 1976, the parasite was only isolated from 11% of these animals. There has been a rapid decrease in the number of infected pigs since then. At the Tama and Shibaura slaughterhouses in Tokyo only about 100 cases were detected annually from 1977 to 1982. Since 1983, only about 20 *T. gondii*-infected pigs, one-fifth of the number ten years ago, have been detected annually in these same two slaughterhouses (Table 3). Because the cat is the definitive host of *T. gondii* and occupies an important position in the transmission of the parasite to pigs, a survey of *T. gondii* infections in cats was carried out in the 1970s and it showed an average of 40% positive throughout the whole country. However, when the survey was repeated in 1982, that number dropped to 18.9%. This is

Table 1

Prevalence of *Cysticercus bovis* in slaughtered cattle in Japan

Year	Cattle slaughtered per year (million)	Total condemnation	Partial condemnation (%)
1960	0.667	0	662 (0.100)
1965	0.917	0	1004 (0.110)
1970	0.979	0	133 (0.014)
1975	1.147	2	49 (0.001)
1980	1.190	0	17 (0.001)
1985	1.539	1	15 (0.001)
1989	1.444	0	17 (0.001)

Ref. Kagei (1990)

Table 2

Cysticercus cellulosae infection in pigs imported from Korea to Japan between December 1988 to September 1964

Port of entry	Animal quarantine #			Yokohama		Kobe		Moji	Total
	Yokohama	Kobe	Moji	Yokohama#	Omiya#	Kobe#	Osaka#	Fukuoka#	
No. exam.	39	27	17	1,398	1,518	629	1,410	911	5,949
No. positive	2	0	0	12	19	4	27	16	80
% positive	0	0	0	0.86	1.25	0.63	1.92	1.85	1.35
Site of parasitism									
Head only	0	0	0	0	0	1**	0	4**	5 (0.08)
Trunk	2	0	0	12	19	3	27	12	75 (1.26)
Total condemnation	2	0	0	12	19	3	27	12	75 (1.26)

: Necropsy of dead pig during the quarantine period
* : Slaughterhouse
** : passed inspection after freezing of meat
Ref Kagei (1990)

Table 3

Prevalence of *Toxoplasma gondii* infection in pigs monitored at Shibaura and Tama slaughterhouses in Tokyo

Year	Pigs slaughtered per year	Infected pigs	Percentage positive
1977	638,522	109	0.017
1978	651,260	121	0.019
1979	702,988	116	0.017
1980	700,404	143	0.020
1981	657,743	72	0.011
1982	610,894	102	0.017
1983	554,494	44	0.008
1984	519,310	44	0.008
1985	571,792	16	0.003
1986	556,363	21	0.004

Ref. Kobayashi (1989)

attributed to an improvement in pig husbandry practices which resulted in a decrease in *T. gondii* infections in pigs, and to stopping the practice of feeding raw meat to cats. These factors subsequently contributed to the decrease in *T. gondii* infection in humans in Japan. Recent data showed that 16% of pregnant women in Tokyo area were sero-positive for *T. gondii;* this is two-thirds the number obtained ten years ago (Kobayashi, 1989). Nonetheless, *T. gondii* infection in humans as an opportunistic pathogen in immunosuppressed individuals has generated substantial interest in recent years, and further attention is warranted.

Since no definitive examination of imported pork for *Trichinella* has been carried out, the actual status is not known. A human case of trichinellosis has been reported and the consumption of pork imported from Canada has been implicated (Takahashi *et al,* 1988).

WILD-LIFE MEAT

With the recent increased craving for gourmet food and an almost non-existent religious restriction on food among the Japanese, and increase in parasitic infections due to the consumption of local and imported wildlife meat is predicted. This is because there is no law controlling the importation of wildlife or meat into Japan, with

the exception of endangered species cited in the Convention on the International Trade on Endangered Species. One of the main reasons for the occurrence of infection is eating wildlife meat raw on the belief that it bestows extra stamina or energy. Normally wildlife meat is cooked before consumption. Consumption of local bear meat raw was the cause of all three outbreaks of trichinellosis in Japan and *T. spiralis* larvae have been detected in bear meat imported from China (Yamaguchi *et al,* 1985).

Eating of uncooked snake and frog has led to *Mesocestoides lineatus,* and both larval and adult *Spirometra erinacei* infections in humans. Although *M. lineatus* normally parasitize the small intestine of dogs and cats, 15 human cases of *M. lineatus* infection have been reported in Japan (Kagei, 1988). Patients were infected after eating raw snake heart, which is thought to be an invigorating agent. Viper and garter snake serve as the second intermediate host for *M. lineatus* and the larvae developed to maturity in humans. Between 1971 to 1988, 121 cases of sparganosis and 11 cases of *S. erinacei* adult worm infection in humans have been reported.

Following the first report of human angiostrongyliasis in Okinawa by Simpson *et al* (1970), 18 cases in Okinawa and 6 cases in the main islands of Japan have been reported. These infections were due to eating food contaminated with *Angiostrongylus cantonensis* third-stage larvae-infected slugs or giant African land snails, and also to the consumption of the infected-molluscs as a remedy for asthma. However, in recent years, awareness of the disease and the enforcement of precautionary measures have brought the disease under control and there are no longer any patients in Japan.

Although the normal source of *Paragonimus westermani* infection in human is the eating of improperly cooked river crabs, ingestion of raw flesh of wild boar harboring immature lung flukes has also been implicated in Kyushu (Miyazaki *et al,* 1978).

AQUATIC FOOD

The centuries-old Japanese custom of eating raw fish as sushi or sashimi has always presented a health risk for parasitic infections. Between 1980 and 1981, of the 1,424 cases of anisakiasis, 73% were due to *Anisakis simplex* larvae and 11% to *Pseudoterranova decipiens* larvae (Koyama *et al,* 1983). The rest of the cases could not be determined because of insufficient information on the larvae extracted from the gastrointestinal tract. Ishikura *et al* (1988) summarized the number of anisakiasis cases in Japan. As of June 1987 there were 4,882 cases. Due to the common occurrence of anisakiasis, many physicians do not even bother to report it. In the case of gastric anisakiasis, the larvae can easily be removed using a gastrofiberscope. However, intestinal anisakiasis may cause ileus which necessitates a surgical operation. In some cases, no larva could be found in the resected lesion. This implies that more clinical cases of intestinal anisakiasis will become known when there are improvements in the diagnostic procedure.

Three cases of *Capillaria philippinensis* infection in humans have been reported in Japan (Nawa *et al,* 1989). It has been postulated that the parasite might have been brought to Japan by migrating birds and transmitted to fish in Japan, where raw fish is a delicacy.

Bolbosoma sp., an acanthocephala, has been reported to infect human in Japan following the consumption of bluefin tuna, a marine fish (Tada *et al,* 1983).

Increasing affluence in Japanese society has enabled the ordinary Japanese to be able to buy the once too-expensive Japanese sweetfish "Ayu" and "Sakura masu" (cherry trout). This implies that more people will be at risk of being infected with *Metagonimus yokogawai* and *Diphyllobothrium latum,* two parasites which utilize fish as second intermediate hosts.

Creeping eruptions in the skin of patients in the Kansai area were noted after swallowing small live loaches which had been imported from Southeast Asia. It was later discovered that the cause of the lesions was the migrating larvae of *Gnathostoma hispidium,* a nematode of pig found mainly in Southeast Asia (Takada, 1989). Reports of *Gnathostoma*-infected loaches imported into Japan was reviewed by Kagei (1990). Recently, larvae of *G. nipponicum* were recovered from patients with similar cutaneous lesions who had eaten loaches from Mie prefecture (Ando *et al,* 1988). *G. nipponicum* is a parasite of the local weasel. Dermatitis due to the migrating larvae of *G. doloresi* a

parasite of wild boar, has also been reported in patients in Kyushu. Although the source of infection was not clear, it was thought that the consumption of raw freshwater fish is responsible (Ogata *et al,* 1988).

In recent years, many cases of *Paragonimus miyazakii* infection were seen among Japanese who had eaten improperly cooked local river crab (Takada, 1989).

As stated above, the risk of parasitic infection does not only lie in the consumption of imported meat or aquatic food, but also in local foods. With changes in the eating habits of the Japanese today, there is always a danger of new parasites infecting the human populations via locally produced food.

FUTURE PERSPECTIVES

As of April 1991, the free-trade system for meat will be implemented in Japan, and it is estimated that the quantity of beef imported will increase about fifty folds. As presented above, improvement in animal husbandry has brought parasitic diseases such as toxoplasmosis, cysticercosis, etc, under control in Japan. However, since there is a high prevalence of zoonotic parasites in the livestock in neighboring countries, it is predicted that these parasites will also be imported into Japan along with the animals or their meat.

As mentioned above, trichinellosis infection in humans in Japan was mainly due to eating wildlife meat, although imported pork has also been implicated. Since the mid-1970s, outbreaks of trichinellosis in Italy and France due to the consumption of horse meat imported from Poland and other East European countries has been reported (Mantovani *et al,* 1980; Bouree *et al,* 1979; Parravicini *et al,* 1986; WHO, 1986; Pozio *et al,* 1988). This is alarming because there is a traditional Japanese dish called "Basashi" (made of raw horse meat) that is quite popular. No local horse has yet been reported to be infected with *Trichinella* and, thus, there has been no human infections from horse meat. However, a joint business venture has been set up with Poland to import 200 tons of horse meat annually into Japan, and this warrants some attention (Kagei, 1990).

Since Japan imports 95% of her food, and with the implementation of the free trading system for meat, it is predicted that there will be a great increase in the volume of livestock and wildlife meat, as well as aquatic food, imported into Japan in the near future. This will naturally increase the frequency of food-borne parasitic infections among the Japanese population.

The ideal way to prevent food-borne parasitic infection is to cook food properly or, in certain cases, to freeze it. However, eating raw food is so deeply rooted in the Japanese culture that the aforementioned prophylactic measures are not applicable. Consequently, the best way to prevent food-borne parasitic infections in Japan is to strictly implement meat inspection at the slaughterhouse. Thus, more effort needs to be put into the inspection system.

In the diagnosis of anisakiasis, there is a need for the improvement or modification of the present methods, such as the use of monoclonal antibodies in ELISAs, gastrofiberscope, and ultrasound, so that better therapy can be achieved.

ACKNOWLEDGEMENTS

We would like to thank Drs H Kamiya, T Hara, Y Oku for supplying us with valuable information, Dr M Playford for reading the manuscript and Mrs S Kudo for helping with the bibliography.

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