

Comparison of Parasitological Education in Veterinary Medicine, Medicine and Pharmaceutical Science Departments in Japan

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Abstract : Parasitic diseases, which are not uncommon in Japan, vary in their degree of severity. However, in recent years, topical news reporting on this subject has increased. *Cryptosporidium parvum* oocysts has caused diarrhea in Japanese residents who drank contaminated tap water, and there have been reports of patients with no overseas travel history who developed malaria in Japan. Additionally, Enterobiasis remains the most common parasitic infection affecting infants in kindergarten and nursery schools. While parasitic diseases of this type are a problem, the extent to which parasitology education is covered in the curriculum remains variable among national, public and private intuitions teaching Veterinary Medicine (VM), Medicine (M) and Pharmaceutical Sciences (P) in Japanese Universities. Here, we compared parasitology education in four faculties. Parasitology education among university faculties, in terms of its amount and quality, differs in the order of VM>M>P ~ 0. The presence of laboratory-based practical lessons generally indicates a higher standard of parasitology education. Furthermore, in national examinations, the number of parasitology-related questions differed in the order of VM>M~P; a trend reflecting the amount of parasitological education in a faculty curriculum. Given that Japan has a sub-tropical climate and an international world presence, it is important that education in parasitic diseases is improved across all faculties to which it is relevant.

Key words : parasitological education, Japanese university facilities, national examination

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Introduction

Parasitic diseases, which are widespread in humans, vary in their severity. Typical examples are shown in Table 1¹⁾. In the Infectious Diseases Control Law of Japan, echinococcosis (tapeworm, *Echinococcus* spp.) and malaria (blood parasite, *Plasmodium* spp.) are classified as category IV pathogens because they are infectious diseases transmitted to people through animals, contaminated food and drink, or insect bites, respectively. In contrast, amoebic dysentery (*Entamoeba histolytica*), cryptosporidiosis (*Cryptosporidium parvum*), and giardiasis (*Giardia lamblia*) are classified as category V pathogens. Category V pathogens are under health surveillance in Japan, and

essential public health information about these diseases are released to medical personnel and the general public to help prevent these infectious diseases from occurring and expanding²⁾. Sexually transmitted diseases caused by parasites currently affecting people in Japan include vaginal trichomoniasis (*Trichomonas vaginalis*), pubic lice, and scabies³⁾. In infants and children, pinworm infection is not infrequently prevalent in nursery schools and kindergartens regardless of the season⁴⁾. Therefore, there should be greater awareness of pinworm testing in Japanese elementary schools. In recent years, tap water has on occasion become contaminated with *C. parvum* oocysts during the purification process, and population-wide diarrhea caused by contaminated drinking water has occurred⁵⁾. Diarrhea is rarely

severe in healthy people, but can be life-threatening disease in immunocompromised or immunosuppressed people.

Contamination of various substances with parasitic eggs is also a problem in Japan. For example, Chinese cabbage kimchi imported from China and Korea has transmitted roundworm eggs to pigs and humans that

have come into contact with soil contaminated with it; therefore, it was removed from supermarkets in Japan from 2005⁶⁾. Also, instances of fecal contamination of children's outdoor sandpits with *Toxocara* eggs and enteric bacteria from dogs and cats has occurred, the solution to which is heat treatment of sand, use of enclosures to prevent animal entry, or use of artificial

Table 1. Overview of major parasitic diseases in humans

Type of parasite	Disease	Route of entry	Main signs and symptom	Growth stage in the human body	Other
Echinococcus	Echinococcosis (hydatid disease)	Oral ingestion of eggs (contact with the canines)	Hepatomegaly, liver failure	Grown to larvae from eggs The parasitic on the liver, lung, brain	Infectious diseases Category IV
Malarial parasite	Malaria	From the skin by the blood-sucking of mosquito Anopheles	Fever, anemia, splenomegaly	Red blood cells and liver cells parasitic	Zoonotic diseases, infectious diseases Category IV
Entamoeba histolytica	Amoebic dysentery	Oral ingestion of cysts	Mucous and bloody stool, watery diarrhea, liver and lung abscess	The parasitic on the small intestine, liver and lung	Zoonotic diseases, infectious diseases Category V
Cryptosporidium	Cryptosporidiosis	Oral ingestion of oocysts (such as from drinking water)	Watery diarrhea, abdominal pain, vomiting	The parasitic gastrointestinal	Infectious diseases Category V, an indicator disease of AIDS diagnosis
Giardia lamblia	Giardiasis	Oral ingestion of cysts (such as from drinking water)	Diarrhea	The parasitic on the duodenum, small intestine, gall bladder	Infectious diseases Category V
Trichomonas vaginalis	Vaginal trichomoniasis	From the vagina, urethra in the pelvic examination of obstetrics and gynecology and sexual activity	Vaginitis, vulvitis, urethritis	The parasite in the vagina, mouth, intestinal	Sexually transmitted disease (STD)
Sarcoptes scabiei	Scabies	Skin contact with animals or other people	Skin rash, itching	The parasitic on the cuticle, epidermis	STD
Pubic lice	Pubic lice disease	To the hair, such as sexual activity	Itching, blue plaques	The parasitic on hair and pubic hair section	STD
Pinworm	Enterobiasis	Oral ingestion of eggs	Itching of the anal area, sleep disorders	The parasitic on the cecum	Test with cellophane tape method (perianal spawning)
Roundworm	Ascariasis	Oral ingestion of eggs (from such as raw vegetables)	Pneumonia with eosinophilia, intestinal obstruction	The parasitic on the small intestine	
Anisakis	Anisakiasis	Oral ingestion of larvae (ingestion of raw fish)	Intestinal obstruction, abdominal pain	The parasitic on the stomach, intestines	

Based on the contents of the book of Kamimura et al¹⁾. Typical parasitic diseases described in the text are summarized.

antibacterial sand⁷⁻⁸⁾. These parasitic diseases are unfortunately relatively familiar in Japan.

Until now, as either a teacher or as a student, the authors have been enrolled or affiliated with the pharmacology or medical school departments of Japanese national or private universities. Therefore, we have shared experience of lectures and practical training on parasitic diseases, including zoonotic diseases. One author is currently enrolled in a private School of Veterinary Medicine. Few people are affiliated with a wide range of medical colleges, so the quality of parasitology education will vary according to where the undergraduate has been taught. This is also complicated because the type of education required will depend on the type of career the education is aimed at. Parasitic disease is included in some courses as part of modules on zoonotic disease, but coverage of this important aspect of public health should be more widespread.

In this paper, we report on parasitology education relevant to the specialist field of each author, and will consider the quality of education in Japan from their own perspectives.

1. Relationships between parasitic diseases and target animals

1-1. Wildlife

Parasitic diseases in wild animals are as numerous as they are in people. Regulation of individuals and the number of seed selection is carried out by it. As will be discussed, among infectious diseases, parasites generally have higher specificity for their hosts than do bacteria and viruses. Humans can become infected with parasites from insects, or from wild animals when the parasite is transmitted by eggs from feces within soil, dust and debris, or from close contact with a wild animal.

Echinococcosis is an example of an infection transmitted by wild animals. The disease, which can be severe, occurs after people inadvertently ingest *Echinococcus* eggs excreted in the feces of dogs and red foxes, which are the host animals in Hokkaido. *E. multilocularis* can grow to adult worms in canines, but only to larvae in the human body. Larvae parasitize the lungs, liver and brain of the human host, and produce a cavity (cysticercus) in these organs. With no effective drugs to treat this disease, surgical intervention may be necessary. Hence, hand washing after contact with animals is vitally important.

1-2. Livestock and poultry

Many animals such as cows, pigs, chickens and sheep

do not only eat the diet they are given. As in the case of wild animals, these animals are highly likely to eat dust and soil when grazing. Because many of these animals are kept in the open air, owners are unlikely to dispose of their feces. Therefore, feces from animals housed in close proximity to each other along with insects that are attracted to fecal matter have high potential to transmit parasites. In addition, opportunities also exist for livestock owners to consume parasite eggs and larvae through contact with fecal matter. In the absence of symptoms of parasitic disease, there is risk of becoming an asymptomatic carrier of parasites. In farm animals, parasitic infection not only leads to abortion, but can also cause malnutrition as well as other potentially serious illnesses. Malnutrition is a big problem in farming and is responsible for deterioration of meat quality in domestic farm animals. Hence, there is a need for preventive action to avoid the risk of disease outbreaks occurring in domestic farm animals. As it is not always clear what type of treatment is required, livestock have been killed without a definitive diagnosis being sought or an inspection of the animal taking place. However, not all diseases require the farm owner and neighbors to seek public health advice on zoonotic diseases in the same way as would be required for more serious diseases like BSE and avian influenza.

1-3. Pets

The numbers of dogs and cats that have been bred in Japan are estimated at 11.53 and 9.75 million, respectively (estimates from the Japanese Pet Food Association, accessed November 2012), and the sum of both equal more than the 16.49 million children under the age of 15 (Ministry of Internal Affairs and Communications Bureau of Statistics, accessed May 2013) (Fig. 1). In recent years, opportunities for these animals to live with humans have increased, and they have become more deeply imbedded in human life than livestock. While livestock are used as food sources, companion animals are treated as part of the family. Therefore, it is also necessary to pay attention to hygiene in the home as well as outdoors to prevent transmission of zoonotic diseases from pet animals to humans. Compared to livestock, pet animals often have better access to veterinary care, as indicated by the many animal practices in Japanese towns. Living conditions for pet animals (such as how often the pet is exercised and whether the owner is exposed to its feces) varies between owners, as does feeding-related hygiene; hence, pet owners are at an increased

risk of acquiring a zoonotically transmitted disease unintentionally.

1-4. Humans

Humans can be infected with parasites by ingesting their contaminated-food or -water. The drinking water supply and sewerage system coverage is 97.6%⁹⁾ and 76.3%¹⁰⁾, respectively, and sanitary conditions in houses are relatively good in Japan. Because parasite eggs and oocysts can withstand chlorine disinfection, there is a possibility that domestic water supplies can become a source of fecal contamination from wild animals. Infants are particularly at risk of ingesting pathogens from environments contaminated with pathogens (e.g., parasitic eggs) from wild animals or pet animals when their hands are not washed after playing in high risk areas. Unlike bacterial and viral infections, parasitic infections may be symptomless or the symptoms may be delayed. Furthermore, many parasites are resistant to disinfection when household items are cleaned. Parasitic infections from food, however, occur regardless of the season and all age groups are affected.

With food-borne parasites, the frequency of infection is not high, but ingestion of parasite larvae through eating raw fish and game meat, and ingestion of eggs from unwashed vegetables poses a risk to public health.

2. Zoonotic diseases caused by parasites

Pathological illnesses caused by organisms are defined as infections (except in the case of BSE), regardless

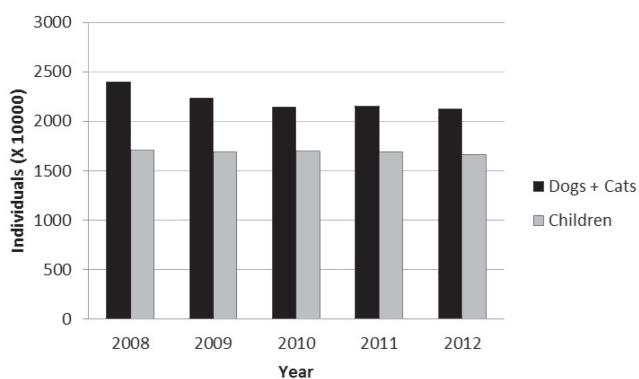


Fig. 1. Trends in the number of dogs, cats and children

The number of dogs and cats represent estimates from the Japan Pet Food Association.

The number of children represents a person under the age of 15 examined by the Ministry of Internal Affairs and Communications Statics Bureau.

of whether the pathogen actually grows within the host. Many parasitic diseases can develop into serious infections. This can happen when a parasite penetrates the body of an animal body unintentionally and cannot grow to its adult stage. An example of this is the nematode *Anisakis* spp., a parasite of marine mammals, the adult of which is parasitic to dolphins and whales. Spawning is also a feature of the host. Normally, the natural host (dolphin) and parasite can coexistence without high morbidity and mortality to the host. When the parasitic eggs invade plankton (e.g. water fleas) via consumption of contaminated fecal matter, they can only develop into the early larval stages. Interestingly, the first time this parasite enters the body of squid and mackerel that feed on plankton, it can develop to the next larval stage. Eventually, *Anisakis* spp. develops into the adult stage after ingestion by whales and dolphins. This parasite cannot develop to adulthood in the human body or grow in the human body, and for this reason, the parasite continues to reside and move within the human body, resulting in diseases such as intestinal- and stomach-anisakiasis.

3. Parasitology education in Japanese university departments

3-1. Veterinary medicine

Parasitic diseases should form a major part of university veterinary medicine lessons related to animals such as livestock. Along with the need for new therapies and parasite surveillance in veterinary medicine, there is also a requirement for teaching classical methods of parasite control. For example, in the case of parasitic diseases caused by mites, observation of the mite's body itself with a microscope may be sufficient to achieve a definitive diagnosis of the disease. In clinical practice, diagnosis is often made based on the presence of parasite DNA and proteins in a sample, and analysis of digitized data is becoming more common. It is estimated that numerous students will, once qualified, go on to practice in veterinary medicine, even though they have not been trained in simple diagnostic analysis of pathological specimens.

The number of universities with veterinary faculties is 16 in Japan. The universities with a course that is linked to the Japanese Society of Veterinary Parasitology comprise 15 schools (Fig. 2, schools are counted as one if there is more than one teaching the same university course). This number does not reflect the quality and content of the lesson taught. But, there is a course that specializes partially in parasitology, and aspects

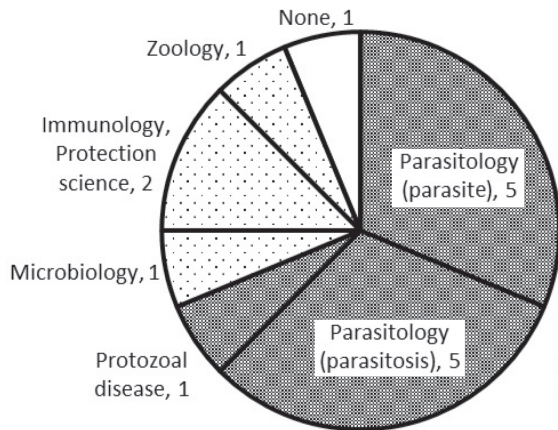


Fig. 2. Name and number of parasitology-related courses for veterinary-related undergraduates

The data represents HP data of the Japanese Society of Veterinary Parasitology in a summarized form¹¹⁾.

Data is distinguished by the parasite name and/or a name associated with the parasite, and/or another relevant name, by filling in the relevant portion.

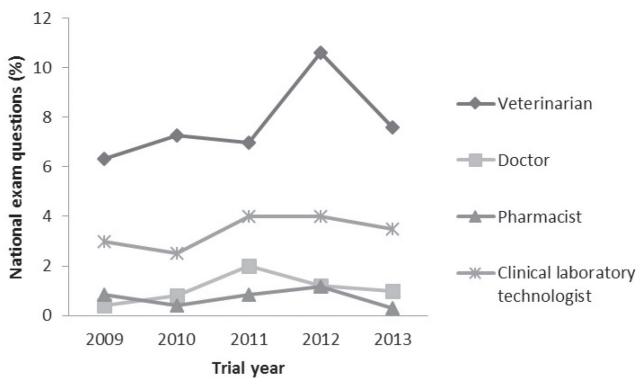


Fig. 3. Percentage of parasitic disease-related questions in national examinations of veterinarians, doctors, pharmaceuticals and clinical laboratory technicians

We observed the past questions for each national examinations from HP of the Ministry of Agriculture, Forestry and Fisheries¹²⁾, the Ministry of Health, Labour and Welfare¹³⁻²⁰⁾ and a preparatory school²¹⁾, and a collection book of past questions²²⁾.

We have compiled the questions where parasite names, growth stages or the word anthelmintic appears in the question or answer choices.

of it include submissions of papers and participation at scientific meetings. The course offered by eleven universities use the word “parasite” or similar names. Courses from other universities, include the words “environment”, “international”, “immunity (quarantine)”, “infection” or “animal”. Students enrolled in these courses can be also considered to have studied bacteria, wildlife and international cooperation, in addition to parasites.

The proportion of parasitology questions in the national test is as high as 7.8% based on the five year average value up to 2013 (Fig. 3). We believe that because there is no cut-off score for each subject, it might be easy to add built-in extra test content even if the educational content for the subject in the university is minimal.

3-2. Faculty of medicine

Surprisingly perhaps, courses covering human parasitology in faculties of medicine are even more fragmented than those in veterinary medicine. The proportion of diseases caused by parasites is a fraction of the total number of human diseases. The majority of parasitology courses primarily teach immunology and infectious diseases. Because non-parasitic diseases

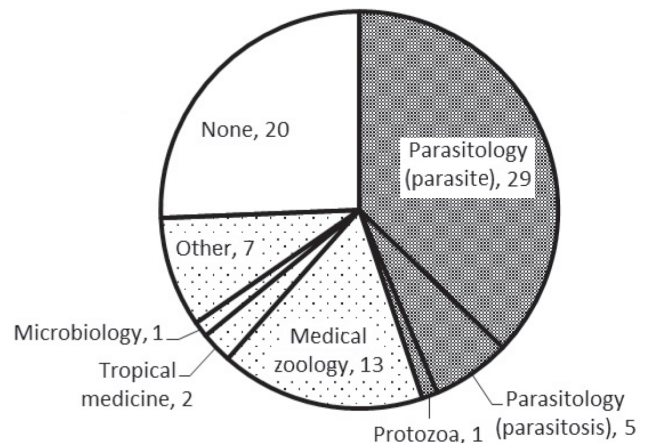


Fig. 4. The number and names of parasitology-related courses in the Tokyo Medical and Dental University school of medicine

Illustrated with excerpts from HP data²³⁾ of the International Environmental Parasitology course, Tokyo Medical and Dental University (secretariat of the Japanese Society of Parasitology).

Names represent parasites or a name associated with parasites, or a related name and data are distinguished by the filling in the relevant portion.

outnumber parasitic diseases in humans, limited teaching about parasitic diseases is the status quo in university education. Because of the situation described above, the amount and quality of parasitic disease education differs markedly between universities, and this is also reflected in the presence or absence of laboratory-based teaching.

The number of university medical schools in Japan is 78. Among them, there are 58 schools with a university course that is linked to the Japanese Society of Parasitology (Fig. 4). Courses that contain the name "parasites" or a word that is similar is 35. Our investigations showed when all relevant medical technicians were included, the percentage of questions related to parasites in the national examination was 1.1% (doctor, no cut-off score) and 3.4% (clinical laboratory technologist, no cut-off score) (Fig. 3).

3-3. Department of pharmacy

In pharmacology education, little is taught about parasitology. There is variation with respect to the degree with which parasitology is taken up by students. For example, anthelmintic drugs are often discussed as part of a lesson, but only in terms of describing the pharmacological action of the component chemicals. Also, anthelmintic plants are covered in herbal science and medicinal botany, but we suspect that little training is carried out in this area and there is no possibility of including more detailed course content. Pharmacology researchers may teach on themes related to parasites, but there are no cases where a parasite name is featured prominently in the course title. Questions on parasites represent a low proportion of the range of questions in the national test at only 0.7% (Fig. 3). The cut-off of each subject is present in the test, but university education is not made as an independent field. It appears that if it is not included in the core curriculum, it indicates that the question is difficult.

For the model core curriculum of the Faculty of Pharmacy, in 2002 (creating initial), specific behavioral objectives (SBO, so-called goals) were shown (vaguely) as one item in microbiology, immunology, and drug therapeutics. However, revisions were made in December 2013. Later, items related to parasites of SBO came to be shown in more detail. Enhancement of parasitology education in the future is expected to be in the pharmaceutical area.

4. Other issues

In veterinary medicine and medical schools, there are multiple courses at first to third level in the fields

of internal medicine and surgery. In contrast, there are many faculties and universities where there are no courses that are parasitology-related, as was mentioned previously. When considering if a parasitology course should be taught in a medical school, the university concerned should determine whether any of the various indigenous and imported parasitic diseases are present in the Japanese prefecture where the university is based.

In Japanese medical schools and schools of veterinary medicine, the number of full-time parasitology faculty members tends to be small. In veterinary faculties, lessons on parasitology are higher as a percentage of the total number of lessons covering all animal diseases. For this reason, there is a need to incorporate better parasitology training into the curriculum and lectures in many universities. However, there is a tendency to reduce the content of parasitic disease training in universities. Currently the need for training in this area is not recognized as an important part of undergraduate education, and unless the situation improves the quality of the education will not produce enough qualified medical staff with an understanding of parasitology. An example of the type of problem poorly trained practitioners might face relates to pharmacists. In Japan, some anthelmintic drugs are widely sold in pharmacies as over-the-counter medicines by technicians lacking parasitology training. There are also many cases of people wanting to travel overseas to developing countries who require preventive medication, and this service is carried out in hospitals. However, the number of experts able to provide advice on tropical parasites is small. Undergraduate education does not adequately prepare pharmacists to give advice on parasitic diseases. Hence, the need exists for a program of post-graduate education in this field.

5. Examples of improvements

As mentioned earlier, parasitic diseases are common and often difficult to diagnose and treat in animals and humans. For prevention and treatment of such diseases, education for doctors, veterinarians, pharmacists and other medical technicians, is indispensable. Educating such personnel is the responsibility of university departments, and this responsibility must come before financial profitability. However, each university is responsible for managing their own courses, setting standards and delivering undergraduate education.

To better develop parasitology education, the following points are essential: 1) better collaboration between

clinical practice and universities, 2) closer partnerships between universities and undergraduate students, and 3) access to further training and professional development such as post-graduate training.

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寄生虫病学教育における獣医学部、医学部、薬学部間の比較

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要 約

寄生虫症は日本において決して多い疾病ではない。またそのすべてが重篤な症状を呈するわけでもない。しかしながら近年、毎年のようにニュース等で話題になっている。クリプトスポリジウムのオーシストの水系汚染により、水道水を飲んだ住民の集団下痢が発生している。また海外渡航歴もない患者が国内でマラリアを発症したという報告もある。蟯虫症は、未だに幼稚園・保育園での乳幼児の集団感染症の主要原因である。このようにこの種の病気は決して軽視できないわけであるが、その為の大学教育の内容や時間数は日本国内の国公立・私立の獣医学部と医学部、薬学部では大きく異なる。今回、著者の在籍経験のある5つの学部での状況を基にそれらの比較・考察を行った。

獣医学部、医学部、薬学部において、研究や高度な教育は獣医学部>医学部>薬学部≒0の順にその度合いは異なっており、これは講座の有無や名称に現れていると考えられる。また国家試験においても獣医学部>医学部≒薬学部の順に出題率が異なっており、授業カリキュラムにおける寄生虫学教育の割合が反映されていると考えられた。

日本の亜熱帯化や国際化を考慮すると、寄生虫症は広い分野で重要な学問であり、これを教育内容に反映させるためには臨床現場との連携や大学間・学部間の提携が必須と考えられる。

キーワード：寄生虫学教育，学部間の違い

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