

# Parasitic zoonotic diseases in Turkey

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## Summary

Zoonoses and zoonotic diseases are becoming more common and they are now receiving increased attention across the world. Zoonotic parasites are found in a wide variety of protozoa, cestodes, nematodes, trematodes and arthropods worldwide and many zoonotic parasites have assumed an important role. The importance of some parasitic zoonoses has increased in recent years due to the fact that they can be agents of opportunistic infections. Although a number of zoonotic parasites are often found and do cause serious illnesses in Turkey, some are more common and these diseases are more important as they cause serious public health problems, such as leishmaniasis, toxoplasmosis, cryptosporidiosis, echinococcosis, trichinellosis and toxocariasis. Information on these zoonotic diseases is provided here as these are the most important zoonotic parasitic diseases in Turkey.

## Keywords

Cryptosporidiosis, Disease, Echinococcosis, Leishmaniasis, Parasite, Trichinellosis, Toxocariasis, Toxoplasmosis, Turkey, Zoonosis.

## Patologie zoonotiche di origine parassitaria in Turchia

### Riassunto

*Le zoonosi e le malattie zoonotiche sono sempre più frequenti e per questo aumenta l'attenzione nei loro confronti. Parassiti zoonotici sono stati identificati su scala mondiale in un largo numero di protozoi, cestodi, nematodi, trematodi e artropodi e molti di essi hanno assunto un ruolo rilevante. Negli ultimi anni alcune zoonosi parassitarie sono aumentate poichè possono essere agenti di infezioni*

*opportunistiche. Tra le parassitosi zoonotiche che causano serie patologie in Turchia, alcune piuttosto comuni, quali la leishmaniosi, la toxoplasmosi, la criptosporidiosi, l'echinococcosi, la trichinellosi e la toxocariasi, costituiscono un problema di sanità pubblica. In questo lavoro si forniscono informazioni su queste zoonosi poichè sono tra le principali malattie parassitarie zoonotiche in Turchia.*

## Parole chiave

Criptosporidiosi, Malattia, Echinococcosi, Leishmaniosi, Parassita, Trichinellosi, Toxocariasi, Toxoplasmosi, Turchia, Zoonosi.

## Introduction

Zoonoses and zoonotic diseases have become more common in recent years and they now attract much attention across the world. Zoonotic parasites are found a wide variety of protozoa, cestodes, nematodes, trematodes and arthropods and a number of zoonotic parasites have assumed a significant role. Furthermore, some of the parasitic zoonoses have gained importance in recent years as agents of opportunistic infections.

Turkey represents a bridge between Europe and Asia. Its surface area extends over 814 578 km<sup>2</sup> and it has seven geographically and climatically different regions and 81 administrative provinces; these points are important in the epidemiology of parasitic diseases. There is no established control programme for any parasitic diseases by government at present. Reports and recording systems for parasitic diseases is not efficient in Turkey, which explains why the true number of cases has been estimated to be greater than the number of officially reported cases.

A number of zoonotic parasites are reported often and they cause serious illnesses in Turkey. However, some are detected more often and these diseases are more important. They cause serious public health problems, such as: leishmaniasis, toxoplasmosis, cryptosporidiosis, echinococcosis, trichinellosis and toxocariasis. Information on these zoonotic diseases is provided in this review on account of their importance as zoonotic parasitic diseases in Turkey.

## Leishmaniasis

The leishmaniasis are caused by 20 species that are pathogenic for humans. These belong to the genus *Leishmania*, a protozoa transmitted by the bite of a tiny insect vector, the Phlebotomine sand fly (2-3 mm in length). Leishmaniasis is present in large parts of Central and South America, Africa, Asia and the Mediterranean. According to World Health Organization (WHO) reports, leishmaniasis is now endemic in 88 countries on five continents with a total of 350 million people at risk and the number of new cases of cutaneous leishmaniasis each year in the world is thought to be about 1.5 million. The number of new cases of visceral leishmaniasis is thought to be approximately 500 000. An estimated 12 million people are presently infected worldwide (58).

Leishmaniasis, caused by three *Leishmania* species, namely: *Leishmania infantum*, *L. tropica* and *L. major*, are endemic in the Mediterranean Basin. These species cause visceral leishmaniasis, anthroponotic cutaneous leishmaniasis and zoonotic cutaneous leishmaniasis, respectively.

In Turkey, human visceral leishmaniasis and canine leishmaniasis, caused by *L. infantum* zymodeme 1 (MON-1), are endemic along the Aegean and Mediterranean coasts and occur sporadically in other regions (36). Anthroponotic cutaneous leishmaniasis is still endemic in regions of south and south-east Turkey (32). In the eastern Mediterranean, cutaneous leishmaniasis is caused by both *L. infantum* and *L. tropica* (42) (Fig. 1).



Figure 1  
Provinces of Turkey in which cases of visceral leishmaniasis have been reported  
Source: Turkish Ministry of Health

The global epidemiology of leishmaniasis is changing with the emergence or re-emergence of the disease in many parts of the world, a change often attributed to population movements, to man-made environmental changes (19) and also to human immunodeficiency virus (HIV) infection (20). Global climatic changes also affect the distribution of vector-borne infectious diseases, including leishmaniasis, in Turkey.

These infections are prevalent where sand fly vectors and mammalian reservoirs exist in sufficient numbers to enable transmission. Phlebotomine sand flies are the vectors of the aetiological agents of leishmaniasis. Several sand fly species, including *P. ariasi*, *P. perniciosus*, *P. neglectus* and *P. perfiliewi*, have been reported to be vectors of *L. infantum* in the Mediterranean Basin (29). Previous studies on sand flies in Turkey have demonstrated the presence of 20 *Phlebotomus* species (or subspecies recently raised to species) that belong to subgenera *Adlerius*, *Larroussius*, *Paraphlebotomus* and *Phlebotomus* (4, 27, 55, 60). Nine of them have been proved to be or could be probable vectors of the Old World leishmaniasis (28). In Turkey, *P. neglectus*, *P. syriacus* and *P. tobbi* have been demonstrated to be the probable vectors of visceral leishmaniasis and, for cutaneous leishmaniasis, *P. sergenti*. *P. tobbi* was found to be positive for *L. promastigotes* in the province of Adana, a region that is endemic for cutaneous leishmaniasis (45).

### Visceral leishmaniasis

Although visceral leishmaniasis has been identified since ancient times, it was not

reported in Turkey until the beginning of the 1900s. The first case was reported from Trabzon city in the region of the Black Sea. Amastigote forms of *L. infantum* were detected in the smears of splenic or hepatic punctions of 11 Ottoman soldiers in Baghdad in 1916. Hafert Kaller reported cases of visceral leishmaniasis in the city of Izmir in the Aegean region in 1918 (51).

Visceral leishmaniasis is endemic in the Aegean and Mediterranean regions and is sporadic in the regions of Marmara, Central Anatolia and the Black Sea. In the last four years, cases have been diagnosed or reported as clusters in 37 provinces in Turkey (Fig. 1).

In the Aegean region, cases reported with visceral leishmaniasis were 55 between 1954 and 1965, and 74 between 1974 and 1980. Since then, the disease has been reported sporadically from many provinces. The number of cases of visceral leishmaniasis reported to Ministry of Health decreased from 71 in 1997, to 34 in 1998, to 22 in 1999 and to 34 in 2000. Of 127 cases reported between 1997 and 2000, 78 (48.5%), 30 (21.3%), 30 (15.7%) and 12 (7.5%) were from the Mediterranean, Central Anatolia, Aegean and Marmara regions, respectively. The number of deaths due to visceral leishmaniasis were reported in 1997 totalled two, one in 1998 and one in 2000; while no death was reported in 1999 (32).

Several diagnostic tests are available to detect anti-*Leishmania* antibodies in human and canine sera. An indirect fluorescence antibody test (IFAT), enzyme-linked immunosorbent assay (ELISA) and direct agglutination tests (DAT) for human and dog sera are available as sero-diagnostic tools in Turkey. These tests combine high sensitivity and specificity (34, 41). In addition, molecular diagnostic tools are used in several research centres in Turkey.

### Cutaneous leishmaniasis

Cutaneous leishmaniasis (with ulcers on the skin) is a zoonosis in most cases (only one species, *L. tropica*, is anthroponotic). Cutaneous leishmaniasis is an endemic anthroponotic disease that is a notifiable disease in Turkey. Although cutaneous leishmaniasis can be traced back many hundreds of years, one of

the first and most important clinical descriptions was made in 1756 by Alexander Russell following the examination of a Turkish patient (58).

Cutaneous leishmaniasis has been referred to as a 'beauty scar', 'Oriental sore', 'Allope sore' or 'annual sore' by people living in endemic areas. Endemic cutaneous leishmaniasis has been reported since 1833, particularly from the south-eastern area of Turkey. The first cultivation of parasites from a cutaneous lesion in Turkey was performed in 1911. Hulusi Behcet, the well-known Turkish dermatologist, described the epitheloid cell layer beneath the sore as a 'stub sign' and stressed its diagnostic importance in 1916 (32, 51).

Cutaneous leishmaniasis is endemic across the Mediterranean and south-eastern Anatolia regions and has also been reported from the Central Anatolia region of Turkey. Cutaneous leishmaniasis is more endemic than visceral leishmaniasis, especially in the south-east and southern regions of Turkey. In the past four years, sporadic occurrence of cutaneous leishmaniasis has been reported in 27 provinces. Of the cases of cutaneous leishmaniasis recorded, 98% were from the south-eastern Anatolia and Mediterranean regions. According to Ministry of Health records, 27 902 patients received treatment for or had confirmed cutaneous leishmaniasis between 1994 and 2005. Of these cases of cutaneous leishmaniasis, 61.6% were reported from the south-east Anatolian region and 33% from the Mediterranean region (Ministry of Health records).

The infectious disease reports and recording system does not function efficiently in Turkey. Consequently, the true number of cases is thought to be higher than the number of cases reported for both cutaneous leishmaniasis and visceral leishmaniasis. Both infections are still significant problems in Turkey, but a decline in the incidence of both infections has been observed in recent years.

The treatment of visceral leishmaniasis and cutaneous leishmaniasis cases is administered free of charge throughout Turkey and all visceral leishmaniasis and cutaneous

leishmaniasis patients have been successfully treated with antimonials. In some cases of visceral leishmaniasis, liposomal amphotericin B (AmBisome [AmBi]) has also been used.

### Canine leishmaniasis

Dogs are the reservoir host of the protozoan parasite *L. infantum* which is transmitted to canines and humans by phlebotomine sand flies (19). The direct role of infected dogs in the epidemiology of human visceral leishmaniasis is controversial (14).

Since clinical manifestations, including weight loss, elongated and deformed nails, mouth ulcers, skin lesions, hair loss, keratoconjunctivitis, dermatitis and lymphadenopathy are only observed in a low proportion of the infected dogs, serodiagnosis has been considered essential when evaluating the prevalence of infection (25).

Canine leishmaniasis is endemic in Turkey. Canine leishmaniasis was first described in Turkey in 1951 in the cities of Bursa and Istanbul (61). Previous studies conducted in the provinces located in the western areas of Turkey revealed that the seroprevalence of canine leishmaniasis ranged between 0.72% and 33.30% in different regions of Turkey (34). Canine leishmaniasis always showed a higher prevalence than human visceral leishmaniasis in all regions studied.

### Toxoplasmosis

Toxoplasmosis is one of the more common parasitic zoonoses encountered across the world. The infection is very common but clinical disease is relatively rare. The prevalence rate is usually higher in warm, humid climates than cold, dry areas and it is also higher at lower altitudes and in older people. The seropositivity rate in human populations is low in children up to 5 years age but then begins to increase and reaches its highest levels in the population aged between 20 and 50 years. The infection or disease also occurs in recipients of organ transplants. Congenital toxoplasmosis is particularly important because of the severity of sequelae

in both the foetus and the newborn. Toxoplasmosis is more severe in immunodeficient individuals, whose condition appears to facilitate the infection (1).

Apart from causing significant economic losses in animal husbandry, *Toxoplasma gondii* also causes toxoplasmosis in humans in Turkey through the consumption of rare or raw meat of infected sheep and cattle (7, 43). There is no reliable information on the prevalence of toxoplasmosis in Turkey and, to date, the incidence of congenital toxoplasmosis is also unknown but the incidence of acute toxoplasmosis in Turkey is not considered to be very high, despite the fact that seropositivity rates are elevated.

Turkish literature published between 1980 and 2000 was reviewed from the point of the epidemiology of toxoplasmosis in Turkey by Saygi (40). The data obtained from this review were collated into five categories and seropositivity rates were as follows:

- hospital patients, 13.9-85.3%
- people who had close contact with animals or those who work in the meat industry, 20.7-57.6%
- apparently healthy people, 23-43.7%
- specific groups, such as homosexuals, haemodialysis patients, 16.3-76.6%
- the prevalence in livestock and domestic animals, 39.5%-78%.

The role of meat-eating habits of people who live in close contact with cats were emphasised among these high rates.

According to Altintas *et al.* (8), anti-*Toxoplasma* immunoglobulin G (IgG) antibodies were found positive in 4 651 (49.4%) of the patients in the Aegean region; 2 287 (21.4%) patients were pregnant women and the positivity rate was 55%. According to the history of these patients, seropositivity was found in 50% of women who had suffered spontaneous abortion, 52% of women who had stillbirths, in 55% women who had abnormal foetal births. In other studies, the seroprevalence of toxoplasmosis was 48.88% in Adana (35), 37% in rural areas in Izmir (64) and 68% in chronic heart failure patients in Kayseri (62). Seroprevalence rates in pregnant women in the

studies performed in the different provinces were as follows:

- 39.6% in Malatya (23)
- 60.4% in Sanliurfa (26)
- 30.1% in Aydin (24).

Acici *et al.* (2) investigated the prevalence of *T. gondii* in the rural areas of the Samsun region in naturally exposed sheep and cattle; they also studied the mechanisms of transmission to humans. Serum samples were collected from 95 sheep, 96 cattle and 72 humans (the owners of the animals). From the 95 samples tested, 47 sheep (49.47%) were positive for IgG antibody to *T. gondii* and, from 96 of other samples tested, 52 cattle (54.16%) were positive for IgG antibody to *T. gondii*. The mean percentage of seropositivity in the 72 farmers was 31.94% (23 people). Due to many factors, including a temperate and humid climate, large numbers of cats, no routine treatment against feline toxoplasmosis, livestock farm management pasturing close to villages for cattle and poor general standards of hygiene, toxoplasmosis was detected at high levels in sheep, cattle and humans in the rural areas of Samsun province.

Recently, one study reported clinical and laboratory findings that were related to active toxoplasma infection associated with 40 immunosuppressed liver transplant procedures in Izmir. Of the 40 transplant recipients, 27 (67.5%) were found to be seropositive for *Toxoplasma* infection and therefore were at risk of reactivated infection. From the serological status of the donors which was ascertained in 38 of 40 cases, 3 (7.9%) of 38 transplants were identified to be from a seropositive donor to a seronegative recipient. In 10 (26.3%) of 38 transplants, both the donor and recipient were seronegative; this excluded *Toxoplasma* as a risk. *Toxoplasma* presents a significant risk to the liver transplant population and polymerase chain reaction (PCR) is a helpful tool when identifying active infections and hence in informing clinical management decisions (15).

Toxoplasmosis has recently become a compulsorily notifiable disease (in 2005), and, since that dated, 33 patients have been

reported (according to Ministry of Health reports).

## Cryptosporidiosis

Cryptosporidiosis is a significant cause of diarrhoeal diseases in humans worldwide, and transmission is usually waterborne or foodborne. To date, this emerging protozoan disease is present in humans around the world, except in Australia and Oceania. Adults and children are infected, more often when immunocompromised by HIV infection (83% of reported cases). To date, at least seven *Cryptosporidium* species (*C. hominis*, *C. parvum*, *C. meleagridis*, *C. felis*, *C. canis*, *C. muris* and *C. suis*) and one genotype (*Cryptosporidium*, cervine genotype) have been shown to be responsible for human infections. Much attention on zoonotic cryptosporidiosis is centred on *C. parvum*. Developing and industrialised countries differ significantly in disease burdens caused by zoonotic species. Exclusive anthroponotic transmission of seemingly zoonotic *C. parvum* subtypes was observed in countries of the Middle East. The use of a new generation of molecular diagnostic tools is likely to produce a more complete picture of zoonotic cryptosporidiosis (38, 59).

There is not much epidemiological information on cryptosporidiosis in Turkey either, apart from some studies conducted in certain provinces by the researchers. According to the data available, Ok *et al.* (31) found 18.8% *Cryptosporidium* spp. in renal transplant recipients in Izmir.

Turkcapar *et al.* investigated the prevalence of *Cryptosporidium* infection in patients who were on chronic haemodialysis due to end-stage renal failure and compared these results with the incidence in the healthy population (49). Stool specimens of 74 adult haemodialysis patients treated on an outpatient basis and 50 healthy individuals were examined for *Cryptosporidium* oocysts by using the modified acid-fast method. While 20.27% (15/74) of patients in the dialysis group had *Cryptosporidium* oocysts in their stools, none

(0/50) of the controls presented any such infection ( $p < 0.001$ ).

In another study, the prevalence of *Cryptosporidium* spp. in Ankara was investigated in faecal specimens from 106 patients with neoplasia and diarrhoea (74 females, 32 males) using Ziehl-Neelsen and Giemsa stains as described by Tanyuksel *et al.* (47). Oocystic forms of *Cryptosporidium* spp. were found in 18 (17%) of these patients.

Tamer *et al.* (46) collected the faecal samples of 707 children and used these to identify *Cryptosporidium* spp. with the modified acid-fast and phenol-auramine staining methods, followed by a modified Ritchie concentration method. All *Cryptosporidium* species isolates were analysed by nested PCR and restriction fragment length polymorphism (RFLP) to differentiate the genotypes of the isolates. After coprological examination, 4 samples were positive for *Cryptosporidium* spp. oocysts. In this study, all 4 oocysts were of zoonotic origin and belonged to *C. parvum* genotype 2, indicating that in Turkey the potential sources of cryptosporidiosis infection of humans comes from animals.

Yilmaz *et al.* (63) investigated the frequency of cryptosporidiosis using ELISA and microscopy and examined its relationship with diarrhoea in Van, Turkey. Stool samples were obtained from 2 000 children with diarrhoea (870 females and 1 130 males aged between 0 and 15 years) who served as study group and 100 children of the same age were randomly selected as a control group. The flotation method was performed first on all stool samples in saturated zinc sulphate solution, after which staining was performed using a modified acid-fast method. All samples were also tested for *C. parvum* antigen by ELISA. Antigen was revealed in 97 (4.9%) of the 2 000 children by ELISA. However, oocysts were only seen in 39 children (1.95%) by microscopy. *Cryptosporidium* spp. were not detected in the control group by either ELISA or microscopy. A significant  $p < 0.001$  relationship between diarrhoea and cryptosporidiosis was found.

Another study was performed to investigate the prevalence of *Cryptosporidium* spp. in workers and slaughtered animals at the Van municipality abattoir in Van (17). A total of 309 faecal specimens from animals (from 167 sheep, 56 goats and 86 cattle) and 87 faecal specimens from workers were examined for *Cryptosporidium* spp. oocysts. Oocysts of *Cryptosporidium* spp. were found in faecal specimens of 22 sheep (13.17%), 6 goats (10.71%) and 7 cattle (8.13%). Intestinal parasites were observed in 34 faecal specimens of workers (39.08%). *Cryptosporidium* spp., *Hymenolepis nana*, *Chilomastix mesnili*, *Endolimax nana* and *Iodamoeba bütschlii* were found in the specimen of one worker (1.14%), *Entamoeba coli* in 4 workers (4.59%), *Blastocystis hominis* (9.19%) in 8 workers, and *Giardia intestinalis* (19.54%) in 17 workers.

Dirim *et al.* (22) found *Cryptosporidium* spp. oocysts a 12-month-old female who presented at Ege University, Faculty of Medicine, Department of Paediatrics, complaining of fever, diarrhoea, respiratory distress and growth-development retardation. The patient was diagnosed with CD40 deficiency (hyper IgM type 3). During the investigation process (which lasted a year) of the case with chronic diarrhoea and necrotic pneumonia, *Cryptosporidium* spp. oocysts were detected in 9 of the 22 faecal examinations and also in transtracheal aspiration liquid examined using the Kinyoun acid-fast staining method.

According to the Parasitology Laboratory of the Ege University School of Medicine in Izmir, faecal samples from 18 806 patients were examined for parasitic diseases between 2003 and 2006 and *Cryptosporidium* spp. oocysts were found in 99 of 18 806 patients (Nevin Turgay, unpublished data). Cryptosporidiosis incidence was higher in summer and early autumn (Fig. 2).

It is known that *C. parvum* and *C. hominis* infections may be spread by contaminated well and tap water. The fact that there is no certain and reliable cure and that the organisms may be found asymptotically in the healthy population increases the importance of cryptosporidiosis. One study has been performed in the Turkish city of Mersin and

surrounding areas (16). A total of 100 samples of water were taken from taps (44 samples), wells (2 samples), the sea (35 samples) and sewage (19 samples) to investigate the presence of *Cryptosporidium* oocysts. *Cryptosporidium* oocysts were detected in five samples of tap water, one sample of well water, one sample of sea water and 4 samples of sewage water.

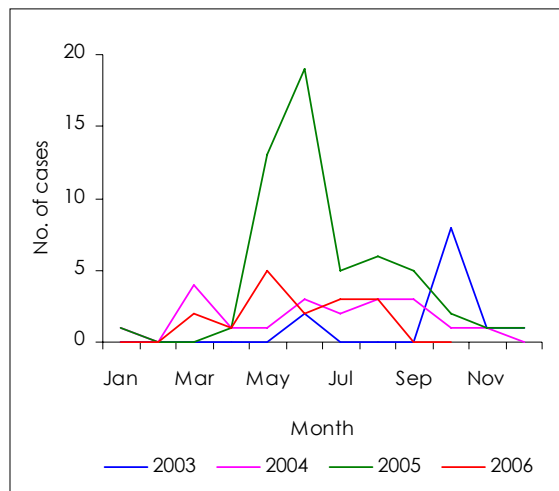


Figure 2  
Distribution of seasonal cryptosporidiosis at the Parasitology Laboratory of Ege University, School of Medicine, Izmir, between 2003 and 2006

## Echinococcosis

Echinococcosis is a chronic disease of humans that has a serious prognosis and is caused by metacestodes of the genus *Echinococcus* (Taeniidae) which include *E. granulosus*, *E. multilocularis*, *E. vogeli* and *E. oligarthrus* species. *E. granulosus* is distributed worldwide and occurs on all continents. *E. multilocularis* is distributed in the northern hemisphere. *E. vogeli* and *E. oligarthrus* are endemic in countries of Central and South America.

Larval infection (hydatid disease; hydatidosis) is characterised by the long-term growth of metacestode (hydatid) cysts in the intermediate host. *E. granulosus* and *E. multilocularis* – the two principal species of medical and public health importance – cause cystic echinococcosis and alveolar echinococcosis, respectively. While both cystic echinococcosis and alveolar echinococcosis are

serious diseases, alveolar echinococcosis has a high fatality rate and poor prognosis if managed incorrectly.

This near-cosmopolitan zoonosis constitutes a public health problem in many regions of Turkey. Although echinococcosis has been recognised in Turkey since 1861, a consistent state policy for disease prevention and control has not been developed and echinococcosis continues to be a major health problem in the country. Echinococcosis is one of the most important helminth diseases in Turkey. Two forms of echinococcosis prevail, namely: cystic echinococcosis caused by *E. granulosus* and alveolar echinococcosis caused by *E. multilocularis*. Cystic echinococcosis occurs throughout Turkey, whereas alveolar echinococcosis predominantly occurs in the eastern Anatolian region. Both cystic echinococcosis and alveolar echinococcosis are known to be endemic but few surveys have been performed. Most data on human cystic echinococcosis and alveolar echinococcosis have been collected from hospitals; only a few population-based epidemiological studies have been performed.

The history of echinococcosis in Turkey was compiled by E.K. Unat who reported that the first identification of hydatid cysts of animals and human was recorded by Anatolian doctors in antiquity (52).

## Cystic echinococcosis

Exposure of humans to *E. granulosus* is common in Turkey due to the lifestyle of the population who live in close proximity to sheep and dogs. Most people live in rural areas and are engaged in animal husbandry. Once a year, a sacrificial festival is held during which a lot of sheep and cattle are slaughtered; the meat of infected intermediate hosts is commonly fed to stray dogs (5). Livestock is also slaughtered for daily meat requirements, with a high proportion of uncontrolled slaughter which facilitates transmission of the parasite. The reported prevalence of cystic echinococcosis in domestic animals in Turkey has ranged from 3.5% to 58.6%, varying widely among locations, with the highest overall

prevalence recorded in sheep, followed by goats, cattle and water buffalo (6, 50).

Dog registration is not compulsory in Turkey and the real number of dogs is unknown; thus, it is impossible to determine the prevalence of *E. granulosus* infection in dogs. According to limited local studies, the prevalence of *E. granulosus* infection in dogs varies widely (from 0.32% to 40%) in different areas of Turkey.

Numerous human cases are reported regularly from medical centres in different parts of the country. According to Ministry of Health records, 52 124 patients had operations to treat or confirm cystic echinococcosis between 1990 and 2005 (this corresponds to 3 257 patients per year). According to some authors, the estimated incidence rate varies between 0.8 and 2.0/100 000 or 0.3-0.087% (6, 65).

The first seroepidemiological conducted study in humans, funded by a grant provided by *Tubitak* (the Scientific and Technical Research Council of Turkey), using the sodium dodecyl sulphate-polyacrylamide gel electrophoresis (SDS-PAGE) and Western blot technique, involved 2 055 people in five villages around Izmir. The results were published by Altintas and co-workers in 1996 (9). According to this study, serum samples were first screened by ELISA and 71 (3.45%) seropositive cases were detected. These samples were examined by indirect haemagglutination (IHA), SDS-PAGE, and Western blotting, and 17 (24%) of them were positive in four tests. However, these patients were not admitted to hospital for further examination (e.g. radiological examination) and the prevalence of cystic echinococcosis in Izmir and surrounding areas was found to be 291 per 100 000 (6/2 055) inhabitants (9).

Province-based field studies using a portable ultrasound scanner were performed to determine the prevalence of cystic echinococcosis in Turkey by several investigators. A total of 6 093 children from 37 primary schools was selected as a representative sample of the total number of 166 766 primary school children, and examined by ultrasound scanner in Manisa

(33). Prevalence was 0.15%, with nine children diagnosed with cystic echinococcosis, seven were new cases and two had been operated previously. A questionnaire devoted to the children revealed no significant relationship between the risk factors and infection ( $p>0.05$ ).

Another community-based mass screening ultrasound study was performed to examine the prevalence of cystic echinococcosis and alveolar echinococcosis in the small, isolated villages surrounding Kars. The study also facilitated the collection of data on risk factors. The people keep large numbers of sheep and cattle and dogs are used as guard animals and are often tethered close to dwellings. A questionnaire conducted prior to ultrasound scanning revealed that hydatid cysts were common in livestock and, when found, were either fed to dogs or discarded where they could be eaten by scavengers. Five patients had small punctuated calcified lesions which could have been abortive *Echinococcus* spp. lesions. Seven (0.3%) out of 2 001 people screened using an ultrasound scanner were found to have images consistent with cystic echinococcosis. Of these, two were cases of cutaneous leishmaniasis, one was cystic echinococcosis 1 (CE1), one was CE2, two were CE3 and one was CE4, based on WHO international classification. Serology for alveolar echinococcosis and cystic echinococcosis (calcified lesions) and cystic echinococcosis for the cutaneous leishmaniasis cases and the CE4 case was performed to further determine the identity of these lesions. Three were found to be cystic echinococcosis and one was alveolar echinococcosis (12).

Although percutaneous treatment (puncture, aspiration, injection, re-aspiration or 'PAIR') of hydatid cysts is relatively new, large series of PAIR have been reported in Turkey (5).

Relatively little information is available on genetic variations of *E. granulosus* in Turkey despite its epidemiological importance. Vural *et al.* (56) reported the circulation of G1 and G3 genotypes in Turkey based on sequence information obtained from the *cox1*. The prominent occurrence of the common sheep strain (G1) in Turkey was recently confirmed



by exclusive detection using PCR-RFLP of ribosomal ITS1 fragment and *cox1* sequencing (53).

### Alveolar echinococcosis

Human alveolar echinococcosis is one of the most lethal cestode infections. In lower Palearctic regions, extending south as far as Turkey and east to Japan, the red fox (*Vulpes vulpes*) is the principal definitive host where predation on arvicoline rodents is primarily responsible for maintenance of the parasite life cycle (44). Alveolar echinococcosis is not as widespread as cystic echinococcosis but is an emerging zoonosis in the Turkey. Alveolar echinococcosis is most prevalent in the eastern and south-eastern regions of Turkey.

Although no detailed information has been published on alveolar echinococcosis in domestic and wild animals in Turkey, the principal definitive and intermediate hosts of *E. multilocularis* are assumed to be red foxes and rodents, respectively. There has been just one report published on *E. multilocularis* in wild animals (in a fox in the north-west of the country in 1965 by Merdivenci (30). There are no reports of *E. multilocularis* in sylvatic animal hosts (5).

The first human case of *E. multilocularis* infection in Turkey was reported by Mutlu in 1939. Uysal and Paksoy (54) examined 20 new cases of alveolar echinococcosis and also reviewed 137 previously reported cases in Turkey. The total number of cases was 157 until the end of 1983. Of the 146 cases that provided information on the place of occurrence, 133 (91%) were from the eastern and central parts of Turkey or the region of the Black Sea where a cold climate prevails. This area should be considered as part of the geographic distribution of *E. multilocularis* which extends from the Caucasian Republics (Azerbaijan and Georgia) to Siberia in the Russia. Most of the cases (76%) occurred between the ages of 30 and 50; 53% were males. A total of 139 cases (92%) were liver infections and most cases (60%) were clinically diagnosed as liver tumours.

Between 1980 and 1998, a total of 202 new alveolar echinococcosis cases were reported.

Age distribution ranged from 7 to 70 years, the mean age was 33.8 and the peak age varied from 31 to 46 years of age; 41.18% were males and 58.82% were females in 119 subjects. The female predominance in Turkey is probably due to fact that, in general, women are equally or more involved in farming and herding than men (10).

The first seroepidemiological study on alveolar echinococcosis in Turkey was performed between 2001 and 2002 (11, 37). In this study, blood samples were collected from 485 participants from the villages of Diyarbakir, Batman, Siirt and Mardin provinces located in the south-eastern regions and 250 blood donors who provided blood to the Blood Centre of Dicle University School of Medicine between October 2001 and October 2002, were examined for the presence of anti-*E. multilocularis* antibodies using ELISA and Western blotting. Of the 485 individuals, 17 were considered to be positive in Em2-ELISA and none of the blood donors in the control group revealed a positive result. The difference was statistically significant ( $p < 0.05$ ).

As the reporting and recording system for infectious diseases has not operated effectively in Turkey, the true number of cases of both alveolar echinococcosis and cystic echinococcosis is considered higher than the number of cases reported. However, recently alveolar echinococcosis was also included in the list of diseases that require notification to the Ministry of Health, so we are hoping that reliable data can now be compiled.

All the above data clearly show that echinococcosis is not limited to certain regions but is a widespread problem in Turkey.

### Trichinellosis

Very few outbreaks of trichinellosis are observed in Islamic countries, given the religious belief to not to eat pork.

An outbreak of trichinellosis occurred in Izmir between January and March 2004. The source of infection was raw meatballs that had been made with a mixture of uncooked beef and pork. In Turkey, raw meatballs are usually made with minced beef, tomato paste and hot

spices but beef that had been illegally mixed with pork of unknown origin was sold by a wholesale butcher to restaurants and street vendors at a lower price than the prevailing market price of beef and this caused the large outbreak in a country with a predominantly Muslim population. A total of 1 098 people who had consumed this food either in 14 restaurants or from the street vendors located in three different neighbourhoods, consulted six different health care centres with a wide range of clinical signs and symptoms. Of these patients, 418 (38.1%) fulfilled the criteria for the diagnosis of acute trichinellosis. The age of patients ranged from 3 to 70 years (3).

Of 474 patients who were admitted to the Atatürk Training and Research Hospital in Izmir during this period with a history of raw meatball consumption, the diagnosis of trichinellosis was confirmed in 154 patients (32.5%, 87 males and 67 females with a mean age of 31 years and an age range of 6 to 67 years). Among the patients with confirmed diagnosis, 79% had myalgia, 77% weakness and malaise, 63% arthralgia, 40% jaw pain, 68% fever, 63% periorbital and/or facial oedema, 49% oedema of the trunk and limbs, 42% abdominal pain, 40% nausea and vomiting, 28% diarrhoea, 23% subconjunctival haemorrhages, 25% macular or petechial rashes, 4% subungual haemorrhaging, 15% cardiac complaints and 0.2% neurological complaints. Nine patients (5.8%) were hospitalised due to severe myalgia ( $n = 2$ ), high fever ( $n = 3$ ), neurological symptoms ( $n = 1$ ), thrombophlebitis ( $n = 2$ ) and palmar erythema ( $n = 1$ ). Eosinophilia was present in 88% of the confirmed cases upon admission. Elevated levels of serum creatine phosphokinase, lactic dehydrogenase and aspartate amino-transferase were detected in 72%, 70% and 16% of confirmed cases, respectively. All confirmed cases recovered without clinical sequelae (48).

Larvae from both meatballs and human biopsies were identified by E. Pozio as *Trichinella britovi* by PCR.

## Toxocariasis

Human infection with *Toxocara* spp. was first described by Wilder (57) in 1950. He identified a nematode larva of unknown species in a retinal granuloma of a child. *T. canis* and *T. cati* are very common parasites of most domestic and semi-domesticated dogs and cats, particularly young animals. Even animals sold through reliable kennels and pet shops can harbour adult worms. This is because, as stated in the section dealing with its life cycle, puppies and kittens acquire *Toxocara* juveniles transplacentally from the infected mother. Therefore, having a litter of puppies in the home has been identified as a significant risk factor (21).

Outdoor parks in urban and suburban settings are, in most cases, highly contaminated with embryonated eggs of *T. canis* and *T. cati*, since it is in this environment that people routinely walk their pets. Burgeoning populations of urban, semi-wild cats and dogs represent a growing problem in many tropical and subtropical regions and most likely contribute significantly to the maintenance of high levels of *Toxocara* eggs in the environment (21, 39).

Visceral larva migrans and ocular larva migrans are two clinical symptoms that result in definable syndromes and are serious health problems wherever they occur.

Demirci *et al.* (18) investigated the seroprevalence of tissue parasites causing toxocariasis and fasciolosis in patients with chronic urticaria. All cases were analysed for antibodies against *T. canis* and *Fasciola hepatica* using a modified ELISA. The excretory/secretory products of *Toxocara* and *Fasciola* were used as antigens (ES-ELISA) in the test. The highest rate of seropositivity to toxocariasis (29.0%) and the highest rate of seropositivity to fasciolosis (14.5%) were found in patients with chronic urticaria. Fasciolosis seropositivity and total seropositivity of toxocariasis and fasciolosis in patients with chronic urticaria was significantly higher than in healthy controls ( $p < 0.05$ ). Toxocariasis seropositivity in patients with chronic urticaria was not significantly higher than that in healthy controls ( $p > 0.05$ ).

In another study, contamination of soil with feline and canine ascarid eggs in eight playgrounds in Kirikkale, Turkey, was investigated every month from February 2003 to January 2004 (13). Dog faeces were also collected. Eggs of *Toxocara* were observed in 5 of 8 (62.5%) playgrounds examined and in 15.6% of 480 soil samples. The number of eggs varied from 1 to 11. Eggs were observed in soil samples collected in February, March to June, August and November, with embryonated eggs appearing in June and August. *Toxoscaris leonina* and *Taenia* spp. eggs and *Isospora* spp. oocysts were also found in 1.5%, 1.0% and 0.2% of soil samples, respectively. Of 26 samples of dog faeces collected, 7.7% were contaminated with *Toxocara* spp. and 11.5% with *Taenia* spp.

## Conclusions

Parasitic zoonotic diseases are common and they cause serious illnesses and have significant economic repercussions in Turkey. The reporting and recording system for parasitic diseases has not been applied properly, which explains why there is no reliable data on the prevalence and incidence rates of the diseases present in Turkey. However, locally published reports reveal that many zoonotic parasitic diseases do prevail in the country. This is why training and the implementation of control programmes are essential; these should be part of government policy.

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