Analysis of *Toxocara* Infection
Toksokarozes invāzijas analīze

Pēteris Keidāns, Anna Krūklīte, Ruta Medne
Institute of Food and Environmental Hygiene, LLU
LLU Pārtikas un vides higiēnas institūts
e-mail: Ruta.Medne@lzra.gov.lv

Abstract. Several cases of human infection with *toxocara* are registered every year in Latvia. Humans are being infected by *T. canis* and *T. cati.* Epizootical situation was investigated, analysing data from 1 January 1999 to 31 December 2007 of the Public Health Agency. Sand samples of 49 sandboxes of children playgrounds were examined to assess the environmental infestation and possible human infection risk sources. The infection intensity (II) and infection extensity (IE) were established in home and stray dogs and cats as well as IE in foxes. The extensity of *Toxocara* infection (IE) in dogs was 23.03%, in cats IE was 45.10%, but in foxes – 48.0%, as well as both IE and II were higher in stray animals than in home animals. Besides, IE and II were higher in young animals (up to one year) compared to older ones. A very high IE (18.4%) was found in sandboxes of children playgrounds.
Key words: Toxocarosis, *T. canis*, *T. cati*, risk, human.

Introduction

Nowadays dogs and cats are not rarity at our homes. Humans have domesticated these animals and have taught them to be docile and to do various tasks, at the same time creating a risk to contact different parasitizes common to animals and human. Literature analysis shows that in many countries 3-80% of dogs are infected with *Toxocara canis* and surroundings are contaminated with *Toxocara* eggs (Straume, 2004; Акбаев, 1998; Overgauw, 1997; Greene, 1990; Eckert, 1992). *Toxocara* eggs can resist frost, moisture, sharp pH change, and can survive in the soil from one to two years. If the dogs or animals of other species, or humans (non-specific host) swallow embrionised parasite eggs, the larvae hatch in the small intestine within one or two days, and then they migrate through the blood stream, liver, lungs, other organs, and tissues causing various lesions.

In puppies, a typical migratory course of *T. canis* is from the lungs to the trachea through the mouth and finally larvae establish themselves in the small intestine were they sexually mature within 10 days. Eggs appear in the puppy faeces in three to four weeks following infection. Infection in young puppies may be responsible for pneumonia, dyspnoea, salivation, weight loss, abdominal distension, dull coat, sometimes vomiting, dermatitis, intestinal torsion, or rupture (Straume, 2004; Eckert, 1992; Акбаев, 1998). In most dogs older than six months and in non-specific hosts, including humans, somatic tissue migration of larvae takes place, when they pass through the lungs to the heart, then through the systemic circulation to various tissues (muscles, kidneys, eyes, brain etc.), and finally they encapsulate retaining vitality for several years (in humans up to 9-10 years). In older dogs, matured parasites usually are found in small number. During the perinatal period, the immunity of the bitch is partly suppressed, and substantial numbers of eggs may be passed in faeces. In pregnant bitches, somatic *T. canis larvae* reactivate on the 40th-42nd day of pregnancy, presumably due to the presence of prolactine and migrate to the placenta where they establish a prenatal infection; or a transmammary transmission occurs when puppies are infected via the milk of the bitch till the 35th day after birth (lactogenic infection). Bitches may infect puppies at the prenatal stage several litters in succession because larvae may remain in the bitch body for several years, and a repeated infection is not necessary (Straume, 2004; Overgauw, 1997; Акбаев, 1998; Greene, 1990; Eckert, 1992). In contrast, a prenatal infection does not occur in cats. *Toxocara* infection more often occurs when cats ingest meat or organs of infected non-specific host, e.g., rodents.

In humans, *Toxocara larvae* during somatic migration may cause lesions in internal organs resulting in *Visceral larva migrans* syndrome: fever, cough, difficulty in breathing, anaemia, eosinophilia, hepatomegaly, weakness, CNS disturbances etc; ocular tissue lesions resulting in *Ocular larva migrans* syndrome: impaired vision, pain, strabismus, occasionally endophthalmitis with a secondary

retinal detachment, uveitis, eyeball abscess etc. The invasion more often occurs as inapparent Covert toxocarosis (Anane, 2006; Kwon, 2006; Zavadska, 2004; Overgauw, 1997; Greene, 1990; Glicman, Scanz, 1987).

Toxocarosis in animals is usually diagnosed by coprological floatation (Fuelleborn, etc.) methods but more rarely diagnosed by immunological methods (ELISA, etc.); whereas in human, diagnosis is based mainly on serological and haematological examinations. In cases of ocular and inapparent toxocarosis, eosinophilia is less expressed, and antibody titre are rather low (Акбаев, 1998; Overgauw, 1997; Eckert, 1992).

The control of toxocarosis is based on preventive measures and treatment by administering fenbendazol, menbendazol, febentel, ivermectin, levomisol, pyrantel, piperazine, and others at the same time treating symptomatically (Zavadska, 2004; Straume, 2004; Macpherson, 2000; Keidāns, 1998; Greene, 1990; Eckert, 1992). *Ocular larva migrans* cases are treated surgically and by local administration of corticosteroids (Zavadska, 2004).

The epizootical situation and toxocarosis distribution should be found out to control and prevent this infection successfully.

Hypothesis: stray animals and foxes are risk factors for human infection of toxocarosis.

The aim of the research was to find out the risk of *Toxocara* infection in humans, and to evaluate the epizootical situation in Latvia.

The following tasks were set:

- to investigate the epizootical situation of human toxocarosis in Latvia;
- to determine the distribution of toxocarosis in cats and dogs;
- to assess the infection level in foxes as a risk factor of toxocarosis;
- to determine risk factors of human toxocarosis.

Materials and Methods

The present investigation of epizootical situation of *Toxocara* infection in Latvia was based on statistical data obtained from the Public Health Agency about human infection with toxocarosis during the period of time from January 1999 to 31 December 2007.

Sand samples of 49 sandboxes of children playgrounds were examined to assess the environmental infestation by *Toxocara* eggs and larvae.

The nature of *Toxocara* infection of dogs and cats depending on the animal age, sex and lifestyle was determinated by coprological examination of standardised Fuelleborn technique (Акбаев, 2006; Keidāns, Krūklīte, 2000). Faecal samples of 521 dogs and 93 cats were examined during the investigation.

Helminthological necropsies of 48 wild foxes were performed according to K. Skryabin technique (Акбаев, 2006; Keidāns, Krūklīte, 2000). Foxes were acquired from hunters.

The nature of *Toxocara* infection of dogs and cats was determined depending on the animal age, sex and lifestyle. The risk of human infection was assessed by statistical methods.

The infection intensity (II) was calculated by the formula:

$$\boldsymbol{I} = X \pm S_X (\lim X_{\min} ... X_{\max}), \quad (1)$$

where $X \pm S_x$ – the number of parasites or eggs in one sample.

The infection extensity (IE) was calculated by the formula

$$\boldsymbol{E} = (X_{(\text{infected})} / X_{(\text{examined})}) \cdot 100. \quad (2)$$

Parasitological examination was carried out in the parasitology laboratory of the Institute of Food and Environmental Hygiene of Latvia University of Agriculture.

All data analyses were performed using the statistical methods (Arhipova, Bāliņa, 2000).

Results

The statistical data of the Public Health Agency show evidence that people were *Toxocara* infected from January 1999 to 31 December 2007 (Table 1).

The data given in Table 1 suggest that the number of *Toxocara* infected people fluctuated reaching the highest number of 149 cases in 2002 and the lowest number – 9 cases in 2006. In 2007 the number of infected people was 10, i.e., 0.44 of cases per 100,000 inhabitants that is 85.1% less than in 2002.

There were 498 people infected by toxocarosis from 1999 to 2003, including 355 (71.3%) in the cities and 143 (28.7%) in the country. Most of infected people amounting to 329 (66.1%) were in Riga (Epidemioloģiskie biļeteni, 1999-2003).

When establishing *Toxocara* infection in dogs and cats, animal lifestyle, age, and sex were taken into consideration.

Samples of dog and cat faeces were coprologically examined. The extensity of *Toxocara* infection (IE) (Fig. 1) in dogs was 23.03%, in cats IE – 45.10%, and in foxes – 48.0%.

As to the extensity of *Toxocara* infection (IE) according to dogs and cats lifestyle, we found out that intensity of *T. canis* infection in stray dogs (35.7%) was significantly higher ($p<0.05$) than in home dogs 13.05%.

Table 1

Number of *Toxocara* infected people from 1999 to 2007

Year	Number of infected people	Number of infected people per 100,000 inhabitants
1999	41	no data
2000	77	3.16
2001	104	4.4
2002	149	6.35
2003	127	5.45
2004	66	2.85
2005	100	4.34
2006	9	0.35
2007	10	0.44
		average (2000-2007)
Total	**642**	**27.34**

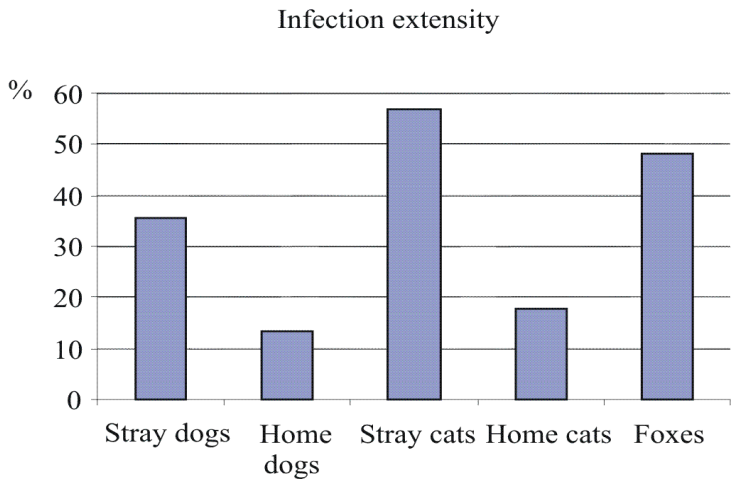

Fig. 1. Extensity of *Toxocara* infection (IE) in dogs and cats by their lifestyle, and in foxes.

As to cats lifestyle, we found out that intensity of *T. cati* infection in stray cats was 56.9% that is significantly higher ($p<0.05$) than in home cats (17.80%), consequently creating a higher risk for people to get *Toxocara* infected.

Analysing the intensity of *Toxocara* infection (II) according to dogs and cats lifestyle, Figure 2 shows that II is significantly higher ($p<0.05$) in stray cats (the mean 6±0.7 eggs per drop) and in stray dogs (the mean 8±2.0 eggs per drop) compared to home animals. The lowest II is in home dogs. Comparing II in home dogs and home cats, the data show evidence that II in home dogs is significantly lower ($p<0.05$) than in home cats.

The data of Table 2 demonstrate that intensity ($p>0.05$) and extensity ($p>0.05$) in male dogs and bitches do not differ significantly.

Investigations carried out in male and female cats show that IE was 47.6% in male cats and 37.5% in female cats meaning that the contact with male cats is more risky (Table 2).

Coprological examinations presented in Table 3 show that extensity of the infection is the highest in dogs up to one year of age – 82%, also II is the highest in this group 6±2.0 (eggs per drop) that might be associated with prenatal or/and lactogenic infection of puppies. The same situation is seen in cats (Table 3): coprological examinations show that the highest IE and II are observed in younger cats up to one year of age: 58.3% and 7±1.2 (eggs per drop) respectively.

Alongside coprological examinations, samples of 49 sand boxes of children playgrounds were examined for the presence of eggs or larvae of *Toxocara*. Nine

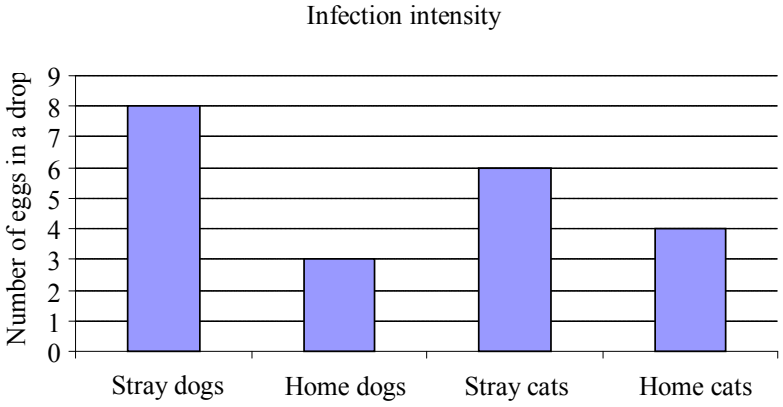

Fig. 2. Intensity of *Toxocara* infection (II) in dogs and cats by their lifestyle.

Table 2

Intensity of *Toxocara* infection (II) in dogs and cats by their sex

Sex	Number of examined samples	Number of infected animals	Infection	
			extensity, %	intensity, number of eggs per drop ±standard error
Male dogs	39	6	15.3	3±0.8
Bitches	40	5	12.5	2±1.1
Male cats	21	10	47.6	4±1.2
Female cats	24	9	37.5	3±0.8

Table 3

Intensity and extensity of *Toxocara* infection (II) in dogs and cats by their age

Age, years	Number of examined samples	Number of infected animals	Infection	
			extensity, %	intensity, number of eggs per drop ±standard error
Dogs (0–1)	67	55	82.0	6±2.0
Dogs (1–3)	21	16	76.1	3±0.4
Dogs (older)	18	8	44.4	2±0.9
Cats (0–1)	48	28	58.3	7±1.2
Cats (1–3)	15	14	31.1	5±0.8

sand boxes were Toxocara infected with extensity of the infection 18.4%.

Figure 3 presents the most important sources of *Toxocara* infection risk in humans. The highest contamination of environment comes from stray cats (40% of cases), and a little less from stray dogs (25%). Sand boxes may be the source of infection in 13% of cases.

Discussion

An increased tendency of human morbidity by toxocarosis in Latvia was seen up to the year 2002, after that it decreased, while in 2007 it increased again. The information of Public Health Agency shows that in 1999 toxocarosis was diagnosed for 41 persons, but in 2002 – already for 149 persons. The number of diseased people per 100,000 inhabitants increased more than three times in these years (Epidemioloģiskie biļeteni, 1999-2007).

This investigation assessed several risk sources of human toxocarosis. The risk of *Toxacara* infection is greater when contacting with cats than dogs. Considering that *Toxocara* eggs stick to the animal

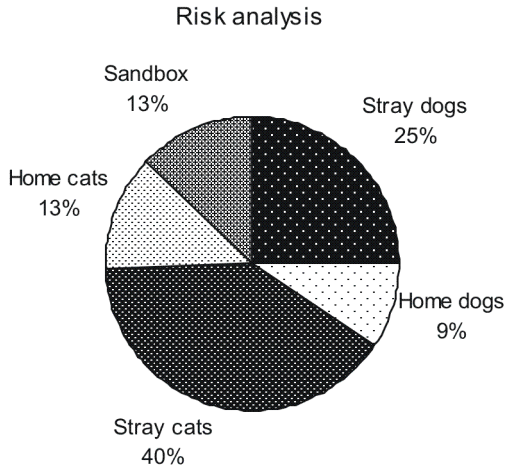

Fig. 3. Risk of toxocarosis.

hair (Buijs et al., 1994), it is important to wash hands after the contact with animals.

Habluetzel et al. (2003) established that IE (64.7%) in hunting dogs in Italy was higher than in other home dogs. The fact that hunting dogs have a contact with contaminated environment in the forests might explain this phenomenon. The present investigation revealed that IE 35.7% of stray dogs is significantly higher than IE 13.5% in home dogs. It might be explained by the weather conditions as in Latvia winters are colder than in Italy; therefore a survival ability of parasite eggs and larvae is reduced.

As *T. cati* infection was established in home cats, it means that a cat litter box is a significant risk factor. The cat litter box should be cleaned every day, and protective gloves should be used.

Literature sources present data that most of morbidity cases by toxocarosis in children are from one to four years of age (Ferreira et al., 2007; Zavadska, 2004; Buijs et al., 1994; Feldman, Parker, 1992; Glicman et al., 1987). According to the data of Public Health Agency about one third of *Toxocara* infected people were children at the age up to seven years. A high-ranking extensity of infection in sand boxes of children playgrounds is an infection risk for children.

Education of people about zoonosis and antiparasitic treatment of pets as well as good co-operation between animal owners and veterinarians would decrease the risk of *Toxocara* infection both in humans and domestic animals.

Conclusions

1. Human toxocarosis in Latvia has affected people of all ages, especially children.
2. Infection intensity and extensity is higher in stray dogs and cats, and most of cases are animals up to one year of age.
3. Foxes are a risk factor for domestic animals and humans because foxes contaminate the environment.
4. Risk of *Toxocara* infection to humans is greater by contacting with cats than dogs.
5. Risk of *Toxocara* infection to humans is greater by contacting with stray dogs and stray cats.
6. There is a risk for children to become toxocarosis infected in the sand playgrounds and playing with young pets.
7. *Toxocara* infected foxes may contaminate the forest environment causing a risk to people to become ill picking berries and mushrooms in forests and consuming without washing them.

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Anotācija

Latvijā katru gadu tiek reģistrēti saslimšanas gadījumi ar toksokarozi. Cilvēkam šo slimību ierosina *Toxocara* ģints nematodes *T. canis* un *T. cati.* Toksokarozes invāzijas epizootisko situāciju pētījām, analizējot Sabiedrības Veselības aģentūras datus laika posmā no 1999. gada 1. janvāra līdz 2007. gada 31. decembrim. Lai novērtētu toksakarozes iespējamos invāzijas avotus, apsekojām bērnu spēļu laukumus, ņēmām smilšu paraugus 49 smilšu kastēs. Noteicām toksokarozes II (invāzijas intensitāti) un IE (invāzijas ekstensitāti) mājas un klaiņojošiem suņiem un kaķiem, kā arī IE lapsām. Suņiem IE bija 23.03%, kaķiem – 45.10%, lapsām – 48.0%, turklāt gan IE, gan II augstāka bija klaiņojošiem dzīvniekiem, salīdzinot ar mājas dzīvniekiem. Arī jauniem dzīvniekiem (līdz gada vecumam) IE un II bija augstāka nekā vecākiem. Ļoti augsta IE (18.4%) bija bērnu rotaļu laukumu smilšu kastēs.