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REVIEW ARTICLE

Epidemiology of human toxocariasis in Poland – A review of cases 1978–2009

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Abstract

Toxocariasis is a helminthozoonosis due to the infection of humans with larvae belonging to the *Toxocara* genus. Humans become infected as a result of accidental consumption of infected eggs containing third stage larvae (L3) nematodes from *Toxocara canis* or *Toxocara cati* species. Toxocariasis was recognized for the first time in the early 1950s, and the first cases of toxocariasis in Poland were described a few years later. Toxocariasis is clinically classified into several types: classic and incomplete visceral larva migrans (VLM) syndrome, ocular larva migrans (OLM) syndrome, neurological toxocariasis (NLM), covert toxocariasis and asymptomatic toxocariasis. In 1994–2005, 18,367 sera of people suspected of being infected with *Toxocara* were analysed, 1.8–76% had anti- *Toxocara* antibodies. In the period 1978–2009, 1,022 clinical cases of toxocariasis were recognized in Poland. In the opinion of the authors, in order to reduce the frequency of toxocariasis in human populations, some prophylaxis should undertaken, e.g. public education of zoonotic diseases, systematic control of animal, deworming of pets, cleaning pets' faeces by the owners.

Key words

toxocariasis, cases, Poland

INTRODUCTION

Toxocariasis. Toxocariasis is a helminthozoonosis. Humans become infected as a result of accidental consumptopn of infectied eggs containing third stage larvae (L3) nematodes classified to the *Toxocara canis* or *Toxocara cati* species [1, 2, 3 4, 5]. At present, *T. canis* is usually considered the etiologic agent of human toxocariasis, but according to Fisher [6], *T. cati* is being under-recognized as a zoonotic parasite. However, in the opinion Li et al. [7], *T. malaysiensis*, which is characterized by low host specificity and shows a great genetic similarity to *T. cati*, may be regarded as a hypothetical species pathogenic to humans.

After ingestion of *Toxocara* infected eggs by human, the eggs get into the intestine where the larvae leave the egg shell. Further migration of larvae is identical to the way they defeated in the body of paratenic host. *Toxocara* larvae have been found in the liver, lungs, heart, eyes and brain of patients with diagnosed toxocariasis [1, 8].

Toxocariasis was recognized for the first time in the early 1950s fifties [1], and the first cases in Poland were described a few years later by Bogdanowicz et al. [2], based on biopsies taken from children with hepatomegaly, anaemia and eosinophilia.

Toxocariasis in humans. Humans become infected following ingestion of infected ova, contaminated food or water. It is known that the consumption of raw, unwashed fruits or vegetables contaminated with *Toxocara* eggs from home gardens can also be a cause of this zoonosis [9]. Studies by Kozan et al. [10] showed the presence of *Toxocara* spp. on 1.5% of unwashed vegetables and fruits. It is probable that the nematode eggs found on the surface of the vegetables come from animal faeces, contaminated with parasites water used for irrigation or compost. Gaspard et al. [11] found *Toxocara* eggs in 43% of samples of compost used for fertilization. Another source is the undercooked meat of paratenic hosts of *Toxocara,* such as chickens, ducks, cattle and rabbits [12, 13].

In addition, human infection is favoured by wrong habits, such as geophagia (soil eating) or onychophagia (nail biting), and general lack of hygiene, eg. lack of hand washing after direct contact with animal fur. Wolfe and Wright [14] found *T. canis* eggs on the hair of 25% out of sixty examined dogs.

The factors favouring infection include: accommodation in rural areas (associated with owning a dog), socioeconomic status (associated with poor hygiene and lack of sewage system) and the type of climate (a warm and humid climate increases the chance of developing invasive forms of parasites, and long-term survival in its environment) [15].

Classification of clinical forms of human toxocariasis. To date, several clinical forms of toxocariasis have been recognized, the most frequent being asymptomatic toxocariasis. However, they are rarely diagnosed forms accompanied by severe pathological changes in a number of internal organs [16]. The manifestation and clinical course are determined by the size of the inoculum, frequency of reinfections, localization of *Toxocara* larvae and the host response [3].

In 2001, Pawłowski [3] proposed a new classification of clinical toxocariasis which included: classic and incomplete VLM (*visceral larva migrans*) syndrome, ocular toxocariasis (OLM), neurological toxocariasis (NLM), covert toxocariasis and asymptomatic toxocariasis.

The classic visceral larva syndrome (VLM) was described by Baeaver et. al. [1]. This is a form characterized by chronic extreme eosinophilia, granulomas lesions in

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the liver, hepatomegaly, pneumonitis, fever, cough and hyperglobulinaemia. According to Pawłowski [3], VLM cases are extremely rare and occur only in small children. An incomplete VLM (iVLM) is more common and is restricted to clinically much less severe cases.

Nematode larvae in the eyes of patients have been described for the first time by Wilder [8], who observed them in the eyeball [24] shelled from patients**.** All the eyes were from children aged 3–13 years, diagnosed with severe retinoblastoma, pseudoglioma or panophthalmitis. Later, nematodes obtained from eyes were differentiated by Nichols [17] as *T. canis*. Changes within the eyes caused by infection with *T. Canis,* defined as inflammation in the vitreous and anterior chambers, granulomas, proliferation of intraocular retinal detachment, intraocular haemorrhages, strabismus and cataracts.

Another form of this zoonosis is neurotoxocariasis (NLM), due to the invasion of *Toxocara* larvae into soft tissue, gray and white matter of the brain or cerebellum, thalamus and spinal cord. Infection often occurs without neurological symptoms of disease, but in symptomatic cases there is no single, well-defined syndrome. NLM is associated with symptoms of CNS in combination with eosinophilic pleocytosis in the cerebrospinal fluid and peripheral blood [18]. According to Dzbeński [18], NLM is a rare form of infection – since 1956, only 30 cases of neorotoxocarosis have been described, including 9 cases without any -neurological symptoms.

Another form of toxocariasis is its covert form [16], characterized by the lack of signs and symptoms which normally allow diagnosis of VLM, OLM or NLM. Covert toxocariasis depends on the local reaction of the organism to the presence of *Toxocara* larvae [3]. This type of toxocariasis is characterized by pulmonary involvement (asthma, acute bronchitis, pulmonitis, Loeffler syndrome), dermatological disorders (dermatitis, eczema), lymphodenopathy and myositis [3].

The last form of toxocariasis is asymptomatic toxocariasis, often diagnosed incidentally during serological testing. It is caused by a small number of larvae infestations. This form is often accompanied by eosinophilia [3].

Envoronmental contamination with infective forms of *Toxocara* spp. Studies for the presence of *Toxocara* spp. eggs in the environment have also been carried out in Poland (Tab. 1). Analysis of the results of a number of Polish authors indicate that the highest level of soil contamination is present in the backyards and family gardens. In other analyzed – sandboxes, playgrounds, parks, streets ands squares, the authors obtained different results. Therefore, in the opinion of authors of the presented study, the level of accumulation of invasive forms of zoonotic parasites in selected areas of Poland depends primarily on the economic and sanitary status of population inhabiting these areas.

Seroprevalence of human toxocarosis. The diagnosis of toxocariasis is essentially based on immunological tests because of the difficulty of locating larvae of the parasites in biopsy tissue. Serum samples are examined for the presence of specific IgM or IgG antibodies by enzyme-linked immunosorbent assay (ELISA), based on excretory–secretory (ES) antigens of *T. canis* larvae. In the 1980s in Poland, tests developed in individual laboratories were used, but today only commercial tests are in use.

Table 1. Prevalence of *Toxocara* spp. eggs in soil in public places in Poland 1996–2010

Town	No. of samples	Positive samples		References
		number	%	
Playgrounds				
Kraków	32	16	50	[19]
Lublin	10	5	50	[20]
Poznań	86	1	0.9	[21]
Sandboxes				
Bytom	14	4	28.6	[22]
Kraków	26	3	11.5	[19]
Lublin	38	12	31.6	[20]
Parks				
Kraków	82	15	18.2	[19]
Lublin	50	11	22	[20]
Poznań	132	12	9	[21]
Streets/Squares				
Bytom	55	7	12.7	[22]
Kraków	44	2	4.5	[19]
Poznań	120	9	8	[21]
Warsaw	690	6	26.1	[23]
Backyards				
Bytom	28	5	17.9	[22]
Łódź	300	7	23.3	[24]
Poznań	134	36	27	[21]
Warsaw	255	21	26.4	[25]

According to Magnaval et al. [9], toxocarosis is one of the most common zoonoses in the world, and their **s**eroprevalence survey conducted in Western countries found 2–5% of apparently healthy adults from urban areas had positive result, compared with 14.2–37% of adults in rural areas [26].

In Poland, a country characterized by a warm temperate climate which, in theory, should result in fewer cases of toxocariasis, in 1994–2005 there were about 16.6–75.6% of seropositive results in the groups of people suspected of being infected with *Toxocara* [30, 32]. Detailed serological results are shown in Table 2.

Tabel 2. Seroprevalence of human toxocariasis in Poland 1994–2005

No. of serum	Research time [years]	Percent of positive samples [%]	Age of patients [years] children	adults	Research centre	References
513	1994–1996	1.8–3.1	1–15	ND	Poznań	[27]
2664	1998–2002	14.2–16.2	2–16	ND	Łódź	[28]
754	2001–2002	43	1–18	ND	Łódź	[29]
5607	1995–2002	25.9–46.4	0–14	ND	Warsaw	[30]
8107	1995–2002	16.6–40.3	ND	A		
242	2002	14.5	Ch	ND	Kołaczkowo – village near Poznań	[31]
137	2002	30.7	Ch	A	Lusowo – village near Poznań	
343	2002–2005	75.6	2–16	ND	Warsaw	[32]

ND – research not conducted in the age group; A – people aged over 18 studied; Ch – persons under 18 studied

The results obtained in Poland are similar to those observed in other European countries, e.g. Slovakia, France and the Netherlands, where the presence of anti-*Toxocara* antibodies were detected in 27.4%, 15% and 11% of people, respectively [48, 49, 50]. However, it is known that positive serological results only confirm *Toxocara* infection, hence toxocariasis must be defined on the basis of clinical manifestations and laboratory abnormalities.

Clinical cases of toxocariasis in Poland. This study presents articles collected from Polish publications from 1992–2012, which described 1,022 cases of toxocariasis diagnosed in children and adults in 1978–2009 (Tab. 3).

Table 3. Clinical cases of toxocariasis in Poland 1978–2009

Research time [years]	No. of cases	Age of patients [years]	Clinical form of toxocarosis					Research Centre
			VLM	OLM	NLM	CT	asymptomatic	
1978 1987 1989 (Papierkowski, et al. 1992) [33]	3	2–6	3	-	-	-	-	Lublin
1987 (Sieczko & Patrzałek, 1992) [34]	1	12	1	-	-	-	-	Kielce
1985–1989 (Bakunowicz-Łazarczyk, et al. 1992) [35]	7	6–12	-	7	-	-	-	Białystok
ND (Żygulska-Mach, et al. 1993) [36]	81	3–18	-	21	-	-	-	Kraków
1988–1994 (Juszko, et al. 1996) [37]	74	2–15	-	74	-	-	-	Warsaw
ND (Celińska, et al. 1996) [38]	20	2–18	13	4	1	-	2	Kraków
1994–1996 (Łużna-Lyskov, et al. 2000) [39]	188	< 18	2	48	-	138	-	Poznań
1996–2001 (Zagórski, et al. 2002) [40]	61	5–72	-	61	-	-	-	Lublin
ND (Wędrychowicz, et al. 2006) [41]	3	-	-	-	3	-	-	Kraków
2002–2005 (Dobosz, et al. 2007) [42]	249	1–16	197	52	-	-	-	Warsaw
2004–2007 (Niedworok, et al. 2008) [43]	178	3–18	1	-	-	122	55	Łódź
2004–2008 (Krzesiek, et al. 2008) [44]	9	1–17	9	-	-	-	-	Wrocław
ND (Urban, et al. 2006) [45]	19	7	-	19	-	-	-	Białystok
2008–2009 (Karney, et al. 2010) [46]	26	1–14	26	-	-	-	-	Warsaw
2003–2009 (Wiśniewska-Ligier, et al. 2012) [47]	103	1–14	98	5	-	-	-	Łódź

ND – date of diagnosis of toxocariasis cases not known

CONCLUSIONS

This review article presents an overview of human toxocariasis in Poland. Infection of nematodes from the genus *Toxocara* relate primarily to children due to the low level of resistance and inappropriate behavior, such as unhygienic habits (not washing hands after playing and contact with animals). Adults are usually infected through the consumption of unwashed fruits and vegetables, meat from paratenic hosts of *Toxocara* spp. (chickens, ducks, cattleand rabbits) and dirty hands after work in soil (farmers, gardeners) [10, 11, 12, 13].

Another risk group for toxocarisis are hunters who do not wear the gloves when in contact with the bodies of killed animals (such as foxes) in which the infected eggs of roundworms can be present. The incidence of toxocariasis is closely related to the infection of dogs and cats and by soil contaminated with *Toxocara* eggs. The level of soil or sand contamination with eggs of *Toxocara* spp. in Poland is variable and depends on the location (urban, rural), type of location (e.g, garden, park, sandpit, playground), and the socio economic level of people living in the area.

Analysis of the results of a number of Polish studies indicates that the highest level of soil contamination is present in backyards, where adults rest and children play. Public playgrounds and sandpits are sites where young children play, therefore, due to their behaviour (geophagia, hand-to-mouth activity), such sites also present a high risk of infection [25].

In the prophylaxis of toxocariasis, regulations should be implemented to prevent pet dogs from entering parks and playgrounds, and require the owners to remove their pet's faeces from public areas [15]. Equally important is the systematic de-worming of pets, which would also contribute to the lowing of the level of environmental contamination.

To reduce the frequency of toxocariasis in human populations, some preventive actions should be undertaken, e.g. educational programmes, systematic control of animals, de-worming of pets, and the cleaning up of pets' faeces by the owners.

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