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Geohelminth egg contamination of children's play areas in the city of Lodz (Poland)

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ABSTRACT

The contamination of soil and sand with helminth eggs in children's play areas in Lodz (Poland) was assessed over two seasons using the flotation method with saturated sodium nitrate solution. A total of 88 samples were examined from 7 children's playgrounds from various public parks, 6 sandpits situated in school or kindergarten areas and 9 school sports fields. The differences in the number of positive samples from these sites were significant ($\chi^2 = 21.83$, d.f. = 2 and $p < 0.0001$). The highest rate of contamination was found in the area around sports fields. (15.7%). There was a significant difference between the frequencies of positive samples from the surface and from the deeper layers of the examined sites ($\chi^2 = 11.41$, d.f. = 1, and $p = 0.0007$). The average density of geohelminth eggs in 100 g of soil or sand was 1.1 from sports fields, 0.4 from playgrounds and 0.07 from fenced sandpits. Throughout the study, 4 genera of nematode eggs (*Toxocara, Uncinaria/Ancylostoma, Ascaris, Trichuris*) and 1 genus (*Cystoisospora* spp.) of oocysts were detected. A total of 62 eggs were recovered, and 43.5% were fully developed to embryonated egg stages. The contamination rate was different in autumn 2010 and spring 2011, but there was no significant difference in the number of positive findings between these seasons. The helminth eggs were found in 10.9% and 7.6% of samples collected in the spring and in the autumn, respectively. The most frequently seen eggs were from *Toxocara* sp., which were the most prevalent in both seasons.

1. Introduction

The main source of geohelminth infection for specific and paratenic hosts is infective eggs or larvae in the natural environment. Young children are the main population at risk of geohelminth infection due to geophagia, onychophagia and poor individual hygiene. Most commonly, children are infected after exposure to contaminated soil, for example, while playing in sandpits or playgrounds. In urban areas, the main source of many zoonoses is soil contaminated with feline and canine faeces. Soil samples from city environments show widespread contamination of the public areas with eggs of nematode parasites, in particular those belonging to the genus *Toxocara, Toxascaris, Ancylostoma, Uncinaria, Capillaria and Trichuris* (Aydenizöz-Özkayhan, 2006; Stojčević et al., 2010; Tylkowska et al., 2010; Ahmad et al., 2011; Bojar and Klapec, 2012). Most of them can infect humans (Loukas et al., 1992; Dutoit, 2005; Klenzak et al., 2005; Areekul et al., 2010; Fuehrer et al., 2011), but *T. canis* and *T. cati* have the greatest epidemiological importance (Pivetti-Pezzi, 2009). The prevalence of *T. canis* in the world varies widely from 3.1% up to 82.6% of dogs, depending on the epidemiological environment (pet, shelter, stray, and rural dogs) (Kornas et al., 2001; Borecka, 2005; Daryani et al., 2009; Awoke et al., 2011). The reported infection rates of *T. cati* in domestic and stray cats vary from 8% to 62.5% (Overgaauw, 1997; Yaman et al., 2006; Sharif et al., 2010).

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Understanding the epidemiology of zoonotic parasite infections is important to minimize the risks to humans. For this reason, many studies have been carried out in recent years to determine the prevalence of geohelminth eggs in the soil of parks, playgrounds, sandpits, beaches, backyards and gardens in the world (Mizgajska, 1997; Matsuo and Nakashio, 2005; Dubná et al., 2007; Tavassoli et al., 2008; Bojar and Klapec, 2012). Depending on country, the contamination rates of *Toxocara* eggs in recreation areas were found to range from 0.6% in Melbourne (Carden et al., 2003) to 97.5% in Greece (Himonas et al., 1992). The epidemiological studies have noted the presence of geohelminth eggs in soil samples in both urban and rural areas in various parts of Poland (Mizgajska-Wiktor and Jarosz, 2007; Rokicki et al., 2007; Perec-Matysiak et al., 2008; Jarosz et al., 2010). Recently, a study has shown a high level of *Toxocara* egg contamination present in soil samples taken from 53 household environment of children with diagnosed toxocarosis in both, rural (30.4%) and urban (23.3%) areas of Lodz voivodeship (Borecka et al., 2010). In other study, to investigate the epidemiology of human toxocarosis a field survey was carried out at homes of 194 children (80 of rural and 114 of urban origin) with diagnosed disease from central Poland (Gawor et al., 2008). Overall contamination rate of soil by *Toxocara* eggs was 27.5% in rural and 21.1% in urban environment in the households examined. These studies showed a high risk of reinfection for the ill children in sites of their residence. There are no data on overall seropositivity in children in Poland. In the years 2004–2007 toxocarosis was confirmed in 178 children of the Polish Memorial Hospital in Lodz (Niedworok et al., 2008). Since there is no published data about the level of helminth contamination of recreation areas in Lodz, the objective of this study was to determine the prevalence of geohelminth eggs in the soil and sand from children's playgrounds, sandpits and school sports fields in order to estimate the risk of infection for the child population living in this city.

2. Materials and methods

2.1. Study area

Lodz is the third-largest city in Poland, with about 737,100 inhabitants, and is located in the central part of the country. Poland is located in a temperate climatic zone with four distinct seasons. Lodz has a mean annual air temperature of 7.5 °C and mean annual relative air humidity of 80%. Dog and cat ownership is high in this city. According to estimates available at the public health service, the ratio of dogs to Lodz inhabitants is of about 1:4.

The surveys were carried out in selected locations in the city of Lodz, on two occasions during October–November 2010 and April–May 2011. The samples of soil and sand were taken from 22 localities: 7 children's playgrounds from various public parks or recreation centers open for general use, 6 sandpits situated in school or kindergarten areas and 9 sites around different school sports fields located in two districts of Lodz (Widzew, Srodmiescie). The playgrounds were situated both in large parks (Poniatowski, Pilsudzki), constituting an area of up to 40 ha, and smaller public recreation areas (Sienkiewicz Park, Staromiejski Park, Jan Ponds, Arturowek), covering an area of 5–40 ha. The parks were unfenced with free dog and cat access. All examined children's playgrounds were located near built-up areas (housing estate, residential district and family houses). Four of the seven playgrounds were not protected from the approach of domestic and stray animals, but the remaining places were enclosed by low fences not exceeding 1 m in height with a 1 m wide gate. All examined sandpits were situated on school or kindergarten areas which were securely fenced; there was no access for domestic and stray animals. Five of the nine examined school sports fields were partially fenced, usually by only one fence from the street side; the rest of the examined school sports fields were unfenced. According to our observations, the domestic dogs had ample access to all examined sports field areas, as these sites are a place favoured by dog walkers.

2.2. Collection of soil samples

A total 88 of samples (about 300 g each) were collected during autumn 2010 and spring 2011 at the same 22 localities. Thirty-six soil samples from area around school sports fields were collected from a 10 m^2 area in 9 various points (9 subsamples), whereas 52 sand samples (children's playgrounds, sandpits) were taken from an area of about 5 m^2 at 6 various points (6 subsamples). Samples of soil or sand were taken both from the surface (0–3 cm superficial layer) of each examined site and from a depth of about 15 cm. The subsamples were combined into one composite sample weighing approximately 300 g. Soil and sand samples were put into plastic bags labelled by number and description.

2.3. Detections of eggs

The samples were examined in the laboratory after drying at room temperature for 2–3 days (depending on soil humidity). All samples (300 g) were sifted through a 4-mm mesh sieve. The geohelminth eggs were recovered in equal portions of 20 g by flotation in saturated sodium nitrate solution (specific gravity 1.30). For each location, in each season, 12 samples of 20 grams each (6 samples from the surface and 6 from the deep layer) were examined. A total of 528 samples, each weighing 20 g, were tested. All stages performed in the isolation of helminth eggs from the samples were completed according to Mizgajska-Wiktor (2005). Cover slips were placed on the tubes and after a 10 min waiting period, were examined for the presence of eggs at 100 and 400 magnifications. No attempt was made to differentiate eggs to the species level. Microscopic recognition of the genus was based on the biometrical analysis of egg size and observation of morphological features of the egg: e.g. colour, shape, number of shell layers, thickness of the shell, stage of embryonic development. Ovoid eggs in the early cleavage stages (4–8 blastomeres) with thin shells were included as carnivore hookworms. The eggs were classified as non-viable (empty, no intact egg wall), unembryonated or fertilized (intact egg wall, with contents), embryonated (with cell divisions), or fully embryonated (with larva). Viability of detected eggs was performed as