

EPIDEMIOLOGICAL IMPORTANCE OF GREEN AREAS AND PUBLIC PLACES CONTAMINATED WITH CANINE FECES IN URBAN ENVIRONMENTAL CONDITIONS

Marko Ristić¹, Ivan Pavlović², Nataša Miladinović Tasić³,
Rade Babić^{4,5}, Biljana Kocić^{3,5}

A continuous increase of dogs population, both strays and pets, presents a permanent epidemiological problem in urban environmental conditions worldwide. These animals permanently contaminate parks, public places, green areas and etc. with faeces. In addition to its unpleasant appearance and odor, dog feces is a high epidemiological danger. Dogs are carriers and hosts of a large number of zoonotic parasitic species the eggs of which are eliminated by faeces and contaminate urban areas. Those parasites are transmitted to humans via faecal contamination, especially to children playing at those dirty places. The most dangerous and also the most common helminth eggs are *Toxocara canis*, *Ancylostomidae spp.*, *Echinococcus granulosus*, *Dipylidium caninum* and protozoas *Giardia lamblia/intestinalis*. The aim of this study is to present the most important species of dog parasites and their impact on human health in urban areas, as well as the possible solutions to this problem. *Acta Medica Medianae 2017;56(3):88-93.*

Key words: epidemiology, dogs, parasites, zoonoses, environmental, contamination

Veterinary Center Subotica, Subotica, Serbia¹
Scientific Veterinary Institute of Serbia, Belgrade²
Public Health Institute Niš, Serbia³
Clinical for Eye Diseases, Clinical Center Niš, Serbia⁴
University of Niš, Faculty of Medicine, Niš, Serbia⁵

Contact: Nataša Miladinović Tasić
Public Health Institute Niš, Serbia
Blvd Dr Zoran Đinđić. 50, 18000 Niš, Serbia
Mail: nmiltasic@yahoo.com

Introduction

There is an increasing number of owned and unowned (stray) dogs in urban environments (1, 2). Dogs and cats play an important role in the societies throughout the world. They are important companions in many households, contributing to the physical, social and emotional development of children and the well-being of their owners (in particular, elderly people) (3, 4). Although pets offer significant benefits to our society, there are well-documented health hazards associated with owning a pet (4-5).

In urban environments, green areas and parks are the main place where children can play

and represent the areas for recreation of urban dwellers, but are also the places where dog owners are running their pets and places where we encounter unowned dogs - usually former pets (6-7). During their stay in those places, dogs contaminate them by their faeces, and besides its unpleasant appearance and odor, the dog feces is a high epidemiological danger because dogs are carriers and hosts of a large number of zoonotic parasitic species (8-10).

Commenting on the results of parasitological examination of green areas in cities around the world, we will see that the pollution in Madrid is 9%, London 15-17%, Michigan 19%, Kansas 20.6%, Utrecht 23%, Barcelona, Belgrade, Paris and Prague 28%, Dublin 32%, Napoli 48%, Buenos Aires 52%, Tokoshima 63%, etc. (1, 9, 11-15). It is known that more than 5% of the contaminated urban areas pose a serious threat to people's health (11-15).

The most dangerous and most commonly found were the eggs of helminths *Toxocara canis*, *Ancylostomidae spp.*, *Echinococcus granulosus* and increasingly protozoan oocyst of *Giardia lamblia/intestinalis*, *Amoeba spp.* and *Cryptosporidium spp.* (15). Children who play there are the most exposed to infections by the fecal-oral route. Tainted streets are also an epidemiological and ecological problem. Stepping into dog feces in shoes can bring parasite eggs in the households and from there to an infection is only a step (13, 16).

The aim of this study is to present the most important species of dog parasites and their impact on human health in urban areas, as well as the possible solutions to this problem.

Toxocara canis

Toxocara canis (*T. canis*) is the most common parasite of dogs. An animal can acquire a *T. canis* infection by several ways: ingestion of eggs, ingestion of a transport host, or by larvae entering the animal while in the uterus or through the milk (17-19). The larvae migrate through the circulatory system after becoming hepatopulmonary migration adults in the intestines of a dog. If they enter body tissues, they can encyst (become walled off and inactive). They can remain encysted in tissues even for months or years. A pregnant dog that has *T. canis* encysted larvae in her tissues can pass them to her puppies through the uterus and placenta and infect the fetal pup. This is why so many puppies have roundworms – they are infected before they are born. Larvae can also enter the female mammary tissues. The puppies can become infected through the milk while nursing (17-19).

Infected dogs shed *Toxocara* eggs in their feces into the environment. Once in the environment, it takes 2 to 4 weeks for *Toxocara* larvae to develop and for the eggs to become infectious. Infection of humans occurs by entering the oral embryonated eggs and larvae of the parasite. The clinical picture and pathoanatomical changes in dogs depend on the degree of infection, age of animals and their general health condition. One can note weight loss, anemia, loss of appetite, which is also often disrupted. The diarrhoeas and constipations interchange and parasite adults can be found. In pups, the oedema of the belly occurs. Neurological symptoms are also sometimes present (17-19).

Humans can be infected by accidentally ingesting *Toxocara* eggs. Many people who are infected with *Toxocara* do not have symptoms of infection (17-19). The ones having symptoms of infection, can have one of the forms of a disease. The first is ocular toxocariasis, occurring when *Toxocara* larvae migrate to the eye (17-19). The symptoms and signs of ocular toxocariasis include loss of vision, eye inflammation or damage to the retina. Typically, only one eye is affected (17-22). The second form is visceral toxocariasis, occurring when *Toxocara* larvae migrate to various body organs, such as the heart, spleen, liver or central nervous system (17-19). The symptoms of visceral toxocariasis include pneumonia, fever, fatigue, coughing, hepatomegalia, myocarditis, epilepsy, wheezing, or abdominal pain. A death may occur in less than 10% if the larvae migrate in the heart or brain (17-19).

According to the data of the CDC, the prevalence of toxocariasis in the USA and Europe ranges between 2-10% and is mostly present in children (23).

Ancylostomidae spp.

Ancylostoma spp. (hookworm) is a common zoonotic parasitic nematode of canidae and felidae, found worldwide. The most common species are *Ancylostomum caninum* (*A. caninum*) and *Uncinaria stenocephala* (17). The development of both kinds of parasites is the same. From the eggs in the external environment, under the favorable conditions (temperature and humidity), the infectious larvae come out, migrating horizontally and vertically on the humid grass. A dog infection occurs by the penetration of infectious larvae through uninjured skin, by ingestion, or by sucking of the milk (galactogenic). The larvae, which penetrate the skin, migrate via blood to the pulmonary capillaries and alveoli, and then reach the digestive tract, where they become adult parasites. The same goes for the larvae ingested through the mouth. A part of the larvae stay in the animal tissue, especially in the mammary glands, from where, after the delivery, they get into the breast milk and infect the pups (17).

The adult worms live in the small intestine of their host animal, where they attach and feed on the host's blood. The adults lay eggs that pass out in the feces and in 2-10 days, the eggs hatch in the soil and larvae are released (24, 25). The larvae enter a host either by being ingested or by burrowing through the host's skin. Diarrhoea, weight loss, sometimes anemia, and the change of general health condition is noticed in infected dogs. In the case of a percutaneous infection, exanthema develops on the spot of larvae penetration. Repeated infections usually lead to more intense skin lesions, such as papules and vesicles (26, 27).

In inappropriate hosts such as humans *A. caninum* is able to enter the skin but cannot proceed into the circulation and continue to the intestine; instead, the disease remains dermal/cutaneous *larva migrans* (DLM/CLM). The larvae migrate in the skin, producing intensely pruritic, serpentine lesions (22). These infections are usually self-limiting. *A. caninum* can cause *visceral larva migrans* (VLM) when larvae migrate to the intestine and produce eosinophilic enteritis (28). The worms do not mature to adults and no eggs are produced, but the infected people may experience severe abdominal pain and eosinophilia (2, 20).

According to the estimations of CDC, the average frequency of the disease is less than 1 person per 2000 (29).

Echinococcosis/Hydatidosis

Echinococcosis is a parasitic disease caused by the infection with tapeworms of the genus *Echinococcus*. In our region it is usually cystic *echinococcosis* (CE), also known as hydatid disease, caused by the infection with the larval stage of *Echinococcus granulosus* (*E. granulosus*), a 2-7 millimeter long tapeworm found in dogs (definitive

host) and pigs, sheep, cattle and goats, like intermediate hosts (30-34).

Canidae are the definitive hosts for the parasite, and these are infected by the consumption of viscera of intermediate hosts that harbour the parasite and also through scavenging infected carcasses. A number of herbivorous and omnivorous animals act as intermediate hosts of *echinococcus*. This means that they get infected by ingesting the parasite eggs in the contaminated ground and develop parasitic larval stages in their viscera – hydatid cysts (30-32). In the stomach and the beginning of the small intestine, scolexes get out from the cysts, attaching to the intestinal walls with their hooks. In 30 – 40 days, small tapeworms will be formed, reaching even several thousands in one host. When they reach sexual maturity, the last back segments (proglottids), which contain eggs, detach themselves from the main body, evacuate themselves via feces into the external environment and are replaced with the new, sexually immature segments (proglottids) (30-32). In a real host, this taeniasis manifests with digestive disturbances, together with interchanging diarrhoeas and constipations, fatigue and weight loss (30).

During the natural course of infection with *E. granulosus*, one or more hydatids cysts develop. Some cysts may grow and persist without a noticeable change for many years (32, 33). Most cysts are present in the liver and lungs, and less frequently in the bones, kidneys, spleen, muscles, central nervous system and eyes (31). After an undefined and variable incubation period, infections may become symptomatic if active cysts exert pressure on the adjacent tissue and induce other pathologic events (33). Cyst rupture is most frequently caused by trauma and may cause mild to severe anaphylactic reactions, and even death, as a result of the release of cystic fluid (34).

The worldwide incidence of human *echinococcosis* is between 1 and 200 per 100.000 inhabitants. In Europe, the incidence of echinococcosis ranges from 1 to 8 per 100.000 inhabitants. In recent years, echinococcosis as an endemic/hyperendemic infection has been documented in many of the Balkan countries (the territory of former Yugoslavia, Romania, Bulgaria, Greece) (31-36).

Giardiasis

Giardia lamblia/intestinalis is a anaerobic flagellated protozoan parasite that colonize and reproduce in the small intestines of numerous mammal species including humans. The protozoa blocks the absorption of nutrients in the intestines, resulting in gastrointestinal problems such as continued or intermittent diarrhea, along with weight loss (37).

Most dogs become infected by drinking water contaminated with feces. In dogs, giardiasis can cause diarrhea, vomiting, weight loss and lethargy – although many infected animals show no signs at all. *Giardia* then infects the small

intestine, and infected dogs pass microscopic cysts in their stool. These cysts, if ingested, can then infect another animal or person (37-39).

Thus the infection is spread from person to person by contamination of food with feces, or by direct fecal-oral contamination. Cysts also survive in water, for example in fresh water lakes and streams (37-39). *Giardiasis* occurs where there is inadequate sanitation or inadequate treatment of drinking water. *Giardiasis* is one of the causes of "travelers diarrhea" that occurs during travels to less-developed countries (37-39). The severity of the symptoms may vary greatly, from mild or no symptoms to severe symptoms. Stools may be foul smelling when the *Giardia* interferes with the absorption of fat from the intestine (malabsorption). Other common symptoms are diarrhea and vomiting. The illness or malabsorption can cause loss of weight. Symptoms and signs of giardiasis do not develop for at least seven days following the infection, but can occur even as long as three or more weeks later. In many untreated patients, however, the infection can last for several months to years with continuing symptoms (37-39).

How to solve the problem

In order to solve the problem of fecal and parasitological contamination of public areas, the principal starting point is regular examination of the green spaces and identification of dog faces in order to gain insight into the epidemiological situation and to start the rehabilitation and eradication of contaminated places (10, 38). It is also necessary for local governments to define the program of control of unowned animals in their environments (38-41).

Environmental control

The samples of grass and soil from green areas in our climate condition were collected from March to October. The material for examination was taken on the basis of indicators of bioclimatic conditions prevailing in the same area leading to the method of bioclimatogram by Uvarov (8, 15).

The samples of dog faeces are sampled in the same location and the same intervals as the samples of soil, grass and sand. The examination is carried using the sedimentation method, flotation method, and sedimentation-flotation method. Identification of eggs, oocysts and adult parasites is performed by using morphometric analysis (17).

Parasitology control of dogs

All dogs, even those on year-round parasite preventive measures and those without diarrhea, should have at least one to two fecal samples performed annually as part of their wellness exam to screen for gastrointestinal parasites. The treatment of parasites is not performed in preventive care without parasitology examination, thus avoi-

ding wrong therapies (8, 17).

Education

One of the key segments is the education, including dog owners, in view of prevailing ignorance about the possible role their pets can play in the spread of certain diseases transmitted by dogs. Their irresponsible behavior and release of dogs in the green areas and playgrounds will thus be avoided or at least reduced. The importance of periodic parasitological examination and deworming of pets should be highlighted. The opinions of owners that dogs kept in their homes are not dangerous is misleading, because the eggs of these parasites are brought in on shoes and dirty hands of owners who have been in contact with other dogs (40-42).

Education of children in kindergartens and schools is also of particular importance, given that most of them have a dog for a pet or come in contact with stray animals. Children should be familiar with the behavior of dogs, putting the emphasis on washing their hands after the game with dogs in the park or sand, etc., but also with the potential related dangers (injury, infection, etc.) (10, 30, 41, 43).

Education of parents is even more important and to this end lectures by experts should be organized, for both children and parents at the same time, especially in preschool institutions.

Training of health professionals (pediatricians) with respect to the problem of larval migrans and other parasitosis is still not given enough attention. They should be educated through seminars, which would enable their involvement in the campaign of patient education.

Finally, education of veterinarians, primarily those with small practices, should also be disseminated through seminars. Their work should also focus on owner education in combating parasites and the need for regular dog stool controls (10, 30, 41, 43).

Legislation

Legislation regulating animal welfare, pasture and walking dogs and other regulations related to municipal hygiene must be rigorously carried out with all the punitive measures against owners. For now, there is communal police that should work in accordance with its authority (40-43).

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Revijalni rad

UDK: 614.76:616.9-036.22

doi:10.5633/amm.2017.0314

EPIDEMIOLOŠKI ZNAČAJ ZELENIH I JAVNIH POVRŠINA KONTAMINIRANIH IZMETOM PASA U URBANOJ ŽIVOTNOJ SREDINI

Marko Ristić¹, Ivan Pavlović², Nataša Miladinović Tasić³,
Rade Babić^{4,5}, Biljana Kocić^{3,5}

Veterinarski Zavod Subotica, Subotica, Srbija¹
Naučni veterinarski institut Srbije, Beograd, Srbija²
Institut za javno zdravlje, Niš, Srbija³
Klinika za očne bolesti, Klinički centar Niš, Niš, Srbija⁴
Univerzitet u Nišu, Medicinski fakultet, Niš, Srbija⁵

Kontakt: Nataša Miladinović Tasić
Institut za javno zdravlje Niš, Serbia
Bul. Dr Zoran Đinđić. 50, 18000 Niš, Srbija
e-mejl: nmiltasic@yahoo.com

Kontinuirano povećanje populacije pasa lualica i kućnih ljubimaca, predstavlja stalni epidemiološki problem u urbanoj životnoj sredini u svetu. Životinje stalno fecesom kontaminiraju parkove, javna mesta, zelene površine i sl. Pored neprijatnog izgleda i mirisa, pseći izmet predstavlja veliku epidemiološku opasnost. Psi su nosioci i domaćini velikog broja zoonoznih vrsta parazita, koje putem fecesa izbacuju i zagađuju urbana područja. Ovi paraziti se putem fekalne kontaminacije prenose na čoveka, naročito decu koja se igraju na tim prljavim mestima. Najopasniji, kao i najčešći su jaja crevnih glista *Toxocara canis*, *Ancylostomidae spp.*, *Echinococcus granulosus*, *Dipylidium caninum* i protozoa *Giardia lamblia/intestinalis*. Cilj ove studije bio je da pokaže najvažnije vrste parazita pasa i njihov uticaj na ljudsko zdravlje u urbanim sredinama, kao i moguće rešenje ovog problema. *Acta Medica Medianae* 2017;56(3):88-93.

Ključne reči: epidemiologija, psi, paraziti, zoonoze, zaštita životne sredine, kontaminacija

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