

## SOCIAL MEDICINE APPROACH IN RESOLUTION OF THE PROBLEM OF CONTAMINATION OF PUBLIC AREAS WITH DOG FECES AND ITS PUBLIC HEALTH RELEVANCE

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Since dogs and humans share their living environments and effectuate very close contacts with each other, with dog owners not caring adequately for their pets, there is a possibility of transmission of particular parasitic diseases from dogs to humans. In view of the fact that dogs are carriers and definitive hosts of a large number of zoonotic endoparasites, their feces may represent a source of infection for humans and a real threat to their health. That is the reason for raising the level of awareness among citizens about the necessity of executing zoohygienic measures in dog breeding, as well as about the significance of causally planned dehelminthization and anti-ectoparasitic treatments. Further, it is essential that dog owners perform regular coprological examinations, immediately after getting the dog and four times a year afterwards, abiding by the principle of shifting the preparations used based on their different chemical formulations. A timely diagnosis of intestinal parasites in dogs and proper treatment of infected animals enable the prevention of these infections in humans. Contamination of public areas with intestinal parasites from dog feces represents a public health problem that should be kept under control using the appropriate social medicine approach. Such an approach would typically involve health education measures related to the control of parasite transmission in the environment, provision of the guidelines to dog owners for prevention of the occurrence, persistence, and spread of zoonotic diseases, and health education of medical and veterinary professionals, pet owners, and the wider community regarding the preservation of the health of both humans and pet animals. An increased level of knowledge and corrected attitudes and behaviors among individuals would certainly contribute to more effective prevention of zoonotic diseases. *Acta Medica Medianae* 2023;62(3): 61-69.

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### Introduction

A large number of dogs worldwide are infected with intestinal parasites, the developmental forms of which are eliminated via feces into the environment, which, due to their zoonotic potential, represent a constantly present threat, especially to pre-school and school children

(1, 2, 3). Dog feces is one of the main sources of contamination in public areas in urban environments, which thus become the primary infection sites for urban human populations (4, 5). There is a pressing need for raising human awareness about this complex problem; a joint action of all the segments of the veterinary and medical professions, pet owners, and people who visit public parks would constitute the prerequisite for sustainability for the concept "One Health", which includes protection of the environment and the health of both humans and animals (6).

In urban parks, the main areas for children to play, pets to walk, people to relax and enjoy themselves, there is a close cohabitation of owners' dogs with free-roaming dogs, where pet dogs are exposed to new parasitic infections. The presence of a large number of these animals in limited urban areas results in the continual contamination of public green areas, parks, and sand playgrounds with adult and developing forms of parasites from the dog's feces (6, 7, 8).

Regarding the geographical distribution and clinical relevance, *Toxocara canis*, hookworms and *Trichuris vulpis* are the most widely distributed dog helminths, but the importance of these pathogenic agents is oftentimes underestimated by veterinary doctors, human medicine doctors, and the community (9). Depending on the severity of dog infection, we should not overlook the eggs of *Dipylidium caninum* and *Taenia* spp., the trematodes of *Alaria alata*, and cystic forms of the *Giardia intestinalis* protozoan, *Amoeba* spp., and *Cryptosporidium* spp. as potential sources of human infection (10, 11, 12).

Changes in living conditions and nutrition of dogs have as a consequence more diverse and more complex health problems in dogs. The very close cohabitation of people and dogs creates opportunities for transmission of certain diseases from dogs to humans. It is therefore necessary that dog owners keep and feed their pets in an appropriate manner, as well as be acknowledged, at least at a basic level, about the etiopathogenesis of parasitic infections that affect their animals. Insufficient knowledge of these problems or an inadequate level of information often cause an unfounded fear of transmission of certain parasites from dogs to humans or, on the other hand, a neglect of the danger of potential zoonotic infections (13).

The aim of this paper is to suggest the need for a comprehensive insight into the problem and the realization of health education measures that would make possible the education of doctors, doctors of veterinary medicine, pet owners, and all those who visit public parks. An improved level of knowledge, together with positive motivation, could possibly help in the eradication of parasitic infection in public places and consequently reduce the degree of overall contamination with feces from infected dogs.

### **Epidemiological significance of canine intestinal parasites**

Pathogenic action of zoonotic endoparasites from the dog feces primarily threatens dog owners, dog breeders who exercise insufficient care about dehelminthization of their broods, children who do not wash their hands after contacts with animals or have a habit of geophagia, farm workers and grocery sellers (especially in semi-rural and rural areas, with lots of free-roaming dogs who defecate on the agricultural land), when unwashed or insufficiently washed food can be a significant source of infection for humans (13). Parasite eggs may enter the organism via inhalation as well, usually in the summer when, in urban environments, dog feces on the streets become dry (14).

The contact of people with soil is one of the routes of spread for intestinal dog parasites. These causative agents reach the soil with canine and human excretions and are able to persist in soil for a long time, making it a potential infection

reservoir (15). Geohelminths are able to survive in soil the longest; they reach the organism of a susceptible individual through wounds in the skin or visible musoca (*Ancylostoma caninum*, *Uncinaria stenocephala*, and *Strongyloides stercoralis*) causing a cutaneous larva migrans (CLM) (16, 17), which may persist in human tissues for as long as several years (18, 19). The infections occurring in this way are mostly sporadic, but in extraordinary circumstances and situations (mass disasters, catastrophes, wars), the disease may occur in the form of epidemics as well (15).

A timely diagnosis of intestinal parasites in dogs and a proper treatment of infected animals make possible the prevention of infections in humans. In humans, as non-specific (paratenic) hosts, after penetrating the bowel wall, *T. canis* larvae migrate (by hepatopulmonary and somatic routes) to the liver, lungs, brain (VLM) and eye (OLM); they there remain active without any morphological changes for more than a year, until they are blocked by the inflammatory reaction and granuloma formation. Clinically, in the cases of OLM, there are vision disorders, endophthalmitis, strabismus, and even blindness (19).

Human infections with hookworms (*A. caninum*, rarely *U. stenocephala*) and rhabditids (*S. stercoralis*) from dog feces tend to occur when their eggs are excreted in a warm, humid soil or sand, where infective larvae develop from the eggs and penetrate the unprotected skin of the arms, legs, feet, gluteal region or back, after the skin comes into contact with contaminated soil or sand. In their passage through the skin, the larvae produce migratory pruritic dermatitis (17, 20).

In a study performed to examine the parks in the territory of Niš municipality (21, 22), two parasites with a zoonotic potential have been diagnosed: the nematode *Capillaria aerophila* in the specimens of dog feces (8–14%), and trematode *Alaria alata* in the specimens of dog feces (22–38%), soil (2%) and sand (16%). *Alaria alata* causes human larval alariasis, which in people produces multi-organ disorders— inflammatory, hemorrhagic, granulomatous, and necrotic lesions in the bowels, lymph nodes, liver, spleen, pancreas, adrenal glands, kidneys, lungs, heart, brain, and spinal cord (23). In the last decade, interest in this trematode and its potential zoonotic significance has been on the rise since this parasite has been diagnosed in Europe and in a number of countries neighboring Serbia, such as Croatia, Romania, and Bulgaria (24, 25).

*Capillaria aerophila* is the cause of human pulmonary capillariasis, which manifests in the infected with the onset of acute bronchitis and bronchiolitis, asthma, and a productive cough. This parasite has been diagnosed in foxes in suburban environments in Serbia (26, 27), which serve as an infection source for dogs; human infections have also been reported in Serbia, which has a special medical significance.

The intestinal parasites from soil and sand diagnosed in dogs represent a serious hazard and an essential potential that may harm human health, especially the health of children aged 3–5 years. Human infections with intestinal parasites hosted by dogs occur mostly by the fecal-oral route (by petting owned dogs and stray dogs, especially on their posterior parts where infective developmental forms of the parasite are located; by touching the mouth with unwashed hands after playing with dogs, especially by children; by playing on the soil and in sand ponds in the parks, around playground slides and swings). If humans are exposed to this sort of risk via contaminated soil and sand or by direct contact with dogs, there is a degree of probability that human infection with these pathological agents of parasitic etiology will actually occur (13).

There are numerous cases of parasitic zoonoses, the causative agents of which are transmitted to people in public areas via contaminated dog feces, as documented by the literature data for the territory of Serbia. Lalošević et al. (28) have reported about a case of respiratory capillariasis in a woman from Sremska Kamenica, resembling a bronchial carcinoma. It is a zoonosis caused by the nematode *C. aerophila*, which circulates among wild carnivores, from which it is transmitted by the fecal-oral route to domestic carnivores (stray dogs and owned dogs) and further to people. Gvozdrenović et al. (29) described a case of a familial epidemic of cryptosporidiosis in which three immunocompetent patients had abdominal cramps and pain in the muscles. Their fecal samples did not contain any blood or mucus, but were very loose and demonstrated cryptosporidium oocysts. After symptomatic therapy, the complaints were cured after 10–17 days. After they completed an epidemiological survey, the authors could not ascertain the source of the infection. There was also the case of a little girl, aged 4.5 years, in whom toxocariasis was detected by indirect immunofluorescence testing. In this patient, the complaints consisted of elevated body temperature, abdominal pain, changes on the skin in the form of an allergic reaction, and 43% eosinophilia. After two months of therapy with albendazole, this clinical case was resolved successfully, as demonstrated by the control examination two years later (30). A retrospective analysis of the findings of examination of feces samples from healthy individuals without any digestive symptoms for the presence of *Giardia lamblia* in the period 2004–2014, positive findings were reported in 574 individuals, with an equal gender ratio, aged on the average  $33.76 \pm 12.93$  years, and especially in those who had a professional contact with food. The highest prevalence was reported in 2005 (4.9%) and the lowest prevalence was in 2014 (0.57%) (31). Perić et al. (32) reported about two Serbian patients in whom there were no anamnestic data about earlier travelings abroad, and in whom cutaneous

*larva migrans* was diagnosed in 2016. The first described patient was a 72 year-old man from Western Serbia, in whom the changes involved the thoracic part of the body. The second patient was a 31 year-old man from Central Serbia with changes involving his right arm. This syndrome usually occurs in people who travel to or stay in subtropical and tropical countries, especially those who frequent beaches. The lesions primarily affect the feet, gluteal region, and other parts of the body in direct contact with contaminated surfaces (soil and sand).

Since humans are non-specific hosts for most of the above mentioned parasites, these organisms cannot complete their developmental cycle up to the adult stage in the human organism. Regarding differential diagnosis, clinicians have much difficulty with some of the dog parasites (*T. canis*, *C. aerophila*, and *A. alata*), the larval stages of which, on their migration route, are halted in particular tissues and organs (liver, lungs, kidneys, heart, lymph nodes) producing cystic formations. Encysted parasitic larvae, after a period of time, may calcify, necrotize, or degenerate, and their presence may confound even the most experienced diagnosticians. Insufficient information and education about what may be etiologically expected can result in serious mistakes in making a valid diagnosis (13).

The intense process of urbanization of Serbian cities leads to the expansion of city belts into the suburbia and holiday settlements inhabited priorly only by foxes. Therefore, a close contact of stray dogs and owned, household watchdogs with foxes has been made possible. Such a contact produces a significant change in the parasitic fauna of dogs, which subsequently eliminate these new infective agents via their gastrointestinal tract onto publicly accessible surfaces, creating a source of infection for humans (27). In Serbia, similar to many other European countries, vaccination of foxes against rabies has been regulated by law since 2010 (administered via oral route, using baits). As a result of that, rabies has been successfully controlled, but the number of foxes has increased, thus increasing the prevalence of parasites for which foxes represent a source or reservoir of infection. In the chain fox – stray dog – owned dog – human, it is just an additional factor of increased risk and probability of human infection with intestinal parasites of wild and domestic carnivores (13, 33). Stray dogs, which freely roam the city parks, represent the most serious threat to human health. It is therefore essential that this problem be resolved in the long term by adopting a strategy that would regulate the number of abandoned dogs, including mandatory parasitological control of public areas likely to be infested (34). Since foxes represent a source of numerous parasitic zoonoses for both stray and owned dogs, an appropriate social medicine approach is necessary in the resolution of this

pressing public health and ecological problem in urban environments.

**A suggestion for a program of health education measures for the resolution of the problem of contamination of public areas with dog feces**

In accordance with the Guidelines of the ESCCAP (European Scientific Counsel Companion Animal Parasites) of 2021 and based on the results of performed investigations of public parks in the territory of Niš, in which four most prevalent endoparasites have been identified (*T. canis*, 36.66–38%; *ancylostomatidae*, 24.66–32%; *T. vulpis*, 20–28%; and *A. alata*, 28%) and contamination of developmental forms of endoparasites has been detected in 38–46% of soil samples and 40% of sand samples (13, 22), a suggestion has been defined by the program of health education measures, categorized into three groups, through which the public health problem of contamination of public areas with dog feces has to be approached.

**I Recommendations by doctors of veterinary medicine for the purpose of controlling parasite transmission in the environment**

For the parasites, the eggs, larvae, or proglottids of which are excreted by feces, the control and elimination of the pre-parasitic stages in the environment are essential for the reduction of the risk of infection in other susceptible animals or people. The populations of foxes and stray dogs in rural and urban environments may represent additional sources of infection for infectious agents that parasitize dogs. Infections of intermediary or paratenic hosts (birds, rodents, snails, and common earthworms) may contribute to the prolonged survival of the pre-parasitic stages in the environment (13).

Most of pre-parasitic stages are very resilient to degradation under the impact of environmental factors (they live from several months to several years). Freshly excreted developmental forms of many parasites can be directly infective (for instance, the eggs of *Taenia* spp. and *Echinococcus* spp). Other parasites, such as nematode eggs, require from several days to several weeks at appropriate temperatures (usually above 16 °C) to transform into the infective stage (35).

That is the reason why it is vital to prevent initial contamination with parasites by implementing comprehensive parasite control programs, which will be based on local epidemiological information and knowledge.

a. Safe disposal of animal feces is essential.

It is necessary to forbid disposal of animal feces in toilets or in compost intended for use in olericulture. In the cultures or regions where laws

do not prohibit this, feces can be disposed of in the collections of home waste.

It is necessary to encourage the measures which would facilitate feces removal, providing appropriate waste bins and special bags to be used for this purpose. Since it is very complicated to control cat defecation in the open, cat parasite control should be the focus of special attention.

Local authorities, especially in urban areas, should adopt and implement the laws that would regulate the control and safe disposal of feces.

b. Adoption and implementation of the laws/regulations by appropriate bodies, which would put under control the population of wild carnivores

c. Implementation of regular dehelminthization of infected animals is necessary in order to reduce contamination of the environment. In appropriate cases (e.g., dogs with persistent clinical signs or suspicion of resistance), it is necessary to perform regular coprological tests four times a year.

d. Implementation of extreme measures for decontamination of very contaminated areas, including removal of contaminated soil or sand or covering it with concrete or asphalt (in very crowded dog breeding kennels, parasite eggs retain their vitality for months or even years in the soil).

e. In breeding kennels or households with several or more animals, a strict treatment and quarantine for new animals is recommended, which is essential in order to avoid bringing in infected animals.

f. Children's playgrounds should be adequately fenced in order to prevent the entry of animals, especially cats.

i. Sand ponds should have protective covers during periods when they are not used by children.

ii. Sand in sand ponds should be regularly replaced (at least once or twice a year) if they are open and probably contaminated with feces.

g. Contaminated areas should be made accessible to sunlight in order to reduce the level of contamination – since drying up and ultraviolet light are very deleterious to parasite eggs, reducing their number.

h. Recommendations for dog owner education

i. At dog reviews, shows, or festivals, discussion forums for dog owners and cynophiles, in the form of open classes.

ii. Pet food distributors in pet shops should be engaged to distribute information materials since it is not sufficient to love a dog or other animal but to know its associated health risks and the transmission of these to the owners.

iii. Creation of a dog owner database, with e-mail addresses to which relevant information will occasionally be sent about dog vaccinations, or treatments against endo- or ectoparasites.

iv. At least twice a year (in the spring and the fall) discussion forums should be organized in hunting associations, debating this issue and handing out education leaflets.

v. Distribution of educational brochures and leaflets about parasitic diseases to pet shops and dog groomers.

vi. Each dog owner and cynophile should get the brochure "One dog, one health"; TV information campaigns should also be organized about the issue of parasitic diseases.

vii. In rural environments, doctors of veterinary medicine should leave the brochure in each visited household or at gathering places in villages.

viii. Level of awareness of the people should be raised whenever possible about the ever increasing number of dogs, possibly causing the problems to future unconscious dog owners.

## **II Recommendations of doctors to dog owners for the purpose of preventing the occurrence, maintenance, and spread of zoonotic diseases**

a) Adequate personal hygiene practices, especially hand washing after contact with pets and before meals;

b) Minimizing exposure of children to potentially contaminated environments, educating them about personal hygiene principles (e.g. regular nail trimming), stressing the importance of adoption of such habits;

c) Wearing gloves when working in the garden;

d) Washing of raw fruits, vegetables, and mushrooms before consuming them;

e) Control of parasitic infections affecting pets through repeated treatments and/or regular diagnostic testing;

f) Prevention of infections (wherever possible), reducing the risk of infections affecting pet animals;

g) Regular disposal of pet feces for the purpose of reducing environmental contamination with parasitic infective stages. Pet feces should not be disposed of in recyclable waste;

h) Regular and complete dog care, aimed to reduce the risk of contamination with helminth eggs;

i) Footwear change in order to prevent living space contamination (professional breeders or those who work in dog shelters for abandoned animals should leave their shoes and work clothes at their workplaces);

People in regular contacts with animals which potentially can transmit zoonotic parasites should be well acknowledged with the risks; the health risks are considerably higher when pregnant women are concerned, or in those already affected with other diseases or immune system suppression. These records should be made available to doctors of human and veterinary medicine without any need for the

personal or familial medical records of the patients. Bearing this in mind, special attention should be paid to:

- immunocompromised individuals, such as the elderly, diabetics, those with HIV infection, those undergoing organ transplantation, those receiving immunosuppressive chemotherapy, or those who receive treatments for autoimmune diseases;

- other susceptible groups, such as pregnant women, babies, or those with developmental disorders;

- people exposed to professional risks, such as farmers, workers in breeding kennels for dogs and cats, and hunters.

## **III Recommendations of doctors regarding health education of medical and veterinary professionals, pet owners, and the community as a whole**

a) The protocols and recommendations for the control of parasitic infections should be clearly communicated to veterinary and paraveterinary professionals and consistently implemented.

b) It is necessary to encourage cooperation between the professions of human and veterinary medicine, whenever possible, since the link between them is extremely important from the point of view of public health, especially in the domains of timely detection, effective treatment, and prevention of zoonoses.

c) Professional brochures, leaflets, and posters placed in veterinary clinics, pharmacies, and shops for pet food and other supplies and equipment are very useful tools in health education. In the era of modern technology and social networks, educational activities can be undertaken electronically as well (web sites). There are also the billboards or visible advertisement boards placed in parks frequented by both people and animals, as well as written educational materials related to the safe removal of one's pet's feces after a defecation in a public area as a potential source of zoonotic parasites.

d) The importance of continued regular and planned dehelminthization or joining the "pet program" should be publicly clarified for all veterinarians, veterinary technicians, and other professionals for animal protection and literally promoted.

e) Through communal, municipal, and republican institutions and communal police, programs should be created for mandatory anti-parasitic treatments, with strict recording about that in the republic's health records (pet passports), and the possibility of checking that by the authorities (communal policemen).

f) It should be regulated by law that each owner who visits public areas with his pet should be obliged to possess and always carry with him the pet passport, which contains the proper evidence of dehelminthization with a veterinary seal and signature.

g) Only responsible ownership of dogs or cats can facilitate care for public health and encourage the acceptance of these animals as human companions.

h) Pet owners should be informed and well acknowledged about potential health risks of parasitic infections, not only for the pets but also for themselves and their families.

#### **IV Educational recommendations for dog owners**

Brochures such as "One dog, one health", through which the broader public is informed and educated, should be distributed to public health centers and institutes, to privately owned laboratories and pharmacies, and made available to patients who own and love dogs.

Brochures should be distributed to all dog breeders who report about new litters and at entry to dog shows via the Cynological Association of Serbia.

#### **V Educational recommendations to those who do not own dogs**

Brochures should be distributed to parents in children's daycare institutions, in schools, and

to patients who regularly visit public health centers and institutes for sanitary examinations.

Preschool and school children should be adequately educated since they represent the riskiest category of the population (in view of their wishes and resolutions to own dogs).

Stray dogs are becoming regular inhabitants of schoolyards and playgrounds, visited during weekends (when not in use) also by parents with small children, who may step into dog feces and thus come into contact with potentially infective material; that is the reason why broader public should be appropriately informed about this problem.

Community service workers whose occupation is to deal with urban hygiene and urban green infrastructure should be educated about the possibility of infection and the proper way to deal with feces in public areas.

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## SOCIJALNO-MEDICINSKI PRISTUP REŠAVANJU PROBLEMA KONTAMINACIJE JAVNIH POVRŠINA FECESOM PASA I ZNAČAJ ZA JAVNO ZDRAVLJE

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Pošto čovek i pas dele životni prostor i ostvaruju veoma blizak kontakt, a mnogi vlasnici ne brinu adekvatno o svojim ljubimcima, postoji mogućnost prenošenja izvesnih parazitskih oboljenja sa psa na čoveka. S obzirom na to da su psi nosioci i pravi domaćini velikog broja vrsta zoonoznih endoparazita, njihov feces može predstavljati izvor infekcije za ljude i opasnost po njihovo zdravlje. Stoga, nužno je podizanje svesti građana o neophodnosti sprovođenja zoonoznih mera u odgoju pasa i značaju kauzalne planske dehelmintizacije i antielktoparazitskog tretmana. Takođe, neophodno je da vlasnici sprovode redovne koprološke preglede, neposredno nakon nabavke psa i četiri puta godišnje, u toku njihovog boravka kod vlasnika, uz poštovanje principa smene preparata na bazi različitih hemijskih formulacija. Pravovremena dijagnostika crevnih parazita kod pasa i ispravan tretman inficiranih životinja omogućuju prevenciju pojave infekcija kod ljudi. Kontaminacija javnih površina intestinalnim parazitima iz fecesa pasa predstavlja problem javnog zdravlja, koji je neophodno staviti pod kontrolu odgovarajućim socijalno-medicinskim pristupom. Ovaj pristup podrazumeva aktivno i plansko sprovođenje Predloga zdravstveno-vaspitnih mera, koje se odnose na kontrolu transmisije parazita u životnoj sredini, pružanje smernica vlasnicima pasa u sprečavanju pojave, održavanja i širenja zoonoznih oboljenja i zdravstveno-vaspitu edukaciju osoblja medicinske i veterinarske struke, vlasnika kućnih ljubimaca i šire društvene zajednice u cilju očuvanja i poboljšanja zdravlja ljudi i životinja. Povećan nivo znanja i korigovani stavovi i ponašanje pojedinaca doprineli bi efikasnijoj prevenciji zoonoza. *Acta Medica Medianae* 2023;62(3):61-69.

**Ključne reči:** pas, intestinalni paraziti, dijagnostika, preventiva, zoonoze

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