Assessment of environmental and public health impacts of dog parks in residential neighborhoods: A case study in Toronto, Canada

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Abstract

The number of pet dogs has been increasing over the last decade, causing more challenges for dog owners taking care of their pets, particularly in current small apartments, as well as larger impacts on public health and environment. Dog owners usually use outdoor public spaces for their dogs to play and defecate. Public spaces are common sites of dog fecal contamination with prevalent rates of gastrointestinal pathogens that are naturally carried by dogs. Dog feces are a serious biohazard. They contain microorganisms that are both pathogenic to humans and resistant to several classes of antibiotics. Extensive spread of these dangerous microorganisms in the area can lead to a pandemic, mainly among children and other vulnerable residents. Biohazard parasites, primarily roundworms of pet dogs, are commonly found in the soil of public parks, particularly in the off-leash areas. These zoonotic parasites infect humans that can result in serious diseases. Direct or indirect contact with polluted soil with pet dogs' trash is one of the main routes of bacteria transmission from animals to humans. The infection rate among dogs' shelter workers and dog owners were assessed respectively as 92% and 67%. Scientific research works performed in various countries indicate the existence of canine parasites in more than 50% (even in some cases 67%) of dog parks. This study aims to assess the environmental and health impacts of off-leash dog park in a public park located in a densely-populated neighborhood of Toronto, Canada based on investigations performed in various countries. Biohazard parasites accumulated in a dog park for a longer time act like a hazardous biological agent, are washed off into the underground water table and released off the plants in heat into the air as aerosol, causing serious diseases in humans.

Keywords

pet; dog; environment; public health; excrements; zoonoses; hookworms; biohazard; parasites; park; safety; parkland; urban planning; landscape; built environment; ecology; Canada

Synopsis

This case-study research highlights the environmental and public health of a dog park in Toronto, Canada in vicinity of a large public school and children playground.

1. Introduction

The number of pet dogs has been continuously increasing, causing more challenges for dog owners taking care of their pets, mostly in small apartments. These dog owners need to take their pets to outdoor public areas, such as public parks, beaches, and dog parks. The development and maintenance of dog parks are generally managed by the municipality. Off-leash dog parks may be constructed in part of an existing public park or as a new park. It is very important to identify and prevent public health risks and to maximize the health benefits to both pet dogs and their owners as well as public at large when designing new off-leash dog parks. The Public Health Office in the municipality organization can and must play important advisory and regulatory roles in planning, design, and later supervising of off-leash dog parks public health related issues. While some pet owners may enjoy off-leash dog parks, it may deny many other people to use parklands.

Parasites from dogs, mostly Canine hookworms, are important nematodes of dogs worldwide, causing zoonotic cutaneous larva migrants in humans. There was recently construction of a dog park at Parkway Forest Park in Toronto, Canada, in a parkland immediately next to a large public primary school, a children's playground, and to outdoor exercise facilities. This construction work in a public parkland includes several essential environmental, engineering, health, and social concerns that must be studied by professional specialists in consultation with the community members. Here, different effects of this alteration to the public parkland are assessed related to public health and protection environment based on similar studies conducted in many countries, including Canada.

2. Environment

The dog park as the subject of this study is part of Parkway Forest Park (hereinafter, referred as Park) located between Don Mills Road, Sheppard Avenue East, and 401/404-DVP Highways across Fairview Mall in north of Toronto (North York). The neighborhood comprises numerous high-rise new condominiums and older rental buildings as well as many older townhouses. Figure 1 exhibits two aerial views of this park in which the dog park area is highlighted with a red line in its south-west corner.

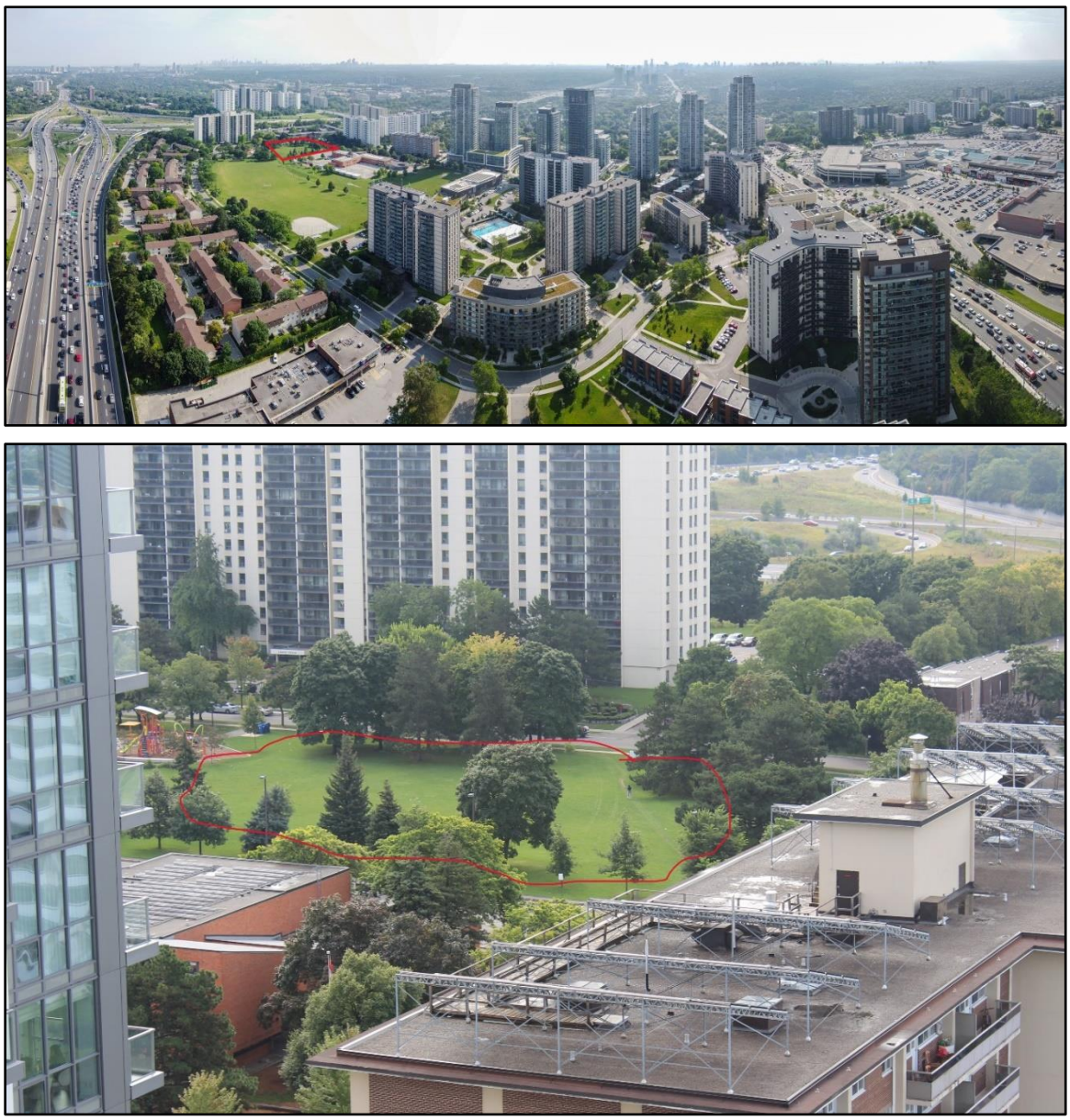

Figure 1. Aerial photos of Parkway Forest Park neighborhood before construction of dog park area shown with red line.

The area includes a large community center (Parkway Forest Community Centre), a public primary school (Forest Manor Public School, FMPS), and a shopping plaza with various medical and business offices and several shops, a drugstore, and restaurants. The Park comprises soccer and baseball fields, two children's playgrounds, and an exercise park. Among all these public facilities, Park itself plays a vital role in the wellbeing and comfort of this very crowded neighborhood. As the aerial photos in Figure 1 reveal, all parts of Park are assigned to some sorts of activities (e.g., sports tournaments) except a limited area at the south-west corner part (marked with red line in photos of Figure 1), which includes a dozen trees between the FMPS parking lot

and the playground. This is the only part of Park that people feel less annoyance and more safely to gather for picnics and other social activities, as exhibited in photos of Figure 2.

Figure 2. Normal environment and activities in south-west corner and other parts of Parkway Forest Park.

In the past, there was no significant environmental concern in this park, but, according to observation in similar cases, after major changes in its design and construction of a dog park, environmental and other problems will arise. Park allows birds and animals to enjoy a peaceful life, while later the normal life of wild animals and birds are violated, and the ecosystem is damaged. Dogs may create disturbing misbehavior to the wildlife. Photos in Figure 3 show squirrels living peacefully with other Park users. Unpleasant and hurting barking dogs all the time and bad odors, especially during school time, is another environmental concern that cannot be overlooked. It has been a major concern in many dog parks close to residential areas; it will not be exceptional in the studied neighborhood.

Figure 3. Dog parks affect and ruin normal wildlife pattern.

A green natural park reachable to all citizens is changed for exclusive usage of pet dogs, green environment replaced with concrete and fences (Figure 4). Moreover, highly windy conditions at the intersection of 401 and 404 highways corridor spread dust containing biohazards and bacteria with particulate matters not only in this neighborhood but transfer to faraway places.

Figure 4. Park before and during construction process. Green Park converted to fenced concrete land.

The environmental impacts associated with every stage of a product or service in their entire life from cradle to grave are usually assessed through execution of life cycle assessment (LCA) method. An LCA investigation on an average pet dog in the European Union (EU) was conducted with consideration of pet food and dog excrements (i.e., urine and feces) [1]. This LCA study discloses that pet dogs can have a significant environmental impact, for example, around 7% of the annual climate change impact for an average EU citizen. Bateman and Gilson studied the environmental effects of pet dogs and found extensive environmental impacts by pet dogs [2]. In addition to direct killing and upsetting of multiple species, particularly birds in parks and shores, their mere presence, even when leashed, can disturb birds and mammals, causing them to leave areas where dogs are exercised. Furthermore, scent traces besides urine and feces left by pet dogs can continue to impose this effect even when dogs are not present. Feces and urine can transfer zoonoses to wildlife and pollute waterways and impact plant growth. Pet dogs

that enter waterways contribute to toxic pollution through wash-off of chemical ectoparasite treatment applications. Some negative environmental impacts of pet dogs are presented in Figure 5, including: (a) predatory behavior and chasing, resulting in fleeing by wildlife, with effects on mortality, energetics and reproduction; (b) presence in an area, resulting in effects on diversity and abundance of multiple taxa, with possible effects on reproduction; (c) entering water, with wash-off veterinary products affecting diversity and abundance of invertebrate taxa, possible subsequent effects on aquatic vertebrates; and (d) presence of urine and feces, with increases in nitrogen in water courses, effects on health of vegetation, and spread of zoonoses and parasites [2].

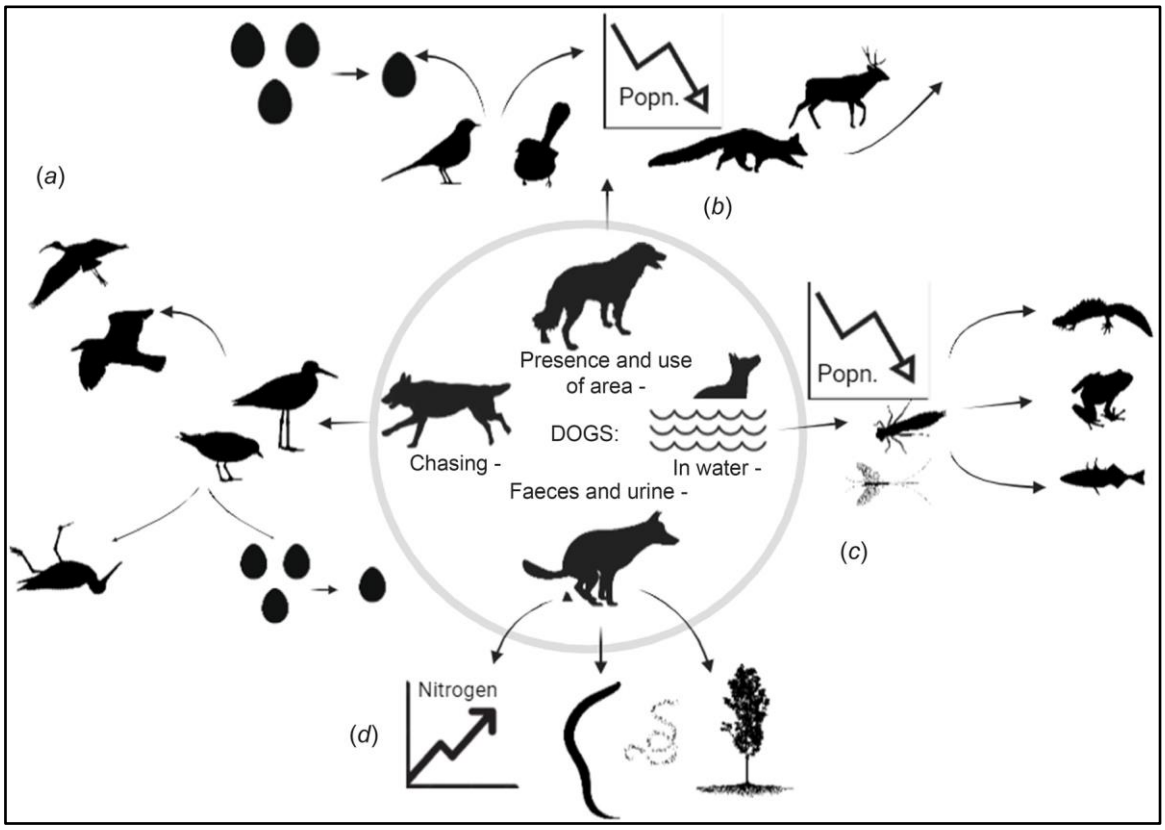

Figure 5. Various negative effects of pet dogs on environment.

3. Public health impacts

Public health can be considered the most crucial factor affected by dog parks based on available scientific evidence. It causes major physical and psychological effects on the neighborhood residents, particularly on children and elderly people. Dogs naturally carry parasites and biohazards, detrimental to human health. Dog park is a place where many dogs carrying different kinds of bugs, biological species, and bacteria gather and pollute the environment (soil, air, underground water), pass bacteria and other parasites to humans and to other animals.

Here, solid observations in various countries about the risks of dogs to public health, specifically in public places such as parks are discussed. Growing evidence suggests that dog parks close to residential areas, schools, and children playgrounds cause serious harm to the environment and public health. As peer-reviewed scientific literature reveals, public health and environment pollution with dangerous biohazards and parasites from dogs are major concerns.

On the evaluation of the potential risk for spread of *Toxocara* parasite by dogs' fur, Maurelli and colleagues found dogs the main animal species for producing zoonotic agents (for example, bacteria, parasites, fungi) [3]. The parasite *Toxocara* (also known as dog roundworm, see Figure 6) can spread to humans from animals, usually dogs or cats, causing Toxocariasis infection, a parasitic infection initiated by the larvae of roundworms that live in the intestines of dogs [4].

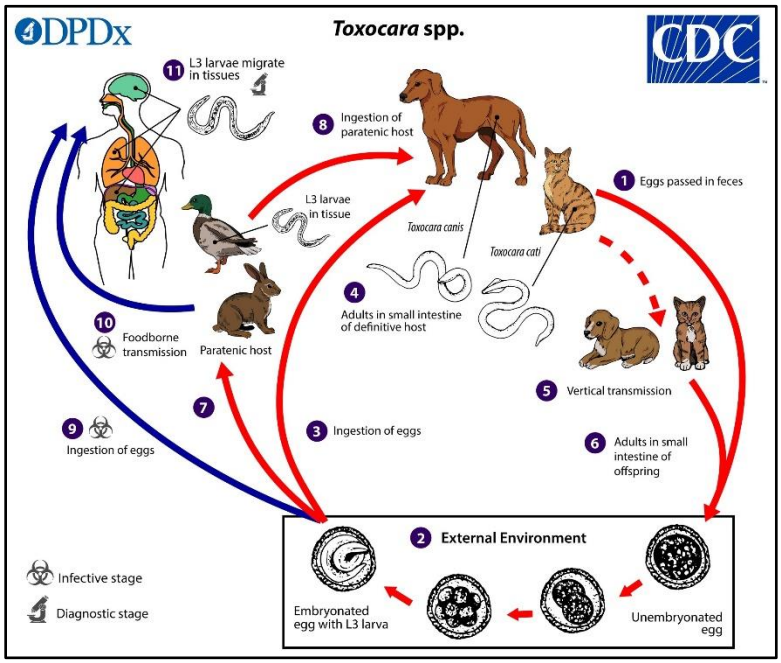

Figure 6. *Toxocara* spp. can follow a direct (one host) or indirect (multiple host) life cycle. Unembryonated eggs are shed in feces of definitive host (canids: *T. canis;* felids: *T. cati*) ❶. Eggs embryonate over a period of 1 to 4 weeks in environment and become infective, containing third-stage (L3) larvae ❷. Following ingestion by a definitive host ❸, infective eggs hatch and larvae penetrate gut wall. In younger dogs (*T. canis*) and in cats (*T. cati*), the larvae migrate through the lungs, bronchial tree, and esophagus, where they are coughed up swallowed into the gastrointestinal tract; adult worms develop and oviposit in small intestine ❹. In older dogs, patent (egg-producing) infections can also occur, but larvae more commonly become arrested in tissues. Arrested larvae are reactivated in female dogs during late gestation and may infect pups by transplacental (major) and transmammary (minor) routes ❺ in whose small intestine adult worms become established ❻. In cats, *T. cati* larvae can be transmitted via the transmammary route ❺ to kittens if the dam is infected during gestation, but somatic larval arrest and reactivation does not appear to be important as in *T. canis* [4].

In another research on zoonotic diseases, parasites were detected in more than 60% of human pathogens [5]. A zoonotic disease, for example Anthrax and Lyme, is a disease or infection

that can be transmitted naturally from vertebrate animals (for instance, dogs, cats, monkeys) to humans or vice versa. Moreover, children are the most at-risk residents regarding dog bites and dog-borne zoonoses, which may lead to severe injuries and illness, or even death [6]. The study on prevalence of intestinal parasites in pet dogs with highlights on zoonosis disclosed that pet dogs harbor a higher frequency of intestinal parasites, varying with age and sex [7]. Similar observations were also reported by Ghasemzadeh and Namazi [8]. They found pet dogs a major source of zoonotic infections that transmit several viral and bacterial diseases to humans. According to this research, zoonotic diseases can be transmitted to humans by infected saliva, aerosols, contaminated urine or feces as well as through direct contact with pet dogs.

Dogs were found to be the most important hosts for *Toxocara canis* parasite, a causative agent of human toxocariasis infection and one of the most widespread zoonotic helminths worldwide [9]. *Toxocara canis* and *Toxocara cati* are two types of diverse roundworms of canids and felids with vital public health consequences due to their zoonotic significance. Toxocariasis is now considered to be the most common human parasitic infection in the United States of America [10]. In another study, the parasitological examination of feces samples from pet dogs revealed infection by six zoonotic and four non-zoonotic parasites in varying ratios. These zoonotic parasites included *Ancylostoma caninum*, *Toxocara canis*, *Dipylidium caninum*, *Echinococcus granulosus*, *Cryptosporidium* spp., and *Giardia* cysts and trophozoites. The other observed non-zoonotic parasites comprised *Toxascaris leonina*, *Trichuris vulpis*, *Taenia* spp. eggs, and *Isospora canis oocysts* eggs (oval-shaped, uninfectious protozoan) produced by the coccidian parasite Isospora canis in dog's small intestine, secreted into feces. The infection rate was found higher in stray dogs (60%) than in pet dogs (40%). The infected dogs in both groups were found generally unhealthy, with poor body condition recorded in 14% of private pet dogs and 64% of stray dogs. The infection rate in humans was observed higher (92%) among dogs' shelter workers than among pet owners (67%) [11].

The contamination levels of Italian parks with canine helminth parasites eggs and the public health risk awareness were studied [12]. These scientists observed that most people are unaware of the health risk related to abandoned canine feces on the municipal soil. They concluded that zoonotic risk due to the high vitality of infective helminths eggs in the soil should always be considered more serious. Moreover, research about on-leash and off-leash policies and their possible effects on the behavior of dog-walkers in Calgary exhibited that off-leash policies in urban parks have negative outcomes for public health [13]. In addition to off-leash policies, factors were observed that need consideration regarding dog-walking and dog-fouling, including application strategies, physical features, socio-demographic characteristics, and modifications to park environment. None of these important factors nor public awareness of health and environmental risks were considered for the dog park in the Parkway Forest Park off-leash area project.

The most common type of pet dogs' leash-related injuries treated at hospitals' emergency departments were identified from a pull followed by a trip/tangle [14]. This can be another health and safety risk that dog parks can cause on humans. The rate of zoonotic enteric parasites in fecal

samples from dogs were examined in three different places of dog shelters, parks, and public roads and the dog owners' awareness of zoonoses as a significant public health risk [15]. The researchers observed a high infection rate of parasites with zoonotic potential in public places. The results require raising understanding among dog owners about the diseases transmitted by dog feces to humans in public places. Unfortunately, many individuals engaged to dogs, either owners or dog-walkers, are not sufficiently familiar with these health issues and related risks or sometimes do not care about the health risks. Intestinal nematodes affecting dogs, such as roundworms, hookworms, and whipworms, have a relevant health-risk impact on animals and, for most of them, on human beings [16]. Both pet dogs and humans are typically affected by ingesting the infection stages (for instance, larvated fully-developed eggs or larvae) present in the environment. Highly contaminated soil and grass with infectious parasitic elements have been detected worldwide in leisure, recreational, and in public and urban areas (parks, green areas, bicycle trails, city squares, playgrounds, sandpits, beaches).

Public health issues associated with the location and operation of off-leash dog parks were investigated [17]. The results from North American off-leash dog parks case studies highlighted the importance of location and design of park, public observance to safety and hygienic practices, and effective regulatory strategies for better control of potential risks of off-leash dog parks.

In their research work on fecal contamination of urban parks by domestic dogs, Mori and colleagues analyzed the extent and patterns of the distribution of dog feces in the urban parks of Calgary, Alberta in Canada [18]. They collected dog feces from randomly selected locations in the parks. The average density of dog feces by different dog-leash policies of the parks and the distribution pattern of the fecal density within the parks were assessed. In this way, the total contamination of the public parks for the entire city was estimated. The research disclosed that off-leash dog parks are largely further contaminated than other types of parks. These results suggest that public park visitors, especially those visiting the surrounding areas of off-leash parks, are exposed to large amounts of dog feces and in this way the related biohazards and parasites.

The treatment of people infected with dog parasites is a critical matter for the healthcare system. Opportunistic pathogens, such as *Enterococcus* spp. in both humans and animals, are highly resistance to antimicrobial agents. In a study in 2021, these pathogens were separated from feces of healthy dogs and urine of dogs with urinary tract infections (UTIs) disease and examined [19]. The experimental observations confirmed pet dogs as carriers of multidrug-resistant enterococci bacteria. These bacteria are indicators of the presence of fecal material in water and, therefore, probable presence of many other disease-causing bacteria, viruses, and protozoa. Stool microflora could be considered as the most probable source of *enterococcal* UTI and *E. faecalis* bacteria. Carried by pet dogs, they are more dangerous and infectious than *E. faecium* bacteria, justifying their more frequent involvement in UTIs.

Health risk factors related to soil-transmitted parasitic worms in dog feces contaminating public areas of Warsaw, Poland were examined [20]. The study consisted of 200 fecal samples

taken from the city and dog parks from selected districts. Each fecal sample was examined using the flotation technique. Eggs of various parasites, including *Toxocara canis*, *Toxascaris leonina*, *Trichuris vulpis*, and hookworms from the *Ancylostomatidae* family were detected in 23 (11.5%) of the fecal samples. The most dominant species were hookworms from the family *Ancylostomatidae* (8%). The presence of parasites was confirmed in 14 out of 20 of the examined locations (70%), including eight city parks (72.7%) and six dog parks (66.7%). This research confirmed the observations of other studies that dogs' feces infect the environment with parasites. It also revealed that the presence of dogs' feces in public areas and the associated parasites is a major public health concern. Similar research was also conducted in Serbia in 2022 and 2023 on 382 pet dogs to examine concentrations of parasitic biohazards [21]. The overall existence of intestinal parasites was observed as 62.6%, with the following detected parasites and their occurrences (Figure 7 from [21]); protozoa: *Cystoisospora* spp. (9.2%), *Sarcocystis* spp. (4.5%), *Neospora caninum*/*Hammondia* spp. (3.7%), *Giardia intestinalis* (11.8%); nematoda: *Toxocara canis* (11.5%), *Toxascaris leonina* (4.2%), family *Ancylostomatidae* (38.0%), *Trichuris vulpis* (21.5%), *Capillaria* spp. (10.5%); trematoda: *Alaria alata* (1.6%) and cestodes (tape-like and segmented worm) from the Taeniidae family tapeworms (1.3%).

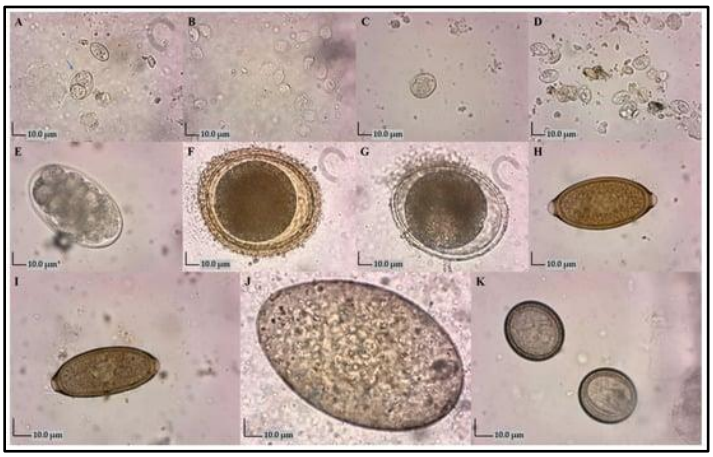

Figure 7. Parasitic elements detected in fecal samples, zinc sulphate flotation (×400): (**A**)—*Cystoisospora* spp. oocyst (blue arrow); (**B**)—*Giardia intestinalis* cysts; (**C**)—*Neospora caninum*/*Hammondia* spp. oocyst; (**D**)—*Sarcocystis* spp. sporocysts; (**E**)—Ancylostomatidae egg; (**F**)—*Toxocara canis* egg; (**G**)—*Toxascaris leonina* egg; (**H**)—*Trichuris vulpis* egg; (**I**)—*Capillaria* spp. egg; (**J**)—*Alaria alata* egg; (**K**)—Taeniidae eggs.

Antimicrobial resistance is a public health threat with an increasing expression in some countries where there is overpopulation of pet dogs. This may facilitate the spread of resistant bacteria, including extended-spectrum β-lactamase enzyme producing Enterobacteriaceae group of bacteria. As such, dogs may turn into reservoirs of resistant bacteria, including pathogenic and zoonotic species, representing a public health concern [22]. Urban dog parks are places where the transmission of diseases occur. Exposure to infective agents, contained within the soil, intermediate hosts (for example, rodents and rabbits), and feces, can directly affect the health of

dogs as well as humans. Other factors that can further influence canine health include age, previous diagnoses of parasites and diseases, and migration.

Many dog owners visit dog parks to encourage socialization and exercise. Such activities are intended to improve health, but unawareness of microbiological organisms can lead to harmful health conditions if not prevented and treated at the early stages. Human populations—particularly children, the elderly, pregnant women, and immunocompromised individuals—may develop physical and neurological damage from exposure to certain species of protozoa, helminths, and other parasites. In this regard, 100 fecal samples of canine pets were collected from 16 urban dog parks in Santiago and Boa Vista Islands of Cape Verde and analyzed [22]. After laboratory examinations using fecal smear and fecal flotation procedures and microscopic observations, canine parasites were found in 50% of stool samples. Out of those observed parasites, *protozoan*, *nematode*, and *cestode* species were identified, most of which have zoonotic potential, highly dangerous to public health.

Many fleas' species can feed on humans. The human flea (*Pulex irritans*) is less-commonly seen in industrialized regions. Although not an effective vector for a disease, it can serve as an intermediate host for the cestodes *Dipylidium caninum* and *Hymenolepis nana*, which are common small intestine tapeworm carried by pet dogs. The cat and dog fleas (*Ctenocephalides canis* and *C. felis*) may also feed on humans [23,24]. The occurrence of endoparasites in dog feces from public places and the amounts of endoparasites in soil were identified as potential risk factors associated with the dog endoparasites infection spread [25]. In a one-year study, a total of 803 dog fecal samples and 148 soil samples from public places were examined for the presence of endoparasite developmental stages. In general, 44% of dog feces samples were found positive of parasites. Six different species of intestinal parasites were detected in dogs: *Toxocara canis* (23%), *Trichuris vulpis* (14%), family Ancylostomatidae worms (10%), *Capillaria aerophilla* (6%), *Ascaris* spp. (1.5%). Overall, 52% of soil samples were positive for at least one endoparasites species. The occurrence of parasitic eggs in the soil was determined as: *Ascaris* spp. (37%), *Toxocara* spp. (29%), *Trichuris* spp. (29%), family *Ancylostomatidae* (2%), and *Toxascaris leonina* (2%).

The high risk to public health from many dog feces dispersed in urban areas, particularly in parks and sidewalks, is a major cause for concern. Dog feces are a serious hazard because they contain microorganisms that are both pathogenic to humans and resistant to several classes of antibiotics. The presence of resistant bacteria in an urban environment corresponds to a public health biohazard which requires control procedures. Cinquepalmi et al. detected *Giardia* parasite cysts in 1.9% of the fecal samples [26]. The predominant *Enterococcus* species were *E. faecium* (61.6%), *E. gallinarum* (23.3%), and *E. casseliflavus* (5.5%). Other species, including *E. faecalis*, were also isolated and detected. These strains exhibited resistance to various antibiotics of clindamycin (86.3%), tetracycline (65.7%), erythromycin (60.3%), and ampicillin (47.9%). High-level aminoglycoside resistance species was also found in 65.7% of enterococci [26]. In another research, virulence genes and antimicrobial resistance in *Enterococcus* strains were collected from dogs and cats in China [27]. The aim of the study was to characterize the antimicrobial resistance

and virulence of *Enterococcus* bacteria from dogs and cats and to assess its zoonotic risk based on a total of 469 enterococci strains from 610 samples, including 238 strains of *E. faecium* and 128 strains of *E. faecalis*. The experimental results confirmed the presence of strains carrying multiple virulent factors and antimicrobial resistance at the same time, suggesting dogs and cats as public health risk as sources of *enterococci* bacteria, causing various diseases, such as UTI, bacteremia, infective endocarditis, meningitis, intra-abdominal infections, and wound infections.

The scale of parasitic and microbial soil pollutions from pet dogs in residential areas, playgrounds, and kindergarten neighborhoods of Kaluga in Russia were analyzed [28]. This may be considered as a general universal study that can be applied to every other place. The research method involved identification of *Toxocara* (dog roundworm) eggs and microorganisms in sandpits, lawns, and boulevards. Assessments of 210 soil and sand samples in different areas of the city uncovered that the soil pollution of boulevards with *Toxocara* eggs was 4.9 times greater than that of normal sandpits and 1.9 times more than that of normal grasslands. Molds of the genera *Aspergillus*, *Penicillium*, *Mucor*, *Fusarium*, *Cladosporium*, *Candida*, *Alternaria*, and *Rhizopus* were sown most often from the soils of lawns and boulevards. The bacterial microbiota was represented by *Clostridium*, *Enterococcus*, *Enterobacteriaceae*, *Salmonella* and *Micrococcus*.

Antimicrobial resistance profiles of *Enterococcus faecium* and *Enterococcus faecalis* isolated from healthy dogs and cats in South Korea were also investigated [29]. *Enterococcus* spp. is usually found in the gastrointestinal tracts of humans and animals. However, they have the potential to produce opportunistic infections that can be transmitted to humans or other animals, along with acquired antibiotic resistance. The occurrence of antimicrobial-resistant *enterococci* in companion animals suggests a serious public health concern.

Health troubles from dogs have been serious in all countries, including Italy where Paoletti and colleagues studied zoonotic parasites in feces and fur of stray and pet dogs [30]. Individual fecal samples collected from 117 and 385 rescue shelters and pet dogs, respectively, were examined through conventional copromicroscopy methods. The observations indicated that canine feces from both private and kenneled animals contain zoonotic parasites, a serious risk for humans and other animals' health, especially when they contaminate the environment. The researchers emphasized the role of dog fur as a source for human infections. In another research in Italy, intestinal parasites of dogs were investigated as a serious threat to human health due to their zoonotic potential [31]. The researchers reported that public areas with larger populations of pets and urban fecal contamination are at high health risk. The major aim of the survey was to determine the prevalence of zoonotic parasites in dog fecal samples collected from the public soils of Milan, Italy. The overall prevalence of intestinal parasites resulted in 16.6%. In the samples, various zoonotic parasites were detected, such as *Trichuris vulpis* (3.7%), *Toxocara canis* (1.7%), *Strongyloides stercoralis* (0.9%), *Ancylostomatidae* (0.4%), and *Dipylidium caninum* (0.4%).

Public spaces are common sites of pet dogs' fecal contamination with prevalent rates of gastrointestinal pathogens carried by dogs. Multiple pet-bound parasite species capable of

infecting humans have been previously reported in fecal samples collected from urban areas around the globe, including Italy. Parasites commonly found in the gastrointestinal tract of pet dogs include small intestinal roundworms (for example, *Toxocara canis* exhibited in Figure 8, *Toxocara cati*, and *Toxascaris leonina*), protozoa (for example, *Cystoisospora* spp., *Giardia duodenalis*, and *Cryptosporidium* spp.), hookworms (for example, *Ancylostoma caninum* and *Uncinaria stenocephala*), whipworms (for example, *Trichuris vulpis*), tapeworms (for example, *Taenia* spp., *Echinococcus* spp., and *Dipylidium caninum*), and lungworms (for example, *Aelurostrongylus abstrusus*, *Angiostrongylus vasorum*, *Troglostrongylus brevior*, and *Eucoleus aerophilus*). Hookworms, *Strongyloides stercoralis*, *Toxocara* sp., and *Trichuris vulpis* were found among the most identified parasites [32].

Figure 8. Photo of *Toxocara canis* roundworms adults spontaneously expelled with the feces by a dog [33].

Chagas disease is a vector-borne neglected zoonotic sickness caused by a flagellate protozoan, *Trypanosoma cruzi*, that affects various mammalian species, including humans and domestic animals. However, due to an increase in population movements and new routes of transmission, *T. cruzi* parasite infection is presently considered a worldwide health concern, not restricted only to endemic countries. Dogs play a major role in the domestic cycle by acting very efficiently as reservoirs and allowing the perpetuation of parasite transmission in endemic areas [34]. This disease, an infection with the parasite *T. cruzi*, is increasingly diagnosed among humans. For instance, exposure of shelter dogs to *T. cruzi* parasite in Texas was found significant at 8.8% [35].

Hydatid disease—a parasitic infection from a tapeworm that causes cysts in the liver and other organs—is a widespread health issue which can be found anywhere in the world. Also called the hydatid worm or dog tapeworm, it is a zoonotic infection caused by adult or larval stages of the cestode *Echinococcus granulosus*. As a cyclophyllid cestode, it stays in the small intestine of canids as an adult, but with important intermediate hosts such as livestock and humans cause cystic echinococcosis. Two types of *E. granulosus* life cycle patterns have been described in Europe, Asia, and North America. Once formed in the human liver, cysts grow as much as 1 cm during the first six months and 2–3 cm every year thereafter, depending on the host's physical resistance [36]. A parasitic tapeworm that potentially causes fatal alveolar hydatid disease in humans, has been

recently detected in dogs in Peterborough, Ontario [37]. The parasite is transmitted when rodents are consumed by a larger animal, but humans can become infected with this tapeworm through contact with dog feces [38].

Genetic studies of the nematode *Strongyloides stercoralis* in Asia have been performed [39]. The authors obtained different results from the previous observations that *S. stercoralis* in people and dogs is the same parasite. Their genomic analyses of Asia showed that these parasites are distinct, parasites of dogs began infecting people when dogs became domesticated as pets. These opposite conclusions can be controversial until more valid evidence are observed.

Imported dogs from overseas into Canada, especially from Ukraine, is a high risk for spreading canine rabies virus [40]. These imported dogs mostly carry various kinds of parasites, such as heartworm (*Dirofilaria immitis*), *Echinococcus* spp., and Brucella canis bacteria in addition to some diseases. Dog park is a place where these imported dogs meet and transfer parasites and diseases to local pets. As a result, parasites will be transferred to dog owners and caretakers and to the entire neighborhood environment, particularly people at higher health risk (children, elderly, and immunosuppressed individuals). Because of high-risk health issue, importation of all commercial dogs from countries considered high-risk for canine rabies virus (including Ukraine) was banned. Despite this restriction, there might be dogs from those high-risk countries in any neighborhood.

In recent research in Dublin, Ireland, Keegan and colleagues observed park entrances as a risk of zoonotic infection to the public, commonly contaminated with infective *Toxocara canis* eggs [41]. The zoology researchers at Trinity College Dublin analyzed soil in 12 Dublin parks and detected roundworm eggs in 75% of parks. They recommended preventive efforts on dog fouling at these sites to decrease risks of zoonotic diseases transmission to humans and to animals. This valuable research results were covered by several media, for example by Raidió Teilifís Éireann [42] and the Trinity College Dublin website [43]. Daily Mail newspaper reported from the same research work that whilst most roundworm infections are mild, in some cases the tiny eggs can enter the bloodstream and make their way to the eyes [44]. Once in eyes, the roundworms can damage the eye upon hatching and, if left untreated, cause blindness. Patients can also experience breathing difficulties if eggs hatch in their lungs.

In addition to biohazard parasites and other health risks, dogs may also attack to people, cause serious injuries and even may end up with death. Some statistical data about this issue is presented in Figure 9 diagram. There have been significant numbers of death from dog's attack. In one of the recent cases on December 9, 2024, a 5-year-old girl was fatally mauled by two pet dogs in Los Angles, USA [45]. A dog park in a neighborhood with a greater population of children at the vicinity of primary school brings various dogs to the area, endangering people, especially children.

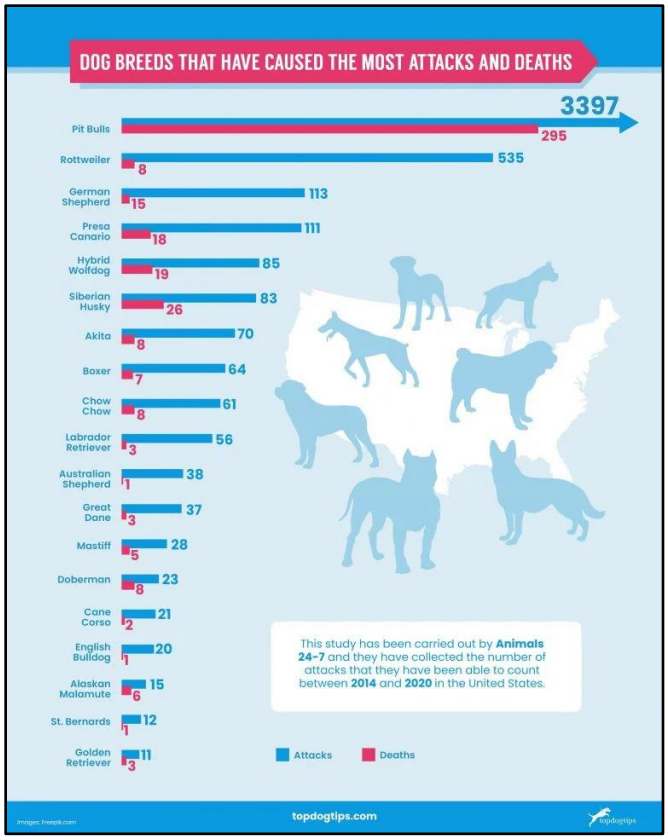

Figure 9. Risks of injury and attack by different dogs. Statistics are the numbers of attacks that were documented in period of 2014–2020 in the United States of America.

4. Social

There is a significant percentage of the population, especially younger children, that are terrified of dogs. The investigated neighborhood is not an exception; it might be more serious with consideration of the population fabric in the area. Negligence of this matter is actually a rejection of many people's enjoyment; even apparently friendly dogs will keep those people away from public park. Because of this matter and also health problems, dogs are usually not allowed in and around the schoolyards, while the signs are sometimes neglected by careless dog owners (Figure 10).

Dog parks commonly cause social confrontation between people with different interests. In August 2024, Toronto's city council adopted the ban on dog walkers from using Ramsden Park off-leash dog park after residents' complaints about the heavy use of and noise disturbance as well as conflicts on cars parking [46]. People must be able to spend time and enjoy themselves in a public park, take their children to a playground or just walk or jog on the sidewalk without having to worry about being harrased and harmed by an off-leash dog and its owner. While dog owners violate rules in the entire studied area, dogs are observed running off leash everywhere, it will be

very unlikely they will comply with the rules including in the off-leash dog park area. As a result, there will be more confrontation among people, not only residents of the Park's neighborhood but people that bring their dogs from other parts of Toronto.

Figure 10. Dogs prohibited signs around FMPS school.

5. Economics

As explained above, dog park in the area significantly affects the environmental, health, and social conditions as well as the value of the entire neighborhood. A section of Parkway Forest Park will be closed to the public, limited for use by dogs' owners and dog walkers. This and other factors can significantly influence the real estate market in the area, obviously devaluing the properties, financially damaging the neighborhood and the owners of properties.

6. Summary and Conclusions

In brief, the dog park investigated in this study is next to a large public primary school, children playground, several outdoor sports fields, and many residential buildings. It causes detrimental effects on the local residents, particularly children, both their physical and psychological health. Unfortunately, most citizens are unaware of the health risk of dog parks. Numerous scientific research works performed in various countries published in scholarly journals have clearly disclosed the existence of canine parasites in more than 50% (even in some cases at a level of 67%) of dog parks. Most soil samples collected and analyzed from dog parks included at least one parasite species. Many of these bacteria are antibiotic resistant; there will be no medical treatment for the infected people. In addition to endangering dogs' health catching illnesses from other dogs, dog park spread highly contagious parasites, fleas, and tick that dogs bring into the buildings and homes. The infection rate among dogs' shelter workers and dog owners were respectively assessed as 92% and 67%. Dog parks also seriously affect the environment and ecosystem of the entire park. Public Park must be shared by all people with no discrimination. Based on the above numerous solid evidence and facts and brief review of various factors, the

construction of a dog park in the studied area is not justified. Biohazard parasites accumulated in the dog park during the time perform like a biological agent, are washed off into the underground water table and released off the lawn in heat into the air as aerosol, causing epidemic diseases in humans.

Declaration of competing interest

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence this research work and the conclusions. This study was performed to the best interests of public health and environment.

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