

OCCURRENCE OF INFECTIOUS AND PARASITIC DISEASES IN ASSOCIATION WITH THE OUTDOOR HABITS OF HOUSEHOLD DOGS AND CATS A CASE-CONTROL STUDY

ESTUDO CASO-CONTROLE DA OCORRÊNCIA DE DOENÇAS INFECTO-PARASITÁRIAS ASSOCIADAS AOS HÁBITOS SEMI-DOMICILIADOS DE CÃES E GATOS DOMÉSTICOS

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SUMMARY

Many owners believe to act in their pets' best interest by allowing them to go outside, with or without supervision. However, outdoor exposure greatly increases the risk of disease and accidents. In this study, we evaluated the association between infectious and parasitic diseases and the outdoor habits of pet dogs and cats. Epidemiological data were obtained from the records of dogs and cats treated at the Teaching Clinic and Hospital Unit of Veterinary Medicine in the city of Pirassununga, state of São Paulo, Brazil. Pets with any form of infection were included in the case study group, and pets with no infectious or parasitic diseases were used as controls. Animals were further divided according to their habits into indoor animals, indoor animals taken for walks, and outdoor animals. The odds ratio of having a disease was calculated from the comparisons among these groups using the MedCalc Statistical Software. We found an increased risk for the occurrence of infectious or parasitic diseases in outdoor dogs and cats when compared to indoor animals (OR of 4.735) and to those taken for walks (OR of 2.303). In light of our results, we suggest that awareness campaigns should also focus on the benefits of keeping pets indoors.

KEY-WORDS: Access to outdoor. Odds ratio. Infection. Canine. Feline.

RESUMO

Muitos proprietários acreditam agir no melhor interesse de seus animais de estimação permitindo-os o acesso ao ambiente externo, com ou sem supervisão. Entretanto, isso aumenta consideravelmente o risco para a ocorrência de doenças e acidentes. Neste estudo, foi avaliada a associação entre doenças infecciosas e parasitárias com relação aos hábitos semi-domiciliados de cães e gatos. Dados epidemiológicos foram obtidos de arquivo de prontuários de cães e gatos atendidos na Unidade Didática Clínico Hospitalar (UDCH) do curso de Medicina Veterinária da FZEA/USP no município de Pirassununga, estado de São Paulo, Brasil. Animais de estimação que apresentaram doenças infecto-parasitárias foram incluídos no grupo de casos; animais sem tais doenças, controles. Os animais foram ainda divididos de acordo em domiciliados, domiciliados frequentemente levados a passeios e semi-domiciliados. A razão de chances para a ocorrência de doenças infecciosas foi calculada a partir da comparação dos grupos supracitados, fazendo uso do software estatístico MedCalc. Encontrou-se um risco aumentado para a ocorrência de doenças infecto-parasitárias em cães e gatos semi-domiciliados quando comparados aos animais domiciliados (OR de 4.735) e quanto aos domiciliados guiados em passeios (OR de 2.303). À luz dos resultados se sugere que campanhas de conscientização foquem também nos benefícios da criação domiciliada de animais de estimação.

PALAVRAS-CHAVE: Acesso à rua. Razão de chances. Infecção. Caninos. Felinos.

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INTRODUCTION

Outdoor life can bring benefits to dogs, especially for athletic and energetic. However, depending on the environment and outdoor habits, this exposure may have more negative than positive consequences. Moreover, aggressive behavior between animals may further potentiate direct transmission of diseases (PROCTER, 2012).

Many studies have suggested a close association between the outdoor habits of dogs and cats and the occurrence of several diseases. Previous work also pointed to the role played by stray animals in urban accidents and incidents, including bites and disease transmission (DUERR *et al.*, 2017). Canine distemper, a highly contagious and serious disease, is mainly transmitted by aerosols of respiratory secretions; acutely infected dogs shed virus in all body secretions, and of all viral diseases it seems to have the most far-reaching implications for susceptible roaming dogs (MONTALI *et al.*, 1987; FROLICH *et al.*, 2000). However, these studies rarely focus on household pets with an outdoor life, specifically as a target for prevention campaigns, which could help in many diseases' prevention.

A bigger proportion of cats live outdoors in comparison to dogs, and owners take them less frequently to the veterinary physician (LUE *et al.*, 2008). Stray or outdoor cats succumb to illness, injury or hunger more frequently than indoor cats. They may also transmit diseases to humans and affect the native fauna, due to their predatory behavior (NEIJENHUIS; NIEKERK, 2015).

Few studies have compared the mortality of indoor and outdoor cats. Epidemiological evidence indicates that, while life indoors increases the risk of certain diseases among cats (e.g., lower urinary tract disorders), greater risk lies outdoors due to aggression from other cats, general injuries and exposure to infectious disease (BUFFINGTON, 2002).

Outdoor cats and kittens, in comparison with indoor animals, will more likely have *Bartonella henselae* infections and flea infestations (FLORIN *et al.*, 2008). Moreover, wild cats and outdoor cats, in comparison to indoor pets, have higher seroprevalence of *Toxoplasma gondii* (NUTTER *et al.*, 2004).

The present study, conducted in the city of Pirassununga, São Paulo, Brazil aimed at further evaluating the association between infectious and parasitic diseases and the outdoor habits of pet dogs and cats. We also discuss the underestimated risks posed by unsupervised outdoor pets.

MATERIAL AND METHODS

Epidemiological data were obtained from the records of dogs and cats treated at a veterinary hospital the Teaching Clinic and Hospital Unit of Veterinary Medicine at the School of Animal Science and Food Engineering (FZEA), University of São Paulo. The case study group included pets diagnosed with an infectious or parasitic disease. The control group included pets with no infectious or parasitic disease, and brought to the clinic for

routine check-ups, vaccination, elective surgery, neoplasms and idiopathic disorders.

Data were obtained from 490 animals, including 424 dogs and 66 cats between early 2014 and June 2016. We obtained information about the outdoor habits of 461 animals, including 401 dogs and 60 cats. Animals were further divided into three groups: I (indoor animals), W (indoor animals taken for outdoor walks) and O (outdoor animals). Data were analyzed according to previously described methods, and submitted to the MedCalc Statistical Software (MedCalc Software bvba, 2016). The study was approved by the Ethics Committee on Animal Use (CEUA/FZEA) under protocol number 4459290118.

RESULTS AND DISCUSSION

Overall, between 2014 and 2016, UDCH-FZEA admitted 904 new animals, averaging 301 new cases per year. Most common diseases found were helminthiasis, bloodborne parasitic diseases, demodicosis and chronic renal failure. Other notable ones are *Mycoplasma* diseases, parasitic otitis, canine distemper, feline leukemia, feline AIDS and feline infectious peritonitis. Castration procedures summed up to 50 dogs and 8 cats submitted to ovary-salpingo-hysterectomy, and 46 dogs and 2 cats to orchiectomy. Those are general data and were obtained by personal communication, and may or may not have been included in this study according to the availability of epidemiological data.

Among the 401 dogs included in the study, 122 were diagnosed with infectious or parasitic diseases and included in the case study group and the remaining animals were included in the control group. Among the 60 cats, 22 were placed in the case study group and 38 in the control group. There were 195 indoor pets (I; 157 dogs/38 cats); 91 outdoor animals, (O; 73 dogs/18 cats); and 175 pets often taken for walks (W; 171 dogs/4 cats). An increased chance of infection was detected in O versus I dogs, with an odds ratio (OR) of 4.735 ($P < 0.0001$, Table 1). In the comparison between W and I dogs, an increase in risk was also detected, albeit with a odds ratio (OR) of 2.303 ($P = 0.0016$, Table 1). In cats, we only compared O and I animals and the risk of infection had an OR of 13.150 ($P = 0.0002$, Table 1).

We evaluated the risk of infection associated with the outdoor habits of dogs and cats in the city of Pirassununga, São Paulo, Brazil. We did not target a specific pathogen, but infections in general. Nevertheless, our results agree with those from numerous previous studies, and suggest that exposure to the outdoors increases the risk of infection among pet animals. Other authors indicate that pet owners cannot completely avoid pet exposure to pathogens, especially protozoans, but understanding risk factors and adopting preventive measures reduces disease incidence (ESCH; PETERSEN, 2013). In fact, many owners already have at least a partial understanding of these factors. According to a recent study about the public perception of parasitic diseases, most of the individuals interviewed pointed to the external environment, followed by direct transmission from infected animals, as potential sources of ectoparasites in pets (MATOS *et al.*, 2015). In Brazil and elsewhere,

public awareness represents a first step towards early diagnosis, management and prevention of zoonotic diseases, which take a toll on the public health system of

developing and developed countries (COLWELL *et al.*, 2011).

Table 1 - Comparison of the risk of infection among dogs and cats with different outdoor habits.

Comparisons*	OR	z value	CI	Significance level
Dog: O vs. I	4,735	4,960	2,5615 to 8.7533	P<0,0001
Dog: W vs. I	2,303	3,159	1,3726 to 3,8660	P = 0,0016
Cat: O vs. I	13,150	3,717	3,3768 to 51,0145	P = 0,0002

*O = outdoor animals, I = indoor animals, W = indoor animals often taken for walks.

According to our results, pet dogs that are often taken for walks have increased risk of infection in comparison with indoor dogs (OR = 2.303). However, in the comparison of outdoor and indoor dogs, we found a twofold greater OR of 4.735. These findings suggest that mere contact with the outdoors does not account for all the risk. Lack of supervision also seems to play an important role in the infection of household pets. Memory biases often affect case-control studies (MEDEIROS *et al.*, 2003), such as ours. In fact, our data did not allow for a detailed analysis of the degree of freedom granted to pets during their walks. Moreover, subjective evaluations by the pet owners did not allow us to stratify the data and discern different conditions during the walks, including, for example, pavement quality and cleanliness among others.

A large proportion of the studies regarding pet diseases focus on planning and implementing control systems, such as vaccination campaigns. The effectiveness of such preventive measures depends on the percentage of animals that receives immunization (ROBINSON *et al.*, 1996). Thus, a successful program must count with the involvement of the general population achieved through mass campaigns and, if possible, "door to door" methods (BERAN, 1985). Moreover, preventive programs must occur periodically because of the high reproduction rates among stray animals, which poses severe logistical challenges to Health Surveillance or Zoonosis Control agencies. In parallel, an increasing body of work points to the benefits of continuous monitoring of parameters such as the number of outdoor animals (SLATER, 2001).

It should also be noted that keeping a dog indoor is an inexpensive prevention measure, as it does not rely on third party services or purchase of products, but still plays its role sometimes even better than expected: in a work by SALB *et al.* (2008) in a remote Northern Canada community, studying dogs' role as sources and sentinels for parasites in persons, it was found that dogs housed outdoors were more likely to have gastrointestinal parasites such as *Toxocara* spp., *Toxascaris* spp., *Cystoisospora* spp. and *Uncinaria* spp. at $p < 0.0001$, while previous veterinary care or deworming had no effect on parasite prevalence. Another survey revealed that positive serology for *Leishmania* spp. showed a significant association with the male gender of dogs and with their rural and outdoor life (ZAFFARONI *et al.*, 1999).

Cats living outdoors also had an increased risk of infection in comparison to indoor cats. However, the OR (13.150) obtained from this comparison was three-fold

greater than the OR obtained from comparing O and I dog groups. The large difference observed may result from feline behavior and from the fact that cat owner less frequently take them to the veterinary physician (LUE *et al.*, 2008). It should be noted that cats can also behave as carnivorous animals, and as such the threat they may cause to the environment should also be taken in consideration. The prevalence of infections also differs between stray and outdoor cats because of distinctions in the behavior of these populations towards humans and other cats (SLATER, 2015). A previous study indicated that outdoor cats that mingle with stray cats often represent the primary source of pathogens (HELLARD *et al.*, 2011). Our study population did not include stray cats making similar comparisons impossible.

Outdoor cats contract and transmit diseases such as feline AIDS and feline leukemia, which may have serious health consequences for the animals (SLATER, 2015). Seroepidemiological samplings performed in Japan for Feline immunodeficiency virus (FIV) indicated that the vast majority (94.7%) of infected cats either had free access to the outdoors or were adopted stray cats (ISHIDA *et al.*, 1989). In a seroprevalence study by LEVY *et al.* (2006) for both FIV and Feline Leukemia Virus (FeLV) it was found a significantly higher risk of seropositivity in pet cats that were allowed outdoors than in pets that were kept strictly indoors.

A previous study had pointed out that the overall prevalence of intestinal parasites in household cats is statistically significantly higher than cats that lived outside or had access to a garden (ZANZANI *et al.*, 2014). One of the most common nematode which infect cats worldwide, *Toxocara cati*, had its prevalence previously correlated with age (young cats) and habitat (outdoor cats) (MIRCEAN *et al.*, 2010).

Our results support the notion that keeping pet dogs and cats indoors has benefits to the animals and to humans. To promote a change in pet owner behavior, one must understand their reasons for keeping pets indoors or outdoors. A small study conducted in the United States concluded that owners of indoor cats feel their pets are safer from disease, accidents and fights with other animals. In contrast, owners of outdoor cats argue that their pets' lives become richer outside their homes. They also state that their cats ceaselessly ask to go out (MOSTELLER; KRAUS, 2013). Dog behavior also affects owner decisions. Dog owners will often keep them indoors to avoid disturbing neighbors with the barks, or to avoid other problems such as self-mutilation and the destruction of fences and other objects that may occur due

to a high level of anxiety and boredom by being without the company of the owner (BRIDGE, 2000).

To our knowledge, this is the first work to evaluate the risk that outdoor access poses for the occurrence of infectious and parasitic diseases as a whole. Many common diseases found in clinical practice, including the ones in UDCH casuistry, were studied before regarding how outdoor access affect its own epidemiology only, as pointed in some discussed examples. However, not every disease seems to have outdoor access as a risk factor. SILVA *et al.* (2012) found no significant association between outdoor access and presence of *Ehrlichia canis* and *Anaplasma platys* in dogs. In a study about several factors for the occurrence of canine parvovirus, it was found that outdoor access had odds ratio <1 for canine parvovirus (CPV) compared to no outdoor access (MIRANDA *et al.*, 2015).

It has long been known that stray dogs and cats pose risks to animal and public health (HILL, 2006). Our results suggest that pets with outdoor habits also pose risks, albeit to a lesser extent. Thus, effective campaigns should target owners who, for their convictions, living arrangements or other reasons, choose to allow their pets outdoors.

CONCLUSIONS

We suggest that keeping pet animals indoors constitutes a key aspect of responsible ownership. Outdoor exposure with or without supervision increases the risk of disease in dogs and cats, representing a health hazard to the animals. Because many of those diseases are zoonosis, it also consists in risks to the owners and to the public in general. A change in pet owner habits can only come from a more consistent discussion about public health and responsible ownership in the appropriate forums.

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