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COMPORTAMENTO, MANEJO E BEM-ESTAR DE GATOS DOMÉSTICOS A PARTIR DE ENTREVISTAS COM TUTORES

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Dissertação de mestrado apresentada ao Programa de Pós-graduação em Comportamento e Biologia Animal da Universidade Federal de Juiz de Fora, como parte das exigências para a obtenção do título de Mestre em Comportamento e Biologia Animal.

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Daiana de Souza Machado

Comportamento, manejo e bem-estar de gatos domésticos a partir de entrevistas com tutores

Dissertação apresentada ao Programa de Pós-Graduação em Ciências Biológicas (Zoologia): Comportamento e Biologia Animal, da Universidade Federal de Juiz de Fora como requisito parcial para obtenção do título de Mestre em Ciências Biológicas. Área de concentração: Comportamento Animal.

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“Dedico este trabalho aos meus amados pais, Sandra e José Luiz, e ao meu querido marido Julio, meus três grandes incentivadores. ”

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“Todo o trabalho é vazio a não ser que haja amor.”

Khalil Gibran

RESUMO PARA DIVULGAÇÃO CIENTÍFICA

A falta de conhecimento sobre o comportamento e modo de criação mais adequado para gatos domésticos pode gerar problemas em muitos aspectos. Um modo de criação incorreto do gato pode trazer prejuízos não apenas a eles, mas também às pessoas que convivem com ele, tanto emocionais quanto relacionados à saúde do gato e de seus donos. Gatos que têm acesso à rua podem se acidentar, pegar doenças e sofrer maus-tratos. Já os gatos que vivem somente dentro de casa e não possuem acesso à rua, podem sofrer de problemas relacionados à separação, que são comportamentos indesejáveis exibidos quando a figura de apego não está presente (na maioria dos casos a figura de apego é o tutor). Estes comportamentos podem ser: eliminação de urina e fezes em local inadequado, miados em excesso e comportamento destrutivo (como arranhar locais inapropriados para o tutor e em excesso). Portanto, os objetivos do nosso estudo foram: caracterizar os problemas relacionados à separação que podem ocorrer com gatos e verificar quais problemas podem acontecer com gatos que têm acesso à rua, buscando assim estimular uma reflexão sobre as melhores práticas de manejo a esses animais. Nós verificamos que gatos que possuem acesso à rua possuem mais chances de pegar pulgas, “doenças transmitidas por fungos” – a esporotricose, “de se perderem”, “serem envenenados”, de “sofrerem maus-tratos” e de “se acidentarem”. Por outro lado, gatos que vivem apenas dentro de casa podem desenvolver problemas relacionados à separação devido à ausência de brinquedos, ausência de outros animais na casa e por ficarem muito tempo sozinhos. Portanto, é preciso levar em conta todos os problemas que podem decorrer do modo de criação dos gatos, para que assim não ocorram danos na saúde física e psicológica do animal e de seus donos.

Palavras-chave: Acesso à rua. Ansiedade por separação. Modo de criação. Problemas comportamentais.

RESUMO

Muitos transtornos podem decorrer em função do tipo de manejo empregado aos gatos domésticos (*Felis silvestris catus*). Os gatos que possuem acesso à rua estão mais propensos a sofrerem maus-tratos, contrair patógenos e parasitos, se envolverem em acidentes de trânsito, além de haver mais riscos de causarem impactos em áreas naturais devido ao comportamento de predação. Por outro lado, os animais que são mantidos confinados podem desenvolver problemas comportamentais, devido à previsibilidade do ambiente e falta de oportunidade de realizar comportamentos naturais, como a exploração. Dentre os transtornos comportamentais comuns em animais de companhia, estão os Problemas Relacionados à Separação (PRS). Os PRS são um distúrbio comum em cães, que também pode acometer os gatos, sendo caracterizados pela exibição de comportamentos indesejáveis durante ausência da figura de apego. O animal pode, por exemplo, eliminar em locais inapropriados, exibir comportamento destrutivo e vocalização excessiva. Portanto, nossos objetivos foram: i) identificar os fatores causais que afetam a prática de permissão de acesso livre de gatos à rua por seus tutores; ii) avaliar os potenciais riscos ao bem-estar do gato associados à permissão de acesso a rua, com base nos relatos dos tutores; iii) desenvolver um questionário para tutores de gatos que permita a identificação de sinais comportamentais mais típicos característicos de PRS, bem como relacionar a ocorrência deste distúrbio com às práticas de manejo empregadas nos gatos amostrados. Para tanto, dois questionários foram desenvolvidos, sendo utilizados em dois estudos distintos, um deles com aplicação online para identificação de questões relacionadas ao manejo e acesso à rua, aplicado a 8.485 tutores de gato, e outro aplicado por meio de entrevistas presenciais semi-estruturadas para identificação de PRS aplicados a 223 tutores de gatos. Para análise dos dados do primeiro estudo, foram usados modelos de regressão logística para obtenção das razões de chances (do inglês *odds ratio*, OR). Assim, alguns dos fatores significativamente relacionados à permissão de acesso de gatos à rua por seus tutores foram: gatos não castrados ($\chi2 = 184,75$), origem do gato ($\chi2 = 742,90$), residências em áreas rurais ($\chi2 = 1622,70$), número de gatos na casa ($\chi2 = 81,32$), presença de outros animais domésticos ($\chi2 = 81,32$), tutores jovens ($\chi2 = 55,83$), respondente que não era dono do gato ($\chi2 = 119,61$), percepção dos tutores sobre o papel do gato na casa ($\chi2 = 125,76$), noção dos tutores sobre potenciais riscos de transmissão de doenças ($\chi2 = 138,69$), falta de conhecimento sobre zoonoses ($\chi2 = 6,44$), falta de conhecimento sobre toxoplasmose ($\chi2 = 43,62$). Já a prática de permissão de acesso à rua esteve relacionada a maiores OR ($p < 0,01$) para contaminação frequente por pulgas (OR = 3,42), esporotricose (OR = 2,36), gato desaparecido (OR = 2,36), envenenamento (OR = 2,15), maus-tratos (OR = 1,57) e acidentes (OR = 8,15). Por sua vez, no segundo estudo a respeito dos PRS, as análises dos dados foram realizadas por meio dos testes exatos de Fisher, qui-quadrado e análise de correspondência múltipla (ACM). Entre os gatos amostrados, 13,45% (30/223) atenderam a pelo menos um dos critérios utilizados para definir o PRS. O comportamento destrutivo foi o sinal mais frequentemente relatado na amostra (66,67%, 20/30), seguido de vocalização excessiva (63,33%, 19/30), micção em locais inadequados (60,00%, 18/30), depressão-apatia (53,33%, 16/30), agressividade (36,67%, 11/30) e ansiedade-agitação (36,67%, 11/30) e, em menor frequência, defecação em locais inadequados (23,33%, 7/30). Além disso, a ocorrência de

PRS esteve associada ao número de mulheres residentes na residência (P = 0,01), ao não acesso a brinquedos (P = 0,04), a ausência de outro animal na casa (P = 0,04) e à tendência de ser deixado sozinho em casa de duas a seis horas por dia (P = 0,09). Concluímos que a prática de permissão de acesso livre à rua relatada por 37,1% dos proprietários pode resultar em severos riscos para o bem-estar dos gatos. Sobre os problemas relacionados à separação em gatos domésticos, estes se demonstram difíceis de identificar devido à quantidade limitada de conhecimento sobre o problema. Para tanto, o questionário desenvolvido neste estudo se mostrou útil na identificação dos principais sinais comportamentais relacionados aos PRS em gatos e poderia ser usado como ponto de partida para pesquisas futuras.

Palavras-chave: Acesso à rua. Ansiedade por separação. Bem-estar. Manejo. Problemas comportamentais.

ABSTRACT

Many problems can occur to domestic cats (*Felis silvestris catus*) due to the type of management employed by their owners. Outdoor cats are exposed to mistreatment, contracting pathogens and parasites, suffer traffic accidents and can to bring impact natural areas due to predation behavior. On the other hand, animals that are kept confined can develop behavioral problems due to the predictability of the environment and absence of opportunity to perform natural behaviors such as exploration. Common behavioral disorders in pet animals include Separation Related Problems (SRP). SRP are a common disorder in dogs there are reports of occurrence also in cats, being characterized by the display of undesirable behaviors during the absence of the attachment figure. The cat may, for example, eliminate in inappropriate places, exhibit destructive behavior and excessive vocalization. Therefore, our goals were: i) to identify causal factors that affects the practice of allowing cats to roam freely by their owners and; ii) evaluate potential welfare risks associated with the allowance of outdoor access, based on cat owners reports; iii) to develop a questionnaire for cat owners which identifies the most typical behavioral signals characteristic of SRP, as well as relate the occurrence of SRP to the management practices applied in the sampled cats. So, two questionnaires were developed, being used in two distinct studies, one of them with online application, for identification of cats management practices and allowance of outdoor access, applied to 8,485 cat owners, and another applied via semistructured interviews, to identify SRP applied to 223 cat owners. For data analysis of the first study, logistic regression models were used to obtain the odds ratios (OR). Some of the factors significantly related to allowance of outdoor access by cat owners were: uncastrated cats ($\chi^2 = 184.75$), origin of the cat ($\chi^2 = 742.90$), residences in rural areas ($\chi^2 = 1622.70$), number of owned cats ($\chi^2 = 81.32$), presence of other pets in the house ($\chi^2 = 81.32$), younger age of owners ($\chi^2 = 55.83$), owner declare not being responsible for the cat ($\chi^2 = 119.61$), owners perception about the role of the cat in the house ($\chi^2 = 125.76$), owners notion about cat potential for transmitting diseases ($\chi^2 = 138.69$), lack of notion about zoonoses ($\chi^2 = 6.44$), lack of notion about toxoplasmosis ($\chi^2 = 43.62$). The practice of allowing outdoor access was related to significantly higher odds ratio ($p < 0.01$) of owners report several welfare problems such as frequent flea contamination (OR = 3.42), sporotrichosis (OR = 2.36), missing cat (OR = 2.36), poisoning (OR = 2.15), mistreatment (OR = 1.57) and accidents (OR = 8.15). In its turn, the statistical analyses of the second study were performed by using Fisher's Exact test, qui-square, and multiple correspondence analysis (MCA). Among the sampled animals, 13.45% (30 / 223) met at least one of the criteria used to define SRP. Destructive behavior was the most frequently signal reported in those cats (66.67%, 20 / 30), followed by excessive vocalization (63.33%, 19 / 30), urination in inappropriate places (60.00%, 18 / 30), depression-apathy (53.33%, 16 / 30), aggressiveness (36.67%, 11 / 30) and agitation-anxiety (36.67%, 11 / 30), and in lower frequency, defecation in inappropriate places (23.33%, 7 / 30). The occurrence of SRP was associated with the number of females living in the residence (P = 0.01), with not having access to toys (P = 0.04), no other animal residing in the house (P = 0.04) and a tendency for being left alone in the house from two to six hours per day (P = 0.09). We conclude that

outdoor management practice reported by 37.1% of cat owners can result in severe risks to the welfare of cats. Regarding to separation related problems in domestic cats, these are a disorder difficult to identify due to the limited amount of knowledge about this issue. The questionnaire developed in this study supported identification of the main behavioral signals related to SRP in cats and could be used as a starting point for future research.

Key words: Behavioral problems. Management. Outdoor access. Separation anxiety. Welfare.

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INTRODUÇÃO GERAL

O gato doméstico vem ganhando notoriedade nos últimos anos e já supera o cão como o animal de companhia mais poupular em alguns lugares do mundo [1-3]. Conforme aumenta o número de gatos mantidos como *pets*, cresce também a necessidade de conhecimento sobre o modo mais adequado de manejo, bem como possíveis impactos da interação com seres humanos no bem-estar gato.

Sobre o modo de criação do gato, há um debate sobre qual tipo de manejo é mais indicado. Muitas pessoas defendem que gatos precisam ser mantidos de modo *free-roaming* ou *outdoor*, isto é, devem ir onde desejam, sem restrições da área de uso [2, 4]. Por outro lado, muitas pessoas também acreditam que o modo mais correto de criar gatos é o exclusivamente domiciliado (*indoor*), permanecendo o animal totalmente confinado sem nenhum acesso à rua [4, 5]. A escolha por cada modo de manejo pode variar de um país para outro [6, 7]. Nos Estados Unidos, por exemplo, a maioria dos tutores de gatos mantem seus animais exclusivamente em ambientes fechados [8]. Já no Reino Unido e na Dinamarca a maioria dos tutores permite que seus gatos tenham acesso livre a áreas externas a residência [2, 9]. No Brasil não se tem informações sobre qual modo é comumente adotado por tutores de gatos, o que torna evidente a necessidade de pesquisas que abordem esse tema.

Ambas as opções possuem riscos e benefícios ao bem-estar do gato. Por exemplo, gatos domésticos que não possuem suas áreas de vida delimitadas por seus tutores podem provocar grande impacto na vida selvagem de áreas naturais [10-12], além de estarem expostos ao contágio de doenças, se envolverem em acidentes de trânsitos [5] e sofrerem injúrias causadas por pessoas ou por outros animais, como cães [7, 13, 14]. Por outro lado, um manejo completamente indoor também pode gerar impactos negativos ao bem-estar de gatos domésticos, visto que as residências são em geral pequenas e pobres em estímulos, o que acaba favorecendo o surgimento de problemas comportamentais. Um transtorno comum em animais domésticos em geral são os Problemas Relacionados à Separação (PRS), que possuem grande impacto no bem-estar dos animais de companhia, sobretudo na relação humano-animal. Os PRS afetam grande parte dos cães domésticos, havendo também relatos de ocorrência em gatos domésticos [15-17].

Os PRS se qualificam por uma condição clínica caracterizada pelo conjunto de comportamentos indesejáveis, exibidos isoladamente ou em associação pelo animal ao ser deixado sozinho ou ao ser afastado da figura de apego [15, 18, 19]. Tal figura pode ser uma

pessoa ou um coespecífico, podendo ocorrer também quando o animal tem o acesso ao seu tutor limitado de alguma maneira, como ao ficar preso em algum cômodo, caixa de transporte ou gaiola [15]. Os comportamentos já descritos como indícios de PRS em gatos foram: vocalizações excessivas, comportamento destrutivo através de arranhaduras, lambedura intensa, defecação e miccção em locais inapropriados [15].

Em geral, pesquisas científicas que envolvem gatos domésticos são escassas quando comparadas às pesquisas com cães, sendo mais escassas ainda aquelas que envolvem interações donos-gatos e o ambiente doméstico [20, 21]. Além disso, há também questões a serem respondidas em relação à permissão do acesso de gatos à rua e ao desenvolvimento de PRS neste grupo. Para compreender e mitigar quaisquer impactos provenientes do modo de manejo é importante entender os padrões de comportamento do gato e como variáveis como o ambiente de criação podem afetar o bem-estar do animal.

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CAPÍTULO 1

Indoors or outdoors cats? A survey research on the animal welfare risks for free-ranging cats

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ABSTRACT: Abstract: Considering the need for research that contributes to estimating the risk factors associated with the management of outdoor cats and the lack of such surveys in Brazil, and in Latin American countries, we aimed: i) to identify causal factors that affect the practice of owners allowing their cats to roam freely and; ii) to evaluate potential welfare risks associated with the allowance of outdoor access, based on cat owners' reports. An online questionnaire with 25 questions was answered by 8 485 Brazilian cat owners. Logistic regression models were used to obtain odds ratios. Some of the factors significantly related to owners allowing their cats to have outdoor access were uncastrated cats, way the cat was acquired, residence in rural areas, the number of owned cats, the presence of other pets in the house, younger owner age, owner declaration of not being responsible for the cat, owner perception about the role of the cat in the house, owner knowledge about cats' potential for transmiting diseases, a lack of knowledge about zoonoses, and a lack of knowledge about toxoplasmosis. The practice of allowing outdoor access was associated with significantly higher odds of owners reporting several welfare problems such as frequent flea contamination, sporotrichosis, going missing, poisoning, mistreatment and accidents. We conclude that the practice of allowing outdoor access, as reported by 37.1% of our respondents, may result in risks to cat welfare. Increasing public awareness through

campaigns that highlight the risks associated with outdoor access would improve cat management practices and welfare.

Keywords: Animal welfare, Cat owners, Management, Online questionnaire, Risk factors.

INTRODUCTION

In recent years there has been an increase in people's preference for having domestic cats as pets, which generates a need to understand how these animals are kept and treated (Sandøe et al 2018). Regarding the management of cats, there is a lot of disagreement about which strategy is the most appropriate. Some people argue that these animals need to free-roam, that is, they should go where they want, without limits artificially imposed to their area of use, and they must exhibit natural behaviors, such as predation (Jongman 2007; Sandøe et al 2018). Free-roaming or free-ranging domiciliated cats are free-circulating owned cats who have a residence but spend most of their time outdoors (Crowley et al 2019; Levy & Crawford 2004; Wald & Jacobson 2013). On the other hand, many people also argue that the most appropriate way to keep cats is exclusively confined (indoors), with the owner controling the feeding, reproduction, and movements of these animals, with limited access to external environments (Jongman 2007; Rochlitz 2003; Rochlitz 2004).

The management choice (indoor or outdoor) may be linked, for example, to cultural aspects, which may differ depending on the cat owners' country of origin (Delgado & Reevy 2018; Rochlitz & Yeates 2019). In the United States, for example, most cat owners keep their animals indoors only (Rochlitz & Yeates 2019). In the United Kingdom and Denmark, however, most owners allow their cats free outdoor access (Foreman-Worsley & Farnworth 2019; Rochlitz & Yeates 2019; Sandøe et al 2018; Siracusa & Provoost 2016). In Brazil, there is no information on the mode that is commonly adopted by cat owners, which suggests a need for research that addresses indoor versus outdoor management and its implications for cat welfare. An investigation of the types of factors or environmental characteristics that affect the practice of allowing cats to roam freely is also relevant.

In terms of cat welfare, both management practices (indoor or outdoor) might encompass risks and benefits, generating a debate about which is more appropriate (Yeates & Yates 2017). For instance, indoor cats are generally more likely to develop obesity, have more urination marking within the home, and are more likely to develop certain types of behavioral problems (Finka et al 2019; Rochlitz 2005; Stella & Croney 2016; Yeates & Yates 2017). In

its turn, outdoor cats are exposed to contagious diseases, traffic accidents and other iniquities (Levy & Crawford 2004; Levy et al 2006; Lockwood 2005; Natoli et al 2005; Rochlitz 2004; Shamir et al 2002; Yeates & Yates 2017). However, little research has used a comparative approach to the indoor/outdoor dilemma, and studies that approach this subject empirically are even scarcer (Buffington 2002; Chalkowski et al 2019; Rochlitz 2005; Yeates & Yates 2017).

Regarding data collection, there is currently an increase in scientific research that uses the internet to obtain data in the applied ethology field (Duffy et al 2017; Finka et al 2019; Sandøe et al 2018; Zito et al 2015). The virtual snowball sampling method is practical and effective for collecting information, as it enables a large sample size in a short period of time (Zito et al 2015). As respondent identification is not required, the likelihood of false reporting can be reduced (Zito et al 2015). Another advantage is that virtual snowball sampling permits access to individuals who are far from the research center, allowing for geographically-wide sampling in countries with a large territorial size, as is the case for Brazil.

Considering the need for research that contributes to estimating risk factors associated with the outdoor management of owned cats, and the lack of such surveys in Brazil and Latin American countries, this research was conducted. The objectives of this study were: i) to identify the causal factors that affect the practice of owners allowing their cats to roam freely and; ii) to evaluate potential welfare risks associated with the allowance of outdoor access, based on cat owners' reports.

METHODS

Ethical statement

Considering that an online questionnaire was used, ethical aspects were attained by ensuring the respondents were widely informed about who conducted the research, and the content and purpose of the study so that they could made an informed judgment about whether they wished (or not) to participate. Confidentiality and anonymity were assured. Respondents were also informed that their participation did not imply any type of financial or other commitment and that they could withdraw from answering the questionnaire at any time.

Questionnaire structure and application

A questionnaire with 25 questions, in Portuguese to be answered by Brazilian cat owners, was developed based on published papers about cat management (Buffington 2002; Rochlitz 2005; Sandøe et al 2018). The questionnaire was composed of multiple-choice and forced-choice questions, in addition to open-ended questions about respondents' information (Table 1). Three sets of closed-questions were included: a) one question about the allowance (or not) of cats' outdoor access to define the predominant type of management that the owner declared to practice (indoor or outdoor); b) 13 questions about cat castration, way the cat was acquired (appeared at the owner's house, adopted from the street, adopted from a shelter, was a gift or was bought), in addition to characteristics of the environment (type of residence, number of cats in the house, presence of other pets in the house) and characteristics of the owners (state of residence, sex, age, primary responsibility for the cat, perception about the role of the cat in the house, knowledge about cats' potential for transmiting diseases, knowledge about zoonoses, knowledge about toxoplasmosis); c) 11 questions related to previous ocurrences of welfare issues as reported by the owners (flea contamination, sporotrichosis, going missing, poisoning, mistreatment, feline immunodeficiency virus (FIV) / feline leukemia virus (FeLV), respiratory tract diseases, accidents, visits to the veterinarian, vaccination and deworming).

Table 1. Online questionnaire applied to cat owners (n = 8,485).

Questions	Responses				
Which Brazilian state do you live?	Brazilian states ( )				
How old are you?	Open question				
What is your sex?	Female ( )		Male ( )		
What is your type of residence?	House ( )	Apartment ( )		Farm ( )	
How many cats live with you?	Open question				
Are you their owner / responsible for them?	Yes ( )		No ( )		
How did you get them?	S/he came to us on her/his own ( )	I adopted her/him from the streets ( )	I adopted her/him from a shelter ( )	S/he was a gift ( )	I bought s/he ( )
Do you have other pets in your house (like dogs, birds, rodents)?	Yes ( )		No ( )		
Do you allow your cat(s) have outdoor access?	Yes ( )		No ( )		
Have your cat(s) ever been involved in accidents when free-roaming, such as car accidents or dog attacks?	Yes ( )		No ( )	S/he is indoor ( )	
Have your cat(s) ever been mistreated when free-roaming?	Yes ( )		No ( )	S/he is indoor ( )	
Have you ever had a cat that poisoned?	Yes ( )		No ( )		
Have you ever had a missing cat that never came back home?	Yes ( )		No ( )		

Have you ever had any cat infected by feline immunodeficiency virus (FIV) / feline leukemia virus (FeLV)?	Yes ( )	No ( )	I don't know what it is ( )	I know what it is, but never examined ( )
Have you ever had a cat with respiratory diseases such as flu or rhinotracheitis?	Yes ( )	No ( )	I don't know what it is ( )	
Have you ever had any cat infected with sporotrichosis?	Yes ( )	No ( )	I don't know what it is ( )	
Do your cat(s) get fleas often?	Yes, very often ( )	Few times ( )	No, never ( )	
How often do you give your cat(s) dewormers?	Always ( )	Just when they have worms ( )	Never ( )	
How often do you take your cat(s) to the vet?	Always, even when they are not sick ( )	Rarely, just when they need ( )	Never ( )	
Are your cat(s) neutered?	Yes, all of them ( )	Just some of them ( )	Almost all of them, except the puppies, which are not ( )	
How often do you vaccinate your cat(s)?	Once in a year, in a public vaccination campaign ( )	Once in a year, in private vet clinic ( )	They were only vaccinated when puppies ( )	Never ( )
Do the cat(s) can transmit diseases?	Yes, all of them ( )	Yes, but only the stray cats ( )	None ( )	
Do you know what zoonoses are?	Yes ( )	No ( )		
Could any of these diseases be related to contamination through cat feces?	Babesiosis ( )	Leptospirosis ( )	Toxoplasmosis ( )	Yellow fever ( )
How do you see the cats' role in your home?	I love them like a family member ( )	I like them, but just as a 'pet' ( )	I don't like them and wish I did not have them ( )	

The survey respondents were recruited using the virtual snowball sampling method. The questionnaire link was sent via social networks (Facebook™, Instagram™, and WhatsApp™) using the free online survey tool 'Google forms' (Google™). The respondents were allowed to participate only if they satisfied the condition of owning at least one cat. Data collection took place between 24th January and 23rd March, 2019. A total of 8 610 participants from all Brazilian states answered the questionnaire, with the highest concentration of responses from the southeast region of Brazil. Thereafter, cleaning of the dataset was performed, in which answers considered dubious were excluded, and responses were included based on the participant's age (must be above 18 years old) and the number of cats (zero cats or more than 55 cats were excluded). Thus, 8 485 responses were analyzed.

Data analyses

Descriptive data analyses were initially performed by obtaining the absolute and relative frequencies of responses. Then, logistic regression analyses were performed with a logit link function for binomial response variables. Logistic regression models generate the probability associated with the occurrence of a given event, estimated through the odds ratio (OR) as a function of one or more independent variables (fixed effects). All analyses were

performed using the Statistical Analysis System (SAS, version 9.2, SAS Institute Inc., Cary, NC, USA) and P-values were considered significant when < 0.05.

First, we tested the effects of the way cats were acquired and castration, in addition to environmental and owner characteristics, on the probability of outdoor access allowance. Logistic models included the type of management as a binomial dependent variable (indoor vs. outdoor) and each of the independent variables were analyzed in separate models. The OR was calculated by exponentiating the regression coefficients (β). The OR refers to the amount the probability of outdoor access increases or decreases for each independent variable category in comparison to the reference class, with OR = 1. Odds ratios with 95% confidence intervals (95% CI) and P-values were estimated for the independent variables (cat castration and the way cats were acquired, characteristics of the environment and characteristics of the owner).

The effects of outdoor access on the occurrence of several factors that are considered to be welfare issues for free-roaming cats were evaluated. The logistic models included the following dependent variables with a binomial distribution (occurrence vs. non-occurrence): frequent visits to a veterinarian, vaccination, deworming, flea contamination, sporotrichosis, FIV / FeLV, respiratory tract diseases, going missing, mistreatment, poisoning and accidents. Type of management (indoor vs. outdoor) was included as an independent variable, with indoor management defined as the reference class (OR = 1), so that the OR of outdoor access could be obtained and discussed.

RESULTS

Factors affecting the allowance of outdoor access

Among the owners surveyed, 37.08% (3 146 / 8 485) allowed their cats to have outdoor access. We evaluated whether cat castration, way cat was acquired and characteristics of the owner and environment affected the likelihood of outdoor access. The allowance of outdoor access was significantly associated with the way cat was acquired ($\chi2 = 742.90$; $p = 0.001$) and castration ($\chi2 = 184.75$; $p = 0.001$); type of residence ($\chi2 = 1622.70$; $p = 0.001$); number of cats in the house ($\chi2 = 81.32$; $p = 0.001$); and the presence of other pets in the house ($\chi2 = 477.89$; $p = 0.001$) (Table 2). Regarding owner characteristics, sex ($\chi2 = 4.81$; $p = 0.03$); age ($\chi2 = 55.83$; $p = 0.001$); responsibility for the cat ($\chi2 = 119.61$; $p = 0.001$); perception about the role of the cat in the house ($\chi2 = 125.76$; $p = 0.001$); knowledge about cats' potential for transmitting diseases ($\chi2 = 138.69$; $p = 0.001$); knowledge about zoonosis

($\chi2$ = 6.44; p = 0.01); and knowledge about toxoplasmosis ($\chi2$ = 43.62; p = 0.001) were related to the allowance of outdoor access (Table 2).

The chance of owners declaring that they allowed their cats to have outdoor acces were higher in the cases of uncastrated cats, cats that appeared by the house and were adopted, residences in rural areas, houses with four to 10 cats and houses with other pets – i.e. with animals of other species (Table 2). In addition, those who identified as male owners, aged 18 to 35 years, respondents who did not declare themselves as responsible for their cats, owners who perceive their cat as a pet, those who had knowledge of cats as potential disease transmitters, but a lack of knowledge about zoonosis and lack of knowledge about toxoplasmosis were more prone to declare that they allowed their cats to have outdoor access (Table 2).

Table 2. Odds ratio (OR) for owners practice of allowing cats outdoor access as a function of the characteristics of the cat, environment and owner assessed (n = 8,485). Where: SE = standard error; CI = confidence interval; RC = reference class.

Characteristic	**OR (SE)**	**Lower CI**	**Upper CI**	χ^2	**p-*value***	**Outdoor (%)**	**Indoor (%)**
Cat origin							
S/he came to us on its own	6.87 (0.08)	5.87	8.03	584.77	0.001	66.91	33.09
I/we bought	0.17 (0.42)	0.07	0.38	18.04	0.001	4.69	95.31
I/we won	2.44 (0.08)	2.08	2.85	122.08	0.001	41.78	58.22
I/we found in the street	1.84 (0.06)	1.63	2.08	98.78	0.001	35.21	64.79
Adoption in campaigns/shelter	RC	RC	RC	-	-	22.75	77.25
Cat castration							
Yes	0.46 (0.09)	0.38	0.54	74.72	0.001	34.34	65.66
Some	1.21 (0.12)	0.95	1.53	2.40	0.12	58.05	41.95
Only kittens are not	0.45 (0.13)	0.35	0.57	40.64	0.001	33.78	66.22
None	RC	RC	RC	-	-	53.4	46.6
Residence type							
Apartment	0.06 (0.19)	0.04	0.09	210.49	0.001	12.10	87.90
House	0.51 (0.19)	0.35	0.73	13.41	0.001	52.79	47.21
House in a rural area	RC	RC	RC	-	-	68.84	31.16
Number of cats							
1	0.75 (0.15)	0.56	1.00	3.75	0.047	36.08	63.92
2	0.65 (0.15)	0.49	0.87	8.09	0.053	32.94	67.06
3	0.73 (0.16)	0.54	1.00	3.94	0.004	35.55	64.45
4	1.18 (0.15)	0.87	1.59	1.12	0.047	46.94	53.06
5 to 10 or more cats	RC	RC	RC	-	-	42.93	57.07
Other pets in the home							
Yes	2.72 (0.05)	2.48	2.98	460.78	0.001	48.63	51.37
No	RC	RC	RC	-	-	25.83	74.17
Owner gender							
Female	0.79 (0.10)	0.64	0.97	4.87	0.03	36.82	63.18
Male	RC	RC	RC	-	-	42.35	57.65
Owner age							
18 to 35	1.49 (0.14)	1.13	1.97	7.83	0.01	40.71	59.29
36 to 59	1.05 (0.14)	0.79	1.4	0.13	0.72	32.65	67.35
60 to 91	RC	RC	RC	-	-	31.51	68.49
Responsible for the cat							

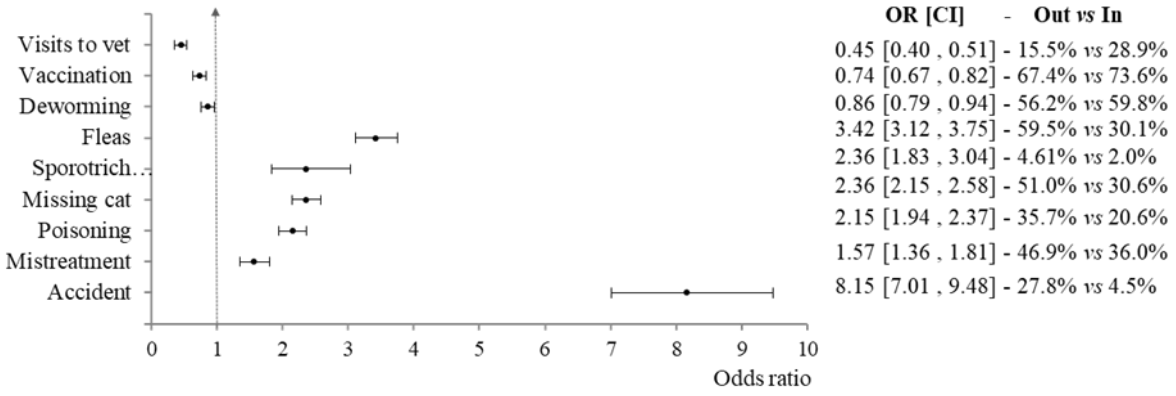
Yes	0.27 (0.13)	0.21	0.34	109.78	0.001	35.96	67.79
No	RC	RC	RC	-	-	64.04	32.21
Perception about cat							
S/ He is a member of the family	0.92(0.73)	0.22	3.86	0.01	0.91	35.64	64.36
I like him, but only as a pet	2.74(0.74)	0.65	11.60	1.87	0.17	62.17	37.83
I don't like him/ I didn't want to have him at home	RC	RC	RC	-	-	37.50	62.50
Cats transmits diseases							
Yes	1.70 (0.04)	1.56	1.86	137.91	0.001	43.98	56.02
None / only free-ranging cats	RC	RC	RC	-	-	31.54	68.46
Notion about zoonosis							
Yes	0.83 (0.07)	0.73	0.96	6.50	0.001	36.61	63.39
No	RC	RC	RC	-	-	40.88	59.12
Diseases transmitted by cat feces							
Others	1.67 (0.08)	1.43	1.94	44.15	0.001	48.39	51.61
Toxoplasmosis	RC	RC	RC	-	-	35.99	64.01

Cat welfare issues related to the allowance outdoor access

Logistic regression analyses were also performed to evaluate risk factors to the welfare of cats according to their type of management (indoor vs. outdoor), with indoor management defined as the reference class (OR = 1). Thus, the variables that had a significant relationship with the declared type of management were: visits to the veterinary clinic ($\chi2 = 203.95$; $p = 0.001$); vaccination ($\chi2 = 36.82$; $p = 0.001$); deworming ($\chi2 = 10.29$; $p = 0.001$); flea contamination ($\chi2 = 709.21$; $p = 0.001$); sporotrichosis ($\chi2 = 44.66$; $p = 0.001$); going missing ($\chi2 = 346.48$; $p = 0.001$); poisoning ($\chi2 = 230.56$; $p = 0.001$); mistreatment ($\chi2 = 37.72$; $p = 0.001$) and accidents ($\chi2 = 922.15$; $p = 0.001$) (Figure 1). No significant effect of management type was found for the previous report of FIV / FeL and respiratory tract diseases ($P > 0.05$).

Thus, owners who allowed their cats to have outdoor access were more likely to report previous occurrences of frequent flea contamination, sporotrichosis, going missing, mistreatment and accidents, as evidenced by a higher OR (Figure 1). Regarding indoor management, owners who declared to maintain their cats indoor were more likely to report frequent visits to the veterinarian, vaccination and deworming, given the higher OR for indoor (Figure 1).

Figure 1. Odds ratio (OR) of the welfare issues for outdoor cats compared to indoor cats (OR = 1, dashed line) reported by cat owners (8,485). Confidence intervals (CI) are expressed by the horizontal bars. Percentages (%) of each welfare issue reported for outdoor (Out) *vs.* indoor cats (In).



DISCUSSION

This study consisted of an online questionnaire survey. Although information obtained through the internet may be subject to selection bias (Finka et al 2019; Zito et al 2015) as it does not reach people without internet access, it can also result in data that is consistent with traditional sampling methods and provide valuable contributions to research in many areas, such as applied ethology (Gosling et al 2004). In this study, we aimed to gather owners' reports and information to contribute to the debate about the most appropriate type of management for domestic cats (indoor or outdoor), with a focus on the causal factors and risks related to the allowance of outdoor access. Most of the owners surveyed did not allow their cats to have outdoor access, but about a third reported allowing their cats to roam freely.

Previous studies have evaluated the impacts of indoor management on cat welfare, suggesting that different risks may be present at home, including household accidents, such as stove burns and poisoning with cleaning products (Buffington 2002; Rochlitz 2005). Accidents involving cats falling off of balconies and windows have also been reported (Rochlitz 2005). Concurrently, free-ranging cats are also exposed to several risks, ranging from dog bite injuries to carbamate poisoning (Marlet & Maiorka 2010; Siracusa & Provoost 2016) and few studies have focused on research related to outdoor access using owned cats. In general, the various papers addressing risk factors related to free-roaming cats have focused on unowned cats, and abandoned and feral animals (Gunther et al 2015; Richards 2004; Seo & Tanida 2018; Sparkes et al 2013). A recent systematic review (Foreman-Worsley & Farnworth 2019) found that only 21 studies were done in the domestic setting, most of which were carried out in shelters, laboratories and feral animals in places where cats had major ecological impacts (Bruce et al 2019; Foreman-Worsley & Farnworth 2019; Zito et al 2019).

It was possible to observe a significant relationship between the allowance of outdoor access and the cat's neutering status. However, it is worth noting that most of the respondents (65.66%) reported castrating their cats. Our findings corroborate those of others obtained in the United States, where most of the cats were neutered (Chu et al 2009; Lord 2008). It is possible that this result has to do with owner awareness of the importance of preventing unwanted reproductions. Although it was less frequent, the 'uncastrated' condition was that with the highest frequency of outdoor access. This result could be explained, in part, by the cats' behavior, since uncastrated cats are more motivated to roam in search of sexual partners (Ferreira et al 2016; Morgan et al 2009). In general, this situation may increase the number of unowned and feral cats in urban and peri-urban environments, leading to concerns related to public health, animal welfare and ecological problems (Bruce et al 2019; Loss & Marra 2017).

As expected, from where cats were acquired was also related to the owners' report of allowing outdoor access. Cats that 'appeared at the owner's house' were six times more likely to have outdoor access than cats that were purchased, which had the lowest frequency of outdoor access. This relationship may occur because, in general, in houses with open yards, it is more difficult to restrain the cat indoors than it is to prevent stray cats from entering in the house. We can also infer that this relationship may have occurred because when an animal is intentionally acquired, either through purchase or through adoption campaigns, owners are more prone to care about their safety.

This result can be linked to other factors we investigated; for example, as the number of cats in the residence increased, the likelihood of outdoor access allowance increased. In addition, we also observed a significant relationship between the allowance of outdoor access and the presence of other species of pets in the residence. In houses with other pets, cats were twice as likely to have outdoor access. We might infer that owner socio-demographic and economic aspects not addressed in this survey could explain these associations. Thus, a shortcoming of the questionnaire was to not include factors such as the area of the city where the respondent lives, payscale group/level, and educational level, among others.

The type of residence also impacted the cat management practices, with higher chances of owners reporting the allowance of outdoor access for farm-living cats, followed by houses in urban areas, and low chances in apartments, as was expected. In farms and houses with gardens and yards, owners could intentionally allow their cats to freely move or it is also possible that they face more difficulty to restrict the cats from roaming, even when they do not intent to allow this behavior. In general, animals living in apartments are more confined,

as apartments are generally arranged at high heights and located in densely populated areas (Sandøe et al 2018). An implication of this result is that even though road traffic in rural areas tends to be lower, some studies have indicated that the risks of traffic accidents are higher in these areas than in urban environments (Wilson et al 2017; Yeates & Yates 2017). Moreover, in rural environments, the risk of contact with wildlife is even greater, which is one of the environmental concerns related to outdoor cats (Bevins et al 2012; Bonnington et al 2013).

With respect to owner characteristics, male respondents had a higher likelihood of allowing outdoor access than females. A study on the factors that influence the temporal patterns of dyadic behaviors and interactions between domestic cats and their owners found that the number of interactions per minute was higher in dyads with a female owner than in dyads with a male owner (Wedl et al 2011). Another study showed that female owners may pay more attention to their cats, showing greater attachment to the pet under their care than males (Martens et al 2016). Regarding the age of owners, 18- to 35-year-old respondents reported allowing greater outdoor access compared to elderly respondents (60 to 91 years old). This may be related to the fact that people over 60 years of age might spend more time at home, given their retirement. Alternatively, we could also hypothesize that such a result can be explained by the fact that younger and elderly people could have distinct styles of attachment to their animals, affecting the type of management they practice.

Respondents were also asked about their level of responsibility for their cats and the role of their cats in the household; 94.48% answered that they loved their cats, which were part of the human family, and among them, 64.36% did not allow their cats to have outdoor access. Among respondents that did not declare themselves as being primary responsible for the cat, the chances of allowing outdoor access were higher. Nowadays the perception of companion animals as members of the human family has became more common among pet owners (Downey & Ellis 2008; Martens et al 2016; McConnell et al 2019; Pongrácz & Szapu 2018). Our data corroborate those of a previous study conducted in Ohio, USA, in which 94% of cat owners reported loving their cats (Lord 2008). All the results of the present study relating owner characteristics to the adopted management practice enabled us to hypothesize that the practice of allowing outdoor access could be related to the type of attachment that owners have with their animals. This hypothesis needs to be tested in future research that empirically evaluates owner attachment to their cats through questionnaires developed specifically for this purpose, as done by Martens et al (2016).

Diseases can be transmitted by domestic cats to people, including sporotrichosis, rabies, giardiasis, dipylidosis, hookworm, toxocariasis, bartonellosis and toxoplasmosis (Chalkowski

et al 2019; Goldstein & Abrahamian 2015). Since the type of management (indoor or outdoor) may be related to the susceptibility of animals to certain diseases (Buffington 2002; Goldstein & Abrahamian 2015), we hypothesized that owners with basic knowledge about zoonosis and their transmissions could restrict their cats from free roaming. Contrary to our expectations, outdoor access allowance was higher for people who reported knowing that cats can transmit disease. We also asked if respondents knew what the term 'zoonosis' meant and only 11.04% reported not knowing its meaning. In this case, the results confirmed our hypothesis, since people who reported knowing the term zoonosis were less likely to allow their cats to roam freely.

Among the zoonosis, the most common zoonosis related to the domestic cat is toxoplasmosis, because cats are the definitive hosts of the disease-causing parasite, the protozoan *Toxoplasma gondii* (Goldstein & Abrahamian 2015; Lepczyk et al 2015). Most of the respondents showed a correct understanding of the relationship between 'contamination through cat feces' and 'toxoplasmosis', with only 8.79% responded erroneously. Also, in this case, a lack of knowledge was related to higher odds for outdoor access allowance. Thus, our results suggest that an owner's lack of proper basic understanding about zoonosis may be related to the type of management used, making them more likely to report allowing their cats to have outdoor access.

We thus investigated welfare issues and risks related to the type of management reported by the owners. Some of these issues were related to practices of preventive clinical care, such as visits to the veterinarian, vaccinations and periodic deworming. All these practices have implications for the welfare of owned animals, especially cats. We noted that cat owners who declared that they allow their cats to have outdoor access were less likely to report regular practices of preventive clinical care. This result may be related to the respondents' socioeconomic aspects, or other underlying cultural issues, such as the owner not perceiving the provision of preventive clinical care to be important (Downey & Ellis 2008; Sandøe et al 2016). On the other hand, the opposite situation, that is, the provision of greater preventive care by indoor cat owners may be influenced by closer human-animal contact. For example, many owners allow their cats to sleep in their beds, according to previous studies (Hoffman et al 2018; Martens et al 2016). Others allow cats to have access to rooms such as the kitchen, and as a result, climb onto dining tables and / or countertops (Martens et al 2016). Therefore, it should be expected that owners that keep their cat exclusively indoors would show greater caution regarding health issues.

Another point commonly related to outdoor cats is ectoparasite infestation, especially the flea (*Ctenocephalides felis*). Flea transmission can occur in many ways, such as by contact with infested conspecifics or by contact with infected environments (Shaw et al 2001). Therefore, we asked respondents how often their cats acquired fleas. Our results suggest that owners reporting allowing outdoor access were up to three times more likely to report frequent flea infestation than indoor cats. Parasitic infestations are common in domestic animals in general, and in many cases endoparasites are also transmitted through ectoparasites such as fleas and ticks, leading to double agent infestations (Rochlitz & Yeates 2019; Shaw et al 2001). Thus, the importance of preventing cats from acquiring fleas is evident, especially for outdoor cats.

In Brazil, there has been an increase in the number of human sporotrichosis cases in recent years, which has made notification of the disease mandatory (Boechat et al 2018; Poester et al 2018). We found that owners that reported allowing their cats to have outdoor access were twice as likely to report previous ocurrences of cat sporotrichosis than owners of cats that were kept exclusively indoors. Epidemiological studies have revealed that outdoor access is a major risk factor for cat contamination, and consequently, human contamination (Boechat et al 2018).

In this study, no significant associations were found between cat outdoor access and contamination by infectious diseases such as FIV / FeLV and feline respiratory tract diseases. We believe this could be due to cat owners' lack of knowledge about these diseases as well as their causes and mode of contamination. When faced with the names of diseases that were unknown to them, respondents were possibly induced to say 'no'. Such a bias reveals the need to change the approach to asking about this disease when elaborating on the subject in future questionnaires. Feline Leukemia Virus (FeLV) and Feline Immunodeficiency Virus (FIV), for example, are present in cats worldwide, such as in the United States (Burling et al 2017), United Kingdom (Stavisky et al 2017), China (Cong et al 2016), Italy (Natoli et al 2005) and especially Brazil (Biezus et al 2019; Rocha et al 2019; Teixeira et al 2019). In general, these retroviral infections, because they have a poor and lifelong prognosis, negatively impact the health and well-being of infected cats; the largest risk group is intact male cats who have outdoor access due to greater aggression, female disputes and, consequently, a higher frequency of copulation (Burling et al 2017; Levy et al 2006; Natoli et al 2005).

Poisoning, going missing and mistreatment are among the most serious risks for outdoor animals. Several reasons prevent cats from returning to their homes. They may get lost on the way back or get involved in traffic accidents (Fraser 2012). Thus, we also asked if

respondents had ever had a cat go missing, and 38.15% reported that they had a cat that did not return home. This situation was more frequently reported by those who reported allowing outdoor access than indoor access (35.7 vs. 20.6%). Regarding poisoning and mistreatment, free-roaming cats are more likely to suffer from injuries caused by people than cats kept indoors (Marlet & Maiorka 2010). In this study, the odds ratio for owners reporting previous cases of poisoning was twice as high for outdoor than for indoor cats. It is important to highlight that the number of reports of cat poisoning is likely even higher than those found in this study, as many animals die before returning home, which may lead owners to think that the animal has chosen to 'move away' (Lockwood 2005; Noleto et al 2017). In Brazil, cases of cruelty and abuse to domestic animals are frequent (Junqueira & Galera 2019; Marlet & Maiorka 2010). According to a study conducted in the city of São Paulo, through the analysis of autopsy records and criminal records of the mistreatment of companion animals (Marlet & Maiorka 2010), compared to dogs (11%), cats were more often victims of cruelty (34%). It should be noted that the most commonly used method was carbamate poisoning (a poison popularly known in Brazil as 'chumbinho') (Marlet & Maiorka 2010). In general, the main motivation leading people to mistreatment is related to cats visiting their homes (Lockwood 2005), as non-owners see free-roaming cats as a problem (Lord 2008).

Outdoor cats have been reported to be subject to other types of accidents, such as falls from high places and traffic accidents (Loyd et al 2013; Rochlitz 2003; Rochlitz 2004; Rochlitz 2005). For this reason, we asked respondents about previous accidents with their cats. Our results showed that the odds ratio of the owners reporting an occurrence of accidents was eight times higher for outdoor than for indoor cats. Indeed, many scientific papers assess accident occurrences, with traffic accidents being the most common accident (Moreau et al 2003; Natoli et al 2019; Natoli et al 2005; Rochlitz 2004; Rochlitz 2004). A study in France showed that cats are up to three times more likely to be hit by cars than dogs (Moreau et al 2003). In many cases, injuries caused by this type of accident lead to the death of the cat. In another year-long study of cats involved in car accidents in Cambridgeshire, England (n = 128), 16 cats were dead on arrival to the clinic and 16% of them did not survive after arrival. A third study in the United Kingdom, with 1 264 cats, found that 3.4% were victims of traffic accidents and, among them, 71.4% died (Wilson et al 2017). Outdoor access was the main risk factor for cats being involved in car accidents (Wilson et al 2017).

Domestic cats have a natural predatory behavior that might occur even when they are fed by the owner, being an innate behavior not necessarily related to hunger (McDonald et al 2015). In spite of not being assessed in this study, it is reasonable to assume that predation of

wildlife could be an additional indeseareable consequence of outdoor access. It was previously shown that feral and outdoor cats may impact the natural environments (Bonnington et al 2013; Ferreira et al 2019; Ferreira et al 2019; Loss et al 2013; Loyd et al 2013). Additionally to predation, outdoor cats can impact native fauna by transmitting diseases, overlapping niche with other wild carnivores (Ferreira et al 2019) and by changing the wildlife behaviours. For example, the presence of cats raise parental defensive aggression in birds, leading them to vocalize more, which can attract other predators (Bonnington et al 2013).

CONCLUSION

We conclude that the allowance of outdoor access by cat owners is related to several environmental and owner characteristics. Owners of outdoor cats are more likely to report that their animals get fleas, sporotrichosis, be poisoned, mistreated, suffer accidents and go missing. Therefore, indoors cats seem to be safer than outdoor cats, with potential to present better levels of welfare, as long as their behavioral needs are met, such as adequate space and environmental enrichment. Increasing public awareness through campaigns that highlight the risks associated with outdoor access could improve cat management practices and welfare.

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CAPÍTULO 2

Identification of separation related problems in domestic cats: a questionnaire survey

Short-title: Separation related problems in domestic cats

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Abstract

Identifying and preventing the occurrence of separation-related problems (SRP) in companion animals are relevant to animal welfare and the quality of human-pet interactions. The SRP are defined as a set of behaviors and physiological signs displayed by the animal when separated from its attachment person. In cats, SRP has been insufficiently studied. Thus, the objective of this study was to develop a questionnaire for cat owners which identifies behaviors that may indicate SRP, as well as relates the occurrence of SRP to the management practices applied in the sampled cats. The associations of SRP with cats' characteristics, as well as owner, environmental, and management traits were investigated. The questionnaire was developed based on the scientific literature about separation anxiety syndrome in dogs and a few papers in cats, and it was completed by 130 owners of 223 cats. Analysis of owners' answers was done through categorization and acquisition of relative frequencies of each response category, followed by Fisher's exact test, chi-square tests in contingency table and Multiple Correspondence Analysis. Among the sampled animals, 13.45% (30 / 223) met at least one of the behavioral criteria we used to define SRP. Destructive behavior was the most frequently reported behavior (66.67%, 20 / 30), followed by excessive vocalization

(63.33%, 19 / 30), urination in inappropriate places (60.00%, 18 / 30), depression-apathy (53.33%, 16 / 30), aggressiveness (36.67%, 11 / 30) and agitation-anxiety (36.67%, 11 / 30) and, in lower frequency, defecation in inappropriate places (23.33%, 7 / 30). The occurrence of SRP was associated with the number of females living in the residence (P = 0.01), with not having access to toys (P = 0.04), and no other animal residing in the house (P = 0.04). Separation-related problems in domestic cats are difficult to identify due to the limited amount of knowledge regarding the issue. The questionnaire developed in this study supported identification of the main behaviors likely related to SRP in cats and could be used as a starting point for future research.

Keywords: attachment, behavioral problems, feline, separation anxiety, welfare.

Introduction

Behavioral problems in companion animals are among the main causes of abandonment in many countries, such as the United States of America, Japan and the United Kingdom [1-4]. For cats, the abandonment usually occurs when the animal exhibits behaviors perceived by owners as problematic, such as aggressiveness towards people and other animals in the house, inappropriate elimination and destructive behavior directed at the house [1, 2, 5-7]. Other behaviors considered problematic but natural to cats include scratching, climbing to high places, nocturnal activities, attention seeking, plant chewing, attempts to escape from the home and vocalizations [8, 9].

As the cat gains greater popularity as a companion animal [10, 11], there is increasing need for knowledge about the human-cat relationship and how it affects cats' behavior and welfare [12, 13]. There is a belief that cats can easily cope with the owners' absence for long periods of time and few studies have been conducted to support that assumption [14]. Recent studies have reported that cats can be considered as social, being able to generate bonds with their owners, and therefore it is likely they also show behaviors and physiological reactions due to the owners' absence [15-19]. For instance, an experiment conducted to verify the attachment of cats towards their owners, using a modified version of the Ainsworth test, found that cats showed a higher frequency of exploratory and playful behaviors when accompanied by their owners, in comparison to when they were alone or accompanied by an unknown person [20, 21]. Similarly, those cats showed a lower frequency of alert and inactivity behaviors when their owners were present [20]. Another study verified an increase of affiliative behaviors in cats after reuniting with their owners [14]. All those studies

revealed that cats express more security and stability in the presence of the owners, while in the owners' absence they were more anxious and stressed. Therefore, it becomes relevant to study whether those animals can develop separation-related problems (SRP).

In the scientific literature, there is divergence regarding the nomenclature used for expressing the behavioral problems related to separation in companion animals with at least three terminologies commonly used: separation-related problems [22, 23]; separation distress [24] and separation anxiety syndrome [15, 25]. In spite of using different terms to describe this condition, some of the behaviors most commonly used to characterize SRP are usually the same: destructive behavior, excessive vocalization and inappropriate elimination when the animal is alone [22, 26]. In this study we will use the term SRP, since it is the most general and includes behavioral disturbances that occur in the presence or absence of physiological signs of stress [23, 24, 27].

Separation-related problems have been vastly studied in domestic dogs [23, 24, 27]; however, for cats few studies have reported the occurrence of SRP [15, 25, 28]. To the best of our knowledge, there are only two empirical studies [15, 28] and one review article [25] addressing this condition in cats. Studies that verify the care practices used by owners and the impacts of management on the welfare of cats are also scarce [6, 12, 29-31].

In the area of companion animal welfare, data provided from owners and/or caretakers are frequently used to estimate the prevalence rates of behavioral problems, behavioral signs of stress (like shaking, crying and excessive barks), use of aversive training methods and other conditions related to poor welfare [4, 32-34]. The majority of dog-focused SRP studies are based on questionnaire data [22, 35-37] since monitoring animals in domestic environments may not be viable.

Due to the importance of questionnaire studies, which enable the identification of relevant biological, social and cultural factors, this study aimed to develop a questionnaire for cat owners which identifies the most typical behaviors characteristic of SRP, as well as relates the occurrence of SRP to the management practices applied in the sampled cats. We hypothesized that i) the questionnaire will be able to identify behavioral signs reported by cat owners consistent with SRP; ii) animals that do not engage in intraspecific interactions and/or live in a restricted area and/or live in environments without enrichment will be more likely to be reported by owners as having behaviors consistent with SRP.

Methods

General View

This study was approved by the Juiz de Fora University Ethics Committee in Research with Human Beings, located in Juiz de Fora, Minas Gerais, Brazil, protocol # 2.084.228. The research participants signed a consent form before answering the questionnaire.

Participants and recruitment

The interviewed population were owners of adult cats (above 6 months of age) residing in the city of Juiz de Fora, Minas Gerais State, Brazil. A total of 223 questionnaires were completed by 130 owners whose cats lived either in houses, apartments or commercial establishments. The snowball sampling method was used, in which the participants suggested new people to take part in the study. Recruitment of the initial sample of participants was achieved through use of social media, Facebook™, WhatsApp™ and Instagram™. Following recruitment, the researchers arranged meetings with the participants and completed the questionnaire during a semi-structured interview.

Questionnaire

A questionnaire was developed based on published literature about separation anxiety syndrome in dogs [22, 23, 25, 26, 35, 36, 38-40] and cats [15, 25]. The initial part of the questionnaire was related to basic information about the animal as reported by the cat owners: name, breed, age, gender, reproductive status (neutered or not) and how long the owner had the cat.

The second part was related to the cat's behavior when the owner was absent and/or visually separated from the cat. Therefore, questions related to the most typical behavioral signs of SRP were incorporated, including four behavioral categories (urination at inappropriate locations, defecation at inappropriate locations, destructive behavior and excessive vocalization) based on Schwartz [15]. Also, we defined three additional categories expressing mental states of the animals (depression, aggressiveness, agitation-anxiety) when the cat was alone or separated from the owner. The inclusion of these mental states was based on the assumptions that emotional health is a neglected subject especially in domestic cats [41] and that people can infer cats' affective states by interpreting aspects of their facial expressions [41, 42]. The answers were 'yes' (Y) or 'no' (N) for each behavioral sign used.

Since previous studies have suggested that characteristics of the owner in addition to traits of the environment and management practices could affect the development of SRP in dogs and cats, the questionnaire included the following additional components: owner gender;

owner age (in years); number of residents in the house (1, 2, 3, 4 to 7); number of female residents (none, 1, 2, 3 to 5); number of male residents (none, 1, 2, 3 to 5); type of residence (house or apartment); access to the whole house (Y, N); outdoor access (Y, N); frequency of access to the street (always, often, occasionally, never); visual access to street (Y, N); access to elevated areas as in shelves, tables or others (Y, N); access to cat toys (Y, N); play with cat toys or other objects (Y, N, only when stimulated, does not have access to toys); frequency in which the cat was left alone in the house (5 to 7 times per week, 1 to 4 times per week, occasionally [i.e. less than once a week], never); duration for which the cat was left alone in the house (< 2 hours / day, 2 to 6 hours / day, > 6 hours / day, never left alone or do not know the answer); presence of other animals in the house (Y, N), change of behavior in the presence of an unfamiliar person (Y, N).

Data analysis

A descriptive analysis of the questionnaire data was made through data categorization and calculating the frequency of each answer. After examining the frequencies of behaviors and emotional states indicative of SRP, cats were characterized as having possible SRP if they met the following criteria: I) cats for which the owners reported two or more behavioral categories used as indicators of SRP (urination at inappropriate locations, defecation at inappropriate locations, destructive behavior and excessive vocalization); II) cats with a positive answer for one behavioral category and one or more emotional states assessed; III) cats for which the owners reported the occurrence of three mental states indicative of SRP (depression, aggressiveness, agitation-anxiety). Cats assigned to one or more criteria defined by the authors were considered as the SRP group. Then, chi-square tests in contingency tables or Fisher's exact tests for 2 x 2 tables were applied in order to verify associations between the demographic characteristics of cat population, owners' characteristics and environmental or management traits with the occurrence of SRP. Data were processed using the software SAS (SAS Institute Inc., Cary, NC, version 9.2) with $P < 0.05$ for significance and $P < 0.10$ discussed as a tendency.

Dependences among variables were verified through Multiple Correspondence Analysis (MCA), which was used to reveal underlying patterns of associations between SRP and the answers regarding the owner characteristics, environmental and management traits. The MCA is an exploratory multivariate technique applied to strictly categorical variables useful for analyzing questionnaire data [43]. This multivariate technique allows exploration of the relationships between several categorical variables simultaneously, which can be

expressed as “clouds” of points in a bidimensional space [43, 44]. MCA reveals the associations between each level of multiple categorical variables, allowing for determination of how the variables are related. This is the main advantage of MCA as compared to the chi-square test, which reveals significant associations between two variables only, and does not reveal the direction of association (i.e. how the variable categories are associated).

The MCA uses the chi-square in order to standardize frequencies and build the base for associations among the levels of the studied variables (named as correspondences) in a contingency table [45, 46]. It assigns scores on rows (corresponding to the subjects) and columns (corresponding to the answers’ categories) in a data matrix, creating charts [46]. All types of categorical variables are acceptable (nominal or ordinal, binary or with multiple levels) without distributional assumptions [43, 44]. Variance is expressed as the inertia, that is the dispersion of the data in relation to independence. The first dimension (Dim. 1) has the greatest proportion of the total inertia in the data set, followed by dimension 2 (Dim. 2), and so on. The distributions of the variables in both dimensions (Dim 1 vs. Dim 2) generates a biplot graph, where each variable category is represented by a point in the scatterplot. Closeness of points is interpreted as the association between rows and columns variables, revealing groups of correspondences [43, 44]. Thus, the MCA results were interpreted by the relative positions of the points and their distribution along the Dim. 1 and Dim. 2 axes. As categories become more related to SRP, the closer they were represented in space, falling in the same side or quadrant of the graphs. These analyses were performed using Statistica 7® (7.0 version).

Results

Behavioral problems and occurrence of SRP

Among all sampled cats, 13.45% (30 / 223) met at least one of the three criteria we used to define SRP and they were owned by 25 different respondents (5 respondents had two cats meeting SRP criteria). Most of the SRP cats 90.00% (27 / 30) met criterion I (i.e. the owner reported two or more behaviors used as indicators of SRP); 70.00% (21 / 30) met criterion II (positive answer for one behavior and one or more emotional states); and 16.67% (5 / 30) met criteria III (the owners reported the three mental states indicative of SRP). Moreover, 50% (15 / 30) of cats met both criteria I and II; and 13.33% (4 / 30) of cats met all three criteria.

Regarding the behavioral / emotional signs in the total population studied (n = 223), depression during the owner's absence was the most frequently reported sign, followed by excessive vocalization, agitation-anxiety and inappropriate elimination of urine (Table 1). The places where inappropriate elimination occurred were: owner's bedroom floor and bed, below furniture in the living room, next to floor drains, carpets, sofas, plant vases, owner's clothes and the kitchen sink. In the SRP group, the frequency of all behavioral signs indicative of SRP was higher than in the general population of cats (Table 1). Destructive behavior was the most reported sign in those cats, followed by urination in inappropriate places, excessive vocalization, agitation, depression-apathy, aggressiveness and, in lower frequency, defecation in inappropriate places.

Table 1. Absolute and relative frequencies (%, within parentheses) of behavioral / emotional signs of separation related problems (SRP) in the cat population sampled (total), in cats regarded as SRP, and in cats without indicators of SRP (Non-SRP).

Behavioral / emotional signs of SPR	Total (n = 223)	SRP (n = 30)	Non-SRP (n = 193)
Destructive behavior	33 (14.80)	20 (66.67)	13 (6.74)
Excessive vocalization	52 (23.32)	19 (63.33)	33 (17.10)
Elimination problems (urine)	23 (10.31)	18 (60.00)	5 (2.59)
Depression-apathy	58 (26.01)	16 (53.33)	42 (21.76)
Aggressiveness	22 (9.87)	11 (36.67)	11 (5.70)
Agitation-anxiety	39 (17.49)	11 (36.67)	28 (14.51)
Elimination problems (feces)	9 (4.04)	7 (23.33)	2 (1.04)

Demographic characteristics of cat population and the occurrence of SRP

The age of the cats varied between 6 months to 16 years, with a mean of 3.9 ± 3.5 years. The cats' characteristics (sex, age, neutering status and breed) were not related to SRP occurrence ($P > 0.05$, Table 2), except for time with the owner ($\chi 2 = 9.23$, $P = 0.03$).

Table 2. Absolute and relative frequencies (%, within parentheses) of the cat characteristics in the cat population sampled (total), in cats regarded as showing SRP, and in cats without indicators of SRP (Non-SRP). The results of chi-square test (or Fishers' exact test in 2 x 2 tables) are shown to test the association between occurrences of SRP and the cats' traits.

Cat characteristic	Total (n = 223)	SRP (n = 30)	Non-SRP (n = 193)	χ^2	P-value
Sex					
Male	89 (39.91)	14 (46.67)	75 (38.86)	-	0.43
Female	134 (60.09)	16 (53.33)	118 (61.14)		
Age (years)					
0.5 to 0.9	24 (10.76)	0	24 (12.44)	4.86	0.18
1.0 to 3.9	112 (50.22)	15 (50.00)	97 (50.26)		
4.0 to 7.9	60 (26.91)	10 (33.33)	50 (25.91)		

≥ 8.0	27 (12.11)	5 (16.67)	22 (11.40)		
Time with the owner (years)					
0.5 to 0.9	51 (22.87)	1 (3.33)	50 (25.91)	9.23	0.03
1.0 to 3.9	98 (43.95)	15 (50.00)	83 (43.01)		
4.0 to 7.9	50 (22.42)	11 (36.67)	39 (20.21)		
≥ 8.0	24 (10.76)	3 (10.00)	21 (10.88)		
Had been sterilized					
Yes	200 (89.69)	29 (96.67)	171 (88.60)	-	0.22
No	23 (10.31)	1 (3.33)	22 (11.40)		
Breed					
Purebred	27 (12.11)	3 (10.00)	24 (90.00)	-	0.78
Mixed breed	196 (87.89)	27 (12.44)	169 (87.56)		

Association between owners' characteristics and the occurrence of SRP

The number of residents varied from 1 to 7, with two or three people in most of the residences. Regarding the characteristics related to the residents, SRP occurrence was significantly associated with the number of females in the residence ($\chi 2 = 12.37$; $P = 0.01$). Most of the sampled residences had a single female (Table 3). Houses with two females had a higher occurrence of SRP than the rest of the sampled population (50.00% vs. 26.94% respectively). The owners who participated in the survey ranged in age from 18 to 75 years. The age and others owner characteristics (sex, number of residents and number of male residents) were not associated with the occurrence of SRP according to Fishers' and chi-square tests ($P > 0.05$) (Table 3).

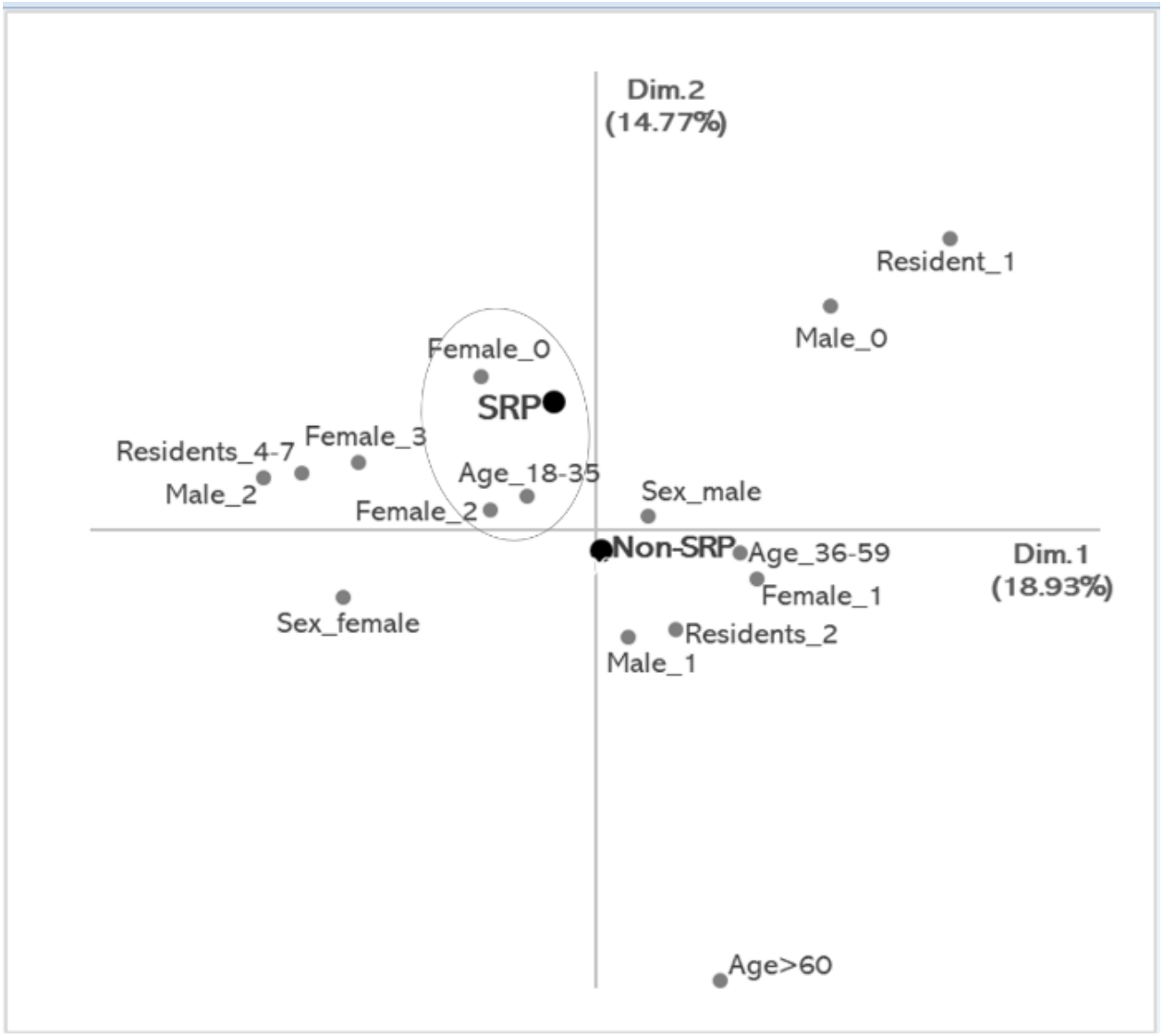
Table 3. Absolute and relative frequencies (%, within parentheses) of the owner characteristics in the cat population sampled (total), in cats regarded as showing SRP, and in cats without indicators of SRP (non-SRP). The results of chi-square test (or Fishers' exact test in 2 x 2 table) are shown to test the association between occurrences of SRP and the owner characteristics.

Owner Characteristics	**Total (n = 223)**	**SRP (n = 30)**	**Non-SRP (n = 193)**	χ^2	**P-value**
Sex					
Male	39 (17.49)	5 (16.67)	34 (17.62)	-	1.00
Female	184 (82.51)	25 (83.33)	159 (82.38)		
Age (years)					
18 to 35	150 (67.26)	24 (80.00)	126 (65.28)	3.07	0.21
36 to 59	65 (29.15)	6 (20.00)	59 (30.57)		
≥ 60	8 (3.59)	0	8 (4.15)		
Number of residents in the house					
1	29 (13.00)	4 (13.33)	25 (12.95)	0.979	0.61
2 or 3	125 (56.05)	19 (63.33)	106 (54.92)		
4 to 7	69 (30.94)	7 (23.33)	62 (32.12)		
Number of male residents					
None	49 (21.97)	10 (33.33)	39 (21.21)	4.30	0.17
1	127 (56.95)	12 (40.00)	115 (59.59)		
2	47 (21.08)	8 (26.67)	39 (21.21)		
Number of female residents					
None	8 (3.59)	3 (10.00)	5 (2.59)	12.37	0.01
1	108 (48.43)	8 (26.67)	100 (51.81)		

2	67 (30.04)	15 (50.00)	52 (26.94)
3 to 5	36 (17.94)	4 (13.33)	36 (18.65)

The MCA generated two dimensions, the first (Dim. 1) accounted for 18.93% of the inertia (eigenvalue: 0.35) and the second (Dim. 2) for 14.77% (eigenvalue: 0.27), yielding a cumulative variance of 33.70%. In Dim. 1 the variable with highest positive contribution to inertia was ‘one resident’ and the variables with highest negative contributions were ‘two male residents’, and ‘4 to 7 residents’ (Figure 1). In Dim. 2, ‘one resident’ and ‘no male resident’ had positive contributions and ‘age ≥ 60’ had the highest negative contribution (Figure 1). Based on the visual analysis of the MCA perceptual map, it was possible to identify that the ‘non-SRP’ category was positioned near the origin (center of the graph). Thus, it did not reveal interpretable patterns of association with the owner traits that deviate from independence. In turn, the ‘SRP’ category was located in quadrant IV of the graph, and revealed an interpretable group of correspondence (associations) of SRP with ‘no female resident’, ‘two female residents’ and ‘age 18 to 35 years' owner characteristics (Figure 1). Based on the closeness among the points of this group, cats whose owners reported behaviors consistent with SRP were associated with households including no female residents, owners aged 18 to 35 years, and two female residents.

Figure 1. Perceptual map of the multiple correspondence analyses for separation related problems (SRP) and the owner characteristics. Grey circle represents the correspondences among the variable categories SRP, ‘no female residents’ (Female_0), ‘two female residents’ (Female_2) and ‘age 18 to 35 years' (Age_18-35).



Association between environmental or management traits and the occurrence of SRP

Among the environmental traits assessed, playing with toys showed a significant association with occurrence of SRP ($\chi 2 = 8.30$; P = 0.04), in which SRP occurred more in cats that had no access to toys compared to the total population sampled (Table 4). The SRP occurrence was also associated with the presence of other animals in the house (Fisher's exact test, P = 0.04). Residences with no other animals had a higher percentage of cats with SRP signs than the non-SRP group (30.00% vs. 14.51% respectively) (Table 4).

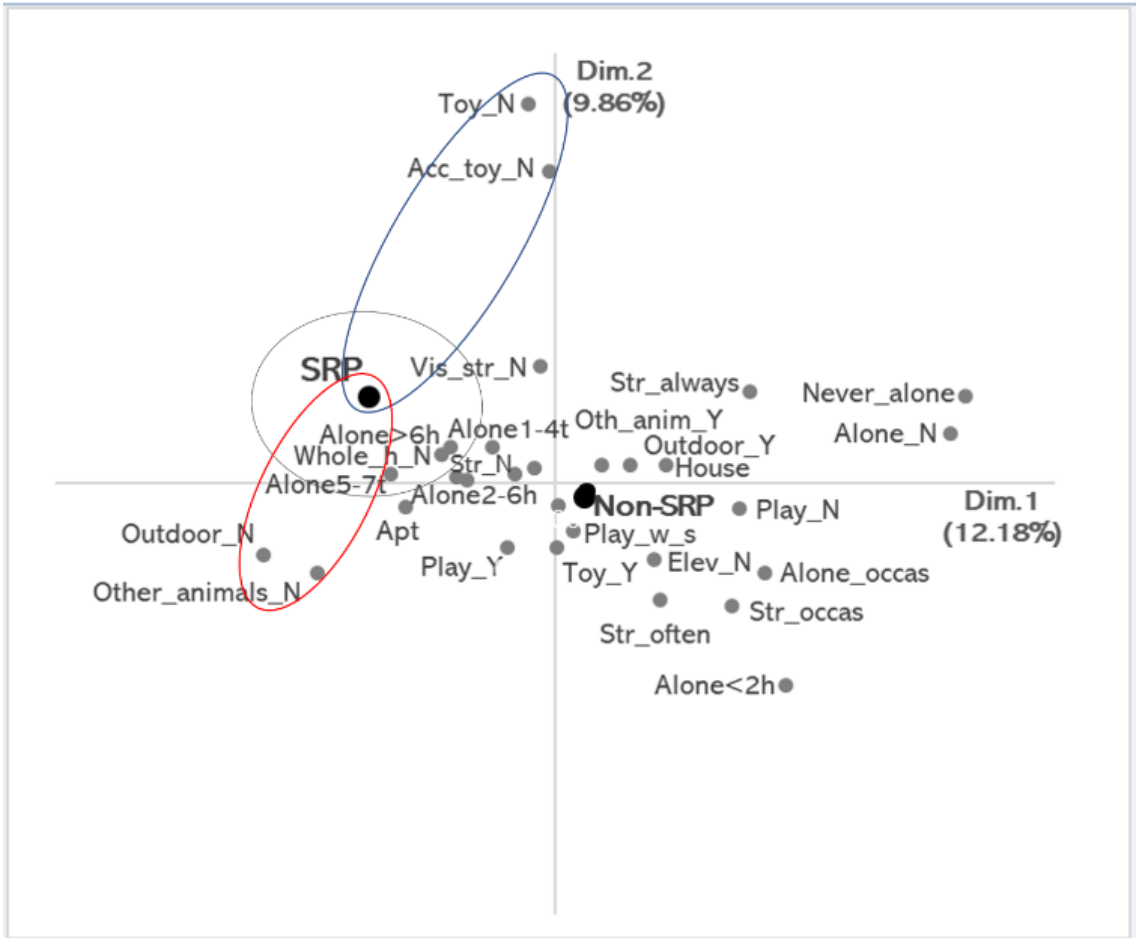
Table 4. Absolute and relative frequencies (%, within parentheses) of the environmental and management traits for the cat population sampled (total), in cats regarded as SRP, and without signs of SRP (Non-SRP). The results of chi-square test (or Fishers' exact test in 2 x 2 table) are shown to test the association between occurrences of SRP and environmental or management traits.

Environment or management	Total (n = 223)	With SRP (n = 30)	Non-SRP (n = 193)	χ^2	P-value
Type of residence					
House	126 (57.01)	14 (46.67)	112 (58.64)	-	0.24
Apartment	95 (42.99)	16 (53.33)	79 (41.36)		
Access to the whole house					
Yes	175 (78.48)	21 (70.00)	154 (79.79)	-	0.24
No (cat is restricted in a single room)	48 (21.52)	9 (30.00)	39 (20.21)		
Outdoor access					
Yes	177 (79.37)	21 (70.00)	156 (80.83)	-	0.22
No (kept exclusively indoors)	46 (20.63)	9 (30.00)	37 (19.17)		
Access to the street					
Always	39 (17.49)	4 (13.33)	35 (18.13)	1.88	0.597
Oftenly	7 (3.14)	2 (6.67)	5 (2.59)		
Occasionally	27 (12.11)	3 (10.00)	24 (12.44)		
Never	150 (67.26)	21 (70.00)	129 (66.84)		
Visual access to street					
Yes	187 (83.86)	23 (76.67)	164 (84.97)	-	0.28
No	36 (16.14)	7 (23.33)	29 (15.03)		
Access to elevated areas					
Yes (in shelves, tables or others)	185 (82.96)	26 (86.67)	159 (82.38)	-	0.62
No	38 (17.04)	4 (13.33)	34 (17.62)		
Access to cat toys					
Yes	185 (82.96)	22 (73.33)	163 (84.46)	-	0.19
No	38 (17.04)	8 (26.67)	30 (15.54)		
Play with toys (cat toys or objects)					
Yes	113 (50.67)	13 (43.33)	100 (51.81)	8.30	0.04
No	28 (12.56)	1 (3.33)	27 (13.99)		
Only when stimulated	54 (24.22)	8 (26.67)	46 (23.83)		
No access to toys	28 (12.56)	8 (26.67)	20 (10.36)		
Left alone in the house (frequency)					
5 to 7 times per week	109 (48.88)	18 (60.00)	91 (47.15)	6.51	0.09
1 to 4 times per week	40 (17.94)	8 (26.67)	32 (16.58)		
Occasionally (less than once a week)	50 (22.42)	3 (10.00)	47 (24.35)		
Never	24 (10.76)	1 (3.33)	23 (11.92)		
Left alone in the house (duration)					
< 2 hours / day	25 (11.21)	2 (6.67)	23 (11.92)	5.58	0.13
2 to 6 hours / day	83 (37.22)	16 (53.33)	67 (34.72)		
> 6 hours / day	86 (38.57)	11 (36.67)	75 (38.86)		
Not left alone or do not know	29 (13.00)	1 (3.33)	28 (14.51)		
Other animals in the house					
Yes	186 (83.41)	21 (70.00)	165 (85.49)	-	0.04
No	37 (16.59)	9 (30.00)	28 (14.51)		
Change with unfamiliar person					
Yes	121 (54.26)	16 (53.33)	105 (54.40)	-	1.00
No	102 (45.74)	14 (46.67)	88 (45.60)		

Two dimensions were retained in the MCA, Dim. 1 accounted for 12.18% of the inertia (eigenvalue: 0.20) and Dim. 2 accounted for 9.86% (eigenvalue: 0.16), yielding a cumulative variance of 22.04%. In Dim. 1 the variable with highest positive contribution to inertia was ‘never left alone in the house (frequency)’ and ‘not left alone or do not know (duration)’, with the highest negative contribution for ‘no outdoor access’ (Figure 2). In Dim. 2, ‘no access to cat toys’ and ‘no access to toys’ had the highest positive contributions and

‘left alone in the house < 2 hours / day’ had the highest negative contribution (Figure 2). Based on the visual analysis of the MCA perceptual map, it was possible to identify that the ‘non-SRP’ category was positioned near the center of the graph and, thus, did not reveal associations that deviate from independence. The SRP category was positioned in the IV quadrant and showed three interpretable correspondence groups. Based on the closeness among the points in the IV quadrant, the first interpretable group of correspondences was composed by ‘SRP’, ‘left alone in the house > 6 hours / day’, ‘no access to the whole house’ and ‘left alone in the house 5 to 7 times per week’. In Dim 1 a second group of correspondences was ‘SRP’, ‘no other animals in the house’ and ‘no outdoor access’. In Dim 2. a third interpretable correspondence group was ‘SRP’, ‘no access to cat toys’ and ‘no access to toys’ (Figure 2).

Figure 2. Perceptual map of the multiple correspondence analyses for separation related problems (SRP) and the owner characteristics. Grey circle represents the correspondences among the variable categories ‘SRP’, ‘left alone in the house > 6 hours / day’ (Alone>6h), ‘no access to the whole house’ (Whole_h_N) and ‘left alone in the house 5 to 7 times per week’ (Alone5-7t). Red circle represents the correspondences among ‘SRP’, ‘no other animals in the house’ (Other_animals_N) and ‘no outdoor access’ (Outdoor_N). Blue circle represents the correspondences among ‘SRP’, ‘no access to cat toys’ (Acc_toy_N) and ‘no access to toys’ (Toy_N).



Discussion

Most studies about cat behavior have been done under experimental conditions (laboratories), in shelters, or in feral cat colonies; thus, there is a gap in the knowledge regarding the behavior of domiciled cats and the interactions with their owners [47-50]. This study provides information about behavioral signs consistent with SRP in a sampled population of domestic cats, as well as about the management practices used by their owners. The questionnaire identified that about 13 % of cats may have signs consistent with SRP according to their owners' reports, and therefore, it could be a promising tool for future research into investigating SRP in cats. We also found elements related to the owner as well as environmental and management characteristics that may predispose cats to be reported by owners as having signs consistent with SRP.

Cats might be regarded as social partners for their owners and vice-versa [51]. For instance, a previous study found temporal patterns of interaction between owners and their cats. Those patterns vary depending on factors that influence the human-cat bond and

relationship, such as the owners and cats personalities and owners sex [51]. For example, the more extroverted the owner's personality, the higher the frequency of per minute interactions with their cats. Moreover, in dyads with a female owner, the number of interactions per minute was higher when compared to dyads with a male owner [51]. In general, both domiciled and shelter cats can benefit from human contact and they seek it through affiliative behaviors [19, 47, 51, 52]. Therefore, it is essential to investigate the possibility of SRP occurrence in domestic cats, given that some studies suggest that cats develop attachment and secure bonding with their owners [20, 51, 53]. For instance, a study found indicators of attachment relationships between humans with their kittens and adult cats, including proximity seeking, separation distress and reunion behavior, as well as individual differences were consistent with attachment style categorizations [53].

In the present study, 30 of 223 evaluated cats (13.45%) were classified as possibly SRP-affected based on the behavioral signs reported by their owners to occur during their absence. A previous empirical study found a prevalence of 19% (n = 136) of cats affected by SRP in a group of 716 animals [15], considering as SRP cats showing one or multiple behavioral signs displayed exclusively in the absence of the attachment figure: inappropriate urination (96 cats), inappropriate defecation (48), excessive vocalization (16), destructiveness (12), and psychogenic grooming (8 cats). Together, these results reveal the likelihood of SRP occurrence in cats along with a gap of information regarding SRP in the species, suggesting this is a neglected issue in the area of behavioral problems in cats. The Fe-BARQ online questionnaire, developed to measure owner-reported behavior in domestic cats, is an extensive list with 149 behavioral questions/items encompassing multiple behavioral factors, most of which capture behavioral problems [4]. Separation-related behaviors are evaluated by six items, including behaviors of 'restlessness – agitation', 'hide and/or slink away', 'lie down or stay still', 'active investigation', 'alert/hyper-vigilance' and 'vocalization' just prior to or during cat separation from the owner [4]. For assessment of SRP, the Fe-BARQ did not include the most typical signs of destructive behavior and inappropriate elimination of urine and feces both exclusively occurring in the absence of the owner, as did the present study. Vocalization when the cat was left alone was included in both questionnaires. While the Fe-BARQ was based on factor analysis from a large sample of respondents (n = 2608), the incidence of each behavioral item indicative of SRP was not reported, nor was the prevalence of possible SRP in the sample [4]. Given the lack of information on cats, the literature on SRP in dogs can be useful for general comparisons. The cat SRP prevalence in the present study was within the range reported in previous studies assessing SRP in dogs: 13% in Dinwoodie

et al. [54]; 17.2% in Tiira et al. [40]; 20% in Martínez et al. [55]; 22.58% in Storengen et al. [38]; 18.4% to 33.1% in Konok et al. [56]; 30% in Blackwell et al. [57]. In most of these studies, the identification of SRP was based on the reports of dog owners (interviews and questionnaires).

It is worth noting that the SRP cats of the present study were reported by their owners as having behavioral or emotional signs consistent with SRP (defined here as SRP group) and did not necessarily have SRP, as the questionnaire still needs further validation based on behavioral observations or experimentation. In addition, none of the owners reported that their cats had any previous diagnosis of SRP by a veterinarian or clinical ethologist. The behaviors and mental states reported in the present study may also indicate other disorders such as generalized anxiety, boredom, or physiological problems. In fact, in a study about separation anxiety in dogs [23], several behaviors observed (inadequate elimination, excessive vocalization and self-mutilation behaviors) were nonspecific and also seen in the control group (dogs without separation anxiety). However, in animals without separation anxiety these behaviors occurred in both the presence and in the absence of the owner [23]. Despite not being able to rule out that the interviewed owners answered the questionnaire based on more general behaviors, during the interviews owners were informed that the signs had to be displayed during owners' absences. One potential problem with this is the possibility of owners not having a valid perception of the behavior and mental states of their cats when they were not present to observe them. However, we should infer that the owners answered based on evidence such as the behavior or body language of the cat when they were absent, which could be based on reports by others residents, neighbors or any kind of sign the cat left in the environment (feces, urine or broken objects). This methodological limitation is difficult to overcome in a questionnaire survey, since the unequivocal view of the cat body language during owners' absence could only be obtained by regular video monitoring of the cats when left alone, which has a low feasibility. A study conducted with dogs addressed the shortcomings of the methodologies based on owners reports to assess separation behaviors [58], whereby a separation-related behavioral score based on owners reports was correlated with dogs behaviors based on video footage of the dogs during the first 25 minutes after they were left alone in the house [58]. Thus, it is reasonable to infer that the respondents of our study had different ways to gather evidence about their cats' behaviors during the owners' absence.

To consider a cat as possibly having SRP, the owner had to report at least two behaviors characteristic of this condition: destructive behavior, inappropriate elimination of

urine, inappropriate elimination of feces, excessive vocalization, necessarily occurring during the absence of the owner. In the group of animals characterized as SRP group, destructive behavior was the most prevalent sign, demonstrated by 66.67% of the cats, as opposed to a 6.74% prevalence in the group of animals with no behavioral signs of SRP (non-SRP). This is one of the most frequently reported behaviors as a symptom of SRP for both cats [15] and dogs [23, 25]. In a study evaluating 200 dogs with SRP and its possible risk factors, destructive behavior was demonstrated by 71.7% of the total sample [23]. Nevertheless, in the present study it is not possible to rule out that the high frequency of destructive behavior reported by the cat owners occurred due to a mistaken perception about scratching behavior. Some of the interviewed owners may not have differentiated natural scratching behavior from abnormal destructive behavior (i.e., when it is shown to a frequent and exaggerated extent). Behavioral problems might be perceived as any behavior shown by the animal that is unacceptable for the owner, but some of them may be natural, such as scratching [9, 59].

Excessive vocalization is a common sign in dogs with separation anxiety [23]. As previously mentioned, for adult cats vocalization is an indicator of stress [60] and also of SRP [4, 15] and, as such, it was included in the questionnaire. We obtained a prevalence of 63.33% for this behavior in the sample, making this the second most reported sign for owners of cats from SRP group. Excessive vocalization can be considered an easily perceived behavior, since it may cause disturbance to other residents and the neighborhood. Despite being easily perceived, it is a non-specific behavioral symptom and potentially indicative of other problems, e.g. cognitive dysfunction syndrome [61].

Regarding inappropriate urination, 60% of the cats defined here as belonging to the SRP group showed this behavior. This is one of the most characteristic signs of SRP, showing high prevalence in previous studies [15, 62]. In the single study we found about separation anxiety in cats, Schwartz [15] found a prevalence of 70.6% for inappropriate urination in a sample of 136 cats with separation anxiety. It has been suggested that inappropriate urination in the absence of the owner could be the only behavioral sign of SRP for cats [15], even when not combined with other evident behaviors and physiological symptoms [62]. It may be usual for urine to be eliminated in places where there is presence of the owner's smell, such as bed, clothes, pillows and shoes [62]. However, it is not possible to guarantee that cat owners are able to distinguish inappropriate urination as a sign of SRP from normal territorial marking with urine. Territory marking by urine (or spray) is a normal feline behavior which tends to happen on vertical surfaces, independent of the presence of the owner in the home. To avoid

this misunderstanding, in the present study during the questionnaire it was reinforced that inappropriate elimination was only considered when it occurred in the owners' absence.

There was a higher frequency of elimination of urine in inappropriate places than inappropriate defecation (60.0% vs. 23.3%, respectively) in cats characterized as possibly having SRP. In a previous study, the frequency of inappropriate defecation was higher, occurring in 35.3% of 136 cats with SRP [15]. Such differences in frequencies of inappropriate defecation may have occurred because the study by Schwartz [15] was based on medical records, so we could infer that inadequate defecation could be a symptom that motivated the owners to seek medical assistance and/or could also be related to some underlying disease. Defecation is also an non-specific indicator of SRP that can occur in conjunction with other behavioral problems or pathological causes [63].

In addition to the behavioral categories previously described as SRP indicators, we included three questions related to owner-perceived cat emotional states, including depression-apathy, agitation-anxiety and aggressiveness. Among those signs the most prevalent was depression-apathy, which occurred in approximately half of the cats belonging to the SRP group. The higher frequency of depression-apathy could indicate that this was a more adequate subjective sign of SRP compared to the other states included in the questionnaire. However, it is also plausible that cat owners had a misperception of their cats' body language, since they are animals with nocturnal habits and long periods of sleep and inactivity during the day [59, 64], which coincides with the period that owners leave home for work. For example, there is evidence that dog owners are able to perceive more evident signs of stress, such as trembling, whining, aggressiveness, excessive barking, and panting, but are rarely able to perceive signs of stress characterized as 'subtle behaviors' such as looking elsewhere, turning head, yawning, and nose licking [65]. Additionally, in a study aimed at identification of cats' facial expressions by humans, it was found that some people can correctly infer the affective states of cats from subtle aspects of their facial expressions [42]. Thus, the lower prevalence of the other two behavioral signs included in the present study could be related to those being less perceptible or more tolerable to cat owners, and thus unnoticed by them. More research is needed to determine to what extent owners are able to perceive emotional states and subtle signs of stress and anxiety from their cats.

In the scientific literature characteristics like gender, age, and neutering status have been reported as risk factors for SRP in dogs [27]. As well, Separation Anxiety Syndrome was more commonly reported in senior female cats than in males, with a prevalence of 27% in females aged 7 years or more [15]. Additionally, destructive behavior was reported as more

frequent in neutered male cats whereas inappropriate defecation was more prevalent in neutered females [15]. However, in this study we found no relationship between cat sex and neuter status with any symptoms consistent with SRP reported by the owners. Most of the cats assessed in the present study were sterilized (89.69%), with only 23 intact individuals included.

Some previous studies also suggested that breed can be related to SRP in dogs [23, 26, 38]. The process of artificial selection for some breeds could explain, in part, the higher susceptibility of SRP in certain breeds [66]. A recent study showed that dog breeds selected for cooperative work with humans were more prone to suffer from separation-related stress behaviors than the breeds selected for independent work abilities [66]. For cats, it was previously suggested that Siamese and Burmese breeds are more prone to developing SRP [15, 62]. There is empirical evidence that Siamese, Burmese and Tonkinese coat patterns are also related to the occurrence of SRP and separation anxiety [28]. The shortage of studies assessing breed effects on the risk of SRP in companion animals may be due to methodological restraints for developing reliable assessments of this question, given the requirement for a large number of animals of different breeds to estimate the SRP prevalence in various dog [40] and cat breeds. For instance, in the present study only 12.11% of the cats were purebred. However, we did not evaluate whether cats reported as purebreds by their owners were indeed purebred based on pedigree information, what could lead to even lower percentages.

As for the owners' traits, a positive association was observed between the report of signs of SRP and the presence of 'no female resident' according to MCA and 'two female residents' in the house. In cats included in the SRP group, 10.00% of them lived in residences with 'no female', while in non-SRP the frequency was much lower at 2.59%. In addition, for the SRP group, 50.00% of cats lived with two females, while in the non-SRP group 26.94% did so. Thus, the relationships found between SRP and number of female residents in the present study were not straightforward and are difficult to explain. Previous findings in dogs had already reported a relationship between SRP and the number of female residents: as the number of females in the house increased, so did the likelihood of the dog developing SRP [35]. Additionally, dogs owned by a single woman were more prone to SRP than those raised by a single man [38]. The reason for this difference is not clear; however, there is some evidence from previous studies suggesting that female owners show more attachment to their pets than male owners, and cats prefer to interact with adult female residents than with children and male adults [33, 51, 67]. As an alternative explanation, it is also plausible that

women showed higher perception of their pets' behavior and body language, and thus owner sex is not necessarily a factor that makes the animal more prone to SRP, but potentially makes the owner more perceptive of SRP signs [33, 67]. Still, regarding the owners' traits assessed in the present study, the MCA correspondence grouping related to SRP also included the variable 'owners' age 18 to 35'. We might infer that this age can be confounded with other traits such as number of female residents and time that cats are left alone for younger owners.

Regarding the environmental and management traits, the more cats' popularity as a pet grows, the greater the need for better management practices and responsible ownership [68]. Responsible cat ownership includes practices that protect those animals from damage and behavioral problems, increasing their welfare. In the present study, cats reported by owners as having behaviors consistent with SRP were related to 'do not have access to toys', 'do not have access to the whole house', 'no other animal in the house', 'no outdoor access' and being left alone in the house '5 to 7 times per week', 'from 2 to 6 hours per day' and '> 6 hours per day'. The confined environments typical of residences usually do not meet the exploratory needs of cats, because they may not provide the stimuli the animal would find in the wild, which makes the environment monotonous and predicable [69]. Thus, environmental enrichment benefits confined cats, helping to reduce the stress caused by confinement, any abnormal behaviors, encouraging exploratory behavior and other uses of the space [69]. In the total population of cats, 12.56% of the animals had no access to toys while in the SRP group 26.67% of them had no access to toys, making this a possible factor related to SRP. Therefore, the use of environmental enrichment, such as cat toys, can be a good option to increase the welfare of confined animals and help to prevent SRP [25, 26, 69, 70].

It was also observed that the frequency and duration of daily periods the animal is separated from its attachment person can be related to the report of signs of SRP by the owners, especially for cats that stay alone from 5 to 7 times a week and more than 2 hours per day, as revealed by MCA. Additionally, the frequency that the cats are left alone tended to be related with reported signs of SRP, according to the chi-square test. In the sample of cats without SRP, there was a lower percentage (47.15%) of animals that stayed alone from 5 to 7 times a week than in the SRP group (60.0%). In the SRP group, only 3.33% of the cats never stayed alone or rarely stayed alone (10.0%), while those percentages were much higher in the total population sampled (10.76% and 22.42% respectively), indicating that cats not left alone are less likely to develop SRP. Cats are considered animals that can easily tolerate the absence of their owners [14]. We speculate that owners who perceive their cats as 'independent' animals might leave them alone for longer periods of time, contributing to the occurrence of

SRP in cats that stay alone for long periods. Further studies should investigate the relationships among owners' perceptions towards cat behavior and the management practices applied that predispose to SRP.

We also observed a tendency for owners reporting signs of SRP in the group of individuals that do not live with other animals at home. A possible explanation for this association is that cats living alone spend more time interacting with their owners than those living with other cats. It is also possible that owners with a single cat 'spoiled' their animal more than those with multiple cats [4, 71]. However, these two possibilities lack scientific support and warrant more research. The simple presence of other cats in the house may not be considered a factor that would prevent the occurrence of SRP in cats [14]. While some authors suggest that multi-cat households can be stressful [72], others indicate that there is no significant difference in stress scores between cats from single-cat and those from multi-cat households [73]. In some cases, having another animal in the environment may be beneficial for certain cats depending on their temperament, since they could maintain positive interactions without agonistic confrontations [64].

In spite of promising results, this study has limitations that must be acknowledged. The interviewed owners were asked about behavioral signs of SRP in their absence (i.e., in absence of the presumed attachment figure), without recording whether the behaviors also occurred when someone else was in the house or exclusively when the animal was alone. This information could elucidate whether those behaviors were more related to general isolation than to the absence of the owner per se. An additional point is that the three criteria used to characterize SRP were arbitrarily defined by the authors. Using a combination of behaviors and mental states to define SRP, we have found a slightly lower incidence than a previous study (13% vs. 19% in Schwartz [15]) in which a single behavioral sign of SRP displayed when cats were separated from the owner were enough to cats being regarded as affected [15]. The prevalence of SRP in a sampled population can be dependent on the criteria used to diagnose SRP, generating a potential source of bias, subjectivity or imprecision that has to be taken into account in future studies. To date, very few exploratory researches were conducted about SRP in cats. The lack of science-based criteria to define SRP in cats reinforce that separation problems can be regarded as a neglected feline behavioral problem that deserves more studies.

Conclusion

Separation-related problems in domestic cats are behavioral disorders that are difficult to identify due to the very limited amount of research conducted to date. The present questionnaire enabled the identification of behaviors (destructive behavior, excessive vocalization, inappropriate elimination of urine) and mental state (depression-apathy) related to SRP in cats, as reported by their owners. Even though the questionnaire cannot be used as a substitute for a detailed investigation of each case, it can be used as a starting point for future research about SRP in cats. It may provide a practical and efficient instrument to help ethologists and veterinarians make initial diagnoses of SRP with more confidence.

Through this study we suggest that some environmental factors can make domestic cats more prone to develop separation-related problems, like the number of female humans in the house, frequency and number of daily hours the cat is left alone, the lack of use of environmental enrichment (e.g. toys), and the absence of other animals in the house. Thus, investigations of management practices to prevent the occurrence SRP should take these factors into consideration.

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