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### Title

Correlation between aggression at the veterinary clinic and problem behaviors at home for cats in the USA

### Permalink

<https://escholarship.org/uc/item/3sp8n9v3>

### Journal

Journal of Feline Medicine and Surgery, 26(2)

### ISSN

1098-612X

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### Publication Date

2024-02-01

### DOI

10.1177/1098612x231214907

Peer reviewed



# Correlation between aggression at the veterinary clinic and problem behaviors at home for cats in the USA

Journal of Feline Medicine and Surgery  
1–10

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DOI: 10.1177/1098612X231214907

journals.sagepub.com/home/jfm

This paper was handled and processed by the American Editorial Office (AAFP) for publication in *JFMS*



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## Abstract

**Objectives** The aim of the study was to determine whether cats that exhibit aggression during veterinary visits are more likely to have behavior problems at home.

**Methods** An online, anonymous, cross-sectional survey was developed and distributed to residents in the USA who were aged over 18 years and who were the primary owners of at least one cat. The survey collected information about cat and household factors, and utilized a validated questionnaire instrument for obtaining behavioral information of pet cats.

**Results** Aggression at the veterinary clinic was reported in 42.6% of the cats. The frequency of aggression exhibited at the veterinary clinic was lower in cats that lived in multi-cat households. Most cats did not receive medications intended to reduce fear, anxiety and/or pain before veterinary visits. Aggression at the veterinary clinic was positively associated with behavior problems at home, including stranger-directed aggression, owner-directed aggression, resistance to restraint, familiar cat aggression, dog-directed aggression, house-soiling, separation-related behaviors and scratching claws on inappropriate surfaces indoors.

**Conclusions and relevance** Cats that exhibit aggression at the veterinary clinic are more likely to exhibit aggression and anxiety-related behaviors at home. Veterinarians should screen cats that exhibit aggression at the veterinary clinic for behavior problems at home to institute prompt diagnosis and treatment.

**Keywords:** Feline aggression; cat aggression; feline behavior problems; cat behavior problems; veterinary visit

**Accepted:** 30 October 2023

## Introduction

The majority of cats are reported to become highly stressed at the veterinary clinic.<sup>1–6</sup> The term stress refers to the physiological and behavioral changes that occur in response to a chemical, physical or emotional stimulus or event ('stressor') that perturbs the body's homeostasis and triggers activation of the sympathetic adrenal medullary and the hypothalamic–pituitary–adrenal cortex axes.<sup>7,8</sup> Possible stressors at the veterinary clinic include the following: transport to the clinic; exposure to unfamiliar surroundings, such as the waiting room and examination rooms; conspecifics and heterospecifics; odors; noises; uncomfortable surfaces; confinement; separation from the owner; full body handling, including scruffing; and physical discomfort or pain.<sup>5,9,10</sup> Cats may initially crouch with their tail wrapped closely to their body,

freeze, attempt to flee or hide and/or purr when faced with a perceived threat,<sup>11</sup> but may escalate to aggression

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if there is no escape from the stressor.<sup>4,11</sup> Signs of aggression in cats include hissing, growling, swatting with their paws and biting.<sup>12</sup>

In addition to immediately compromising animal welfare, stress associated with veterinary visits may affect feline behavior and health beyond the clinic. Surveys of cat owners show that cats remain remote and unfriendly for several days after the clinic visit, with fewer than half of cats showing a rapid recovery after returning home from a clinic appointment,<sup>4,13</sup> suggesting that veterinary visits result in prolonged stress in cats.<sup>4</sup> Prolonged stress can have adverse effects on immunity and general health, including exacerbating comorbid conditions.<sup>14,15</sup> One well-known physiological sequelae of the stress response in cats is activation of the lower urinary tract and the development of feline interstitial cystitis.<sup>16,17</sup>

Prolonged stress may also contribute to or exacerbate long-term patient behavior problems.<sup>15,18</sup> The term 'behavior problem' is used to describe any behavior exhibited by the cat, including variations of normal feline behavior and behaviors that may originate due to a physical or behavioral pathology, that are undesirable to the owner.<sup>19</sup> Fearfulness and aggression are common behavior problems reported by owners in companion cats outside of the veterinary context.<sup>18–23</sup> Other commonly cited owner-perceived behavior problems in companion cats include house-soiling, scratching, crepuscular activity, vocalization, compulsive behavior, excessive grooming/self-mutilation and attention seeking.<sup>19,20,23–25</sup> Previous studies have shown that 55–98% of cat owners reported that their cats experienced one or more behavior problems.<sup>20,22,24</sup> A recent study suggested that cat owners are more likely to view their cat's behavior as problematic if the behavior directly affects their lifestyle or environment.<sup>23</sup> Behavioral problems can be indicative of poor welfare and are one of the most common reasons for euthanasia,<sup>26</sup> relinquishment of companion cats to animal shelters<sup>27–29</sup> and unsuccessful rehoming.<sup>30</sup>

Given the dramatic impact of behavior problems on companion cat welfare, better tools are needed to identify behavior disorders in cats. However, many cat owners lack knowledge necessary to understand their cats,<sup>31</sup> and while veterinarians acknowledge the importance of understanding animal behavior, they report themselves to be lacking in behavioral training.<sup>32</sup> The aim of the present study was to identify the daily behaviors of cats in the USA that exhibit aggression at the veterinary clinic using the Feline Behavioral Assessment and Research Questionnaire (Fe-BARQ), a validated owner-reported quantitative behavioral evaluation of pet cats,<sup>33</sup> to evaluate whether aggression at the veterinary clinic is associated with behavior problems at home in cats in the USA. The Fe-BARQ consists of 100 questions measuring 23 distinct behavioral factors that describe different aspects

of companion cat behavior, including, but not limited to, general activity, aggression toward people, other cats and dogs, and compulsive behaviors. It also includes 15 separate miscellaneous behaviors that may reflect owner-perceived behavior problems, such as excessive vocalization, urine spraying and inappropriate scratching. The Fe-BARQ utilizes Likert scales to evaluate the frequency of behavior occurrence. Our hypothesis was that the score from Fe-BARQ question 93 (Q93), which states 'Does your cat growl, hiss, scratch or bite when examined or treated by a veterinarian?', would be positively correlated with Fe-BARQ scores from the sections evaluating aggression and anxiety-related behaviors in the home.

## Materials and methods

### Study design

An online, anonymous, cross-sectional survey was developed. The survey was written in English, and the final 155-item survey and study design were reviewed by the University of California Davis Institutional Review Board (IRB number 1942653-1) and determined to be exempt from human-subjects research oversight.

The inclusion criteria were as follows: respondents must be aged over 18 years; the current primary owners of at least one cat; and residents of the USA. Respondents owning more than one cat were instructed to complete the survey for the cat whose first name started with the letter closest to the first letter of the alphabet, as asking respondents to select a cat at random may have led to a greater degree of selection bias. The exclusion criteria were as follows: respondents who were aged under 18 years or were not the primary caregiver of at least one cat; respondents who were not residents of the USA; a response rate less than 90%; and failure to answer Q93 in the Fe-BARQ. Respondents were automatically exited from the survey if they were aged under 18 years, were not the primary caregiver of at least one cat and did not live in the USA.

The survey was built, designed, reviewed and pilot tested, and made available online using an online survey tool (Google). Respondents were solicited between 18 August and 7 September 2022 through social media channels; sharing was encouraged. No monetary compensation was provided to survey respondents.

As part of the survey, respondents were asked to complete the Fe-BARQ. The Fe-BARQ consists of 100 questions that are grouped into 24 sections, each containing a variable number of individual questions or items, measuring different behavioral factors or traits, including activity/playfulness, sociability, stranger-directed aggression, touch sensitivity/owner-directed aggression, resistance to restraint, familiar cat aggression, dog aggression, fear of unfamiliar dogs, fear of novelty, separation-related behavior, predatory behavior, excessive/compulsive

behaviors, inappropriate elimination and 21 miscellaneous factors, which are not part of the preceding sections (see file 1 in the supplementary material). All items were assigned a score using a Likert scale (0 = never, 1 = seldom, 2 = sometimes, 3 = usually, 4 = always). To obtain an overall score for each trait, the scores of the items in each section were averaged for each section. The 15 items in the 'Miscellaneous' section of the Fe-BARQ were scored individually on a scale of 0–4.

Aside from the 100 Fe-BARQ questions, there were 52 additional questions for single-cat households and 55 additional questions for multi-cat households included in the survey. Questions were added to evaluate for additional associations between Q93 from the Fe-BARQ and other variables. Furthermore, the authors anticipated using data collected from the surveys for future research studies. Of these additional questions, 32 collected information about the individual cats for which the surveys were completed, including demographic information such as age, sex, reproductive status, breed, and when and from where the cat was acquired, and information about the cat's lifestyle and environment. Household descriptive data collected included the number of people and pets living in the home, the type of residence and its location, the approximate size of the home and respondents' demographics, including age, gender, marital status and highest level of education. Respondents had the option to select 'Prefer not to answer' to any questions inquiring about personal information of the owners. For multi-cat households, two additional questions asked respondents to use a Likert scale to indicate how often at least one other cat in the household licked, slept directly next to, avoided and/or ignored, and/or growled, hissed, swatted or bit at the cat for which the survey was completed, and how often the cat for which the survey was completed licked, slept directly next to, avoided and/or ignored, and/or growled, hissed, swatted or bit another cat in the household.

The survey included questions for respondents to select a time range describing the last time their cat was brought to the veterinary clinic, and whether they physically observed their cat being handled by the veterinarian or veterinary staff at the time of the most recent visit. The survey also included questions as to whether the cat received any medications or supplements intended to reduce fear and anxiety before the most recent veterinary visit, and if so, respondents were asked to select the psychotropic medication(s), supplement(s), pheromone analog and/or analgesic(s) that their cat received beforehand from a list. An open-ended response to enter medications or other products not included in the list was provided.

Five Likert-scale questions were included as to whether respondents thought their cat has behavior problems, how stressful those behavior problems were for

them, and whether they considered rehoming and/or euthanizing their cat because of their cat's behavior (see file 2 in the supplementary material).

### *Statistical analysis*

Sample size calculations were performed to determine the minimum number of survey responses needed to represent the USA cat owner population with optimal precision (margin of error = 5%; level of confidence = 95%). According to the pet owner statistics from the American Veterinary Medical Association in 2017–2018, the number of households owning cats in the USA was approximately 32 million (31,896,077).<sup>34</sup> Based on this, it was determined that the number of responses should be greater than 385. However, a greater number of responses were obtained in case questionnaire responses were eliminated from the statistical analysis due to the exclusion criteria. Furthermore, the online survey tool had very high convenience for the statistical analysis, even with a larger number of respondents; therefore, additional responses were collected to maximize the representativeness of the statistics.

Descriptive statistics evaluated the following individual cat information: sex; age; breed; source from which the cat was obtained; indoor/outdoor status; information about the cat's lifestyle and environment; the number of cats in the household; whether medication(s) and/or supplement(s) intended to reduce fear, anxiety and/or pain were administered before veterinary visits; household descriptive data; and respondent demographics. Intact cats were eliminated from this analysis due to the small sample size.

In order to explore specific relationships between Q93 scores and the above listed variables, non-parametric approaches best suited to categorical and Likert (ordinal) data, including Wilcoxon rank-sum test with continuity correction for binary variables or Kruskal-Wallis or Spearman's rank correlation for categorical variables, were utilized. While the survey collected information on owner-observed behaviors, including allogrooming, avoidance and aggression, exhibited toward and from other cats in multi-cat households as well as specific medication(s) and/or supplement(s) administered before vet visits, these additional variables were not evaluated in the statistical analysis due to the limits of the scope of the study. Spearman's correlation analyses were conducted to assess if relationships existed between Q93 scores and Fe-BARQ section scores, including activity/playfulness, sociability with people, directed calls/vocalizations, purring, attention seeking, sociability with cats, stranger-directed aggression, touch sensitivity/owner-directed aggression, resistance to restraint, familiar cat aggression, dog aggression, fear of unfamiliar dogs/cats, fear of novelty, separation-related behavior, trainability, predatory behavior, prey interest, location preferences for resting/

**Table 1** Demographic information for 759 survey participant cat owners in the USA

Variable	Category	Respondents
Sex/reproductive status	Neutered male	403 (53.1)
	Intact male	1 (0.1)
	Neutered female	353 (46.5)
	Intact female	2 (0.3)
Breed	Domestic shorthair	453 (59.7)
	Purebred	276 (37.8)
	Mixed breed	124 (16.3)
	Other	18 (2.4)
Indoor/outdoor status	Indoor only	546 (71.9)
	Indoor and outdoor	211 (27.8)
	Outdoor only	2 (0.3)
Number of cats in the household	1	221 (29.1)
	2	244 (32.2)
	3	132 (17.4)
	4	69 (9.1)
	5	38 (5.0)
	6	18 (2.4)
	7	7 (0.92)
	8	12 (1.6)
	>8	18 (2.4)

Data are presented as n (%)

sleeping, excessive/compulsive self-grooming, other compulsive behaviors, inappropriate elimination, elimination preferences, crepuscular activity and individual questions from the 'Miscellaneous' section. Spearman's rank correlation for categorical variables were used to evaluate associations between Q93 and the questions 'How frequently does this cat exhibit problem behaviors?', 'How stressful is/are the behavior problem(s) for you?' and 'Have you ever considered rehoming or euthanizing this cat due to his/her behavior?' All tests performed were two-tailed, and significance was set at  $P < 0.05$ . Data management, statistical analyses and visualization were performed with statistical software (R Studio; R Core Team).

## Results

### Survey respondent information

A total of 1237 respondents from the USA participated in the survey. Of those, 508 were excluded based on the exclusion criteria. The resultant 759 respondents met the inclusion criteria, with 61.4% of surveys included in the statistical analysis.

### Cat demographic information

The mean age of cats was 7.5 years (age range 1.5–16.5). Most cats were neutered males (403/53.1%) and females

(353/46.5%) and domestic shorthair cats (453/59.7%) (Table 1).

### Multi-cat households

Of the respondents, 221 (29.1%) had one cat, 244 (32.2%) had two cats, 132 (17.4%) had three cats, 69 (9.1%) had four cats, 38 (5.0%) had five cats, 18 (2.4%) had six cats, seven (0.92%) had seven cats, 12 (1.6%) had eight cats and 18 (2.4%) had more than eight cats in the household (Table 1).

### Veterinary visits

Regarding the time of the most recent veterinary visit, 485 (63.9%) cats were brought to the veterinary clinic within the past 6 months, 177 (23.3%) cats were brought to the clinic in the last 6–12 months, 68 (9.0%) cats were brought to the clinic within the last 1–2 years and 29 (3.8%) cats were brought to the clinic more than 2 years before completion of the survey. Most respondents (651/85.8%) indicated that they physically observed their cat being handled by the veterinarian or veterinary staff at the most recent veterinary visit, while 108 (14.2%) respondents had not observed their cats being handled by veterinary professionals at the most recent veterinary visit.

A total of 142 (18.7%) cats received at least one medication and 508 (66.9%) cats did not receive any medications or supplements intended to decrease fear, anxiety and/or pain before the most recent veterinary visit. There were 109 (14.4%) respondents who did not respond to this question.

### Respondent stress due to their cats' behavior problems

Regarding the Likert-scale question 'How stressful is/are the behavior problem(s) for you?', where 1 = not at all stressful and 5 = very stressful, the respondents answered as follows: 262 (34.5%) selected 1, 176 (23.2%) selected 2, 79 (10.4%) selected 3, 38 (5.0%) selected 4, 27 (3.6%) selected 5 and 177 (23.3%) did not respond. The average score was 2.0. Of the 528 respondents who answered this question, 320 (55.0%) indicated that they experienced some degree of stress due to their cat's behavior problem.

### Assessment of responses to Q93 from Fe-BARQ

Q93 from the Fe-BARQ read 'Does your cat growl, hiss, scratch or bite when examined or treated by a veterinarian?' Respondents answered Q93 as follows: 436 (57.4%) never; 133 (17.5%) seldom; 67 (8.8%) sometimes; 59 (7.8%) usually; and 64 (8.4%) always. A Kruskal–Wallis rank-sum test showed that the Fe-BARQ scores from Q93 did not show statistically significant associations with the cats' sexes, breeds and indoor/outdoor status. Spearman's rank correlation found that cats that were 'sometimes' aggressive at the veterinary clinic were significantly older in age than the other four groups ( $P = 0.002$ ).

**Table 2** Statistically significant associations with corresponding correlation coefficients between question 93 scores from the Fe-BARQ ('Does your cat growl, hiss, scratch or bite when examined or treated by a veterinarian?') and Fe-BARQ section scores for 759 cats in the USA

Fe-BARQ section	Correlation coefficient ( $\rho$ )	<i>P</i> value
Stranger-directed aggression	0.458	<0.001
Owner-directed aggression	0.267	<0.001
Resistance to restraint	0.439	<0.001
Familiar cat aggression	0.199	<0.001
Dog aggression	0.319	<0.001
Separation-related behavior	0.101	<0.006
Excessive/compulsive self-grooming	0.122	<0.001
Inappropriate elimination	0.090	<0.014
Miscellaneous behaviors	0.377	<0.001
Scratches inappropriate surfaces	0.081	0.026
Destructive behavior when home alone	0.116	0.002

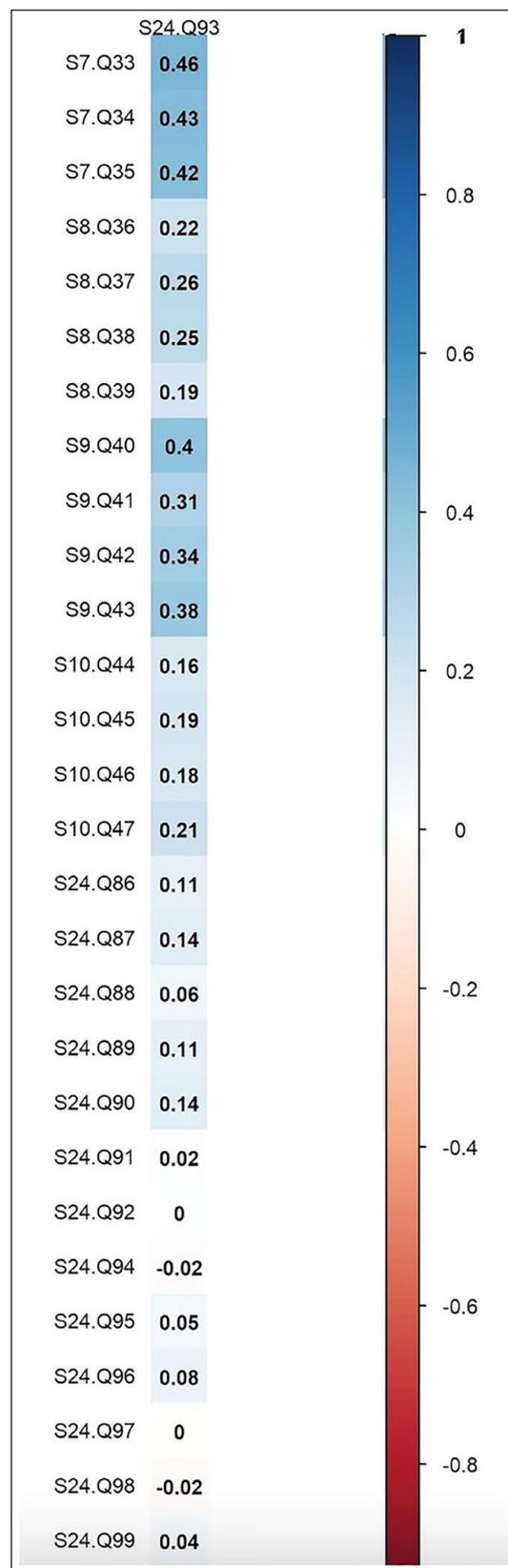
#### Association between Q93 scores and other Fe-BARQ scores

Spearman's rank correlation tests found that scores from Q93 showed statistically significant positive associations with scores from the following Fe-BARQ sections: Section 7 – Stranger-directed aggression ( $\rho = 0.458$ ,  $P < 0.001$ ); Section 8 – Owner-directed aggression/touch sensitivity ( $\rho = 0.267$ ,  $P < 0.001$ ); Section 9 – Resistance to restraint ( $\rho = 0.439$ ,  $P < 0.001$ ); Section 10 – Familiar cat aggression ( $\rho = 0.199$ ,  $P < 0.001$ ); Section 11 – Dog aggression ( $\rho = 0.319$ ,  $P < 0.001$ ); Section 13 – Fear of novelty ( $\rho = 0.075$ ,  $P < 0.0413$ ); Section 14 – Separation-related behavior ( $\rho = 0.101$ ,  $P < 0.006$ ); Section 19 – Excessive/compulsive self-grooming ( $\rho = 0.122$ ,  $P < 0.001$ ); Section 21 – Inappropriate elimination ( $\rho = 0.090$ ,  $P < 0.0138$ ); and Section 24 – Miscellaneous behaviors ( $\rho = 0.377$ ,  $P < 0.001$ ) (Table 2).

There were statistically significant positive correlations between Q93 scores and the following questions from the 'Miscellaneous' section: 'Gives sudden and loud vocalizations (meowing, yowling) either during the daytime or at night (without another cat or animal in sight)' ( $\rho = 0.139$ ,  $P < 0.001$ ); 'Scratches claws on inappropriate objects or surfaces indoors' ( $\rho = 0.081$ ,  $P = 0.026$ ); and 'Chews or damages inappropriate objects when left alone at home (destructive behavior)' ( $\rho = 0.116$ ,  $P = 0.002$ ) (Figure 1).

#### Association between Q93 and multi-cat households

Spearman's rank correlation found that there was a statistically significant negative correlation between the Q93 score and the number of cats in the house, such that the



**Figure 1** Correlation matrix of question 93 scores from the Fe-BARQ ('Does your cat growl, hiss, scratch or bite when examined or treated by a veterinarian?') with Fe-BARQ questions from Fe-BARQ sections 7–10 and 24

higher the number of cats in the household, the lower the frequency of aggression exhibited in the veterinary clinic ( $\rho = -0.119$ ,  $P < 0.001$ ).

#### *Association between Q93 and whether medication(s) and/or supplement(s) were administered before veterinary visits*

A Wilcoxon rank-sum test with continuity correction found that cats that exhibited aggression at the veterinary clinic as indicated in Q93 were statistically significantly more likely to have received medication(s) and/or supplement(s) intended to decrease fear, anxiety and/or pain before veterinary visits ( $P < 0.001$ ). Cats that received no medications or supplements had significantly lower Q93 scores ( $P < 0.001$ ). There was no statistically significant association between cats that received pharmaceuticals and cats that received both pharmaceuticals and supplements and Q93 scores.

#### *Association between Q93 and other survey questions*

The Spearman's rank correlation showed statistically significant positive correlations between Q93 scores and the questions 'How frequently does this cat exhibit behavior problems?' ( $\rho = 0.140$ ,  $P < 0.001$ ) and 'How stressful is/are the behavior problem(s) for you?' ( $\rho = 0.274$ ,  $P < 0.001$ ).

#### *Consideration for euthanasia or rehoming due to a behavior problem*

Regarding the question 'Have you ever considered rehoming or euthanizing this cat due to his/her behavior?' 559 (73.7%) responded no and 23 (3.0%) responded yes; the resultant respondents did not answer the question. There was no statistical significance between responses to these questions and Q93.

## **Discussion**

This is the first study, to the authors' knowledge, to demonstrate that owners of cats that display aggression at the veterinary clinic are more likely to report that their cats have behavior problems at home.

Cats that exhibited aggression at the veterinary clinic were more likely to exhibit aggression toward familiar and unfamiliar people, cats and dogs. Cats that displayed aggression at the veterinary clinic were also more likely to exhibit other problem behaviors, including scratching on inappropriate objects or surfaces indoors, separation-related behaviors, urination and defecation outside of the litter box, and excessive grooming.

As fear and anxiety are common motivations for aggression at the veterinary clinic,<sup>4,35</sup> they are also common motivations for aggression toward humans,<sup>36-38</sup> other cats<sup>39,40</sup> and dogs<sup>41</sup>, house-soiling disorders including toileting and marking,<sup>42,43</sup> scratching on inappropriate

objects,<sup>44</sup> separation-related behaviors<sup>45</sup> and excessive grooming.<sup>36</sup>

However, this study did not establish cause-and-effect between aggression at the veterinary clinic and behavior problems at home. Owners of cats that exhibit aggression at the veterinary clinic may be more likely to recognize behavior problems at home. Given that most respondents to the survey (85.8%) physically observed their cat being handled by the veterinarian or veterinary staff at the most recent veterinary visit, the direct observation of their cat's behavior during veterinary visits may have led to these respondents being more likely to recognize their cats' aggression at the veterinary clinic as problematic. In addition, the presence or absence of the owners as well as physical examination location may have affected the stress levels of cats during veterinary visits.<sup>46</sup> Further, associations between the reported behavior in the Fe-BARQ and physical factors – including pain,<sup>47</sup> cognitive decline,<sup>48</sup> dermatological disease (for excessive grooming)<sup>49</sup> and lower urinary tract disease (for house-soiling)<sup>42</sup> – and environmental and social factors – including relationships with other cats in the household,<sup>19,36,42</sup> the provision of resources and environmental enrichment,<sup>50,51</sup> and litter box characteristics and management (for house-soiling)<sup>43</sup> – that may cause or contribute to problem behaviors were not evaluated. Interpreting the association found between aggression at the veterinary clinic and house-soiling is limited by owners potentially misidentifying the house-soiling cat in a multi-cat household.<sup>43</sup>

Among all behavioral issues, aggression, house-soiling and scratching of inappropriate surfaces have been the most commonly cited behavior problems in cats.<sup>18,19,21,22,25</sup> Behavioral issues significantly disrupt the human-animal bond,<sup>31,52</sup> lead to substandard care<sup>31,52</sup> and have frequently been cited as reasons for euthanasia and relinquishment of cats to shelters.<sup>26-29</sup> Based on the finding in this study that cats that exhibit aggression at the veterinary clinic are also more likely to exhibit aggression during restraint and handling, including when medicated by a familiar person, cats that exhibit aggression at the veterinary clinic may be not only less likely to receive thorough medical care at the veterinary clinic, but may be also less likely to receive medications and basic physical care, including nail trimming and grooming at home.

A promising finding in this study is that the majority (73.7%) of owners did not think about rehoming or euthanizing their cats due to behavior problems, even though most of the owners reported that they were stressed by their cats' behavior problems. Contrary to studies that have shown that cat owners may bypass essential veterinary care due to their cats' and their own stress associated with veterinary visits,<sup>2,4,6</sup> this study found that almost 90% of cats were brought to the veterinary clinic in the last 12 months, with 64% of those cats

being brought to the veterinary clinic in the last 6 months. This finding is consistent with another study that showed that cat owners have a positive attitude to having their cats regularly checked by a veterinarian.<sup>4</sup> These data are promising, as previous research has suggested that less frequent veterinary visits may lead to medical problems going undiagnosed, treatment becoming more complicated and costly by the time existing diseases are identified by owners, and financial losses to the veterinary clinic.<sup>2,4</sup> It is possible that the number of cats receiving veterinary care in this study was influenced by COVID-19 lockdowns and quarantine periods, decreased availability of veterinary professionals and veterinary hospitals limiting their cases to essential/emergency services in the time before this survey became available.<sup>53,54</sup>

The finding that cats that are aggressive at the veterinary clinic are more likely to have behavior problems at home is especially pertinent, given that close to half (42.6%) of the cats for which the surveys were completed exhibited aggression when examined or treated by a veterinarian. If the survey had evaluated for non-aggressive body language signs consistent with fear and anxiety, such as attempting to escape, freezing and hiding,<sup>11</sup> the number of cats in this survey that were reported to experience stress during veterinary visits would likely have been higher. This supports the need for veterinary clinics to follow guidelines that promote cat friendly veterinary interactions.<sup>35</sup> As a component of these guidelines, pharmacological agents may be used to overcome a cat's distress associated with carrier confinement, transport and veterinary examinations.<sup>35</sup> While cats that exhibited aggression at the veterinary clinic were more likely to receive medications and/or supplements intended to reduce fear, anxiety and/or pain before veterinary visits in this study, the majority (66.9%) of cats did not receive an anxiolytic before their most recent veterinary visit. Given that most cats are stressed during veterinary visits,<sup>1-6</sup> this suggests a missed opportunity for veterinarians to reduce veterinary visit-related stress in cats. This is especially important given that a recent study found that the majority of companion cat owners reported that they would or might consider giving psychoactive medications to their cats, particularly situational anti-anxiety medications, but only half of the owners were aware of the availability of psychoactive medications for cat behavior problems.<sup>55</sup>

The finding that cats that are aggressive at the veterinary clinic are more likely to have behavior problems at home necessitates that cats exhibiting aggression at the veterinary clinic be screened for behavior problems at home to provide early diagnosis and intervention of behavior problems, optimize the chance of treatment success and preserve quality of life for both the cat and owner.<sup>56</sup> However, the current means of screening cats for behavior problems are limited. Cat owners tend not to recognize behavior problems until they are overt and

advanced,<sup>31</sup> and tend not to seek behavior help for their cats,<sup>31</sup> including from veterinarians.<sup>57</sup> While veterinarians, with professional training and regular opportunities to observe feline behavior are in a unique position to screen for behavior problems, one study found that only 3.3% of owners reported that their veterinarian had recommended that they seek behavioral help for their cat.<sup>55</sup>

While veterinarians should ideally conduct behavioral assessments on all feline patients at wellness visits,<sup>56</sup> the findings of this study demonstrate that behavioral assessments of all cats that exhibit aggression at the veterinary clinic should be prioritized.<sup>31</sup> Veterinarians could utilize standardized behavioral history forms,<sup>56</sup> and should encourage the client to discuss any concerns or questions they may have about their pet's behavior. When needed, general practitioners should request specialist advice from veterinary behaviorists. Veterinarians should also become comfortable recognizing signs of fear and aggression during veterinary visits<sup>35,58</sup> so that cats at risk of having or developing behavior problems at home are promptly identified.

The present study also found that as the number of cats in the household increased, the frequency of aggression exhibited in the veterinary clinic decreased. Previous studies have found that cats from multi-cat households exhibit less aggression toward humans<sup>19,36</sup> and that the company of other cats is beneficial for fearful cats.<sup>24</sup> While there has historically been concern about increased social and stress levels of cats living in multi-cat homes,<sup>59-63</sup> other studies found no significant differences between the number of behavior problems reported in single-housed cats and cats living in multi-cat households,<sup>64-67</sup> suggesting that other environmental factors in the home, such as high densities causing decreased resource availability, may be a more important influence on cat behavior than simply the number of cats present.<sup>31</sup> On the other hand, owners who have multiple cats may be more informed about cat behavior and more likely to recognize aggression and behavior problems. This is the first study, to the authors' knowledge, to find that cats from multi-cat households may be less likely to exhibit aggression at the veterinary clinic, but this finding warrants further research on the potential emotional and behavioral benefits of intra-species relationships.

The findings in this study must be interpreted with consideration given to several limitations. While statistically significant, some of the correlation coefficients between Q93 scores and Fe-BARQ section scores were low, suggesting weak correlations. Correlation coefficients were low between Q93 and the Fe-BARQ section scores from 'Familiar cat aggression', 'Separation-related behavior', 'Excessive/compulsive self-grooming', 'Inappropriate elimination' and questions from the 'Miscellaneous behaviors' section, including 'Scratches claws on inappropriate objects or surfaces indoors' and

'Chews or damages inappropriate objects when left home alone (destructive behavior)'. The statistical significance found in these associations may have been due to data size rather than due to the size of the effect, as the *P* value may decrease as the sample size increases.

While owner assessments are considered an effective way to estimate the presence of behavioral problems in companion animals,<sup>21</sup> the limitations of the study include those common to survey studies. Selection bias may have been present with the data collected being self-reported, which relies on the cat owner's ability to accurately assess their cat's behavior, and representing perceptions of cat owners at one point in time; survey questions may have been subject to differences in interpretation; the survey excluded cat owners who did not have access to the Internet or social media;<sup>68</sup> and the survey required that respondents be comfortable answering questions in the English language. Furthermore, because the survey was distributed largely via special interest groups online, this convenience sampling limits the ability to generalize the findings to the general population.<sup>68</sup> Despite these limitations, studies have shown that online data collection is a reliable method in which to gather information.<sup>69,70</sup>

In addition, the reliance on the Fe-BARQ proposed further limitations. While the Fe-BARQ appears to be a comprehensive, internally consistent and valid questionnaire instrument for evaluating behaviors in pet cats based on owner reports,<sup>33</sup> section scores may be strongly influenced by extreme values and 'pooling fallacy' when data that conflate prevalence with intensity is pooled to produce a section score.<sup>71</sup>

## Conclusions

Surveys distributed to cat owners in the USA found that many cats exhibit aggression at the veterinary clinic, and that cats that exhibit aggression at the veterinary clinic are more likely to show aggression and anxiety-related behaviors at home. Given that behavioral conditions may worsen over time and significantly impact feline emotional and physical health and welfare, these results highlight the importance of veterinarians obtaining a more thorough behavioral history from the owners of cats that exhibit aggression at the veterinary clinic to be proactive in diagnosing and addressing these problems. This study also found that the majority of cats did not receive medications or supplements intended to reduce fear, anxiety and/or pain before veterinary visits. Given that the majority of cats are stressed during veterinary visits, this indicates a missed opportunity for veterinary professionals to improve the welfare of cats during veterinary visits. Lastly, this study also found that cats from multi-cat households were less likely to exhibit aggression at the veterinary clinic, calling for more research on the potential emotional benefits of intraspecies relationships.

**Supplementary material** The following files are available as supplementary material:

File 1: JFMS original study supplementary material – Survey questions.

File 2: FeBARQ master.

**Conflict of interest** The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding** The authors received no financial support for the research, authorship, and/or publication of this article.

**Ethical approval** This work did not involve the use of animals and therefore ethical approval was not specifically required for publication in *JFMS*.

**Informed consent** This work did not involve the use of animals (including cadavers) and therefore informed consent was not required. No animals or people are identifiable within this publication, and therefore additional informed consent for publication was not required.

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