Prevalence of 17 feline behavioral problems and relevant factors of each behavior in Japan

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ABSTRACT. Undesirable behaviors exhibited by cats are regarded as feline behavioral problems. Like canine behavioral problems, feline behavioral problems are commonly reported by owners. Thus, in order to advise cat owners appropriately, veterinarians, particularly general veterinary practitioners, are encouraged to have sufficient knowledge of these problems. However, in ordinary Japanese homes, only a small number of feline behavioral problems have been investigated in terms of prevalence and relevant factors. Comprehensive survey data may improve understanding of feline behavioral problems. In the present study, we distributed an online survey including general information and questions about 17 feline behaviors which can be problematic for owners, to investigate: (1) the prevalence of feline behavioral problems, (2) the most common behavioral problems, and (3) relevant factors for each behavior. We collected 1,376 valid responses. Among all cats, 75.7% exhibited at least one behavioral problem. "Pica" and "Showing fear while on the examination table" were the most frequently reported behavioral problems. To identify factors related to the expression of each behavior, we conducted multiple logistic regression analyses, with the presence of behaviors as objective variables and cats' general information as explanatory variables. Age, sex, breed, number of cats in the household, and type of residence were each associated with more than one behavior. The present study revealed the prevalence of 17 feline behavioral problems in Japanese homes and relevant factors of each behavior. These findings will help veterinarians understand and address feline behavioral problems.

KEY WORDS: behavioral problem, feline, online questionnaire survey, prevalence, relevant factor

The term "Behavioral problem" refers to behavior exhibited by an animal that is unacceptable to the owner, regardless of its level of abnormality [2, 8, 11]. Therefore, the same behavior can be regarded as either a behavioral problem or non-problematic normal behavior depending on the owner's perspective. Because owners typically consult veterinarians regarding behavioral problems [14], veterinarians, especially general practitioners, need to have sufficient knowledge about behavioral problems in their area.

Cats are popular companion animals, and are commonly treated by veterinarians. The number of cats is greater than the number of dogs in Japan [20]. In addition, it is increasingly common for people in Japan to keep cats inside the house [20], which may increase the frequency of behavioral problems. The prevalence of feline behavioral problems in Japan was analyzed in a previous study focusing on seven behaviors in 100 cats that visited a veterinary clinic for reasons other than behavioral problems [31]. However, that study did not include several behaviors that are frequently reported as behavioral problems (e.g., fear-related behaviors, excessive grooming) [2, 3, 17, 30, 33]. In addition, the number of samples in that study was too small to accurately clarify the prevalence. Given that there are approximately 9 million cats in Japan [20], a survey would require at least 384 samples to estimate the prevalence accurately (95% confidence level with margin of error equal to 0.05) [5]. Therefore, a more comprehensive survey is crucial for improving current understanding of common feline behavioral problems in Japan.

To control behavioral problems, veterinarians are also expected to advise their clients regarding prevention of the onset of problems in their cats. It has been reported that cats show different behavioral characteristics depending on their physical features,

including their breed and sex [27, 29]. Although several studies have revealed the relevant factors in one or several behaviors [1–4, 9, 17, 22,27–31, 33], to the best of our knowledge, they have largely focused on aggression and inappropriate elimination. Given that any behavior can become a behavioral problem, comprehensive analyses of a wide variety of behaviors would also be beneficial to help veterinarians understand relevant factors for the expression of each behavior.

In the present study, we conducted an online survey to obtain information about 17 kinds of feline behaviors. We asked owners about the frequency and degree of annoyance regarding each behavior. When the expressed behavior troubled the respondents, we regarded the behavior as a behavioral problem, regardless of its frequency, abnormality or degree of annoyance. We then analyzed (1) the prevalence of feline behavioral problems, (2) the most common behavioral problems, and (3) the relevant factors for the expression of each behavior, to improve understanding of these 17 behaviors.

MATERIALS AND METHODS

Online questionnaire

We developed an original online questionnaire regarding feline behaviors. In the questionnaire, we obtained general information about owners and their cats, and the frequency and degree of annoyance for 17 types of feline behaviors. General information included the owner's age, sex, residential area, type of residence, the number of cats in the household, cat's breed, age, sex and neutering status, age at neutering, living area, source of acquisition, and age at acquisition (Supplementary Table 1). We determined the 17 behaviors of interest as follows. Because we believed that the Fe-BARQ [13] contains too many questions for respondents to complete easily, we derived items from the Fe-BARQ that were found to be frequently reported behavioral problems in previous studies [1–4, 17, 22, 28, 30, 31, 33], and by cat owners at the Veterinary Behavior Clinic in the Veterinary Medical Center of The University of Tokyo, and summarized them. Furthermore, we added questions regarding behaviors that are not included in the Fe-BARQ but are commonly reported as behavioral problems by owners in previous studies [2, 3, 9, 17, 30, 33] and at the Veterinary Behavioral Clinic. The draft questionnaire was checked by five cat owners and improved based on their comments.

Each behavior was described in detail on the questionnaire, as shown in Supplementary Table 1. For example, "Inappropriate scratching" was described as follows: "Scratching somewhere other than on a claw board". Respondents were asked to report the frequency of each behavior within the last 3 months, using a 5-point scale (5 =always, 4 =often, 3 =sometimes, 2 =rarely, 1 =never). If respondents were unsure or could not rate the behavior using the scale, they were asked to choose "NA (unknown or not applicable)". Respondents were also asked to report the degree to which they were troubled by each behavior, using a 4-point scale (4 =very troubled, 3 =moderately troubled, 2 =not really troubled or 1 =never troubled). Because the questionnaire was written in Japanese, the authors translated it into English for this report. The English version of the questionnaire was not checked by back-translation.

Respondents and data collection

Voluntary respondents were recruited from among subscribers of an online magazine published by the online pet products store "Doctor's Advice PEPPY" (Shinnippon Calendar, Osaka, Japan) in February 2018, as in our previous study [35]. Responses were collected without any restrictions on cats' characteristics, such as breed or age. Respondents with multiple cats were requested to answer the survey questions for only one cat. All responses were provided to the authors after omitting participants' personal information, such as names and e-mail addresses. The following responses were excluded from the analyses: responses lacking any of the requested general information, responses with more than one "NA" response for behavioral questions whose response rate was more than 90%, responses reporting that the owner had only one cat but the cat exhibited "Aggression toward housemate cat(s)", and responses regarding any behavior for which a respondent reported being "moderately troubled (rating of 3)" or "very troubled (rating of 4)" but reported a behavior frequency of "never (rating of 1)". It should be noted that the analysis included responses indicating that respondents were "not really troubled (rating of 2)" in regard to a behavior with a frequency of "never (rating of 1)". This was because a substantial number of respondents seemed to regard "not really troubled (rating of 2)" and "never troubled (rating of 1)" as indistinguishable. Indeed, for at least one behavior, 188 of 1,376 respondents (13.7%) answered that they were "not really troubled (rating of 2)" even though their cat "never (rating of 1)" exhibited a behavior. In cases of duplicated responses, one response was excluded. This survey was conducted with the approval of the Ethics Review Committee of the Faculty of Agriculture at The University of Tokyo.

Data analyses

The analyses were conducted in accord with our previous study [35]. When respondents answered that their cat showed a particular behavior (ratings from 2 to 5) and that they were troubled by the behavior (ratings from 3 to 4), the behavior was regarded as a behavioral problem. We did not define behaviors about which participants reported being "not really troubled (rating of 2)" as behavioral problems because it was unclear whether "not really troubled (rating of 2)" and "never troubled (rating of 1)" were differentiated by respondents. To reveal the prevalence of behavioral problems, we calculated the percentage of cats exhibiting at least one behavioral problem. We also calculated the number of cats exhibiting each behavior to reveal the most common behavioral problems.

Given that any behavior can become a behavioral problem once it appears, we investigated factors related to the expression of each behavior. Because the Shapiro-Wilk test revealed that the frequency of behavior did not follow a normal distribution, we converted the frequency of behaviors into the presence (ratings of 2 and more) or absence (rating of 1) of behaviors, and used

them as objective variables in multiple logistic regression analyses. Responses of NA were excluded from the multiple logistic regression analyses. General information used as explanatory variables included the following: age (categories: young [<2 years old], adult [2–6 years old], senior [7–10 years old], or geriatric [≥11 years old]), sex (categories: female or male), breed (categories: Scottish Fold, American Shorthair, or other breeds), the number of cats in the household (categories: one, two, three or more than three), and type of residence (categories: house or apartment). Age was categorized as above, to reveal differences in the odds of each behavior among age groups. Each sex includes both intact and neutered cats. We chose Scottish Fold (*n*=79) and American Shorthair (*n*=62) as independent categories of breed because the numbers of responses were larger than for other pure breeds. Other cats were combined into the "other breeds" category. Details of "other breeds" are shown in Supplementary Table 2. Adult cats and other breeds were treated as a reference for age and breed. For the other factors, the first category listed above for each factor was treated as the reference. For analysis of "Aggression toward household cat(s)", cats living in households with only one other cat were treated as a reference. We did not include respondent's age and sex in the analyses because we focused on factors associated with the cat, which are most useful to veterinarians. Residential area was excluded from analyses because this information was subjective. We also did not include information regarding the cat's neutering status, living area, source of acquisition and age at acquisition; most cats were neutered and lived inside the home; the source of acquisition was influenced by breed (i.e., pure breed or mix breed); and age at acquisition was related to the source of acquisition.

Based on Bonferroni correction (0.05/17 behaviors), the significance level was set at *P*<0.0029. Odds ratios calculated in the multiple logistic regression analyses were presented with 99.71% confidence intervals. All analyses were performed using R version 3.6.0 [25].

RESULTS

Basic information

Of 1,673 responses, 1,376 were valid. Given that approximately 9 million cats live in Japan [20], the number of samples in the present study (*n*=1,376) was sufficient to estimate the situation in Japan [5]. Responses were collected for 26 purebred cats and mix breed cats (Supplementary Table 2). Mix breed (*n*=991, 72.0%) was the most common breed category, followed by Scottish Fold (*n*=79, 5.7%) and American Shorthair (*n*=62, 4.5%). Regarding age, cats were classified as young (*n*=173, 12.6%), adult (*n*=551, 40.0%), senior (*n*=340, 24.7%), and geriatric (*n*=312, 22.7%). There were 667 (48.5%) female cats (intact *n*=31, neutered *n*=636) and 709 (51.5%) male cats (intact *n*=39, neutered *n*=670). Among all cats, 1,314 (95.5%) were indoor cats. Respondents obtained their cats from rescue (*n*=804, 58.4%), pet stores (*n*=259, 18.8%), breeders (*n*=89, 6.5%), and other sources (*n*=224, 16.3%). Regarding the type of residence, 854 (62.1%) and 522 (37.9%) cats lived in houses and apartments, respectively. A total of 616 (44.8%) cats were the only cat in the household, while 375 (27.3%), 162 (11.8%), and 223 (16.2%) cats lived with one, two, or more than two housemate cats, respectively. Regarding cat owners, 43 (3.1%) were ≤29 years old, 1,211 (88.0%) were aged 30–59 years, and 122 (8.9%) were aged ≥60 years. The number of female and male respondents was 1,289 (93.7%) and 87 (6.3%), respectively. A total of 441 (32.0%), 583, (42.4%), and 352 (25.6%) respondents lived in urban, suburban, and rural areas, respectively.

Prevalence of each behavioral problem

Response rates to questions about the frequency of behavior ranged from 51.1% to 99.9% (Fig. 1 and Supplementary Table 3). All cats exhibited at least one behavior. As a whole, 1,041 (75.7%) respondents stated that they were moderately or very troubled (ratings of 3 or 4) by at least one behavior exhibited by their cat.

Figure 1 shows the number of cats whose behavior troubled their owners and the number exhibiting each behavior. All 17 behaviors could be regarded as behavioral problems. The most common behaviors that troubled respondents were "Pica" (*n*=416, 30.2% of 1,376 cats) and "Showing fear while on the examination table" (*n*=410, 29.8%).

Relevant factors of each behavior

The number of cats included in the multiple logistic regression analyses ranged from 703 to 1,374. In all of the analyses, the smaller group of objective variables included more than 35 cats, which was sufficient to satisfy the requirement based on the "effect of the number of events per variable (EPV)" [32]. McFadden's pseudo R-squared values in the analyses were between 0.02 and 0.08 (Supplementary Table 3). Each factor was related to more than one behavior (Table 1 and Supplementary Table 3). Regarding age, young cats showed significantly higher odds of "Separation anxiety", "Pica", and "Wool sucking and fabric eating", and senior cats exhibited significantly higher odds of "Excessive self-grooming" and "Aggression toward housemate cat(s)" than adult cats. Conversely, geriatric cats showed significantly lower odds of "Inappropriate scratching", "Nocturnal overactivity", "Chasing or jumping on small animals", "Pica", "Wool sucking and fabric eating", "Fear of unfamiliar approaching people", and "Fear of loud noises, such as thunder and/or fireworks" than adult cats. As for sex, the odds of "Aggression toward family members", "Aggression toward unfamiliar people" and "Aggression toward housemate cat(s)" were significantly lower in male cats than female cats. Scottish Fold and American Shorthair exhibited significantly lower odds of "Fear of unfamiliar approaching people", and the latter also exhibited significantly lower odds of "Fear of unfamiliar approaching cats" than other breeds. Compared with cats with no housemate cats, cats with one other housemate cat showed significantly lower odds of "Separation anxiety" and "Aggression toward family members", cats with more than two other housemate cats showed significantly lower odds of "Aggression toward family members", and cats with more than two other housemate cats showed significantly lower odds of
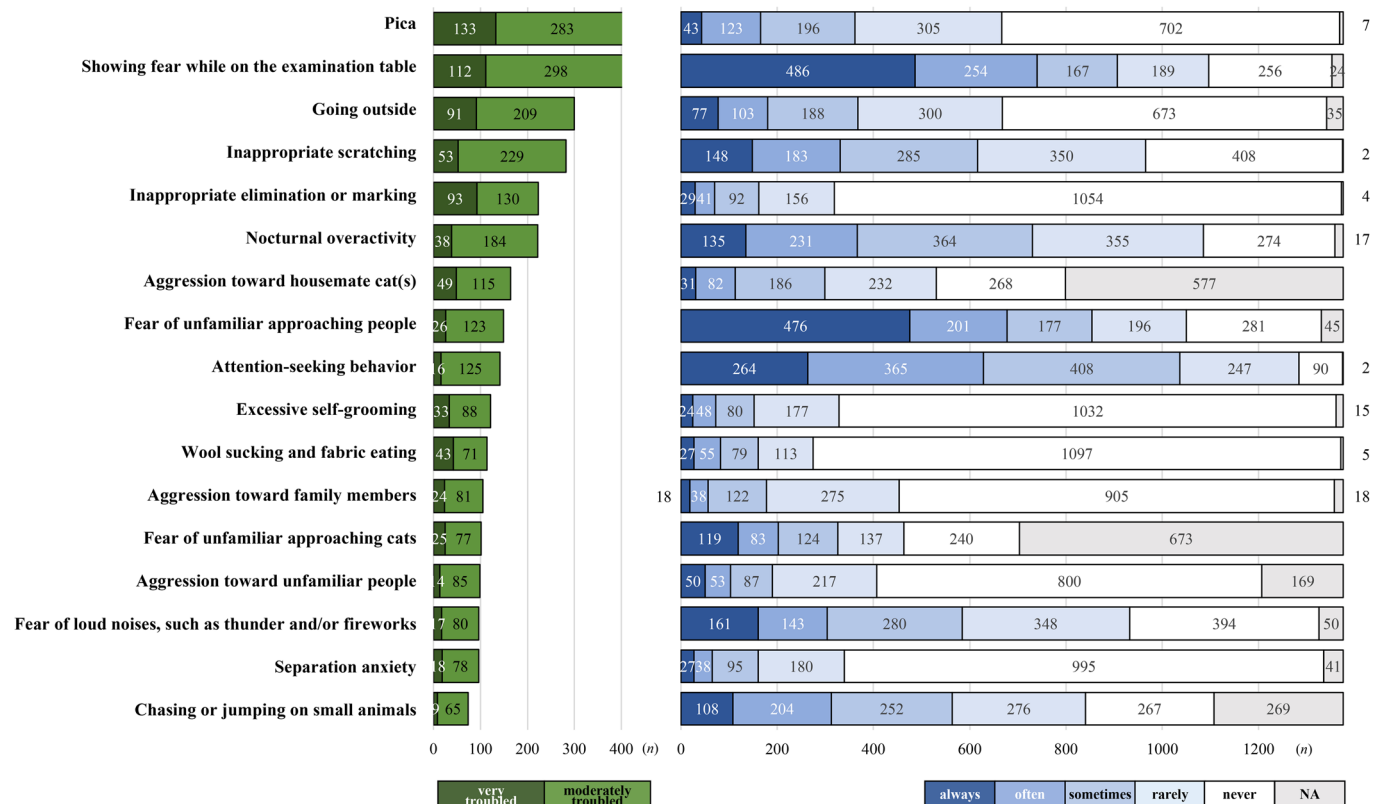
Fig. 1. The number of cats troubling their owners and exhibiting each behavior. The left panel shows the number of cats whose owner reported that their cat exhibited the behavior (from "always" to "rarely") and "very" to "moderately" troubled them. The right panel shows the number of cats exhibiting each behavior. The total number of cats is 1,376.

Table 1. Odds ratios of each behavior which were related to each factors

Behaviors	Age (Adult)			Sex (Female)	Breed (Other breeds)		Number of cats in the household (One)			Type of residence (House)
	Young	Senior	Geriatric	Male	Scottish Fold	American Shorthair	Two	Three	More than three	Apartment
Inappropriate scratching			0.59							
Nocturnal overactivity			0.38							**1.68**
Chasing or jumping on small animals			0.30							
Going outside									0.61	0.60
Attention-seeking behavior									0.32	
Separation anxiety	**1.96**						0.61		0.49	
Excessive self-grooming		**1.68**								
Pica	**1.84**		0.40							
Wool sucking and fabric eating	**2.27**		0.49							
Fear of unfamiliar approaching people			0.52		0.36	0.23				**1.62**
Fear of unfamiliar approaching cats						0.29				
Fear of loud noises, such as thunder and/ or fireworks			0.57							**1.54**
Showing fear while on the examination table									0.53	
Aggression toward family members				0.56			0.53	0.49	0.58	
Aggression toward unfamiliar people				0.62						
Aggression toward housemate cat(s)	**1.98**			0.38			NA			

Only behavioral problems and factors for which a significant difference emerged are shown. NA: Not applicable (The category "Two" was regarded as reference). Significance level: $P<0.0029$. The reference category of each factor is shown in parentheses. Odds ratios >1 are bolded. Odds ratios <1 are italicized.

"Going outside", "Attention seeking behavior", "Separation anxiety", "Showing fear on the examination table", and "Aggression toward family members". Cats living in an apartment exhibited significantly higher odds of "Nocturnal overactivity", "Fear of unfamiliar approaching people", and "Fear of loud noises, such as thunder and/or fireworks", while exhibiting significantly lower odds of "Going outside".

DISCUSSION

We investigated the prevalence of 17 feline behavioral problems in ordinary Japanese homes. Our online survey revealed that 1,041 of 1,376 cat owners (75.7%) were troubled by at least one behavioral problem. The most common behavioral problems were "Pica" and "Showing fear on the examination table". To understand the relevant factors of each behavior, we analyzed the relationships between general information and expression of 17 behaviors. We found that age, sex, breed, number of cats in the household, and type of residence were each related to more than one behavior. These findings clarified the prevalence of 17 feline behavioral problems in Japan and the relevant factors of each behavior.

In the present study, we found that 75.7% of cats exhibited at least one behavioral problem. This result suggests that feline behavioral problems are common in Japan. We previously conducted a similar online survey targeting dog owners and found that 86.0% of dogs troubled their owners by their behaviors [35]. The prevalence of behavioral problems among cats revealed in the current study was slightly lower than that reported in our previous study of dogs. This difference may have been caused by a difference in the number of investigated behaviors between the two studies. Specifically, we investigated 17 feline behaviors in the present study, whereas 25 canine behaviors were surveyed in our previous study [35]. Including a greater number of behaviors would be expected to increase the percentage of respondents who report being troubled by at least one behavior. Nonetheless, the prevalence of feline behavioral problems in the present study (75.7%) was lower than that reported in a previous study focusing on seven feline behaviors (83.0%) [31]. However, that study reported the prevalence of the behaviors themselves, rather than the prevalence of behavioral problems. In the present study, a behavior was regarded as a behavioral problem when respondents answered that their cat showed the behavior and they were troubled by the behavior. In addition, differences in the characteristics of the sampled cats, (e.g., breed and neutering status) may have also contributed to the difference. Despite these differences, the current findings suggest that behavioral problems are a common concern among cat owners. Therefore, there would be substantial demand for the prevention and treatment of behavioral problems among cats kept in ordinary Japanese homes.

The current study involved several limitations related to the online survey method, which should be considered. Respondents were recruited from subscribers of an online magazine published by a pet products store, and the sample was biased toward females (93.7%) and owners who kept neutered cats (95.0%) indoors (95.5%). Given that 54.0% of cat owners in Japan are female and 77.2% and 78.3% of cats are neutered and kept indoors, respectively [20], the bias in the sample may have affected the results. For example, since females are reported to exhibit higher levels of neuroticism than males [12], female owners might be more troubled by their cats' behaviors than male owners. Therefore, the prevalence of behavioral problems (75.7%) may have been higher in the present study sample compared with the general population. The prevalence of "Inappropriate elimination or marking" in the present study may have been underestimated because neutering decreases marking behavior [15]. Furthermore, since owners who keep their cats inside the house are typically hesitant to let their cats go outside, it is possible that the prevalence of "Going outside" was overestimated in the present study. Future analyses based on a more representative sample would be helpful for clarifying the situation in Japan more accurately.

Among 17 behaviors, "Pica" was found to be the most common behavioral problem in this study. In addition, the odds of "Pica" were higher among young cats compared with adult cats. These results suggest that owners of young cats need to be particularly careful to prevent this behavior. Many participants were worried about this behavior, possibly because ingesting non-food items such as toys or strings can negatively impact on a cat's health. For example, esophageal or gastric perforation, and intestinal obstruction can occur as a result of pica. In some cases, surgical treatment is required to remove foreign bodies [7, 16]. Consistent with the present findings, a retrospective study revealed that the mean age of 21 cats that visited first-opinion practice because of gastrointestinal foreign bodies was 1.8 years old [16]. Therefore, the prevention of pica appears to be important for protecting a cat's health. Cats exhibit pica for many reasons, including normal exploratory behavior, deprived environment, medical problems that cause polyphagia, compulsive disorder, anxiety, and iatrogenic induction of polyphagia [18]. However, pica can be prevented by removing substances that are likely to be bitten off or swallowed from a cat's living area. Therefore, veterinarians are encouraged to advise owners, particularly owners of young cats, to prepare a safe environment for their cat.

The present study revealed that "Showing fear on the examination table" was the second most common behavioral problem among cats. This finding indicates that veterinarians should take this problem seriously. This result suggests that preparing a comfortable clinic environment for cats is strongly required by owners. Cats are known to be vulnerable to stress in the veterinary clinic, as demonstrated by an increase in hiding behaviors and high blood glucose levels in the clinic [23]. However, owners can do little to ameliorate distress in their cats once an examination starts. Therefore, veterinary clinic staff are encouraged to prepare a comfortable environment for cats. Some attempts have been reported regarding the reduction of cat stress in clinical settings. The Feline Friendly Handling Guidelines [26] and Nursing Care Guidelines [10] were produced by the International Society of Feline Medicine (ISFM) and the American Association of Feline Practitioners (AAFP). In addition, the Cat Friendly Clinic (CFC) standard was launched by ISFM, which is an international standard regarding the abilities of staff and clinical equipment for providing a low stress clinical environment for cats [19]. However, only 165 clinics have been awarded Cat Friendly Clinic status in 2019 in Japan [21]. Therefore, there is a growing need for veterinarians to have both knowledge and skills for reducing cat stress

in the clinical environment.

In the present study, we examined the relevant factors of 17 behaviors. Although low values of McFadden's pseudo R-squared implied that other factors not included in the present study would be also related to the presence of the behaviors, our findings are valuable for veterinarians advising their clients regarding behavioral problems based on the status of each cat. The influence of age and sex on behavioral problems is of particular interest. The results revealed that the odds of more than half of the studied behaviors changed markedly with age. Although a longitudinal study is needed, this result suggests that owners need to shift their attention to different behaviors according to their cat's age. This finding may be particularly important for owners keeping multiple cats, as they often live with cats of different ages. Given that many cat owners have multiple cats in their homes [17, 28, 31], veterinarians are encouraged to widely inform owners regarding the need to give special consideration for each cat according to its age, rather than caring for all cats in the same way.

The odds of all types of aggression investigated in the present study (i.e., aggression toward family members, unfamiliar people, and housemate cats) were significantly lower among male cats than female cats. This result suggests that female cats were more aggressive than male cats in ordinary Japanese homes. The level of aggression among cats in the present study seems unlikely to have been severe, because many respondents were not troubled by the behavior. Thus, we believe that female cats, who tend to be more aggressive than male cats, were likely to exhibit minor aggression in everyday situations. The present finding was consistent with the results of previous epidemiological studies. For example, a previous study in the Valencian region in Spain reported that 76% of 936 cases of feline aggression toward people were caused by female cats [24]. In addition, female cats accounted for 67% of 623 cat bites reported in Dallas [34]. Nonetheless, analyses of the relationships between sex and aggression have produced variable results between studies [2, 3, 6, 22, 30, 31, 33]. This discrepancy might be caused by differences in the type or severity of aggression, or the neutering status of cats included in the studies. To understand the influence of sex on aggression in depth, further investigation is needed.

In conclusion, the current study revealed the prevalence of 17 feline behavioral problems and the relevant factors related to each behavior in Japan. The results of the present study, together with our previous study in canines [35], will be useful for veterinarians to advise their clients regarding behavioral problems in their cats and dogs. Given that common behavioral problems would be changed according to popular breeds and living environment, continuous surveys at appropriate time points are needed to increase understanding of the situation of behavioral problems in Japan.

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