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Attitudes and Behaviours Towards Cats and Barriers to Stray Cat Management in Bulgaria

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ABSTRACT



This research uses an online questionnaire ($n = 1148$) to survey the Bulgarian public's attitudes and behaviors toward owned and stray cats and explore potential barriers to stray cat population management. Generally, the survey participants indicated positive attitudes toward stray cats, with 82.0% of the respondents reporting feeling sorry for stray cats. Semi-ownership behaviors were prevalent, with 82.5% feeding stray cats but only 18.1% neutering the cats they fed, posing a barrier to stray cat management. Overall, the respondents held mixed attitudes toward neutering. Of all cat owners sampled ($n = 859$) only 47.2% had neutered all their cats and 44.4% of owners allowed cats outdoor access or their cats lived exclusively outdoors. Multinomial logistic regression predicted that intact cats were more likely to be allowed to roam free and reproduce, which may present a significant barrier to stray cat population management. This is the first academic survey on attitudes toward cats in Bulgaria and the findings should contribute to stray cat management and ultimately improve feline welfare.

KEYWORDS

Public attitudes; Bulgaria; neutering; stray cat management; semi-ownership

Introduction

Bulgaria has been a member of the European Union since 2007, and it is subject to its directives and regulations on animal welfare. The country introduced the *Animal Protection Act* in 2008 which includes general provisions for animal welfare, keeping and care, pet animals, stray animals, implementation and enforcement. The Act prohibits the culling of cats and dogs as a population management method, and since 2011 animal cruelty has been considered a criminal offense. There is no definition of stray cats in the legislation, however, they may be defined as “socialized domestic cats who don’t – or don’t appear – to have an owner” (Cats Protection, 2017). The chapter on Stray Animals (Articles 40–56) outlines the National Programme for Containment of the Stray Dog Population, which focuses entirely on building and management of shelters, animal welfare and health in shelters, and adoption. The only mention of stray cats is in Article 56 which states that the same strategy shall apply in the case of stray cat overpopulation, however, there is no definition provided for the term “overpopulation” in the Act. The biology dictionary has defined “overpopulation” as a population that has exceeded the carrying capacity of its environment (net Editors, 2019). However, in 2018 the Bulgarian Food Safety Agency, the institution responsible for the implementation of the Act, announced that due to a lack of data it cannot officially declare a state of stray cat overpopulation. With regards to animal welfare standards, at the time of writing in May 2022, Bulgaria was not listed on the Animal Protection Index from World Animal Protection.

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Pet cat ownership and stray cats in Bulgaria

By the 1980s Bulgaria had transitioned into an industrial economy with a rapid increase in urbanization, and a higher density of stray animal population in urban areas. The earliest available statistics show a slow but steady increase in cat ownership between 780,000 in 2012 to 802,000 in 2020 (Bedford, 2021). With an estimated one in ten people owning a cat in Bulgaria, cat ownership is 6% higher than dogs (Cooper Pet Care, n.d.). However, there is no empirical research and only limited anecdotal information on cat ownership practices. A 2013 report commissioned by Animal Rescue Sofia suggested that up to 80% of owned dogs and cats lived exclusively outside, either chained or roaming free (Animal Rescue Sofia, 2013). Although the Animal Protection Act (2008) stipulates that owned animals should be neutered unless owners are able to keep or rehome the litter, Animal Rescue Sofia (2013) estimated that only 17% of owned cats and dogs were neutered. Cat microchipping and registration are not compulsory under the law and therefore there are no official data on these.

Stray cats are generally a human-created problem with consequences affecting both human and animal health and welfare (McDonald, Farnworth, & Clements, 2018). For society, the main issues reported relate to nuisances such as fighting or scavenging, the transmission of viruses, and contamination of the environment through feces and urine (International Companion Animal Management Coalition, 2011). For stray cats, welfare concerns include malnutrition, mistreatment, poor health, lack of shelter and appropriate thermal conditions, resulting in reduced lifespan and high mortality rate (International Companion Animal Management Coalition, 2011). The number of stray cats in Bulgaria is currently unknown as a population survey has never been conducted. Only Plovdiv municipality has publicly reported stray cat estimates ranging between 7623 for 2009 to 5294 for 2020 (Plovdiv Municipality, n.d.). However, it has been suggested that the number of stray cats has been increasing in recent years due to the decline of the stray dog population (Gechev & Ivanova, 2016). In 2021, the international non-governmental organization (NGO) Four Paws reported that 70% of the communications they receive from the public relate to cats which could be considered one of the few reliable sources of information regarding the situation of stray cats in the country (News, 2021). According to the Bulgarian Risk Assessment Centre on Food Chain (Vasileva, 2018), the root causes for the rapid cat population growth in Bulgaria are pet cat abandonment, owners letting unneutered cats roam free, feeding of stray cats, and inappropriate municipal solid waste management.

In the absence of neutering, feeding stray cats is another major contributing factor to population increase due to the improved reproductive capacity of stray cats (International Companion Animal Management Coalition, 2011). This practice is common in Bulgaria although several municipalities have outlawed the feeding of cats and dogs in public spaces, creating discord within the local communities and leading to several people being issued fines (Radenkova, 2019).

Attitudes toward stray cats in Bulgaria

Attitudes toward stray cats in Bulgaria have not been subject to academic research to date. Despite this, media coverage suggests that in recent years Bulgarian citizens have become more sensitized toward the welfare and suffering of strays. Police statistics indicate that cruelty toward stray cats and dogs is on the rise with 349 cases reported for 2018 compared to 178 in 2014 (Smolyan BGvestiNet, 2019). As a result, in 2019 a Bulgarian NGO launched a petition against the cruelty to stray animals, which was signed by 2,500 people and followed by a protest in front of the Council of Ministers building (Slavcheva, 2020).

Stray cat management

Stray cat population management involves developing strategies and models to evaluate the population dynamics in order to reduce stray cat numbers (International Companion Animal

Management Coalition, 2011). It is a multi-faceted public issue with ethical, economic, environmental, and social dimensions. Cats are prolific breeders, and their catching and surveying is difficult in built-up areas (McDonald & Skillings, 2021), making stray cat population management particularly complex. Another issue is the lack of research and data on population dynamics, spatial distribution, and the fact that estimates are not based on empirical evidence (McDonald & Skillings, 2021). In a 2007 review of stray animal control practices across 30 European countries, 34 of the participating NGOs reported a lack of systematic population control measures for stray cats compared to dogs, and an inability to identify effective management practices (Tasker, 2007). In 2011 the International Companion Animal Management Coalition (ICAM) published the first comprehensive humane cat population management guide developed by several of the most active charities in this area, recognizing trap-neuter-return as the most humane population strategy.

Many root causes have been identified for the existence of stray cats and most of these relate to human behavior. According to the British Small Animal Veterinary Association (BSAVA), the term “responsible pet ownership” incorporates many different elements such as providing for the welfare needs of the animal and protecting it from harm and pain, but also registration and microchipping, controlling the pet’s reproductive ability, and preventing abandonment (British Small Animal Veterinary Association, 2022). Lack of responsible cat ownership is at the core of the stray cat problem (Finkler & Terkel, 2012; International Companion Animal Management Coalition, 2011), with other common contributors including inappropriate containment and semi-ownership behaviors. Semi-ownership behavior is defined as people feeding stray cats that they do not own, often in the absence of neutering, thus contributing to the increase in the stray cat population (Zito et al., 2015).

Several humane management strategies have been developed over the years to curb the population of stray cats. There is a growing body of academic research which suggests that the practice of Trap-Neuter-Return (TNR) leads to a long-term, sustainable reduction in the number of stray cats (Kreisler, Cornell, & Levy, 2019; Swarbrick & Rand, 2018). The participation of local communities is of vital importance with every management strategy due to the influence they exert on population dynamics through their actions, inactions and attitudes, keeping the population in flux through interventions such as neutering, abandonment and adoption (Flockhart and Coe, 2018). Therefore, it is of paramount importance that any management strategy is shaped to fit the geopolitical, cultural and socio-economic context of the country and aligned with the expectations and concerns of the community (De Ruyver et al., 2021).

In this context the main objectives of this study are: Firstly, to explore current cat ownership practices in Bulgaria. Secondly, to examine the attitudes and behaviors of Bulgarian residents toward stray cats. Thirdly, to assess which demographic variables influence attitudes and behaviors toward stray cats. Finally, to explore any barriers to stray cat management in Bulgaria.

Methods

Data collection, questionnaire and sampling

This research was carried out as an online questionnaire developed in the Jisc survey platform. A questionnaire comprising 31 closed questions was used and consisted of three sections: the first gathered demographic and socio-economic data, the second was concerned with attitudes and behaviors toward stray cats and the third explored cat owner’s attitudes and behaviors. Definitions of owned and stray cats, and neutering were provided in the relevant sections of the questionnaire. Section two used Likert-scale items which were designed with a five-point scale recommended for exploring general public attitudes with the inclusion of a mid-point to reduce miss-response to reversed items bias (Weijters, Cabooter, & Schillewaert, 2010).

The questionnaire was drafted first in English and then translated to Bulgarian by the first author who is a native Bulgarian speaker and back-translated by a translator. The questionnaire was piloted on ten colleagues in animal welfare before launching. Feedback was incorporated before publishing it online. The questionnaire was available between the 10th of July 2021 and the 8th of August 2021. The survey was distributed in over 300 existing Facebook groups, organized by area of residence and created by local residents. Facebook was used as it is the preferred social media platform in Bulgaria (Statista, 2022). Two inclusion criteria were stipulated; firstly, respondents needed to be residents of Bulgaria, and secondly, respondents had to be aged 18 years or over. Ethical approval for conducting the research was received from the University of Winchester in the UK.

Statistical analysis

Data were imported into Microsoft Excel for cleaning and then exported into IBM SPSS Statistics 26 for analysis. The survey collected 1158 responses over four weeks, however, after data cleaning, there were a total of $n = 1148$ responses included in the results with 10 respondents removed due to missing data. Despite the large sample size, the results of this study may not be generalizable and thus are interpreted with caution and within the sample population. Attitudes were explored with 5-point Likert-scale questions in which the values were recoded into “Agree,” “Not sure” and “Disagree” for analysis. High internal consistency between all items was indicated when Cronbach’s alpha tests were performed for the questions on sentience (0.854), attitudes (0.743), neutering (0.830) and stray cats’ needs (0.785). The Likert-scale question on attitudes toward semi-ownership scored an α -coefficient of 0.696, which according to Bryman (2012) cannot be considered acceptable, and therefore was not included in the results.

Although the term “gender” was used in the questionnaire the more appropriate term “sex” was chosen for the analysis due to the limited number of categories available under it. Furthermore, in the Bulgarian language, there is only one word used to describe both gender and sex covering all biological, social and identity nuances of the word (Dineva-Karabadzhakova, 2018). Sex was recoded into a dichotomous variable by excluding the category “Prefer not to say” due to the low number of respondents (1.0%). Similarly, cat ownership status was also re-coded by combining “No, but I regularly feed cats that I do not own” with “No, I have never had a cat” because these two categories showed no significant difference when examined and were combined for simplicity. Data on cat ownership was disaggregated by the sex of the respondent for analysis so that sex-related differences can be established. Furthermore, owners of more than one cat were asked to answer the questions in relation to only one of them.

Results were cross-tabulated between key demographic variables, levels of agreement with the Likert-scale items on general attitudes toward stray cats, neutering and stray cat feeding, and were analyzed using chi-square test for association. Dunn-Bonferroni post-hoc tests were used to further examine significant differences between groups. Individual p-values were compared with the adjusted Dunn-Bonferroni p-values for each category with $p < 0.003$ for age and $p < 0.008$ for sex, parental and cat ownership status. The highest level of education completed had no significant associations with any of the statements and is not reported in the findings.

Multinomial logistic regressions were performed to discover associations between the likelihood of owned cats being neutered, allowed to roam, and reproducing as potential contributors to the stray cat population. Several variables were made dichotomous for more precise analysis: Containment (Indoor-only/Having outdoor access), Given birth (Yes/No), Neutering (Yes/No), Vaccination (Yes/No), Microchipping (Yes/No). The number of owned cats was also recoded (One/Two/Three or more) to reduce the number of categories for the regression. The logistic regressions were run with all demographic variables however, no associations were found.

Limitations of the study

The primary limitation of this research is its non-probability sampling technique, affecting the generalizability of the results. Consistent with self-selected surveys, female respondents were overrepresented in this study, with 79.4% of respondents being female, 19.7% male, and 1% preferring not to say. Female overrepresentation risks introducing bias, however, research in animal welfare often reports women as the majority of survey respondents potentially due to greater concern with animal welfare (De Ruyver et al., 2021; Finkler & Terkel, 2012; Rand, Fisher, Lamb, & Hayward, 2019).

Results

Demographic data

The survey was completed by 1148 respondents, 79.4% (911) of whom were female. All age groups were represented with those over 40 making up 50.8% of all respondents. Responses were received from all 28 areas of the country, with 46.7% derived from the four major cities Sofia, Plovdiv, Varna and Burgas. The demographic data of the respondents are summarized in Table 1.

Table 1. Summary of demographic information of respondents.

Variable	%(n)
Age	
18–22	8.2 (94)
23–29	16.8 (193)
30–39	24.2 (278)
40–49	25.7 (295)
50–59	17.5 (201)
60+	7.6 (87)
Gender	
Male	19.7 (226)
Female	79.4 (911)
Prefer not to say	1.0 (11)
Education*	
High school	9.8 (113)
Technical/Vocational School	14.8 (170)
Bachelor's degree	31.5 (362)
Master's degree	39.9 (458)
PhD	3.9 (45)
Parent	
Yes	58.8 (675)
No	41.2 (473)
<i>N</i> = 1148	

*Indicates the highest level of education attained as indicated by participants.

Cat ownership in Bulgaria

Of all participants in the study, 75.5% were either current or past cat owners, and 24.5% had never owned a cat. Almost half (49.1%) of the cat owners in the study reported owning one cat and 30.8% of the owned cats were neutered over the age of one year. Regarding birth rate, 71.6% of cat owners responded that their cat had not given birth or was male. Of the cats that had given birth, 47.1% had one litter, 28.3% had two and 24.6% had three or more litters. Only

20.4% of the owners admitted to losing or abandoning a cat, with 51.4% of them reporting that their cat had escaped. Moreover, 81.1% of the respondents who had lost or abandoned a cat, reported that their cat had not been neutered at the time. Most cat owners preferred to follow advice from a veterinarian (73.5%), followed by friends or family (42.3%), charities (30.7%), the Internet (26.2%), and television (14.9%).

When disaggregated by sex the data generally followed the observed total values, however, the data set contained a disproportionate number of female respondents. Of all female participants, 77.4% were cat owners compared to 68.1% of the male respondents. In terms of the number of owned cats, more women indicated owning three or more cats (30.5%) compared to 18.4% of the men. Although, 41.7% of all cat owners regardless of sex reported to have not neutered their cat, 29.2% of the female owners who had, neutered their cat under the age of one year as compared to 19.4% of the male owners. When birth rate was compared, 45.7% of the female respondents indicated that their cat had not given birth compared to 31.8% of the male sample. A full overview of the cat ownership practices is shown in [Table 2](#).

Table 2. Cat ownership trends in Bulgaria.

Variable	Response	Male %(n)	Female %(n)	Total %(n)
Cat Owners*	Yes	68.1 (154)	77.4 (705)	75.5 (859)
	No	31.9 (72)	22.6 (206)	24.5 (278)
Number of owned cats**	1	56.3 (58)	47.6 (242)	49.1 (300)
	2	25.2 (26)	21.9 (111)	22.4 (137)
	3+	18.4 (19)	30.5 (155)	28.5 (174)
Cat neutering age	<4 months	0.6 (1)	1.1 (8)	1.1 (9)
	Between 5–11 month	18.8 (29)	28.1 (198)	26.4 (227)
	>1 year	33.8 (52)	30.2 (213)	30.8 (265)
Cats that have given birth	Not neutered	46.8 (72)	40.6 (286)	41.7 (358)
	Yes	34.4 (53)	27.1 (191)	28.4 (244)
Number of litters per cat	No	31.8 (49)	45.7 (322)	43.2 (371)
	Male cat	33.8 (52)	27.2 (192)	28.4 (244)
	1	39.6 (21)	49.2 (94)	47.1 (115)
	2	34.0 (18)	26.7 (51)	28.3 (69)
Abandoned/lost cats	3+	26.4 (14)	24.1 (46)	24.6 (60)
	Yes	25.3 (39)	19.3 (136)	20.4 (175)
Neutering status of lost/abandoned cat	No	74.7 (115)	80.7 (569)	79.6 (684)
	Neutered	15.4 (6)	19.9 (27)	18.9 (33)
	Intact	84.6 (33)	80.1 (109)	81.1 (142)

*Indicates the number of participants who currently own a cat or have previously owned a cat.

**Includes responses only from those participants who currently own a cat.

Reproduction, microchipping, and containment

The section on cat owners' behaviors toward their cats asked about reproduction, vaccination, microchipping and containment. The question regarding vaccination did not explicitly state the type of vaccine, but rather, the practice of vaccinating a cat with a common vaccination course for cats in Bulgaria including feline herpes virus (FHV), feline calicivirus (FCV), and feline panleukopaemia virus (FPV). The survey found that 41.7% of cat owners had not neutered any of their cats, 29.3% had not vaccinated any of them and 85.7% had not microchipped any of them. When asked about reasons for not neutering their cats, 17.6% of the cat owners chose "Other," indicating they likely did not want to answer, or the options provided were unsuitable. Following disaggregation by sex of the respondents, no differences were found with regard to neutering and microchipping status, nor containment practices. However, 39.0% of the male cat owners

had not vaccinated their cat compared to 27.1% of the female cat owners. Over half (55.7%) of the owners kept their cats indoor only, and, 44.3% either allowed them outdoor access or let them live exclusively outside. Figure 1 provides details on the neutering, vaccination and microchip status of owned cats.

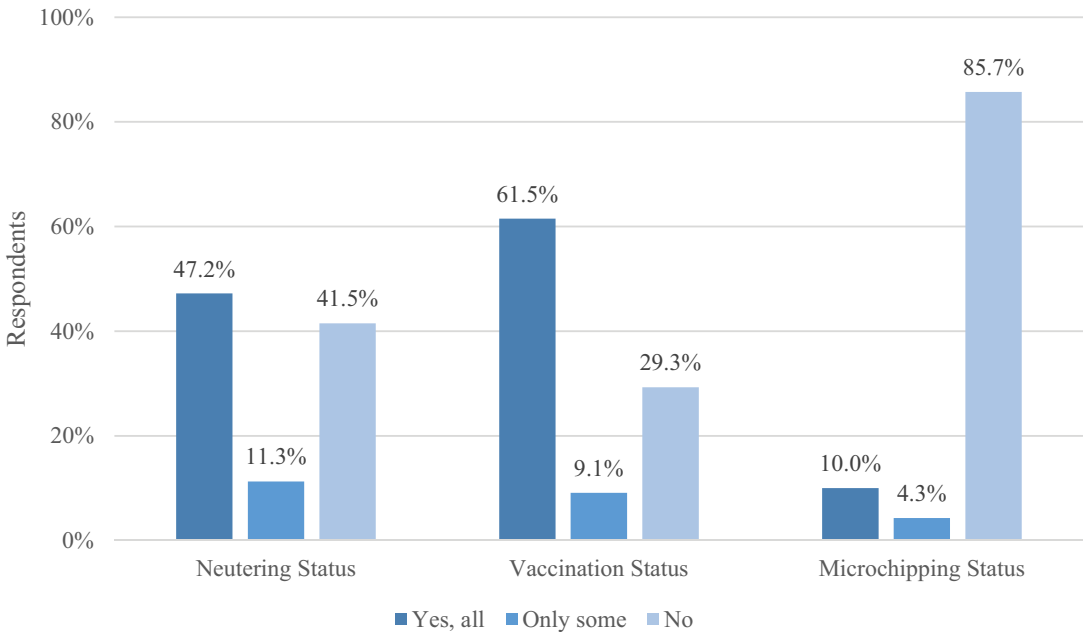


Figure 1. Bar chart displaying the level of neutering, vaccination and microchipping of owned cats in Bulgaria.

General attitudes and behaviors toward stray cats

Overall, respondents believed cats to be sentient, and agreed that cats can feel happiness (89.5%), suffering (94.5%) and pain (96.9%), can experience boredom (74.8%) and fear (95.6%). Participants revealed positive attitudes toward stray cats, with 82% responding that they felt sorry for them. Generally, stray cats were not considered a nuisance with the term “nuisance” encompassing urinating, defecating and noise. Figure 2 provides further details on attitudes toward stray cats in Bulgaria.

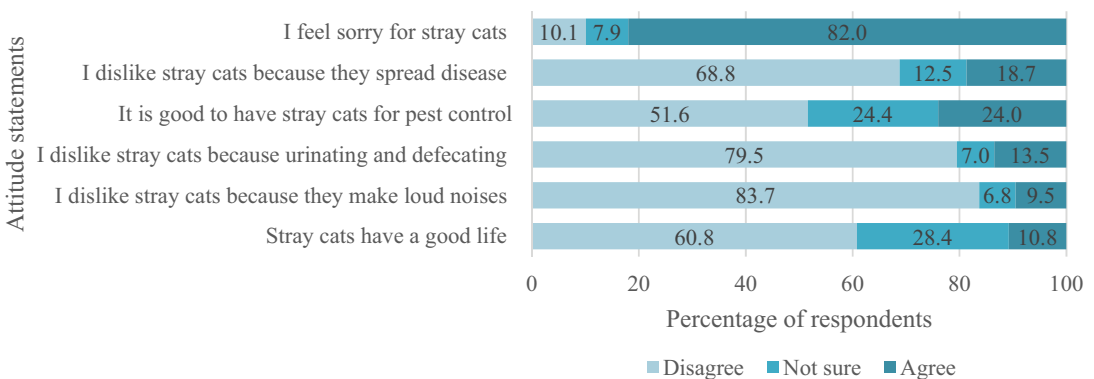


Figure 2. Bar chart displaying attitudes toward stray cats in Bulgaria.

Generally, respondents considered the provision of veterinary treatment (91.8%) and food/water (83.8%) of the highest importance for stray cats, followed by vaccination (78.0%), neutering (72.9%) and shelter (69.1%). Respondents showed mixed beliefs about neutering: 60.9% agreed or were unsure whether a female cat should give birth before being neutered, and 68.3% disagreed or were unsure whether cats younger than a year could be neutered. **Figure 3** provides further information regarding attitudes toward neutering.

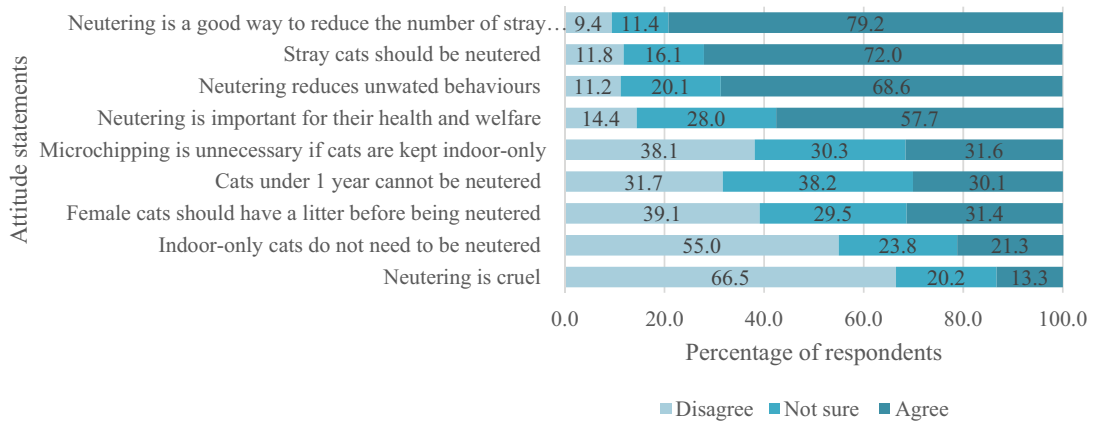


Figure 3. Bar chart displaying attitudes toward neutering in Bulgaria.

Overall, respondents were either very or quite concerned with stray cat overpopulation (60.8%). Half of the participants (51.0%) supported trap-neuter-return as the preferred management option, followed by trap-neuter and keep in a shelter (28.4%). Almost two-thirds believed that everyone in the community should be responsible for stray cats, and 19.4% thought that responsibility falls with the municipality.

In terms of semi-ownership behaviors, respondents fed stray cats regularly (30.3%), occasionally (35.5%), rarely (16.7%) or never (17.5%). Additionally, 81.9% of respondents had never neutered a stray cat. Reasons for not neutering varied among respondents and included cost (24.1%), intention to do so (14.9%) and belief it was immoral (9.8%).

Associations between demographic variables and general attitudes toward stray cats

Male respondents as well as participants aged 50–59, and those with children were more likely to agree that it was good to have stray cats for pest control compared to women, participants aged 30–49, and nonparents. Parents and non-owners were more likely to agree that cats were a nuisance because of urination, defecation, and loud noises than cat owners and nonparents. The post hoc Bonferroni adjustment indicated no significant differences between groups agreeing with these statements. Women, nonparents and cat owners were more likely to feel sorry for stray cats, while men, non-cat owners and parents were likely to think that stray cats had a good life.

Associations between demographic variables, semi-ownership and attitudes toward neutering

A correlation between demographic variables and feeding frequency showed that female participants and respondents who owned cats were more likely to feed stray cats regularly

than men and non-cat owners. Parents were more likely to never feed stray cats compared to people with no children. Bonferroni post-hoc test showed that respondents' age did not have significant associations with feeding frequency at adjusted $p > 0.002$. A significant association was found between sex and cat ownership and reasons for not neutering stray cats. Women and cat owners were more likely to report cost as the main reason, whereas men thought that neutering was immoral and non-owners were unaware of neutering. Chi-square analysis with Bonferroni post-hoc tests between key demographic variables and cat feeding frequency are provided in Table 3.

Table 3. Associations between demographic variables and stray cat feeding frequency in Bulgaria.

	Regularly		Occasionally		Rarely		Never	
	%	<i>p</i>	%	<i>P</i>	%	<i>p</i>	%	<i>p</i>
Gender (<i>p</i> = 0.001)								
Female	33.0	0.001	36.9	0.075	15.3	0.044	14.8	0.001
Male	20.4	0.001	30.5	0.075	20.8	0.044	28.3	0.001
Parent (<i>p</i> = 0.001)								
Yes	27.9	0.030	34.5	0.430	15.4	0.153	22.2	0.001
No	33.8	0.030	36.8	0.430	18.6	0.153	10.8	0.001
Cat Owners (<i>p</i> = 0.001)								
Yes	35.7	0.001	39.3	0.001	15.5	0.047	9.6	0.001
No	13.8	0.001	23.8	0.001	20.6	0.047	41.8	0.001

Note 1. Associations were examined using Chi-square tests, followed by a Bonferroni post-hoc analysis. Feeding frequency is represented in columns and demographic variables in rows, followed by the percentage of people feeding cats within each demographic group, with their individual adjusted *p*-values.

Note 2. Bold indicates significance at a Bonferroni adjusted level of $p < 0.002$.

Associations between attitudes toward neutering and demographic variables showed that men were more likely than women to agree that neutering was cruel and less likely to support stray cat neutering. Women and cat owners were likely to agree that neutering reduced anti-social behavior. Respondents aged 18–22 years were likely to believe that cats younger than one year could not be neutered but also that stray cats should be neutered. Men and non-cat owners were more likely to agree that indoor-only cats did not need to be neutered compared to women and cat owners. Participants aged 50+, parents and cat owners were likely to believe that indoor-only cats did not need to be microchipped.

Responsible cat ownership

The likelihood of an owned cat being neutered was positively associated with vaccination and microchipping status, containment and number of owned cats. Participants who vaccinated their cats and kept them indoor-only were significantly more likely to neuter them than those who had not been vaccinated and let their cats roam freely. Owners of three or more cats were four times more likely to allow them outdoor access than those who owned only one or two cats. The likelihood of a cat reproducing was associated with outdoor access and the number of owned cats, with households with three or more cats being five times more likely to have had a litter than those with one or two. The full results from the multinomial logistic regressions are presented in Table 4.

Table 4. Multinomial logistic regression results of factors affecting the likelihood of owned cats being neutered, allowed to roam, being abandoned or lost, and having given birth, in Bulgaria.

Variable		<i>p</i>	OR	95% CI
Likelihood of owned cats being neutered				
Vaccination status	Yes	0.001	2.47	1.575–3.873
	No (reference)			
Microchipping status	Yes	0.001	5.91	2.205–15.831
	No (reference)			
Number of owned cats	3+	0.044	1.77	1.014–3.101
	2	0.022	1.93	1.098–3.402
	1 (reference)			
Containment	Indoor-only	0.001	4.49	2.861–7.041
	Outdoor access (reference)			
Likelihood of owned cats being allowed to roam				
Neutering status	Yes	0.001	0.23	0.147–0.357
	No (reference)			
Vaccination status	Yes	0.009	0.54	0.339–0.855
	No (reference)			
Microchipping status	Yes	0.192	1.52	0.510–2.854
	No (reference)			
Number of owned cats	3+	0.001	4.18	2.482–7.036
	2	0.011	1.95	1.167–3.265
	1 (reference)			
Likelihood of owned cats to have given birth				
Number of owned cats	3+	0.001	5.24	3.242–8.466
	2	0.015	1.98	1.145–3.440
	1 (reference)			
Containment	Indoor-only	0.001	0.16	0.103–0.248
	Outdoor access (reference)			

Note 1. Bold indicates OR significantly different to 1.

Discussion

Cat ownership practices in Bulgaria

The survey results indicate that cat ownership was high in the sample with 75.5% cat owners. However, the levels of responsible cat ownership encompassing vaccination, reproductive status, and containment, as defined by the BSAVA, are relatively low when compared to existing research. Only 58.5% of all cat owners indicated that they had neutered all or some of their cats with no sex-related differences between male and female owners when the results were disaggregated. The total figure is lower than the reported data from other countries, such as 73% in Israel (Finkler & Terkel, 2012), 80% in Germany (Kuhne, Hooek, Kramer, & Hackbarth, 2019), and 91% in the UK (Murray, Roberts, Whitmarsh, & Gruffydd-Jones, 2009). The vaccination practice in this study was higher than neutering, with 70.6% of owners indicating that all or some of their cats were vaccinated, however, the results showed a slightly lower vaccination rate of owned cats among the male sample when compared to female cat owners. On the other hand, microchipping was lower than vaccination rates with only 14.3% of cats microchipped and significantly lower than the 89% reported in Australia (Rand, Fisher, Lamb, & Hayward, 2019). These findings indicate that there is a gap between responsible cat ownership practices as reported in this survey and existing studies, which can be addressed through further research into educational activities and awareness campaigns ran in other countries and adapting successful practices in Bulgaria.

More than half (55.7%) of the cat owners kept their cats indoor-only which is higher than results from other countries such as 46% in Israel (Finkler & Terkel, 2012) and 45% in the US (Lloyd & Hernandez, 2012). Of those cats with some outdoor access, 48.1% were unneutered, and of those who lived outside, 74.3% were not neutered. Conversely, in a study from Germany, only 12% of cats with outdoor access were intact (Kuhne, Hooek, Kramer, & Hackbarth, 2019), reaffirming the lower levels of responsible pet ownership and in particular neutering rates reported in this study. Moreover, cat owners

in the sample appear to be relying on outdated information while veterinarians and charities may not be playing a sufficient role to challenge misinformation. For example, 61% of the respondents in this study either agreed or were unsure whether female cats should have a litter before being neutered. Therefore, as a preferred source of advice, veterinarians may need to focus on promoting responsible pet ownership; and charities may need to increase their efforts in becoming a trusted source of information.

Public attitudes toward stray cats and neutering

Public attitudes toward stray cats in the study were generally positive, with respondents disagreeing that stray cats were a nuisance. Of all respondents, 60.8% agreed that stray cats did not have a good life, indicating a level of concern for their welfare which may suggest an openness for future campaigns and behavioral interventions. Perceptions of responsibility differed from other countries, with 66.1% of the respondents believing everyone in the community should be responsible for stray cats. Conversely, in Italy, more than half of the participants believed it was the council's responsibility (Slater et al., 2008), and in the UK, a third thought it was charities' (McDonald, Farnworth, & Clements, 2018). It can be conjectured that the difference in opinion may be due to a general distrust in both official institutions and non-governmental organizations and their ability to deal with the problem.

When examining demographic differences in public attitudes toward stray cats parents were more likely to have negative attitudes and believe that stray cats spread disease than nonparents. Age and sex also influenced public opinion, with older participants and men likely to agree that stray cats had a good life. Future campaigns aimed at improving the welfare of stray cats may need to be designed to address the concerns raised by parents and to be further targeted to the specific demographic groups examined above.

Overall, the survey indicated a general lack of awareness of the health and welfare benefits of neutering to stray cat populations. The study found that 42.3% of the respondents either disagreed or were unsure whether neutering was important for the health and welfare of the cat. Men were more likely to perceive neutering as a negative practice and disagree with its benefits, compared to the women in the sample. Although, by definition neutering can certainly be considered mutilation, on a population level it is the most humane method of cat and dog population management (International Companion Animal Management Coalition, 2011; World Organisation for Animal Health, 2009). According to International Companion Animal Management Coalition (2011), stray cat neutering increases welfare and reduces fighting, morbidity and mortality. Furthermore, it has been suggested that neutering minimizes health risks such as incidences of mammary neoplasia which is the third most common type of cancer in cats, as well as preventing the occurrence of pyometra and ovarian neoplasia (Overley, Shofer, Goldschmidt, Sherer, & Sorenmo, 2005).

Semi-ownership behavior

Of the 1148 participants, 82.5% indicated that they fed stray cats, with female respondents more likely to regularly feed them than male respondents. This rate is higher than reported in other countries: 22% in Australia (Toukhsati, Bennett, & Coleman, 2007), 26% in the US (Lord, 2008), and 55% in Israel (Finkler & Terkel, 2012), which may be due to geographical differences or a difference in the number of stray cats in these countries. Only 18.1% of all participants in this study had neutered a stray cat, similar to the reported 20% in Australia (Toukhsati, Bennett, & Coleman, 2007) with the main reason stated for feeding but not neutering being cost, followed by intention to neuter, and the belief that neutering is immoral.

The reported high rate of feeding stray cats as a main component of semi-ownership behavior suggests empathy but also a lack of awareness of the negative consequences of feeding but not neutering. Whereas feeding does temporarily increase the welfare of the individual cat, in the long term its welfare may decline due to improved reproductive ability especially for female cats, increased dependency on human caregivers and higher risk of conflict with humans. On

a population level, feeding in the absence of neutering promotes uncontrolled breeding (Toukhsati, Bennett, & Coleman, 2007) as semi-owned cats can have higher reproductive success than non-owned cats (International Companion Animal Management Coalition, 2011). As a result, the observed semi-ownership behavior could be a significant contributor to the stray cat population in Bulgaria.

Barriers to stray cat population management in Bulgaria

Human actions, inactions and behaviors can be seen as the root cause for the presence of stray cat populations with owned cats being one of the key sources of unowned cats. Consistent with existing research into stray cat population management, the barriers found in this study directly relate to behaviors and practices toward owned cats.

The multinomial logistic regression analysis showed that owners who vaccinated their cats were twice as likely to also neuter them, compared to those who did not vaccinate, similar to results from a UK study (Murray, Roberts, Whitmarsh, & Gruffydd-Jones, 2009). However, 29.3% of the cat owners in the study had not vaccinated any of their cats which corresponds with the lower neutering rate. Therefore, increasing cat vaccination rate through information campaigns could also increase the neutering rate of owned cats. Furthermore, no demographic variables were associated either with neutering or vaccinating, suggesting a need for extensive awareness campaigns to increase knowledge of the practices.

The multinomial logistic regression also showed that households with three or more cats were four times more likely to allow their pets to roam. Considering that cats can be prolific breeders (International Companion Animal Management Coalition, 2011) intact cats roaming free may be a key contributor to the stray cat population. The analysis found that birth rate was associated with outdoor access with 47.9% of the owned cats in the survey that had given birth also allowed to roam outside. Given that 41.5% of owners had not neutered their cats, and 44.4% allowed their pets to roam or live exclusively outside, neutering and containment could arguably pose the most substantial barriers to stray cat population management in Bulgaria, and responsible pet ownership should be addressed urgently.

The study found that neutering age can also be a potential barrier to stray cat population management. Of all survey respondents, 68.3% agreed that cats younger than a year cannot be neutered or were unsure, and 31.1% of the cat owners indicated that they had their cat neutered over the age of one year.

Although rare, cats can reach sexual maturity and can become pregnant as early as four-month of age (Murray, Roberts, Whitmarsh, & Gruffydd-Jones, 2009) thus some of the respondents' female cats could have given birth prior to neutering. Additionally, 28.4% of the cat owners in the sample reported that their cat had given birth to at least one litter of kittens. Therefore, there is scope to reduce owned cats' birth rate by lowering neutering age, as suggested by Murray, Roberts, Whitmarsh, and Gruffydd-Jones (2009), who reported a similar birth rate of 29% for owned cats in the UK.

Conclusion

The results of this study indicated a generally positive perception of stray cats, and this evidence of empathy is an important foundation for any public behavioral intervention to improve stray cat welfare and manage their populations. However, knowledge and awareness regarding neutering, microchipping, and stray cat management were relatively low, while semi-ownership behaviors were prevalent. Greater efforts by NGOs, veterinarians and municipalities are required to increase knowledge of general welfare principles and the negative impacts of feeding but not neutering stray cats, through educational campaigns. More focus is required particularly on parents, men, and young adults to address knowledge gaps and perceptions about cat welfare. The benefits of neutering and

trap-neuter-return as an effective stray cat management practice should be promoted to the Bulgarian public along with more widespread and accessible neutering programmes led by municipalities and local charities.

The findings of this study suggested that the main barriers to stray cat population management posed by cat owners are likely to be unneutered cats allowed to roam and reproduce. Moreover, abandonment and semi-ownership behaviors will further prevent the sustainable reduction of stray cats. In contrast, non-owners may fail to put normative social pressure on owners to care for their cats responsibly due to their lack of interest and knowledge of stray cat management. Finally, more campaigns targeted at both cat owners and non-owners are needed to raise the value of cats in the community and overall awareness of cat welfare. With time, this will lead to increased neutering and microchipping, reduced birth rate and abandonment, and ultimately higher responsible pet ownership levels that aid the management of the stray cat population in Bulgaria

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Data availability statement

The data that support the findings of this study are openly available in Figshare at https://figshare.com/articles/dataset/Vasileva_and_McCulloch_-_Dataset/20099021/1.

Ethics Compliance

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by a University of Winchester ethics review committee in 2021.

Consent

Informed consent was obtained from all subjects involved in the study

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