



Contrasting practices and opinions of UK-based veterinary surgeons around neutering cats at four months old

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Abstract

Background Many cats in the UK are not neutered before reaching potential breeding age. The purpose of this investigation was to understand the prevalence of veterinarians' behaviours around neutering cats at four months of age and to identify any needs of the veterinary profession on this.

Methods A sample of 483 veterinarians that completed a cross-sectional online questionnaire were included in quantitative and qualitative analyses.

Results Almost 70 per cent of veterinarians indicated they were comfortable carrying out neutering on cats of four months of age, and approximately half of veterinarians indicated they would recommend neutering client-owned cats at four months of age if practice policy permitted. There was no association found between these practices and geographic risk factors. Instead, neutering at four months was associated with the gender of the veterinarian, their practice policy and whether they routinely neuter unowned cats. Veterinarians have contrasting beliefs on similar themes, depending on whether they neuter kittens at four months or not, including differing opinions on general anaesthetic, surgery risks, owner compliance and their perceptions of neutering practices within the wider profession.

Conclusion Familiarity and experience with the procedure, alongside perceived norms, are central to beliefs. We also highlight informational and learning barriers.

Introduction

Unowned cats are a concern in many parts of the world,¹⁻⁴ including the UK.⁵ Although there currently is no fact-based estimation of the number of free-roaming unowned cats in the UK, we know that unowned cats are ubiquitous in localised areas.⁶ Additionally, the demand for rehoming spaces at cat welfare organisations nationally exceeds availability, with the majority operating at full capacity⁷ and many cats on rescue centre waiting lists.⁸ This has important implications in terms of both the social and environmental problems often associated with overpopulation, but also importantly, the welfare of the individual cats. This has previously been described as a

cat crisis,⁹ and neutering is an integral solution with an estimated 80 per cent of owned cat litters accidental.¹⁰ Although, neutering rates in the UK are high (92 per cent¹¹), neutering has to be carried out early enough to prevent accidental litters in order to be most effective. The majority of unplanned pregnancies occur between four and nine months of age¹² and, although unusual, female kittens can become pregnant at four months.¹³ Despite this, a high proportion of owned cats are not being neutered before a possible age of breeding, with just 14 per cent of cats neutered by four months.¹⁴

Prepubertal neutering is primarily concerned with neutering animals before they reach sexual maturity. The British Veterinary Association and the British Small Animal Veterinary Association support neutering of pet cats from 16 weeks,^{15 16} a recommendation also made by the Federation of Veterinarians of Europe, which defines neutering cats post-four months as late.¹⁷ Consequently, our study focuses on four months of age for neutering as the primary recommendation for pet cats, but we recognise that in some circumstances, neutering earlier than four months is often desirable and safe if appropriate procedures are followed.¹⁵ Prepubertal neutering is also supported by cat welfare organisations

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(The Cat Group¹⁸ and the Cat Population Control Group¹⁹). Despite these recommendations, previous studies have highlighted that, in the UK, prepubertal neutering is not practised consistently^{20 21} with a significant overlap between reported ages of neutering and the possible age at which cats enter puberty. Indeed, studies suggest that UK veterinarians prefer neutering at a higher age than their counterparts in New Zealand, Australia and the USA.^{21 22} Legislation and differences in the social and environmental effects of cat overpopulation are likely to play a role in these geographic differences; for example, neutering at three months is mandatory in some Australian jurisdictions (section 74 of the Domestic Animals Act 2000²³). Comparatively, the UK government does not currently have an active role in neutering policy. In the absence of legislation and where cats are able to free-roam or both sexes cohabit, the veterinary profession is paramount in educating owners and preventing the cycle of accidental litters. Unwillingness to neuter at 16 weeks poses a significant barrier to cat owners who want to prevent unplanned litters. Additionally, owners may be more compliant if neutering is arranged to follow primary vaccinations, when engagement with preventative veterinary care is likely to be at its highest. Prepubertal neutering is also important for cat rescue organisations and breeders, for whom veterinarian refusal to neuter early enough precludes the neutering of cats prior to homing,^{24 25} although in these circumstances, neutering earlier than 16 weeks is often desirable.

Interestingly, UK veterinarians have stronger support for prepubertal neutering in the case of stray or feral animals.²¹ While this is beneficial to the welfare of unowned cats,²⁶ it is largely tackling a symptom of the overpopulation problem and not necessarily the cause. The dynamics of cat populations are interlinked and unlikely to be exclusive, with fluidity between classes of cats.²⁷ Pet cats mix with unowned cats; accidental litters can feed into the stray population; and both stray and owner relinquished cats make up an important source of intake into shelters (42.3 per cent vs. 45.1 per cent, respectively⁸). Therefore, the prevention of unplanned litters and consistent messaging from veterinarians on the appropriate age to neuter are of importance for all cats regardless of ownership status.²⁸

A key concern for veterinarians who do not practise four-month neutering is the risk of negative consequence for the patient, both in the short term, such as anaesthetic risk and surgical complications, and in the longer term, with regard to potential associated medical conditions and behavioural problems. To date, these concerns have not been observed in studies exploring outcomes of neutered cats.^{29–34} However, it is legitimate that veterinary professionals need to be confident in the evidence base when undertaking veterinary procedures, especially elective procedures such as neutering, having declared that their constant endeavour is to ensure the

health and welfare of animals committed to their care.³⁵ Consequently, we set out to understand the prevalence of veterinarians' behaviours around feline neutering in the UK and the potential questions or needs from the veterinary profession on this. Specifically, our objectives were to explore (1) what drives differences in neutering-related behaviours among veterinarians, (2) what the perceptions are around four-month neutering, (3) what the perceptions are of veterinarians towards the prevalence of four-month neutering in the wider veterinary community and (4) what training or information is lacking.

Methods

Sample population

The target population was all practising veterinarians in the UK that routinely see cats as part of their day-to-day work. Respondents that did not meet these criteria were disqualified from completing the questionnaire.

Data collection

A cross-sectional design was used to obtain data. The study was carried out as an open online questionnaire developed in SurveyMonkey (SurveyMonkey, San Mateo, California, USA; www.surveymonkey.com). The questionnaire consisted of four sections. Section 1 asked about the veterinarian and the practice that they work in. Section 2 asked about their current practices around neutering cats at four months, including whether they carry out neutering on kittens four months old or would carry it out practice policy permitting and whether they recommend neutering client-owned kittens at four months. Section 3 used a combination of open-ended questions and Likert scale questions to obtain views on four month neutering, including perceptions of prevalence across the wider veterinary community. Section 4 enquired about any barriers to four-month neutering, specifically focusing on any training and information needs. Data were collected between January and March 2019. Participants were recruited through several different online channels, including Facebook, Twitter and websites.

Responses were downloaded from SurveyMonkey into Microsoft Excel V.2016 for data cleaning. Responses were removed from participants who were not veterinarians, who did not answer any questions or the pertinent questions in section 2 and duplicate responses. In addition to the questions within the questionnaire, practice postcodes were used to match each respondent against databases containing Index of Multiple Deprivation (IMD) rankings and deciles, urban and rural classifications, latitude, longitude and regions obtained from the Office of National Statistics (<http://www.ons.gov.uk>). The IMD provides an overall relative measure of deprivation for areas across England based on seven different domains of deprivation. The areas are ranked according to their deprivation score.

Additionally, deciles are calculated, whereby decile 1 represents the most deprived 10 per cent of areas nationally, and decile 10 represents the least deprived 10 per cent of areas nationally. The definition of IMD varies between regions; therefore, only data from English practices were used in this analysis, given its larger sample size.

Statistical analysis

Generalised linear models (GLMs) with a quasibinomial error structure were used to identify explanatory variables associated with veterinarians that (1) currently neuter cats at four months or would if it was practice policy versus those that do not and (2) would recommend neutering client-owned cats at four months of age, practice policy permitting versus those that would not. Explanatory variables included IMD rankings, IMD deciles, urban and rural classifications, regions, gender, time since qualification, practice type, number of owned cats the practice sees for neutering per week, number of unowned cats the practice sees for neutering per week and the practice policy on neutering as understood by the responding veterinarian.

To analyse beliefs around four-month neutering, we defined two groups of veterinarians: (1) veterinarians that neuter at four months or younger (VNAFs), which included veterinarians who currently neuter cats at four months of age or would if it was practice policy and would recommend neutering client-owned cats at four months of age; (2) veterinarians that neuter older than four months (VNOFs), which included veterinarians who do not currently neuter cats at four months of age and/or would not recommend neutering client-owned cats at four months of age. χ^2 tests were used to test for associations between differences in beliefs, influences and wider perceptions of neutering with their current practices (VNAF versus VNOF). All statistical analyses were carried out in R V.3.4.3.³⁶

Thematic analysis

Responses to open-ended questions were extracted into NVivo Pro V.11,³⁷ a qualitative data management program, for thematic analysis. A single coder categorised free-text responses regarding (1) general views around four-month neutering, (b) perceptions of the prevalence of four-month neutering within the wider veterinary community and (c) views on information and training required to carry out four-month neutering. This content analysis enabled responses to be categorised into key overarching categories and identification of underlying themes.

Results

Sample

The sample comprised 572 veterinarians who volunteered to complete an online survey. Records were removed in accordance with the following criteria:

duplicate responses (n=18), no answers provided (n=48), no answers provided to section 2 of the survey on current practices around neutering cats at four months (n=21) and data provided by veterinary nurses, which were not the target of this study (n=2). Consequently, the analysis for the current study included demographic and practice-associated information for 483 individuals.

Age of neutering

Sixty-eight per cent of the veterinarians (n=329) reported that they either currently neuter cats at four months of age or would if it was practice policy. Looking at potential geographic, individual and practice-level factors that are associated with neutering at four months, we found that a significantly lower proportion of veterinarians neuter at four months in practices that do not neuter unowned cats or infrequently neuter unowned cats, which included stray, feral and community cats (GLM: $F_{2,468}=5.44$, $p=0.005$; [figure 1A](#)). We found no association between other individual or practice-level factors and the probability of a veterinarian neutering cats at four months.

Fifty-two per cent of veterinarians (n=239) would recommend neutering client-owned cats at four months of age if policy permitted. This is less than those who would practise it. Female veterinarians were significantly more likely to recommend four-month neutering than male veterinarians (GLM: $F_{1,452}=5.9$, $p=0.03$; [figure 1B](#)). The proportion of veterinarians that recommend four-month neutering (or would if policy permitted) also increased for those that had a policy that allowed for neutering owned cats at four months (GLM: $F_{1,452}=29.9$, $p<0.001$; [figure 1C](#)). We found no association between other individual or practice factors and probability of a veterinarian recommending neutering owned cats at four months.

The survey had a good reach across all UK regions. There were no significant geographic differences in whether veterinarians practise or recommend four-month neutering according to latitude, longitude, regions, urban or rural classifications or IMD deciles and rankings.

Of the 483 veterinarians who answered the question, 336 (70 per cent) reported that their veterinary practice had a policy for the age at which cats are neutered, 128 (26 per cent) reported that their practice did not have a policy and the remaining 19 (4 per cent) did not know if their practice had a policy. Of the 332 veterinarians who provided more detail about their practice's policy, 81 per cent (n=269) of policies allowed neutering owned cats at four months; 11 per cent (n=37) did not allow for neutering at four months; and the remaining 8 per cent (n=26) were unsure if it allowed for neutering at four months. This equates to 56 per cent of veterinarians (n=269) working in practices with a policy that allows for neutering of owned cats at four months.

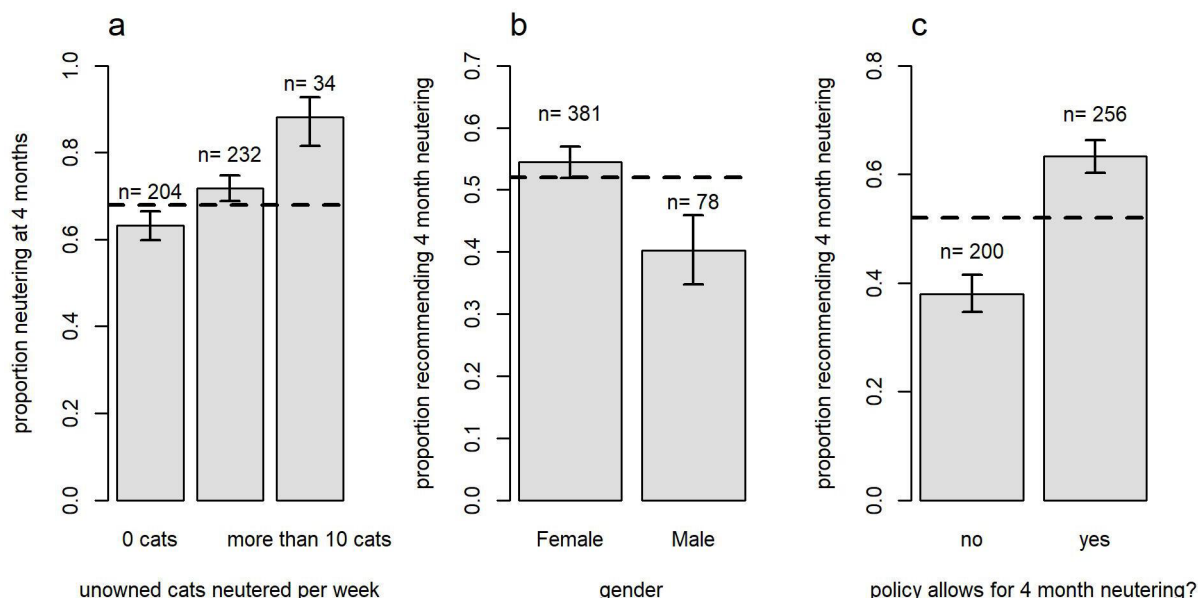


Figure 1 (A) Proportion of veterinarians neutering cats at four months (or would if it was practice policy) in relation to the number of unowned cats (including stray, feral and community cats) that visit their practice for neutering (\pm SE) as predicted from a GLM; n=sample size; dashed line=sample mean. (B,C) Proportions of veterinarians that would recommend client-owned cats are neutered at four months (or would if practice policy permitted) in relation to gender of veterinarian and practice policy (\pm SE) as predicted from a GLM, n=sample size; dashed line=sample mean. GLM, generalised linear model.

Differences between veterinarians

Beliefs on four-month neutering

We compared the beliefs of VNAF with VNOF.

Similar responses to general neutering statements indicate no fundamental differences in ideologies around neutering generally between VNAF and VNOF; both equally agreed that neutering was good for cat welfare (>95 per cent agreement) and population control (>97 per cent agreement) (table 1).

However, while less than 1 per cent of VNAF considered four-month-old cats too small or young to neuter, around a quarter of VNOF considered four-month-old cats too young and too small to neuter. VNOFs were also less likely to agree that four-month neutering is beneficial for cat welfare and population control (table 1).

Open-ended questioning revealed themes underpinning both positive and negative views around four-month neutering.

For VNAF, five key themes on the benefits of four-month neutering were identified; these included

1. Controlled breeding (n=64).
2. Surgery (n=58).
3. Postoperative recovery (n=47).
4. Owner compliance (n=13).
5. General anaesthetic (n=10).

For many VNAFs, the key benefit was preventing unwanted pregnancies, with one veterinarian explaining, 'I think it is ideal, the fewer cats [that are] left entire, the better control [we have of] the feline population. We tend to find if owners say they want to wait we end up with unexpected pregnancies and often a never-ending cycle'.

Surgery was also commonly remarked on, with VNAF considering it quicker or safer: 'All positive. Quicker surgery. Smaller wound'. Recovery time was also considered quicker and with fewer complications, 'seeing the kittens recover so quickly, eating and playing within the hour of neutering compared with a cat in season speaks for itself'.

Question	Group	N	Disagree (%)	Neutral (%)	Agree (%)	χ^2 test statistic (P value)
Cats are too small at four months to neuter.	VNAF	216	200 (92.6)	15 (6.9)	1 (0.5)	<0.001*
	VNOF	234	100 (42.7)	72 (30.8)	62 (26.5)	
Cats are too young at four months to neuter.	VNAF	215	207 (96.3)	8 (3.7)	0 (0)	<0.001*
	VNOF	232	116 (50)	64 (27.6)	52 (22.4)	
Neutering is beneficial for cat welfare.	VNAF	215	4 (1.9)	1 (0.5)	210 (97.7)	0.19
	VNOF	233	5 (2.1)	6 (2.6)	222 (95.3)	
Neutering at four months is beneficial to cat welfare.	VNAF	216	3 (1.4)	22 (10.2)	191 (88.4)	<0.001*
	VNOF	233	40 (17.2)	106 (45.5)	87 (37.3)	
Neutering is beneficial to controlling the number of unwanted cats.	VNAF	215	2 (0.9)	0 (0)	213 (99.1)	0.14
	VNOF	229	3 (1.3)	4 (1.7)	222 (97)	
Neutering at four months is beneficial to controlling the number of unwanted cats.	VNAF	216	6 (2.8)	2 (0.9)	208 (96.3)	<0.001*
	VNOF	231	16 (6.9)	52 (22.5)	163 (70.6)	

* indicates significant difference between VNAF and VNOF (P<0.05).
VNAF, veterinarian that neuter at four months or younger; VNOF, veterinarian that neuter at older than four months.

VNAF considered four-month neutering beneficial for owner compliance as it fits in with vaccination schedule as one veterinarian explains, 'I think it's a perfect suggestion for age. It's before sexual maturity so no accidental matings and usually while owners are 'interested' in their kitten [as they have] just finished vaccines so [are] still in regular contact with the vet'.

Some VNAFs mentioned the safety of the general anaesthetic protocol 'the quad anaesthesia protocol is quite safe for young kittens', including 'reduced [general anaesthetic] time'.

For VNOF, five key themes were identified, these concerns were

1. Size and development (n=51).
2. General anaesthetic and analgesia (n=29).
3. Surgery (n=26).
4. Lack of applicability to their practice (n=26).
5. Lack of compliance from owners or colleagues (n=14).

For many VNOFs, the key issue was concerns around the size and development of four-month-old kittens, with one explaining they 'feel it is beneficial to the cat to reach maturity before neutering'. Other commonly remarked on problems included the perceived increased anaesthetic risk and concerns around analgesia, 'It feels too early for a routine general anaesthesia, if it can be avoided I prefer to wait until [the cat is] a bit more mature. Usually anaesthetic procedures are more unstable in younger patients'.

Surgery was also perceived to be more complicated: 'It is inevitably more tricky surgery in a smaller cat' and unfamiliar 'I would feel nervous initially at the surgery, which is probably a bit silly as I'm very experienced at neutering cats'.

Some VNOFs did not see four-month neutering appropriate for owned cats, as they do not see unowned cats 'No need [to in a] relatively affluent area with little stray or feral cat population[s]'. Others highlighted that colleagues and owners may not be compliant with a change in policy: 'I would do them if neutering policy allowed. [I am] unsure of owners' reactions to surgical procedures on such young cats'.

Beliefs on four-month neutering in the wider veterinary profession

When asked about their beliefs regarding the wider veterinary profession, VNOFs were more likely to disagree that four-month neutering is widely practised; they also were less likely to agree that veterinary professionals have a responsibility to encourage four-month neutering, with limited knowledge and skills pertaining to four-month neutering within their practice teams (table 2).

Responses to open-ended questioning on the perceived perceptions of four-month neutering within the wider veterinary community were received from 377 participants. Thematic analysis revealed contrasting viewpoints. Thirty-six per cent of responses perceived the veterinary community to be generally accepting of four-month neutering (eg, 'I assumed it was standard practice to neuter at four months'). Thirty-nine per cent of responses perceived the veterinary community to be largely in favour of traditional age neutering (eg, 'I believe most vets recommend neutering at around 6 months'). Twenty-five percent perceived there to be mixed views depending on the circumstance (eg, 'it depends on [the] situation, [in] areas with high feral colonies it would be seen as a necessity, [whereas in] areas with more owned cats there is likely less enthusiasm about doing [it] at a young age').

Training and understanding

VNOF indicated they felt significantly less able to make the case to peers and owners regarding the benefits of four-month neutering. They reported fewer resources and less confidence and practice support for four-month neutering. They were also more likely to be affected by the opinions of staff and owners (table 3).

Open-ended questioning found that a lack of evidence on the effect of four-month neutering was a recurrent theme (n=70). This was sometimes in reference to more information on the long-term effects relative to neutering at an older age '[more information on the] benefits associated [with four-month neutering]

Table 2 Agreement with statements regarding the wider perceptions of neutering within the veterinary community categorised by whether they are VNAF or VNOF

Question	Group	N	Disagree (%)	Neutral (%)	Agree (%)	χ^2 test statistic (P value)
Four-month neutering is widely practised in the UK.	VNAF	214	66 (30.8)	72 (33.6)	76 (35.5)	<0.001*
	VNOF	230	125 (54.3)	60 (26.1)	45 (19.6)	
Veterinary professionals have a responsibility to encourage neutering.	VNAF	217	1 (0.5)	3 (1.4)	213 (98.1)	0.58
	VNOF	234	0 (0)	3 (1.3)	231 (98.7)	
Veterinary professionals have a responsibility to encourage four-month neutering.	VNAF	217	8 (3.7)	51 (23.5)	158 (72.8)	<0.001*
	VNOF	232	76 (32.8)	113 (48.7)	43 (18.5)	
All vets in my practice have the skill to neuter at four months.	VNAF	214	10 (4.7)	19 (8.9)	185 (86.4)	0.001*
	VNOF	232	35 (15.1)	21 (9.1)	176 (75.8)	
There is limited knowledge about the benefits of four-month neutering within my practice teams.	VNAF	216	126 (58.3)	35 (16.2)	55 (25.5)	<0.001*
	VNOF	232	45 (19.4)	43 (18.5)	144 (62.1)	

* indicates significant difference between VNAF and VNOF (P<0.05).

VNAF, veterinarian that neuters at four months or younger; VNOF, veterinarian that neuters at older than four months.

Table 3 Agreement with statements regarding influences on neutering practices categorised by whether they are VNAF or VNOF

Question	Group	N	Disagree (%)	Neutral (%)	Agree (%)	χ^2 test statistic (P value)
The feelings of clients about neutering strongly influences the advice I give them.	VNAF	215	159 (74)	25 (11.6)	31 (14.4)	0.14
	VNOF	234	153 (65.4)	35 (15)	46 (19.6)	
I have all the physical resources I need to neuter at four months.	VNAF	217	4 (1.8)	5 (2.3)	208 (95.9)	<0.001*
	VNOF	233	21 (9)	18 (7.7)	194 (83.3)	
I am confident in my ability to neuter at four months.	VNAF	217	3 (1.4)	7 (3.2)	207 (95.4)	<0.001*
	VNOF	233	22 (9.4)	18 (7.7)	193 (82.8)	
Negative opinions of other staff in my practice prevent me from recommending four-month neutering.	VNAF	209	177 (84.7)	17 (8.1)	15 (7.2)	<0.001*
	VNOF	226	149 (65.9)	32 (14.2)	45 (19.9)	
The opinions of clients affect my decision on the age of neutering I will recommend.	VNAF	215	162 (75.3)	26 (12.1)	27 (12.6)	0.005*
	VNOF	233	142 (60.9)	43 (18.5)	48 (20.6)	
My practice would support me if I neutered cats at four months.	VNAF	209	5 (2.4)	14 (6.7)	190 (90.9)	<0.001*
	VNOF	226	22 (9.7)	47 (20.8)	157 (69.5)	
I am confident that I can make the case to peers around four-month neutering.	VNAF	208	8 (3.8)	22 (10.6)	178 (85.6)	<0.001*
	VNOF	227	63 (27.8)	72 (31.7)	92 (40.5)	
I am confident that I can make the case to cat owners around four-month neutering.	VNAF	214	3 (1.4)	16 (7.5)	195 (91.1)	<0.001*
	VNOF	233	50 (21.5)	62 (26.6)	121 (51.9)	

* indicates significant difference between VNAF and VNOF (P<0.05).
VNAF, veterinarian that neuters at four months or younger; VNOF, veterinarian that neuters at older than four months.

when compared with older neutering, including figures on changes in risk', but also several other distinct contexts. Some veterinarians wanted clinical studies on the procedure itself: 'Clinical proof that [there is] no increased risk to cats for example, GA at young age and hypothermia in a small young cat'. Others mentioned a lack of access to evidence.

Training in general anaesthetic protocols was commonly mentioned (n=29): 'Information on how long to starve pre-GA and advice on drug protocol'.

Some veterinarians require training in surgical protocols (n=11), with a lack of confidence and experience in early neutering: 'I have had very little training on early neutering, just read articles about it'.

Also, some veterinarians (n=16) were unsure what training was required as they have never done it before: '[I am] not entirely [sure] what training would be required. [I am] confident in [my] skills for spaying but [I am] not sure how it would be different, [I] just don't know enough about it'.

Discussion

This study found that not all veterinarians based in the UK consistently neuter cats at four months. This is largely consistent with earlier studies and highlights that although prevalence may be increasing the rate of adherence to current recommendations of UK veterinary associations^{15 16} is slow, perhaps in part due to a lack of awareness, with many veterinarians unaware that half the profession routinely undertake it. We add to this evidence by providing insight into the potential drivers and perceptions of neutering cats at four months within the veterinary profession. The picture that emerges is contrasting, whereby veterinarians have significantly different beliefs around perceptions and the norm of four-month neutering. We discuss these results alongside informational and training barriers.

Around half of veterinarians surveyed would recommend four-month neutering routinely for client-owned cats and over half of practices had a policy that allowed for it. Although the findings are based on a convenience sample that may not be generalisable, the results are similar to recent findings.³⁸ This figure has increased since earlier studies that found less than half of UK veterinarians considered pre-pubertal neutering desirable²¹ and more than 10 years ago only 28 per cent of veterinarians considered it appropriate to neuter 12- to 16-week-old kittens.²⁰ The increase in uptake of four month neutering is also reflected in the number of practices registered on the Kitten Neutering Database, a public resource of veterinary practices who will neuter four-month-old kittens.¹⁹

We found female veterinarians were more likely to recommend neutering at four months for client-owned cats. Additionally, veterinarians that would recommend it were more likely to work in a practice that has a policy that allows for it, despite the question phrased irrespective of current policy. This indicates the importance of within-practice experience, with veterinarians potentially less likely to perceive risk with increased experience²² and more likely to consider neutering cats at four months the norm. This study is cross-sectional and unable to differentiate between association and causation, so we cannot discount that veterinarians are preferentially choosing practices that are aligned with their views or changing policies to align with opinions established at previous practices. However, previous studies have similarly found that experience within practice to be important for veterinarians and veterinary nurses in terms of their attitudes and behaviours in other veterinary contexts.³⁹⁻⁴¹

Interestingly, we found that while half of veterinarians recommend four-month neutering for

client-owned cats, almost 70 per cent of veterinarians carry out four-month neutering. One explanation may be that veterinarians are performing prepubertal neutering in response to owner requests, but they do not recommend doing it. However, previous studies have shown that many cat owners believe pregnancy is not possible until a queen is five months of age or more,¹⁰ and only a minority of owners intend to get their cat neutered by four months.¹⁴ An alternative option is that many veterinarians consider age of neutering context specific. Indeed, similar to other studies,²¹ we find significant links between prepubertal neutering and the number of unowned cats the practice sees; veterinarians that work in a practice that sees unowned cats routinely are more likely to practise four-month neutering. Thematic analysis revealed a perceived lack of need in some areas, with the rationale being that if strays are not present, then prepubertal neutering is not necessary. However, we know that cats and their owners are not confined to the vicinity of their veterinary practice, and veterinary practices are only seeing a subset of the cat population.¹¹ Although more work is needed to explore the dynamic nature and fluidity of cat populations, consistency in messaging across the veterinary profession is key to ensure owners and cats are provided with the same standard of care, even if locally the problem is difficult to conceptualise.

It is anticipated that the neutering rates of unowned cats are lower⁴² and their abundance higher^{3 43} in areas of social deprivation; however, we found no links between IMD and prepubertal neutering. This result indicates that there are veterinarians across deprived and affluent areas carrying out the procedure, and that not all veterinarians hold the previously mentioned view of some VNOFs that it is not applicable in some areas. Additionally, there was no difference between urban and rural areas, regions, latitude and longitude. With no significant spatial, socioeconomic or geographic determinant, the prevalence of four-month neutering appears to be irrespective of location and is instead determined more by the demographics of the veterinarian and the intrinsic policies of the practice.

Our study found that all veterinarians had similar ideologies about the importance of neutering for cat welfare and population control. Additionally, veterinarians considered the profession to play an important role in encouraging neutering irrespective of the age of cats they neuter. However, veterinarians that do not carry out neutering of four-month-old kittens were less likely to consider prepubertal neutering beneficial to population control and individual cat welfare. This may in part be due to ambiguity with the term 'cat welfare', which may be interpreted as an immediate or long-term effect; indeed, veterinarians that do not carry out neutering of four-month-old kittens may perceive a greater short-term reduction in welfare as part of the neutering procedure itself or

a longer-term impact. Free-text responses illustrated that veterinarians have contrasting views on the same themes, depending on whether they neuter kittens at four months or not. Polarised views included surgery (easier versus more complicated), general anaesthetic (reduced complications versus increased risk) and owner compliance (increased versus reduced compliance). Additionally, veterinarians that do not routinely carry out or recommend pre-pubertal neutering were more likely to consider cats too small and underdeveloped at four months. These results highlight the importance of familiarity and experience with the procedure to improve self-efficacy. This result is similarly found across studies of health professionals, with confidence an important barrier to procedural changes.⁴⁴ Indeed, free-text responses found that training in protocols and techniques were desirable for some veterinarians. However, given many veterinarians are influenced by their own practice and may lack resources and colleague support, this poses a potential barrier. In order to gain experience and self-efficacy with the procedure veterinarians may have to seek support elsewhere. External resources could include seeking mentor or peer support from a kitten neutering champion, which can be found online alongside training videos and anaesthetic protocols.^{19 45} Additionally increased engagement with shelter medicine offers another potential route for training opportunities, where early neutering (often younger than four months) is considered safe and appropriate compared with the harm for non-neutering.¹⁵ Further exploration of how to overcome this barrier, given the potential lack of within-practice support, is an important consideration.

In addition to training, an improved evidence base was a commonly emerging theme, with veterinarians calling for clinical and long-term studies on the impact of age of neutering. Longer-term studies on client-owned cats would be beneficial, given the evidence has largely been based on shelter cats to date.^{30 31} However, many studies do exist highlighting both the clinical safety^{32 33 46–48} and lack of longer-term impact of the four-month neutering on health.^{29 34 49 50} Previous editorials have signposted to resources and evidence.^{13 45} This includes evidence around a lack of osteoporotic risks due to delayed physeal closure,⁵¹ weight gain,^{49 52} urinary tract problems^{29 34} or behaviour problems^{30 31 49} for cats neutered prepubertally compared with a traditional age. Additionally, evidence suggests neutering prior to 6 months greatly reduces the risk of mammary tumours.⁵³ Given the amount of evidence already available, an understanding of the academic literature surrounding this issue is essential for veterinarians to have conviction in neutering practices and to justify undertaking procedures on animals to themselves, clients and colleagues. Consequently, limited access to resources may also be a barrier as was highlighted by a few veterinarians.

Interestingly, the contrasting views extended to the perception of the prevalence of four-month kitten neutering in the wider veterinary community. Over half of veterinarians that do not carry out four-month neutering disagreed that it was widely practised, compared with just 30 per cent of veterinarians that do. Further questioning revealed over a third of veterinarians considered four months to be the norm, whereas a third considered six months to be widely practised. These results highlight contrasting beliefs and the influence of social norms, a finding paralleled in the health profession (eg, Honda and Gorin⁵⁴), again validating the importance of peers in shaping perceptions of the wider community.

Conclusion

Our study has highlighted that over half of UK veterinarians recommend neutering of client-owned cats at four months, and almost 70 per cent are willing to practise it. Practice-based policy is an important indicator of carrying out the procedure, highlighting the importance of within-practice experience and social norms. The contrasting behaviours between veterinarians and veterinary practices highlight a potential barrier to further uptake of four-month neutering, which limits the training available and potentially access to resources. We recommend veterinarians that are interested in four-month neutering to explore shelter medicine, online resources and peer-to-peer support processes. However, more research in this area would be beneficial to identify how best to support veterinarians to make procedural changes and improve access to and development of evidence around four-month neutering.

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Data availability statement All data relevant to the study are included in the article.

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