Opinions of veterinarians about the age at which kittens should be neutered

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The mean age recommended by veterinary practices for neutering kittens is 22·6 weeks, with only 28 per cent of veterinarians considering it appropriate to neuter 12- to 16-week-old kittens. Multivariable logistic regression was used to identify variables associated with veterinarians' opinion that 12 to 16 weeks is an appropriate age at which to neuter kittens. Significant risk factors included time since graduation, perception of the problem of there being too many unwanted domestic cats and their practice's policy on the recommended neutering age. Veterinarians who thought that neutering eight- to 11-week-old rescue kittens before homing was justified and veterinarians who had neutered 12- to 16-week-old domestic kittens within the previous year were more likely to consider that neutering 12- to 16-week-old kittens was appropriate. Veterinarians who thought that surgical complications, anaesthetic complications and lower urinary tract disease were, or might be, more likely to occur in kittens neutered at 12 to 16 weeks than in those neutered at six months of age, were significantly less likely to think that neutering 12- to 16-week-old kittens was appropriate.

VETERINARIANS recommend that cats should be neutered, to control the population and provide health and behaviour benefits. Andersen and others (2004) estimated that at least 75 per cent of adult cats needs to be neutered to limit the population size. Thrusfield (1989) estimated that in 1986, the size of the UK domestic cat population was approximately 6·2 million. More recently, the population has been reported to be increasing and, in 2004, there were estimated to be approximately 9·6 million cats in the UK (Pet Food Manufacturers Association 2007). Although veterinary surgeons encourage owners to neuter cats that are not intended for breeding, and despite the efforts of UK cat charities that offer discounted or free neutering, it has been estimated that 46 per cent of female domestic cats remain unneutered at 12 months of age (Chipman 1990). In the UK, neutering rates have been reported to range between 42 per cent and 100 per cent (Chipman 1990, Horsfield 1998, Bradshaw and others 1999) and, in the USA, between 33 per cent and 91 per cent (Alexander and Shane 1994, Patronek and others 1997, Mahlow 1999, Levy and others 2003).

Neutering has other benefits, including reducing aggression between cats, increasing cats' affection towards people and enhancing their suitability as pets (Stubbs and others 1996). In addition, neutered cats have a lower risk of contracting some infectious diseases (Schneider 1983, Rohrbach and others 2001), and are possibly at lower risk of road traffic accidents and other traumatic injuries because they are more likely to be recovered by their owners than 'lost' unneutered cats (Lord and others 2007). In female cats, uterine disease is usually avoided and the risk of mammary tumours is reduced after they have been neutered.

The recommended age for neutering cats is traditionally approximately six months (Olson and others 2001, Stalker 2004), but it has been suggested that they can be neutered safely at between six and 24 weeks of age (Aronsohn and Faggella 1993, Howe 1997, Howe and others 2000). Neutering cats before the traditional age of six months has several advantages. Many owners do not realise when their cat reaches puberty and neutering the cat before it reaches puberty would therefore be expected to avoid unwanted pregnancies. In addition, rescue centre kittens can be neutered before they are adopted, thereby ensuring that they are neutered before they have a chance to breed. Feral kittens that have been trapped can be neutered before their release, thus avoiding the need to re-trap them. The British Small Animal Veterinary Association (BSAVA) supports the Cat Group's recommendation that domestic kittens should be neutered at about four months of age (Cat Group 2006). Despite these recommendations, anecdotal reports suggest that only a small proportion of cats are neutered before they are six months old. If these reports are correct then it is not clear whether it is as a result of the owners' or the veterinarians' reluctance to neuter kittens earlier than the traditional age.

The aims of this study were first, to produce descriptive statistics on the age at which UK veterinary practices recommend domestic cats to be neutered, and the extent to which 'early neutering' (defined as neutering at 20 weeks of age or under) is being requested by clients, felt to be appropriate and carried out by veterinarians. A second aim was to identify factors that affected the opinion of veterinarians on whether or not it was appropriate to neuter domestic kittens aged 12 to 16 weeks. This information can be used to recommend strategies to reduce the age at which veterinarians feel it is appropriate to neuter kittens, and thus increase the power of neutering to control the cat population, and reduce the incidence of traumatic injuries, and infectious and non-infectious diseases that are more common in unneutered cats.

MATERIALS AND METHODS

Study design

A cross-sectional design was used to obtain data relating to the age at which neutering was recommended for the cats of clients of veterinary practices, and the veterinarians' experience of, and opinions on, the advantages and disadvantages associated with neutering cats aged eight to 20 weeks.

A questionnaire containing 17 questions was mailed to the 4142 recipients of the December 2005 issue of the Cats Protection veterinary newsletter. A covering letter requested that the questionnaire should be completed and returned by a veterinary surgeon. Most, but not all, of the recipients were veterinary surgeons and it was therefore not possible to obtain an accurate estimate of the response rate of those eligible to complete the questionnaire. Throughout the questionnaire, the questions relating to neutering specified the neutering of clinically healthy cats. A copy of the questionnaire is available from J. K. M.

Statistical analysis

A descriptive summary of the responses was produced. This included the respondents' attitudes towards neutering cats aged eight to 20 weeks and their experience of, and responses to, clients who had requested the 'early neutering' of cats during the previous 12 months. A summary was produced of the respondents' agreement with statements relating to the perceived advantages and disadvantages associated with neutering cats aged eight to 11 weeks, 12 to 16 weeks and 17

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to 20 weeks compared with neutering cats aged six months. The respondents were given the choice of indicating that the statements were: false, true for males and females, true for males only, true for females only, in addition to the option of a 'don't know' response. However, owing to the small numbers of responses in some categories, the three categories indicating that the respondent believed the statement to be true for males and/or females were combined.

Chi-squared tests were used to test for associations between variables related to the cat (sex and age category), the veterinarian's country of graduation (UK or non-UK) and their neutering experiences and opinions. Statistical significance was set at $P<0{\cdot}05$.

Univariable and multivariable logistic regression models were then used to identify explanatory variables associated with the belief that it was appropriate to neuter 12- to 16-week-old domestic kittens. The outcome variable under investigation was determined by the veterinarians' response to a question asking whether or not they considered it appropriate to neuter clinically healthy male and female domestic kittens aged 12 to 16 weeks.

Case and control definitions

A case was defined as a veterinarian who considered that it was appropriate to neuter 12- to 16-week-old domestic kittens. A control was defined as a veterinarian who considered that it was not appropriate to neuter 12- to 16-week-old domestic kittens. All the veterinarians fulfilling the case or control definition were included in the analysis, but there were missing data for some variables.

Potential explanatory variables included in the questionnaire were tested for their association with the outcome under investigation (appropriateness of neutering 12- to 16-week-old domestic kittens) by using univariable logistic regression models. The statistical package Egret (Cytel Software) was used to analyse the data. Variables with a univariable $P<0{\cdot}2$ were considered for inclusion in the multivariable model, which was constructed using the technique of backward elimination. The effect of biologically plausible interactions between variables was also tested in the model. Table 1 lists the variables that had a univariable $P<0{\cdot}2$ and were retained in the multivariable model.

Veterinarians who indicated either that they considered neutering 12- to 16-week-old kittens was associated with an increased risk of anaesthetic complications, surgical complications and/or lower urinary tract disease compared with neutering six-month-old cats, or they did not know whether or not there was an association between the age of the cat and the risk of associated problems, were combined in the multivariable analysis. It was considered that veterinarians in these two categories might be less supportive of neutering 12- to 16-week-old kittens than veterinarians who considered that there was no increased risk of these problems, and that combining the two categories would lead to a more informative multivariable model.

The multivariable model was based on 161 cases and 386 controls. Calculations showed that the dataset had a statistical power of 80 per cent to detect odds ratios of greater than 2·0, based on $P<0{\cdot}05$ and assuming that 15 per cent of the control vets were exposed to the risk factors under investigation, for example, that 15 per cent of the control vets thought that there were too many domestic cats in their practice area (Epi-Info 6; CDC).

RESULTS

A total of 875 questionnaires were returned, a response rate of 21 per cent. However, some questions on some of the questionnaires were not answered.

TABLE 1: Variables included in the multivariable analysis of factors associated with a vet's opinion of whether or not it is appropriate to neuter 12- to 16-week-old domestic kittens

Variable	Description
Too many cats	Vet considers there are too many domestic cats/kittens in their practice area
Neutered 12 to 16	Vet has neutered a client-owned domestic kitten aged 12 to 16 weeks during the previous 12 months
Anaesthetic 12 to 16	Vet considers that neutering kittens at 12 to 16 weeks is associated with a higher risk of anaesthetic complications
Surgical 12 to 16	Vet considers that neutering kittens at 12 to 16 weeks is associated with a higher risk of surgical complications
Lower urinary tract disease 12 to 16	Vet considers that neutering kittens at 12 to 16 weeks is associated with a higher risk of lower urinary tract disease
Policy justifies 8- to 11-week neutering	A rescue charity policy of neutering all kittens before homing justifies the neutering of male and/or female kittens at 8 to 11 weeks
Years graduated	Number of years since graduating from veterinary school
Age recommended	Age at which the practice recommends the neutering of client-owned domestic kittens

Descriptive results

Of the 863 veterinarians who answered the question, 842 (97·5 per cent) reported that their veterinary practice had a policy for recommending the age at which client-owned domestic kittens should be neutered. The age recommended ranged from 12 to 32 weeks with a mean (sd) of 22·6 (2·2) weeks. Fifty-one per cent of the veterinarians reported that they recommended client-owned domestic kittens should be neutered no earlier than six months of age.

Tables 2 and 3 summarise the percentages of the veterinarians who had received a request to neuter kittens of different ages during the previous 12 months and, based on these requests, the percentages who agreed to neuter them. There were no significant differences between the percentages of the veterinarians who agreed to neuter male or female kittens in any of the three age groups, and the percentages increased as the kittens became older.

Similarly, the percentage of veterinarians who stated that they considered it appropriate to neuter kittens aged 20 weeks or less increased as the age of the kitten increased (Table 4), and there were no significant differences between the likelihood that the veterinarian considered it appropriate to neuter male or female kittens in any of the three age groups.

Veterinarians were asked to state their views on six potential advantages and disadvantages that might be perceived to be associated with neutering cats before the age of six months. The results are summarised in Table 5.

TABLE 2: Percentages (numbers) of veterinarians who had received a request during the previous 12 months to neuter clinically healthy, client-owned domestic kittens aged eight to 20 weeks

Age of kitten	Male kittens	Female kittens
8 to 11 weeks	5·2 (44/844)	4·8 (40/838)
12 to 16 weeks	19·5 (165/848)	18·5 (156/842)
17 to 20 weeks	67·2 (581/864)	64·9 (561/864)

TABLE 3: Percentages (numbers) of veterinarians who had agreed to neuter clinically healthy, client-owned domestic kittens aged eight to 20 weeks following a request from a client during the previous 12 months

Age of kitten	Male kittens	Female kittens
8 to 11 weeks	29·5 (13/44)	25·0 (10/40)
12 to 16 weeks	63·0 (104/165)	58·3 (91/156)
17 to 20 weeks	89·5 (520/581)	89·1 (500/561)

TABLE 4: Percentages (numbers) of veterinarians who considered it appropriate to neuter kittens aged eight to 20 weeks

Age of kitten	Male kittens	Female kittens
8 to 11 weeks	4·9 (36/740)	4·5 (33/734)
12 to 16 weeks	27·7 (207/746)	27·6 (203/736)
17 to 20 weeks	75·2 (600/798)	77·7 (621/799)

Twenty-four of 118 (20·3 per cent) veterinarians who had graduated from overseas universities had become aware of 'early neutering' during their undergraduate studies, compared with 92 of 746 (12·3 per cent) who had graduated from UK vet schools (P=0·02). However, despite this difference in their training as an undergraduate, the veterinarians graduating from non-UK universities were not significantly more likely than the veterinarians graduating from UK universities to think that neutering kittens at eight to 11 weeks, 12 to 16 weeks or 17 to 20 weeks was acceptable.

Multivariable analysis

A multivariable model (Table 6) was constructed to quantify the associations between the factors associated with the veterinarians' opinions about whether or not it is appropriate to neuter 12- to 16-week-old domestic kittens.

DISCUSSION

Despite recommendations by the BSAVA and the Cat Group that domestic kittens should be neutered at approximately 16 weeks of age, and the apparent absence of any data that support six months as the ideal age for neutering client-owned cats, the mean (sd) age recommended for neutering was 22·6 (2·2) weeks. Fifty-one per cent of the veterinarians recommended six months or older for neutering client-owned domestic kittens, whereas in New York State, Spain and others (2002) recorded that only 35 to 39 per cent of veterinarians thought that the earliest age at which client-owned dogs and cats should be neutered was six months or more. This difference may be related to differences in the early neutering training received by undergraduate students in the two countries. Some support for this hypothesis was provided by the significantly greater exposure to early neutering training reported by veterinary graduates from non-UK universities than UK universities. However, there was no significant difference between the opinions of these two groups about the appropriateness of early neutering. It was not possible to identify the location of the non-UK universities, and further investigation into the training received in different countries and the opinions about early neutering of veterinarians graduating from these universities would be of interest.

Approximately 5 per cent, 19 per cent and 67 per cent of the veterinarians had been asked by clients to neuter clinically healthy cats aged eight to 11 weeks, 12 to 16 weeks and 17 to 20 weeks, respectively. These figures suggest that the owners may have been reluctant to have their kittens neutered before the traditional age of six months, possibly as a result of advice received from their veterinary practices. However, although some owners requested that their cats should be neutered before the traditional age of six months, 37 per cent of the veterinarians reported that they had declined to neuter a clinically healthy cat aged 12 to 16 weeks and 10 per cent had declined to neuter 17- to 20-week-old cats. Approximately 5 per cent, 28 per cent and 77 per cent of the veterinarians thought that it was appropriate to neuter cats aged eight to 11 weeks, 12 to 16 weeks and 17 to 20 weeks, respectively. These figures suggest that the identification of risk factors associated with veterinarians' opinions on the appropriateness of neutering 12- to 16-week-old kittens would give scope to increase the proportion of veterinarians considering that neutering cats in this age group was appropriate, by the use of intervention studies. The potential factors that might have influenced the veterinarians' opinions about neutering 12- to 16-week old kittens were therefore investigated by means of a multivariable analysis (Table 6).

Eight factors showed a significant association with the veterinarians' opinions about whether or not neutering 12- to 16-week-old domestic kittens was appropriate.

The veterinarians who considered that there were too many domestic cats/kittens in their practice area were approximately twice as likely to think that neutering client-owned domestic kittens at 12 to 16 weeks of age was appropriate. This relationship was weaker than might have been expected (observed ratio=2·13). Its weakness may be related to the veterinarians' recognition of the complexity of the relationship between the proportion of cats that are neutered and the size of the cat population.

The veterinarians who had neutered 12- to 16-week-old client-owned domestic kittens during the previous 12 months were approximately 8·4 times more likely to consider that neutering kittens in this age group was appropriate, than the veterinarians who had not neutered cats in this age group, suggesting that positive experiences and a lack of side effects may have induced a positive attitude.

The veterinarians who believed that neutering kittens aged 12 to 16 weeks was, or may have been, associated with an increased risk of either anaesthetic or surgical complications were approximately 40 per cent and 33 per cent, respectively. This group was less likely to consider that neutering 12- to 16-week-old kittens was appropriate than the veterinarians who believed that there were no increased risks. Twenty-nine per cent of the veterinarians considered that neutering cats at 12 to 16 weeks of age was associated with an increased

TABLE 5: Percentages (numbers) of the opinions of veterinarians on the accuracy of six statements relating to the potential advantages and disadvantages associated with neutering at eight to 20 weeks compared with neutering at six months of age

Compared with kittens neutered at six months of age, kittens have an increased risk of …	Response: True	False	Don't know
Anaesthetic complications if neutered at:			
8 to 11 weeks	56·7 (493)	26·8 (233)	16·5 (143)
12 to 16 weeks	29·1 (253)	53·7 (467)	17·1 (149)
17 to 20 weeks	7·8 (68)	80·6 (700)	11·6 (101)
Surgical complications if neutered at:			
8 to 11 weeks	22·7 (197)	59·6 (518)	17·7 (154)
12 to 16 weeks	13·7 (119)	71·9 (625)	14·4 (125)
17 to 20 weeks	4·9 (43)	86·5 (752)	8·5 (74)
Perioperative infection of illness if neutered at:			
8 to 11 weeks	17·1 (149)	65·5 (569)	17·4 (151)
12 to 16 weeks	7·8 (68)	79·3 (689)	12·9 (112)
17 to 20 weeks	3·5 (30)	88·7 (771)	7·8 (68)
Developing lower urinary tract if neutered at:			
8 to 11 weeks	26·0 (226)	30·6 (266)	43·4 (377)
12 to 16 weeks	24·1 (209)	34·6 (301)	41·3 (359)
17 to 20 weeks	15·4 (134)	46·5 (404)	38·1 (331)
Later problems associated with delayed growth and plate closure if neutered at:			
8 to 11 weeks	26·4 (229)	24·3 (211)	49·4 (429)
12 to 16 weeks	23·0 (200)	29·6 (257)	47·4 (412)
17 to 20 weeks	14·7 (128)	42·5 (369)	42·8 (372)
Compared with neutering at six months, neutering at … is more effective in controlling the number of unwanted cats			
8 to 11 weeks	40·6 (353)	40·2 (349)	19·2 (167)
12 to 16 weeks	49·0 (426)	33·9 (295)	17·0 (148)
17 to 20 weeks	62·6 (544)	21·3 (185)	16·1 (140)

risk of anaesthetic complications and 14 per cent considered that there was an increased risk of surgical complications, compared with the risks associated with neutering cats at six months of age (Table 5). The opinions of these veterinarians do not appear to be supported by published evidence; Howe (1997) reported that neutering kittens as young as seven weeks of age was associated with a more rapid recovery from anaesthesia than neutering kittens at seven months of age, and the duration of surgery was shorter for cats neutered at 12 to 23 weeks of age than for those neutered when 24 weeks or older. Olson and others (2001) considered that early neutering was safe for kittens if anaesthetic and surgical protocols were modified appropriately, and that surgical morbidity rates might be lower in animals neutered early than in those neutered at the more conventional age of six to nine months. Aronsohn and Faggella (1993) reported the neutering of 96 kittens aged six to 14 weeks with no major anaesthetic complications arising. The association between these two factors (risk of anaesthetic and surgical complications) and the veterinarians' opinions on the appropriateness of neutering 12- to 16-week-old kittens thus appears to be unjustified.

The veterinarians who thought that kittens aged 12 to 16 weeks have, or may have, an increased risk of developing lower urinary tract disease than kittens neutered at six months of age, were approximately 50 per cent less likely to think that neutering client-owned domestic cats aged 12 to 16 weeks was appropriate than the veterinarians who thought that there was no increased risk. This perceived increased risk appears to be unfounded; Howe and others (2000) followed up cats for up to three years after gonadectomy and reported no adverse medical consequences, including no increased risk of lower urinary tract disease in early-neutered cats, and Root and others (1996) reported that the age of neutering was not associated with a decrease in urethral diameter.

The veterinarians who thought that a rescue charity policy of neutering all kittens before they were adopted would justify the neutering of all male and/or female kittens at eight to 11 weeks of age were approximately six times more likely to think that neutering 12- to 16-week-old domestic kittens was appropriate. Thus, the opinion that neutering kittens housed at rescue centres was appropriate at eight to 11 weeks of age was strongly associated with the opinion that neutering 12- to 16-week-old client-owned kittens would also be appropriate.

There was a negative linear relationship between the number of years since graduation from veterinary school and the likelihood of a veterinarian considering that neutering was appropriate for 12- to 16-week-old kittens, the likelihood decreasing slightly with every additional year since graduation. Hence, a veterinarian who graduated in 1986 (20 years before the data were collected) was associated with an odds ratio of 0·44 ($0{\cdot}96^{20}$), whereas one who graduated in 2005 was associated with an odds ratio of 0·96 ($0{\cdot}96^{1}$). Thus, a veterinarian who graduated 20 years ago was approximately half as likely to consider that neutering kittens aged 12 to 16 weeks old was appropriate than one who had graduated the previous year. This relationship may be due to a gradual reduction in the recommended age of neutering kittens, to increases in the early neutering training of undergraduates, and/or to a reluctance of older veterinarians to change their opinions about the minimum age at which it is appropriate to neuter kittens. More recently qualified veterinarians have more information and may thus be more open-minded about the 'early' neutering of kittens.

The age at which a practice recommended neutering client-owned domestic kittens was associated with the veterinarian's opinion on the appropriateness of neutering 12- to 16-week-old kittens. The likelihood of a veterinarian considering that neutering was appropriate for 12- to 16-week-old kittens decreased as the age at which the veterinarian's practice recommended neutering increased. This association might have been expected because some of the veterinarians would have had an input into the age for neutering kittens recommended by the practice.

TABLE 6: Multivariable logistic regression model of odds ratios (ORs), 95 per cent confidence intervals (CIs) and P values of factors associated with a vet's opinion of whether or not it is appropriate to neuter clinically healthy client-owned domestic 12- to 16-week-old kittens

Variable	Cases (%) (n=161)	Controls (%) (n=386)	Adjusted* OR (95% CI)	P
Too many domestic cats				
No†	75 (46·6)	273 (70·7)	1·00	
Yes	86 (53·4)	113 (29·3)	2·13 (1·28-3·52)	0·004
Neutered 12- to 16-week-old kitten				
No†	96 (59·6)	373 (96·6)	1·00	
Yes	65 (40·4)	13 (3·4)	8·35 (3·91-17·8)	<0·001
Anaesthetic complications 12 to 16				
True/Don't know†	30 (18·6)	210 (54·4)	1·00	
False	131 (81·3)	176 (45·6)	2·50 (1·43-4·38)	0·001
Surgical complications 12 to 16				
True/Don't know†	11 (6·8)	132 (34·2)	1·00	
False	150 (93·2)	254 (65·8)	3·02 (1·36-6·70)	0·006
Lower urinary tract disease 12 to 16				
True/Don't know†	69 (42·9)	269 (69·7)	1·00	
False	92 (57·1)	117 (30·3)	1·81 (1·08-3·04)	0·02
Policy justifies 8- to 11-week neutering				
No†	58 (36·0)	318 (82·4)	1·00	
Yes	103 (64·0)	68 (17·6)	6·08 (3·65-10·11)	<0·001
Years graduated			0·96 (0·94-0·99)	0·005
Age recommended for neutering			0·75 (0·65-0·88)	<0·001

* Adjusted for all variables shown, † Reference category

The multivariable analysis showed that the opinions of veterinarians on the appropriateness of neutering kittens aged 12 to 16 weeks were related to factors such as their experience of neutering kittens in this age group in the previous 12 months, their perception of the advantages and disadvantages associated with the procedure and how long it had been since they graduated from veterinary school. Many of the veterinarians' opinions appear to be founded on prejudices, because the authors are not aware of any scientific studies that indicate that the risks of anaesthetic or surgical complications, or lower urinary tract disease are increased in kittens neutered at an early age. A criticism of the questionnaire is that the statements listed in Table 5 were phrased to suggest that neutering younger cats would be associated with disadvantages compared with neutering cats at six months of age, and may have led to a higher proportion of the veterinarians agreeing with the statements. However, the association between the opinions of the veterinarians about the appropriateness of neutering kittens aged 12 to 16 weeks and their opinions about the accuracy of these statements is unlikely to have been affected by this bias.

The veterinarians who received the questionnaire was a convenience-based sample of recipients of the Cats Protection veterinary newsletter, potentially including a higher proportion of veterinarians involved or interested in the work of feline rescue centres than a random sample of UK veterinarians. This sampling bias would probably have resulted in a higher proportion of the respondents being willing to neuter cats less than 20 weeks of age than among the UK veterinary population as a whole, as a result of their greater exposure to the 'early neutering' practices recommended for rescue cats and by some cat charities. In spite of this potential bias, the results provide evidence of a general reluctance by UK veterinarians to carry out 'early' neutering of clinically healthy, client-owned domestic cats. Further education and training of veterinarians in the techniques of neutering young kittens, and the provision of information on the advantages and disadvantages associated with neutering cats at different ages, is

recommended to reduce the age at which veterinarians are prepared to neuter kittens. Research into the attitudes of cat owners towards the age of neutering is also warranted.

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