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### Veterinary attitudes towards pre-pubertal gonadectomy of cats: a comparison of samples from New Zealand, Australia and the United Kingdom

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## Scientific Article

## Veterinary attitudes towards pre-pubertal gonadectomy of cats: a comparison of samples from New Zealand, Australia and the United Kingdom

MJ Farnworth\*<sup>§</sup>, NJ Adams\*, K Seksel<sup>†</sup>, NK Waran<sup>‡</sup>, NJ Beausoleil<sup>#</sup> and KJ Stafford<sup>#</sup>

### Abstract

**AIM:** To compare the attitudes and practices of a sample of veterinarians in New Zealand, Australia and the United Kingdom (UK) towards pre-pubertal gonadectomy of cats.

**METHODS:** Respondents' demographics were gathered using an electronic questionnaire distributed via professional veterinary associations in the target countries, as were minimum age at gonadectomy and typical age of puberty. Desirability of pre-pubertal gonadectomy was gauged using three response categories ('yes', 'no' or 'sometimes'), respondents were then able to justify the response given. Two-way Analyses of Variance (ANOVA) followed by *post hoc* Tukey HSD tests were used to test whether there were differences in minimum ages for gonadectomy within and between countries and between providers and non-providers of services to pounds (or animal welfare centres). Views on the desirability of pre-pubertal gonadectomy relative to demographics were explored using a Likelihood Ratio Test.

**RESULTS:** The survey received 717 responses. Most respondents believed pre-pubertal gonadectomy was either entirely or 'sometimes' desirable (556/621), few thought it was undesirable (65/621). Minimum age at gonadectomy was significantly affected by country surveyed and provision or non-provision of services for pounds. *Post hoc* Tukey HSD analysis indicated the mean age of both spaying and castration (4.3 months) in the UK was significantly different from both Australia (spaying: 3.4 months, castration: 3.2 months) and New Zealand (spaying: 3.4 months, castration: 3.2 months) (all  $p < 0.001$ ). Mean ages at spaying and castration were also significantly different ( $p = 0.008$ ;  $p = 0.019$ , respectively) for non-providers (spaying: 3.9 months, castration: 3.8 months) of services to pounds when compared to providers (spaying and castration: both 3.6 months).

Likelihood Ratio Tests indicated significant effects amongst countries and between genders relative to the desirability of pre-

pubertal gonadectomy. Respondents from the UK were more likely to answer 'no' ( $p = 0.004$ ) or 'sometimes' ( $p = 0.050$ ) as compared to those from New Zealand or Australia. Females were more likely to respond with 'sometimes' as opposed to 'yes' than males. Reasons for considering pre-pubertal gonadectomy desirable or sometimes desirable focussed on reducing unwanted pregnancies and improving population control, as well as improving rates of adoption, owner compliance and cat behaviour and health.

**CONCLUSIONS AND CLINICAL RELEVANCE:** In general, pre-pubertal gonadectomy is considered a desirable procedure by those practitioners that responded to the survey. However age at which any such procedure occurs differs depending upon a number of factors. Differences among countries may relate to the specific veterinary association's guidelines or possibly differences in social discourse which affect perception of cats. There is substantial overlap between the reported minimum age of gonadectomy and the age at which cats can enter early puberty, allowing a window for unintentional pregnancy when pre-pubertal gonadectomy does not occur.

**KEY WORDS:** *Cat, castration, desexing, early, spay, sterilisation, pre-pubertal gonadectomy, early-age neutering*

### Introduction

Pre-pubertal gonadectomy in cats is defined as 'neutering well before the onset of puberty' (Howe *et al.* 2000) and is any time prior to 23 weeks. The traditional age for gonadectomy is 6 months (Howe 1997) with a normal range of 5 to 9 months (Preston Stubbs *et al.* 1996; Root Kustritz 2007). Pre-pubertal gonadectomy is a broad category which encompasses and exceeds 'early-age neutering' which, in New Zealand, is considered to

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ANOVA	Analysis of variance
ASAVA	Australian Small Animal Veterinary Association
BSAVA	British Small Animal Veterinary Association
BVA	British Veterinary Association
CAS	Companion Animal Society
F	Female
M	Male
NZVA	New Zealand Veterinary Association
TNR	Trap-Neuter-Release
UK	United Kingdom
USA	United States of America

occur between the ages of 1.5–4 months (Walsh and Worth 2008) and generally between the ages of 1.5–3.5 months in the United States of America (USA) (Root Kustritz 2002). The latter age is considered appropriate by proponents of early-age neutering in the UK (Joyce and Yates 2011). Both pre-pubertal gonadectomy and early-age neutering allow early sale or adoption of cats without the associated risk of breeding (Spain *et al.* 2004).

The age at which puberty occurs in cats varies substantially; however, it is generally considered to occur between 5 and 9 months for queens and 8 to 10 months for toms, but can occur as early as 3.5 months (Little 2011a,b). This indicates that the risks of accidental pregnancy or insemination are greater if pre-pubertal gonadectomy is performed closer to the traditional age of puberty, a risk that is seemingly mitigated through the use of early-age neutering. Studies in the United Kingdom (UK) and New York State in the USA indicate that 51% and 39% of practitioners respectively recommended gonadectomy no earlier than 6 months of age for client-owned cats (Spain *et al.* 2002; Murray *et al.* 2008). The appropriateness of gonadectomy at the traditional age is being debated (Joyce and Yates 2011). A contemporary study in the USA indicates that, at 6 months of age or younger, 43% of cats were spayed or neutered compared to 77% at between 6 and 12 months of age and 87% between 12 months and 4 years of age (Trevejo *et al.* 2011). This suggests that, in the USA at least, later gonadectomy continues to be a common practice.

Pre-pubertal gonadectomy is considered desirable for cats being re-homed from shelters (Spain *et al.* 2004) as it prevents unintended pregnancies whilst allowing animals to be re-homed early enough for effective socialisation to occur (Root Kustritz 2002). It is also recommended for tom cats to prevent potentially dangerous post-pubescent aggressive behaviour (Root Kustritz 2007). In addition to reducing the number of cats being relinquished to shelters, pre-pubertal gonadectomy may also reduce the number of adult cats entering shelters, as those relinquished are significantly more likely to be entire than spayed or neutered (Patronek *et al.* 1996). Anecdotally, practitioners may only encounter a cat once prior to pubescence, therefore encouraging and practicing pre-pubertal gonadectomy prior to sale or adoption may function to reduce the number of cats reaching sexual maturity. Particularly since post-adoption/post-purchase compliance with spay and neuter programmes, even if the surgery costs are pre-paid, is low (Bushby and Griffin 2011). In general, sexually entire cats younger than 10 months of age are less likely to be registered with a veterinarian and vaccinated annually (Murray *et al.* 2009), suggesting that some owners of cats may wait until after pubescence to engage veterinary services. Cat owner education about the benefits of early veterinary care, and in particular pre-pubertal gonadectomy, is therefore important.

Both surgical (Aronsohn and Faggella 1993a), anaesthetic (Aronsohn and Faggella 1993b) and analgesic (Mathews 2008) practices have been deemed safe for use in cats between the ages of 1.5 and 3.5 months. The immediate impact of surgery on pre-pubescent cats (e.g. in terms of pain experienced) during a critical developmental phase, as opposed to older more developed cats, remains relatively unexplored. There are few short-term (Howe 1997) or long-term side effects following pre-pubertal gonadectomy (Preston Stubbs *et al.* 1996; Howe *et al.* 2000; Spain *et al.* 2004) and there are potential behavioural benefits for early-age neutered toms (Spain *et al.* 2004). Reviews of the topic continue

to suggest that the benefits outweigh the costs, with the caveat that a practitioner must consider the anaesthetic risks to the patient (Bushby and Griffin 2011; Joyce and Yates 2011), consider its individual health parameters and consult with the owner (Reichler 2009). How contentious pre-pubertal gonadectomy (before 6 months of age) is has not been fully ascertained, however early-age gonadectomy (before 4 months of age) remains contentious due, in part, to the historical perception that it may carry long-term risks (Bushby and Griffin 2011). A recent study of 875 veterinarians in the UK showed that only 28% believed gonadectomy between 3 and 4 months of age was appropriate, less than 5% thought it appropriate below 3 months of age (Murray *et al.* 2008).

The attitudes of veterinarians, whether positive or negative, towards pre-pubertal gonadectomy will clearly impact upon its use and therefore its effectiveness in controlling the cat population. Much of the exploration around veterinary attitudes towards pre-pubertal gonadectomy has occurred in the USA (e.g. Spain *et al.* 2002) and the UK (e.g. Murray *et al.* 2008) and focussed on early-age gonadectomy. However 'traditional' veterinary attitudes and practices concerning pre-pubertal gonadectomy of cats may vary between countries, especially in countries such as New Zealand and Australia where the cat is both a popular pet and a 'pest' species subject to stringent controls, driven in part by public concern for native wildlife (e.g. New Zealand: Farnworth *et al.* 2011; Australia: Toukhsati *et al.* 2012).

This research sought to establish the general attitudes of veterinary practitioners towards pre-pubertal gonadectomy (minimum age at surgery and perceived costs or benefits to the patient) in three different countries, namely New Zealand, the UK and Australia. It was hypothesised that there would be a wide age range given for pre-pubertal gonadectomy of cats. Although the majority of cats will be pre-pubescent in this age range, cats which reach puberty early remain at risk of unwanted pregnancy and sexual activity. In addition, this research explored whether professional association with welfare centres impacted upon the age at gonadectomy and the perceived desirability of pre-pubertal gonadectomy. We hypothesised that the desirability of pre-pubertal gonadectomy and willingness to perform the procedure earlier would vary relative to country of practice. We also hypothesised that provision of services to welfare centres and pounds would significantly impact upon perception and use of the procedure.

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## Materials and methods

This study targeted companion animal veterinarians in New Zealand, Australia and the UK. A questionnaire containing 34 questions, taking approximately 10–15 minutes to complete (Supplementary Table 1<sup>1</sup>) was disseminated on-line (www.surveymonkey.com) through a direct link promoted by the New Zealand Veterinary Association's Companion Animal Society (NZVA-CAS), the British Veterinary Association (BVA) and British Small Animal Veterinary Association (BSAVA) and the Australian Small Animal Veterinary Association (ASAVA). To improve response rates, the associations and people responsible

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**Table 1. Responses (n = 717) to questions from a survey concerning pre-pubertal gonadectomy of cats. Responses are shown by country in which the respondent currently practices, New Zealand (n = 249), United Kingdom (n = 269) or Australia (n = 199). Data are represented as total number (percentage), median (total range) or mean (total range) for a given response.**

Variable	Response	New Zealand	United Kingdom	Australia
Gender (n = 717)	Male	104 (41.8)	91 (33.8)	50 (25.1)
	Female	145 (58.2)	178 (66.2)	149 (74.9)
Do you provide services for pounds or welfare centres? (n = 715)	Yes	119 (52.2)	144 (53.7)	67 (33.5)
	No	130 (47.8)	124 (46.3)	131 (65.5)
Is pre-pubertal gonadectomy desirable? (n = 621) <sup>a</sup>	Yes	125 (59.5)	108 (45.6)	110 (63.2)
	No	16 (7.6)	36 (15.2)	13 (7.5)
	Sometimes	69 (32.9)	93 (39.2)	51 (29.3)
Median years since graduation		20 (1–53)	18 (1–58)	14 (1–56)
Median percentage of workload comprising gonadectomy of cats		6–10% (0–85)	6–10% (0–80)	11–15% (0–80)
Median age (months) a cat is considered 'adult' for the purposes of analgesia and anaesthesia		5.5 (1–12)	5.5 (1–12)	5.5 (1–12)
Spaying: Mean minimum age (months) <sup>b</sup>		3.4 (<1–8)	4.3 (<1–6.5)	3.4 (1.5–6)
Castration: Mean minimum age (months) <sup>b</sup>		3.4 (1.5–6)	4.3 (<1–8)	3.2 (1–6)
Mean age at puberty (months)		5.9 (1.5–10)	5.6 (<1–10)	5.8 (2.5–9)

<sup>a</sup> UK respondents were more likely to respond 'no' ( $W = 8.342$ ;  $df = 1$ ;  $p = 0.004$ ) or 'sometimes' ( $W = 3.848$ ;  $df = 1$ ;  $p = 0.050$ ) as compared to 'yes' than those from either New Zealand or Australia. No significant differences were found between New Zealand and Australia

<sup>b</sup> Following *post hoc* Tukey HSD analysis UK respondents' minimum ages for spay and castration were significantly different (both  $p < 0.001$ ) to those for New Zealand and Australia. New Zealand and Australia did not significantly differ for either procedure

for promoting the survey were prompted to remind their members on two occasions during data collection.

Only responses to 16 of the 34 questions were considered in this paper. This included basic information about the respondent including gender, year of qualification and country of current residence. In addition, respondents were asked whether they currently performed services for pounds, shelters or animal welfare centres and, if so, what proportion of their caseload comprised such activities. In the final section respondents were asked the age at which they considered a cat to be adult for the purposes of analgesia and anaesthesia, the age at which they considered puberty to occur in cats, the minimum age at which they would perform a spay or castration, and whether or not they considered pre-pubertal gonadectomy to be desirable. In the case of questions concerning the minimum age that it is appropriate/acceptable for cats to undergo gonadectomy, response options were in 2-week increments. An open-ended discretionary question allowed respondents to clarify why they considered pre-pubertal gonadectomy to be desirable or undesirable. Respondents were also asked about their use of analgesics and anaesthetics during routine gonadectomy. Responses to those questions were not considered further in this paper.

### Statistical analyses

The data were described in terms of percentage of respondents providing a given answer as well as providing mean or median values and ranges where appropriate. Statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 19.0 for Windows (IBM Inc., Chicago IL, USA). A multiple logistic regression approach was used to examine the relationships among country of practice, time since graduation, gender of respondent and whether or not the respondent performed services for shelters, pounds or welfare centres on veterinary attitudes towards the desirability of pre-pubertal gonadectomy. This approach followed an assessment of the suitability of the data to this approach using Pearson Chi-square test.

Differences in minimum age at which spaying and castration were performed were assessed among the countries of practice and between providers and non-providers of services to welfare centres and pounds using a two-way ANOVA. Differences among countries relative to estimations of when puberty occurred were established using a one-way ANOVA. For 'minimum age at time of spay' a single outlier was removed (12 months, next highest category reported 6.5 months) and age categories were aggregated (1.5 and 2 months became '2'; 2.5 and 3 months became '3' etc.). These manipulations ensured that the assumption of homogeneity of variance, using Levene's test, were not violated ( $p > 0.05$ ). *Post hoc* Tukey HSD analysis was then used to establish where the significant difference occurred among countries of practice.

For open-ended responses to whether or not pre-pubertal gonadectomy was considered desirable, a descriptive analysis of common themes was conducted to allow comparisons among countries and to ascertain whether or not responses were consistent with the literature. Responses were categorised by using key words to limit the sample to possible cases (e.g. 'pregnancy'). Each case was then read and subjectively assigned to a theme by the researcher. For example a respondent indicating 'sometimes' with the rationale 'to prevent unwanted pregnancy' would enter the theme 'if unwanted pregnancy, unnecessary breeding or early oestrus are probable', if the rationale were 'owners often fail to spay females and pregnancy can occur' it was assigned to the theme 'if owner or purchaser is unlikely to sterilise at a later date/prior to mating'.

## Results

### Basic demographics

There were 717 responses to the survey. Of these 249 (34.7%) were from New Zealand, 269 (37.5%) were from the UK and

199 (27.8%) from Australia. For New Zealand this response rate represents 41.6% of the total NZVA-CAS membership (S Blaikie,<sup>2</sup> pers. comm.). The UK and Australian sample groups were less easily contacted and the percentage response rates for the UK (269/4500; 6%; T Sainty,<sup>3</sup> pers. comm.) and Australia (199/1460; 13.6%; M Cole,<sup>4</sup> pers. comm.) are substantially lower than those for New Zealand. A greater percentage of females (F) responded than males (M) (Table 1) when compared to the veterinary associations statistics which are as follows: ASAVA: F = 49.2%, M = 50.8%; BVA: F = 57.9%, M = 42.2%; NZVA-CAS: F = 49%, M = 51%. The age at which puberty was considered to occur was not significantly different between the countries surveyed (5.7–5.9 months;  $F_{(2,616)} = 1.534$ ,  $p = 0.217$ ).

The minimum age which was considered appropriate/acceptable for either spaying or castration was highly variable (<1.5 to 6.5 + months). A single respondent from New Zealand indicated a minimum age of 12 months for both procedures and these data were excluded from analysis as outliers. Most respondents considered pre-pubertal ( $\leq 5.5$  months) spaying or castration to be appropriate (579/609 and 583/617, respectively), although a substantial number of these did not consider early-age spaying or castration (<4 months) to be appropriate (192/579 and 177/583, respectively) (Table 2).

#### Differences between veterinary practitioners

Our data proved suitable for use in a multinomial logistic regression ( $\chi^2 = 4.145$ ;  $df = 4$ ;  $p = 0.387$ ). Likelihood ratio tests were used to assess the effect of each parameter in the model. To ensure the model was as parsimonious as possible, aspects of the multinomial logistic regression which lay well beyond the parameters for significance ( $p < 0.5$ ), namely time since graduation ( $\chi^2 = 0.854$ ;  $df = 2$ ;  $p = 0.652$ ) and whether or not the respondent performed services for shelters, pounds or welfare centres ( $\chi^2 = 0.696$ ;  $df = 2$ ;  $p = 0.704$ ) were excluded and a reduced model was then executed using the parameters which were either significant or close to significance ( $p < 0.1$ ). These were country of practice ( $\chi^2 = 17.424$ ;  $df = 4$ ;  $p = 0.002$ ) and gender of respondent ( $\chi^2 = 5.707$ ;  $df = 2$ ;  $p = 0.058$ ). Significant results were then obtained for country of practice ( $\chi^2 = 18.836$ ;  $df = 4$ ;  $p = 0.001$ ) and gender of respondent ( $\chi^2 = 8.496$ ;  $df = 2$ ;  $p = 0.014$ ) in the simplified model. These were retained and further analysed using parameter estimates to establish the magnitude of any effect.

Respondents from the UK were significantly more likely than respondents from New Zealand or Australia to report 'no' or 'sometimes' as opposed to 'yes' when asked if pre-pubertal gonadectomy was desirable ('no'  $W = 8.342$ ;  $df = 1$ ;  $p = 0.004$ ; 'sometimes'  $W = 3.848$ ;  $df = 1$ ;  $p = 0.050$ ). The likelihood ratio parameter estimates indicated UK respondents were 2.6 times more likely to say 'no' and 1.5 times more likely to say 'sometimes'. Non-significant differences were identified between the likelihood ratio parameter estimates that respondents from Australia or New Zealand would say 'no' or 'sometimes' as compared to 'yes' ('no'  $W = 0.067$ ;  $df = 1$ ;  $p = 0.796$ ; 'sometimes'  $W = 1.437$ ;  $df = 1$ ;  $p = 0.231$ ) (Table 1).

Levene's test indicated the response variable (minimum age at gonadectomy) showed similar variances across the two factors: country of origin and provision of charity services. Q-Q plots conducted for the response variable (age) for each of the levels of these two factors all plotted close to a straight line, indicating little departure from normality. In addition, ANOVA procedures may be reasonably robust to departure from normality if sample sizes are not dramatically different and are large. Our data fulfil both criteria. Given our survey design we feel confident that our responses from veterinarians are independent of each other. Accordingly, we used the two-way ANOVA protocol based on Type III sum of squares and estimated marginal means to perform the tests. This approach accounted for potential problems associated with uneven sample size among groups.

There were significant differences in the minimum age at which gonadectomy was performed for both spaying ( $F_{(2,265)} = 275.286$ ,  $p = 0.004$ ) and castration ( $F_{(2,263)} = 191.495$ ,  $p = 0.005$ ) among countries. Similarly, whether or not individuals provided services to pounds or animal welfare centres had a significant effect on the minimum age at which spaying ( $F_{(1,265)} = 76.657$ ,  $p = 0.008$ ) and castration ( $F_{(1,263)} = 37.932$ ,  $p = 0.019$ ) were performed (Table 3). *Post-hoc* Tukey HSD analysis indicated that, for country of practice, the difference lay between the UK as compared to New Zealand and Australia. For the UK both procedures had a significantly greater minimum age (spaying and castration  $p < 0.001$ ; Table 1). There were no significant difference between New Zealand and Australia for either procedure (spaying:  $p = 0.998$ ; castration:  $p = 0.434$ ) (Table 1). There was no significant interaction between country of practice and provision of services to shelters and pounds on minimum age at either spaying or castration ( $F_{(2,625)} = 0.240$ ,  $p = 0.787$  and  $F_{(2,623)} = 0.329$ ,  $p = 0.720$ , respectively).

The gender of the respondent had a significant effect upon the response to the question 'do you consider pre-pubertal gonadectomy to be desirable' (Table 4). Likelihood Ratio Tests indicated that men were significantly less likely to respond with 'sometimes' as opposed to 'yes' when compared to women ( $W = 8.146$ ,  $df = 1$ ,  $p = 0.004$ ). There was no significant difference in the likelihood that a woman or men would say 'no' as opposed to 'yes' ( $W = 0.166$ ,  $df = 1$ ,  $p = 0.683$ ).

#### Open-ended responses

Reasons for indicating that pre-pubertal gonadectomy was not desirable (Table 5) were similar across the three countries. These tended to focus upon negative consequences for the patient including perceptions that unspecified aspects of the procedure meant it was too risky, or respondents indicated they believed it to be unnecessary.

Those respondents that indicated it was 'sometimes' desirable considered it more desirable for cats that were likely to breed unintentionally, either through early oestrus or being in an uncontrolled environment (e.g. mixed-sex households). Support was also strong for the pre-pubertal gonadectomy of animals from shelters, pet shops and pounds rather than those kept as companions by private clients. Respondents from New Zealand and Australia appeared more concerned with owner compliance around gonadectomy than respondents from the UK, indicating that if animals were unlikely to be seen regularly pre-pubertal gonadectomy was preferable. Respondents from the UK showed strong support for the pre-pubertal gonadectomy of feral and stray cats, especially those that were to be returned to their point

<sup>2</sup> S Blaikie, Secretary of NZVA-CAS, Kapiti Coast, New Zealand

<sup>3</sup> T Sainty, Head of Membership, BVA, 7 Mansfield Street, London, UK

<sup>4</sup> M Cole, Administration Officer, ASAVA, Unit 40, 6 Herbert Street, St Leonards, New South Wales, Australia

**Table 2. Number (and %) of respondents to a survey on pre-pubertal gonadectomy that would spay (n = 609) or castrate (n = 627) a cat at a given minimum age. Rows equal total number of respondents.**

Procedure	Minimum age in months										
	<1.5	2	2.5	3	3.5	4	4.5 <sup>a</sup>	5	5.5	6	6.5+
Spaying	4 (0.5)	16 (3)	83 (14)	40 (7)	120 (20)	124 (20)	49 (8)	117 (19)	26 (4)	28 (4)	2 (0.5)
Castration	5 (1)	27 (4)	91 (15)	40 (6)	117 (19)	126 (20)	43 (7)	110 (18)	24 (4)	29 (5)	5 (1)

<sup>a</sup> 4.5 months is considered the cut-off point between the groups pre-pubertal/early-age and pre-pubertal only

**Table 3. Mean minimum age (response range) in months at which respondents to a survey on pre-pubertal gonadectomy (n = 632) that did or did not provide services for pounds or welfare centres performed spaying or castration of cats.**

Procedure	Provision of services to pounds or welfare centres	
	Yes (n=297)	No (n=335)
Spaying*	3.6 (<1–6.5)	3.9 (<1–6.5)
Castration**	3.6 (<1–8)	3.8 (<1–8)

Minimum age at which a given procedure would be performed was significantly different between practitioners that do and do not provide services for pounds or welfare centres:

\* ( $F_{(1,265)} = 76.657$ ;  $p = 0.008$ )

\*\* ( $F_{(1,263)} = 37.932$ ;  $p = 0.019$ )

of pick-up, rather than be rehomed. A small number (5–11%) considered it to be desirable only if the potential benefits, such as improved prospects for re-homing, outweighed specific concerns, for example, complications resulting from non-maturation of the reproductive tract in males. A substantial minority of those who responded either 'yes' (18–25%) or 'sometimes' (6–22%) also cited that the cat population required controlling due to over-population and/or public and ecological nuisance.

For veterinarians that indicated pre-pubertal gonadectomy was 'sometimes' desirable, those from the UK were 13 times more likely to use it as part of a Trap-Neuter-Release (TNR) programme than veterinarians from either New Zealand or Australia (26% vs. 2%). Conversely, veterinarians from Australia and New Zealand were nearly four times more likely to respond that there was a cat over-population problem associated with public or ecological nuisance (22% vs. 6%; Table 4).

In contrast to those indicating 'sometimes', respondents stating 'yes' believed that pre-pubertal gonadectomy improved the health and welfare of their patients by reducing the risk of mammary tumours and disease transmission (e.g. Feline Immunodeficiency Virus). They also felt that the earlier a procedure occurred the faster the recovery due to reduced tissue trauma. Many (26–49%) considered that the procedure made patients better pets by improving behaviour, through prevention of sexual behaviours such as spraying and roaming in males and behaviours associated with oestrus in females. By far the greatest reason for undertaking the procedure, reported by 55–57% of those that believed pre-pubertal gonadectomy was desirable, was to prevent unwanted litters and pregnancies.

## Discussion

This paper presents the first data on attitudes towards pre-pubertal gonadectomy in Australia and New Zealand and is the

**Table 4. Responses to the question 'Do you consider pre-pubertal gonadectomy to be desirable?' as reported for 621/717 respondents to a questionnaire concerning pre-pubertal gonadectomy of cats. Totals are given by gender of respondent with percentages in parentheses.**

Is pre-pubertal gonadectomy desirable?	Male	Female
Yes	128 (61.8)	215 (52.0)
No	23 (11.1)	42 (10.1)
Sometimes <sup>a</sup>	56 (27.1)	157 (37.9)

<sup>a</sup> Male veterinarians were significantly less likely to say 'sometimes' as opposed to 'yes' when compared with female veterinarians ( $W=8.146$ ;  $df=1$ ;  $p=0.004$ ).

There was no difference in the likelihood that either male or female veterinarians said 'no' as opposed to 'yes' ( $W=0.166$ ;  $df=1$ ;  $p=0.683$ )

first to use a single survey to explore the relative attitudes of veterinarians among these countries and the UK. There were no significant differences in the age at which puberty was typically considered to occur (5.7–5.9 months). Therefore differences in the reported minimum ages for spaying and castration are not simply artefacts of an overall difference in age at which cats are considered to enter puberty among the three countries.

It is important to note that the subject of this survey, pre-pubertal gonadectomy, encompasses early-age neutering, therefore confounding of the results is inevitable. Most veterinarians in the sample did not oppose pre-pubertal gonadectomy and substantially fewer opposed this than is found for early-age neutering in the UK (Murray *et al.* 2008). However, pre-pubertal gonadectomy can encompass ages that are considered 'conventional' (e.g. 5 months (Preston Stubbs *et al.* 1996)). As such, reduced opposition when compared to early-age neutering is likely. Most respondents would spay or castrate cats at an age considered to be pre-pubertal, however a substantial minority (35%) would not perform these procedures at ages congruent with 'early-age neutering'. As puberty onset varies widely, and can occur as early as 3.5 months of age (Little 2011a), cats may enter puberty and become pregnant, or sire young, between the ages typically used to categorise early-age (4 months) and pre-pubertal (<6 months) gonadectomy. If gonadectomy is to be used to maximum effect for limiting the unwanted cat population then it is reasonable that practitioners should consider implementing spaying and castration at ages between 3.5 months of age (Root Kustritz 2002) and 4 months of age (Walsh and Worth 2008). Our data indicate that veterinarians in New Zealand and Australia are significantly more likely to spay or neuter cats at or below these ages compared to veterinarians in the UK. Accordingly, many New Zealand and Australian veterinarians are already meeting the age targets for gonadectomy currently being encouraged in the literature ( $\leq 3.5$  months (Joyce and Yates 2011)).

The difference in minimum age for spaying and castration among countries has at least three possible explanations. The first is that

**Table 5. Major themes arising from descriptive analysis of respondents' reasoning behind answers to the question 'Do you consider pre-pubertal gonadectomy to be desirable?' when responding to a survey about pre-pubertal gonadectomy in cats. Data are represented as percentage of total providing a specific response. Total number of written responses = 553. Due to their open-ended nature, single responses may contain multiple themes.**

Response	Major themes	Theme cited by respondents from		
		New Zealand	Australia	UK
No (n = 51)	Unnecessary/costs outweigh benefits	6/14 (43%)	4/11 (37%)	7/26 (28%)
	Affects growth and hormonal profile	0/14 (0%)	2/11 (18%)	7/26 (28%)
	Causes health problems	3/14 (21%)	1/11 (9%)	4/26 (16%)
	Procedure (e.g. anaesthesia) carries excessive risk	2/14 (14%)	2/11 (18%)	4/26 (16%)
	Personal objection	3/14 (21%)	2/11 (18%)	4/26 (16%)
Sometimes (n = 190)	If unwanted pregnancy, unnecessary breeding or early oestrus are probable	18/60 (30%)	12/46 (26%)	28/84 (33%)
	If the animal is from a shelter, pet shop or to be re-homed early	16/60 (27%)	17/46 (37%)	17/84 (20%)
	If owner or purchaser is unlikely to sterilise at a later date/prior to mating	17/60 (28%)	15/46 (33%)	5/84 (6%)
	To prevent the cat over-population problem/nuisance/ecological damage.	13/60 (22%)	10/46 (22%)	5/84 (6%)
	If stray or feral or a colony cat (TNR) <sup>a</sup>	1/60 (2%)	1/46 (2%)	22/84 (26%)
	If the risks to health are outweighed by benefits (e.g. able to be re-homed)	3/60 (5%)	4/46 (9%)	9/84 (11%)
	Can prevent problem behaviours (e.g. roaming/spraying).	7/60 (12%)	5/46 (11%)	5/84 (6%)
	If requested by owner or breeder.	4/60 (7%)	2/46 (4%)	2/84 (2%)
	Depends on individual cat (size, maturity)	3/60 (5%)	3/46 (7%)	3/84 (4%)
	For females only	3/60 (5%)	3/46 (7%)	2/84 (2%)
	Depending on time of year/season	3/60 (5%)	2/46 (4%)	1/84 (1%)
	If it minimises disease risk (e.g. FIV) <sup>b</sup>	2/60 (3%)	0/46 (0%)	1/84 (1%)
Yes (n = 195)	Prevents unwanted litters/pregnancies	71/126 (56%)	48/88 (55%)	51/90 (57%)
	Improves behaviour	49/126 (39%)	43/88 (49%)	23/90 (26%)
	Better way to control population/prevent nuisance or ecological damage	31/126 (25%)	16/88 (18%)	17/90 (19%)
	Improves health and welfare outcomes / faster recovery	19/126 (15%)	16/88 (18%)	8/90 (9%)
	Easier, safer or less traumatic for patient	16/126 (13%)	11/79 (13%)	7/90 (8%)
	Ensures owner compliance	9/126 (7%)	9/88 (10%)	5/90 (6%)
	No reason not to/no evidence of risk	3/126 (2%)	2/88 (2%)	1/90 (1%)

<sup>a</sup> TNR: the process by which unowned cats are spayed or neutered and returned to the area they were captured but are not adopted or housed

<sup>b</sup> FIV: feline immunodeficiency virus

the difference between New Zealand and the UK may lie in the practices endorsed by the veterinary associations of each country. The NZVA policy states that it 'supports pre-pubertal desexing of dogs and cats from 8 weeks of age' (NZVA 2009) whilst the BVA and BSAVA follow the guidelines of The Cat Group, who argue 'a case for 'earlier' neutering at around 4 months' (Anonymous 2012). However, the ASAVA guidelines state that 'Veterinarians should exercise their professional judgement of the appropriate age for desexing individual cats'. The fact that Australian practitioners show agreement with those in New Zealand indicates that other aspects may be affecting minimum age at gonadectomy beyond explicit veterinary association guidelines.

The introduction of cats, and their resulting impact on naïve native fauna, means they are considered a pest species in New Zealand (Farnworth *et al.* 2010) and Australia (Bengsen *et al.* 2011). An informal search of the scientific literature did not reveal similar discussions within the UK. Neutering at the earliest possible age is cited as a major route by which cat population, and therefore impact, can be curbed (Bushby and Griffin 2011) without compromising cat welfare. For veterinarians that indicated pre-pubertal gonadectomy was 'sometimes' desirable, the foci of the open-ended responses differed between countries. In the UK pre-pubertal gonadectomy was more often reported as desirable as part of a TNR programme compared with New

Zealand or Australia. Conversely, veterinarians from Australia and New Zealand were more likely to report a perception that there was a cat over-population problem. Although both responses are associated with a perceived need to manage the cat population, anecdotally TNR is not commonly used in New Zealand or Australia as it does not mitigate the immediate effects of stray or feral cats. Farnworth *et al.* (2011) have previously shown that TNR for stray and feral cats in New Zealand is only marginally more popular with the general public than lethal trapping.

The second possibility is that veterinarians in Australia and New Zealand undertake gonadectomy sooner as a result of the propensity in those countries for stray and feral cats to be controlled using lethal methods. Further exploration of veterinary attitudes towards stray and feral cats in these countries may be of value.

Finally, a third possibility may result from the sampling method. The UK convenience sample included both the BVA and BSAVA, the memberships of which overlap. Samples from New Zealand and Australia only included the associations that concern small animal practitioners. It is possible that the general membership opinions of the BVA and BSAVA differ. The BSAVA members may or may not have more knowledge of current practices as they relate specifically to cats, and shelter medicine, than the more general BVA membership.

Unfortunately this research cannot determine this as it cannot distinguish between responses from these two UK groups.

Although provision of services to welfare centres or pounds was not found to affect the desirability of pre-pubertal gonadectomy, it did have a significant effect on the minimum age at which gonadectomy occurred. Providers of such services were more likely to use early-age neutering than non-providers. Given that shelters often require gonadectomy of animals before adoption and early adoption is preferred to allow effective socialisation (Root Kustritz 2002), it is perhaps unsurprising that they spay and castrate earlier. Shelters may be more able to implement earlier gonadectomy as there are no requirements for owner consent for relinquished cats. Veterinarians who provide such services may also be more likely to be exposed to cat overpopulation problems and euthanasia of unwanted cats than non-providers. Similarly, the literature indicates that early-age neutering, rather than pre-pubertal gonadectomy, is considered useful for shelter cat management (Spain *et al.* 2004; Trevejo *et al.* 2011). This may be positively encouraged from as young as 1.5 months when re-homing cats (Bushby and Griffin 2011; Joyce and Yates 2011), mainly for the improvement of animal welfare and population management reasons. Consistent with this, respondents indicating that pre-pubertal gonadectomy was 'sometimes' desirable primarily focussed on its ability to benefit cats from a shelter (Root Kustritz 2007). They also indicated it was useful to ensure owner compliance with recommendations for gonadectomy, which has been shown to be low (Bushby and Griffin 2011). Given that many cats are free-roaming before the traditional neutering age of 6–8 months, focussing only on cats from shelters, or those of recalcitrant owners, may not be sufficient to curb population growth. A study in the USA indicated that there was a clear difference in veterinary perception of the need for pre-pubertal gonadectomy depending on whether the patient originated from a shelter or a private client (Spain *et al.* 2002). This may be problematic, as evidence from the UK suggests that for cats the majority of unplanned pregnancies occur between 4–9 months of age (Murray *et al.* 2009). Therefore the longer an owned cat remains entire the greater the risk of accidental pregnancy.

Our study indicated differences in the desirability of pre-pubertal gonadectomy based upon country of practice and the gender of the respondent. However, in contrast to Murray *et al.* (2008), we found no relationship between the acceptability of neutering between 3–4 months and time since graduation. Respondents from the UK were significantly more likely than those from New Zealand or Australia to indicate that pre-pubertal gonadectomy was undesirable or only desirable in certain circumstances. This may reflect the current discussion of early-age neutering which continues to be considered controversial in the UK (Murray *et al.* 2008; Joyce and Yates 2011; Sparkes 2011). This may not be the case for New Zealand and Australia, however further research should consider, and make explicit, the differences between the terms 'early-age neutering' and 'pre-pubertal gonadectomy'. Overall, male practitioners were more likely to unequivocally answer in the affirmative when compared to females.

Veterinarians who stated it was undesirable to perform pre-pubertal gonadectomy often focussed on the perceived risks, including long-term health problems. These have been cited as potential issues in early literature (e.g. Romatowski 1993), however all subsequent explorations of the effects of patient age on post-surgical complications or developmental problems

conclude that there is little or no foundation to these concerns (Howe *et al.* 2000; Reichler 2009; Bushby and Griffin 2011). We suggest that rejection of pre-pubertal gonadectomy may fail to consider the wider implications of cat overpopulation, including high euthanasia rates for unwanted cats (Spain *et al.* 2004). Based upon euthanasia statistics alone, it has been suggested that veterinarians should perhaps receive greater education around the procedures and benefits of early-age neutering (Root Kustritz 2007). Practitioners that indicated pre-pubertal gonadectomy was desirable identified a range positive benefits including behavioural benefits (see Spain *et al.* 2004) and the potential to improve population management (see Reichler 2009; Joyce and Yates 2011). They also cited that there were fewer surgical complications during pre-pubertal gonadectomy (Howe 1997).

Our New Zealand sample is a more substantial proportion of NZVA-CAS members than is the case for equivalent professional organisations in the UK and Australia. Consequently, our conclusions should be considered with some degree of caution.

In conclusion, it is evident that pre-pubertal gonadectomy is contentious for a small minority, but less so than early-age neutering. In New Zealand and Australia pre-pubertal gonadectomy and early-age neutering are common. Veterinarians who provide services to pounds and welfare centres spay and castrate animals earlier than those who do not, possibly due, in part, to a greater recognition of the social and environmental effects of cat overpopulation. Continued education about the benefits of pre-pubertal gonadectomy and the lack of empirical evidence supporting health concerns may continue to improve its acceptance. This is of particular relevance to the substantial proportion of veterinarians that consider pre-pubertal gonadectomy relevant only to certain groups of cats (e.g. those from shelters). As time of implementation for any veterinary procedure is also dependent upon owners' attitudes towards them, we propose this would be a suitable topic for future research. Given that our results indicate that veterinary attitudes may differ between countries, it is important to explore them both nationally and comparatively rather than relying on inference from studies in other nations.

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