



## Research

## Effect of early-age gonadectomy on behavior in adopted shelter kittens—The sequel

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## ABSTRACT

Veterinary practitioners are often concerned about kitten safety during prepubertal gonadectomy and about the potential effects of this technique on health and behavior. Previous studies such as the Sterycat project, a prospective study with randomized treatment (prepubertal gonadectomy of shelter cats aged 8–12 weeks) and control (gonadectomy of shelter cats aged 6–8 months) groups, concluded that there were no differences in the occurrence of potentially undesirable or undesirable behaviors expressed by adopted shelter cats. The purpose of this study was to extend data collection within the framework of the Sterycat project. Behavioral data were collected from owners via an online survey, between 5 and 7 years after adoption. Our data from 162 cats (110 prepubertal and 52 traditional age gonadectomy) indicated no effects of age at gonadectomy on the total number of potentially undesirable or undesirable behaviors per cat, nor on the occurrence of individual behaviors commonly known to be expressed by cats and likely to be problematic to the owner. There are no indications that prepubertal gonadectomy leads to different occurrence of potentially undesirable and undesirable behaviors than gonadectomy at traditional age. Consequently, there are no behavioral objections against the practice of prepubertal neutering of shelter cats.

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## Introduction

If surgical gonadectomy in cats is the most reliable and permanent method of contraception to date (ACC&D, 2013; Looney et al., 2008; Reichler, 2009), then prepubertal gonadectomy, that is, removal of the gonads before a cat becomes sexually mature, increases that efficiency compared to gonadectomy at the traditional age of 6 months or later. In case of the latter, some cats may have already reached adolescence before the procedure, potentially resulting in successful insemination, gestation, and parturition (Jackson, 1984; Jemmett and Evans, 1977).

Reservations toward prepubertal gonadectomy raised by veterinary practitioners are situated at the level of the technical aspects of the procedure (anesthetic and surgical protocols), the short- and long-term health outcomes, as well as concerns regarding the behavioral development of kittens. All but one of the studies investigating the effect of early gonadectomy on cat behavior claimed that behavior did not seem to be affected by prepubertal gonadectomy (Murray et al., 2008; Porters et al., 2014b; Spain et al., 2002; Stubbs et al., 1996). The remaining studies found a decrease in occurrence of hyperactivity, increased timidity toward strangers in males and females, and an increase in hiding behavior in males when those behaviors were considered not to be serious problems by the owners (Spain et al., 2004).

Until the study by Porters et al., (2014b), no long-term prospective studies with randomized treatment-control groups existed. Through the 4-year Sterycat project, which started in 2010, Porters et al., (2014b) were able to show that early gonadectomy had no effect on behavioral development in shelter kittens.

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However, the study did not register data beyond 24 months after adoption, a time point corresponding to the start of social maturity in cats (Overall, 1997; Lowe and Bradshaw, 2001; Ley, 2016). Furthermore, because the Sterycat project was limited in duration, not all cats included in the project had been adopted for 24 months when data collection ended midway 2013. The authors recognized both aspects as a weakness in the study but intended to resample the cats at a later point in time, to investigate the effects of prepubertal gonadectomy on behavior of the cats as adults.

The purpose of the present study was to extend the data collection within the framework of the Sterycat project, that is, to collect data from the original Sterycat project cats beyond 24 months after adoption. The data sets from the original Sterycat project and a follow-up study were combined in a longitudinal analysis, comparing behavior in cats that had been neutered at the estimated age of 8–12 weeks versus the traditional age of 6–8 months. Two hypotheses were examined. The first hypothesis was identical to that of Porters et al., (2014b) was that age at gonadectomy does not affect the total number of (potentially) undesirable behaviors in adopted shelter cats. The second hypothesis was not examined by Porters et al., 2014b: age at gonadectomy does not affect the occurrence of individual undesirable behaviors.

## Materials and methods

The protocols of the Sterycat project and the follow-up study were approved by the local Ethical Committee (Faculty of Veterinary Medicine, Ghent University, Belgium) (license number EC 2010/019, 2011/077, and 2016/108) and the Deontological Committee (Sterycat project: Federal Public Service Health, Food Chain Safety and Environment, Brussels, Belgium; follow-up study: Environment Department, Brussels, Belgium).

### Animals

The initial study population has been described earlier (Porters et al., 2014b). Briefly, kittens estimated to be aged between 8 and 12 weeks were recruited from Flemish shelters between May 2010 and August 2012. The selected kittens underwent gonadectomy at the age corresponding to the group they had been randomly assigned to (2/3 at the age of 8–12 weeks, being the prepubertal gonadectomy group [PPG]; 1/3 at the age of 6–8 months, being the traditional age gonadectomy group [TAG]). The details of the anesthetic and surgical protocols, as well as complication rates in PPG and TAG cats have been reported elsewhere (Porters et al., 2014a; 2015).

### Postadoption survey instrument

As described in Porters et al., (2014b), people who had adopted kittens included in the Sterycat project were requested to complete an online survey at 5 different time points, that is, 2, 6, 12, 18, and 24 months after adoption. Data collection for this part of the study ended midway in 2013. Next, a follow-up to that study was conducted in 2016 by creating an online questionnaire using a subset of questions from the original survey, sufficient to repeat the analysis on the “long-term survey” data as referred to in Porters et al., (2014b). Because the online platform from the Sterycat study was no longer available, the follow-up survey was conducted using SurveyMonkey instead.

Because the follow-up study was a Master’s student project, and thus even more limited in time than the original Sterycat project, it was not possible to distribute surveys to the owners according to the date of entry into the project, that is, the adoption date. Doing so would have allowed sampling cats at a specific point in time after

adoption, as had been the case in Porters et al., (2014b). Instead, all owners were sent the invitation for the follow-up survey in September 2016. As a result, time after adoption at the time of this last survey ranged from 60 to 84 months (5–7 years).

The data presented in this article concern the occurrence of the same behaviors as listed in Porters et al., (2014b). The definitions of the behavioral categories remained unchanged: potentially undesirable behaviors are those behaviors indicated by the owners that may be potentially troublesome to the owners (based on available literature), whereas undesirable behaviors are a subset thereof, that is, cat behaviors indicated by the respondents as being exhibited and being disturbing to them and/or their family members. Respondents were asked whether a certain behavior was currently expressed by their cat and, if not, whether it had been expressed in the last 2 years. When a respondent answered affirmatively to either of these 2 questions, they could indicate whether the behavior was considered by them and/or other family members to be disturbing.

### Statistical analysis

The data obtained from the follow-up survey were first examined using descriptive statistics. Next, inferential statistical analyses were performed on the combined data set, which included data from the cats collected at 2, 6, 12, 18, and 24 months after adoption (Porters et al., 2014b), as well as from the follow-up survey conducted at 60–84 months after adoption.

#### *Effect of treatment and sex on the total number of (potentially) undesirable behaviors per cat*

Similar to the methods used for the Sterycat project (Porters et al., 2014b), for each survey, the total number of either potentially undesirable or undesirable behaviors was calculated per cat at each of the 6 time points the survey had been conducted. Before the analysis, data were tested for normality and for equal distribution of male and female cats in the PPG and TAG groups using a chi-square test. If data were not normally distributed, a log10 transformation of the data was performed for the analysis.

Next, the effects of gonadectomy at 2 different ages (PPG vs. TAG), of sex, and of time point of survey administration were examined by means of a repeated measures model allowing for correlation between the responses at different time points for a specific kitten, using PROC MIXED (SAS, v. 9.4). Two models were built, 1 for total number of potentially undesirable behaviors and 1 for total number of undesirable behaviors, using those 3 factors and their interactions as fixed effects. Time point was included as repeated statement and kitten ID as subject. Using a stepwise backward regression method, which gradually eliminates nonsignificant effects from the model, the final model was determined.

#### *Effect of treatment and sex on the occurrence of individual potentially undesirable behaviors*

The previous analysis examined the total number of (potentially) undesirable behaviors per cat. The rationale for this parameter was developed in the study by Porters et al., (2014b). We assumed that the more potentially undesirable and/or undesirable behaviors a cat shows, the more likely that cat is to be incompatible with the human household and the higher the risk of relinquishment will be. In approaching the analysis in this way, however, we ignored a lot of information about individual behaviors because owners consider some behaviors of their cat to be more problematic than others (Casey et al., 2009). Consequently, we decided to deepen the analysis by Porters et al., (2014b) and, in this article, also examined the effect of prepubertal gonadectomy on the occurrence of certain individual behaviors. We selected 10 behaviors, based on their high occurrence as reported in the questionnaires at most of

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