Original Article

Impacts of Species, Gender Disparities, and COVID-19 Lockdowns on Population Control: Insights from 337,590 Dogs and Cats in Bangkok Metropolitan Administration (BMA), Thailand (2009-2023)

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Abstract

Surgical sterilization stands as a key solution to address the overpopulation of dogs and cats, with numerous influencing factors impacting the success of population control efforts, including species, gender, and financial conditions. The emergence of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), or COVID-19, in 2020 has significantly altered human life and impacted pet animals. Lockdown restrictions were implemented in various countries, including Thailand, affecting the cumulative data of neutered animals, which was subsequently analyzed in this study. There were 337,590 dogs and cats from 2009 to 2023, and the data were systematically categorized by years, species, and gender. The findings revealed a higher prevalence of sterilization in cats compared to dogs, with females undergoing the procedure more frequently than males. Our results indicated that careful consideration should be directed toward the national policy of pet sterilization, with a focus on gender differences and the growing cat population in society. The significance and benefits of sterilization should be equally emphasized for both genders and must be highlighted as a matter of both public and national concern. Notably, the number of neutered animals during the COVID-19 restriction period was lower than in the non-restriction period. The consequence could result in worsening the overpopulation problem soon, suggesting that the national rabies prevention and population control program must be more concerned.

Keywords: cat, COVID-19, dog, gender, surgical sterilization

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Introduction

In Thailand, the Department of Livestock Development reported that 2016 the canine and feline population was approximately ten million. The surge in pet ownership has led to issues of abandonment and overpopulation. Addressing this challenge, surgical sterilization emerges as a key strategy, involving procedures like ovariohysterectomy (spaying) for females and orchidectomy (castration) for males. Beyond population control, surgical sterilization in dogs and cats proves beneficial in addressing specific health concerns, such as pyometra and mammary gland tumors in females, as well as androgen-induced conditions like benign prostatic hyperplasia (BPH) and testicular neoplasia in males (Fukuda, 2001; Reichler, 2009; Robbins, 2003). Additionally, early neutering before 5.5 months of age has shown efficacy in reducing behavioral problems like roaming, mounting, fighting, and unwanted urine spraying, especially in male cats (Spain *et al.*, 2004). Nevertheless, the surgical method raises certain concerns, including the risks associated with anesthesia and surgery, as well as potential issues such as obesity and urinary incontinence in female dogs (Burrow *et al.*, 2005). Moreover, there is an elevated risk of joint disorders in Labrador and Golden Retrievers when neutered before six months of age (Hart *et al.*, 2014).

While surgical neutering has traditionally served as the primary method for achieving permanent contraception in dogs and cats, the success of population control is influenced by various factors. These factors include age, species, gender, owner attitudes, social influence, ethics, economy, and financial conditions, with the latter being identified as the most critical factor according to the previous study (Finkler and Terkel, 2012). In Thailand, the Veterinary Public Health Division of the Department of Health, under the Bangkok Metropolitan Administration (BMA), provides free-of-charge surgical neutering services for dogs and cats. This initiative has proven instrumental in significantly reducing the incidence of pet overpopulation in Bangkok.

The recent outbreak of the coronavirus disease 2019, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was a primary global concern, including in Thailand from 2019 to 2022. COVID-19 profoundly impacts various aspects of human life, including the economy, physical health, mental health, and lifestyle (Haleem and Javaid, 2020). Due to the high spread of COVID-19, the government implemented policies such as social distancing and lockdowns, depending on the severity of the disease at that time. In Thailand, Bangkok experienced lockdowns in two episodes, from March to July 2020 and from December 2020 to July 2021, corresponding to the outbreak's first and second to third waves, respectively. The effects of COVID-19 were not limited to humans; pets also experienced disruptions in daily life, social behavior, and finances (Carrol *et al.*, 2022; Piotti *et al.*, 2021).

The objective of this study was to elucidate the prevalence of species and gender on surgical sterilization rates within the Bangkok Metropolitan Administration (BMA) from 2009 to 2023. Additionally, we aimed to investigate whether the implementation of lockdown restrictions by the Bangkok Metropolitan Administration to contain COVID-19 had any discernible impact on the program for controlling the population of dogs and cats.

Materials and Methods

The animal data were obtained from the Veterinary Public Health Division, Department of Health, The Bangkok Metropolitan Administration (BMA), Thailand, over 15 years (2009-2023), including species, gender, and the number of animals enrolled in BMA neuter clinics. Additionally, data on the COVID-19 lockdown periods were obtained from the Department of Disease Control website (https://ddc.moph.go.th) to identify the specific periods of lockdown imposed due to the COVID-19 pandemic. All data were cumulated into the spreadsheet using Microsoft Excel (Office 365) (Microsoft Corporate, Redmond, Washington, USA). The number of species (dog or cat) and genders (male or female) were calculated. The data were analyzed using SAS programs for Windows version 9.4 (SAS Institute Inc., Cary, NC, USA) with $p < 0.05$ considered significant. The normality was tested using a Kolmogorov-Smirnov test. The variables examined in the study included gender, species, COVID-19 lockdown month, and the number of neutered animals. Pearson's and Spearman's correlation tests were used to examine the relationship between parametric and non-parametric variables, respectively. Furthermore, to compare the gender and species data, an independent T-test was utilized to evaluate the significant differences between the variables.

Results

The BMA neuter clinics enrolled 337,590 dogs and cats from 2009 to 2023, and the data were systematically categorized by years, species, and gender. The total number of dogs and cats is shown in Figure 1. Significant correlations were observed between species, gender, and the number of neutered animals. Concerning species distribution, a Kolmogorov-Smirnov test revealed a non-normal distribution of neutered animals within each gender. When considering individual species, the enrolment of female dogs and female cats (Fig. 2A) for surgical sterilization consistently surpassed that of males throughout the observation period (2009-2023). Specifically, cats underwent neutering at a significantly higher rate than dogs ($p < 0.05$) (Fig. 2B). Moreover, an overarching trend revealed a noteworthy prevalence of females over males in the neutering process ($p < 0.05$) (Fig. 2C).

Between 2020 and 2022, the neutering of dogs and cats witnessed a decline compared to the preceding years (2009-2019) ($p < 0.05$) (Fig. 1). Monthly data (mean ± SD) for neutered animals in 2020 exhibited significant disparities between COVID lockdown months (Mar-Jul, Dec) (1,121.5 ± 398.6) and non-lockdown months (1,814.8 ± 247.1) ($p < 0.05$) (Fig. 3). While there was no notable correlation between lockdown and non-lockdown months for neutered

dogs, a substantial decrease in the neutering of cats was observed during the lockdown period (937.2 ± 306.4), compared to the non-lockdown period (1,525 ± 146.5) ($p < 0.05$).

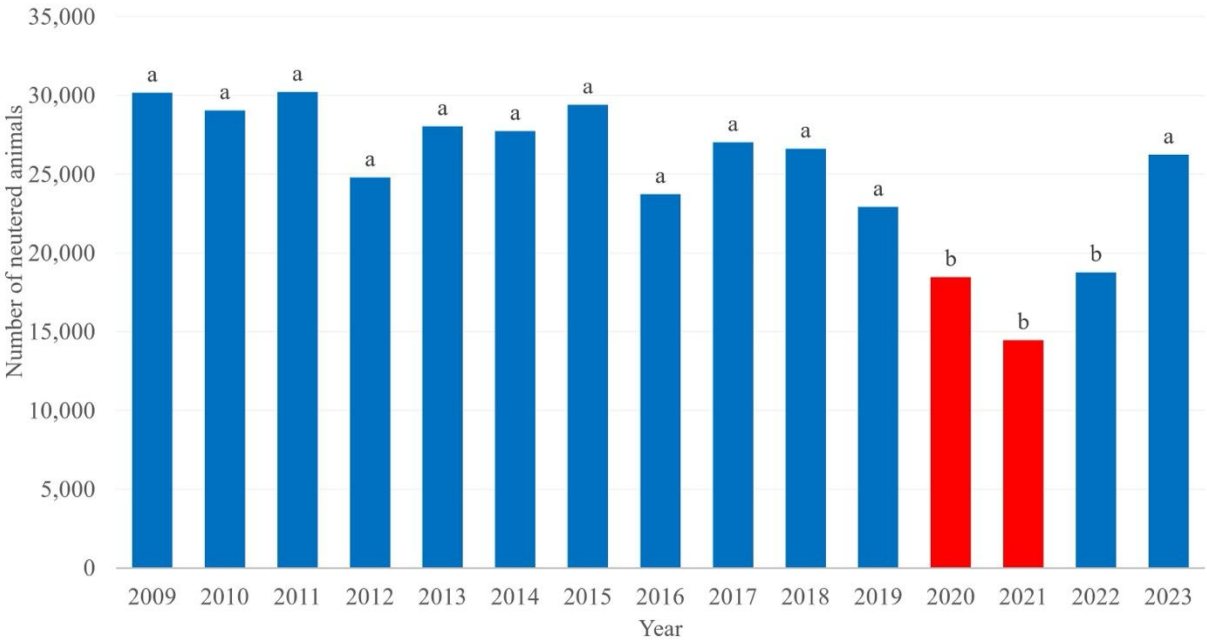

Figure 1 The total number of neutered dogs and cats in BMA neuter clinics during 2009-2023, the COVID lockdown year (red) and non-lockdown year (blue).

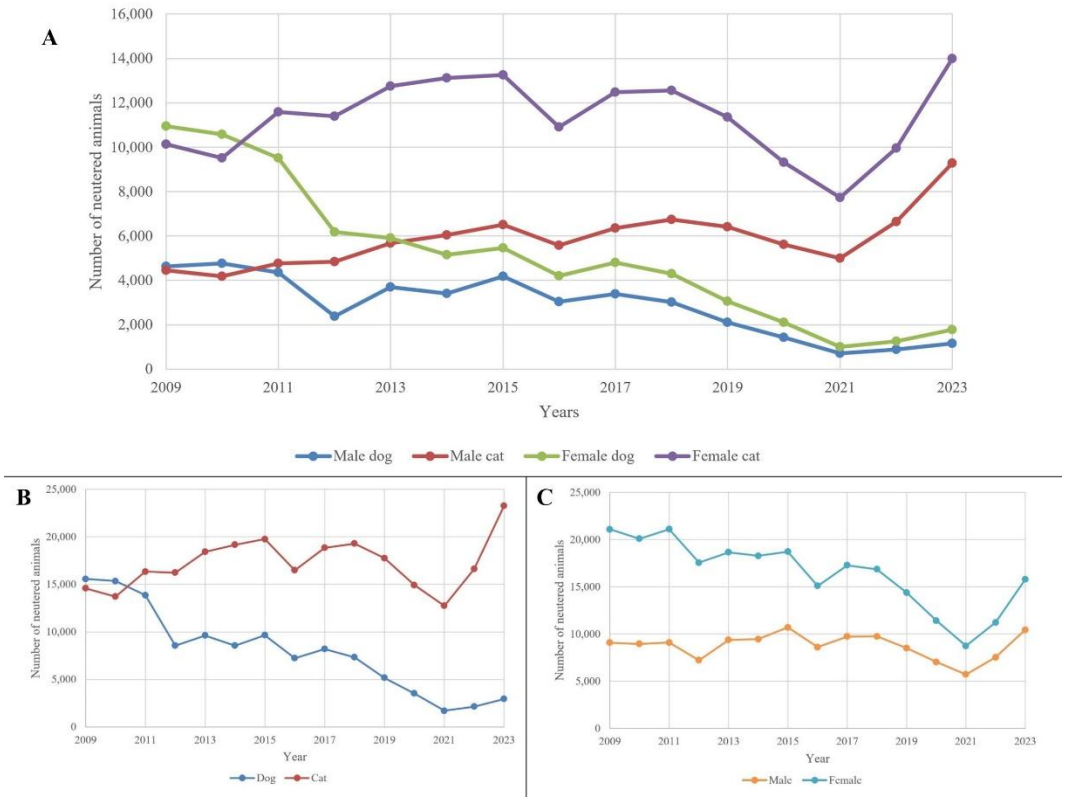

Figure 2 The number of male dogs, female dogs, male cats, and female cats (A), neutered dogs and cats (B), and neutered males and females (C) in BMA neuter clinics during 2009-2023.

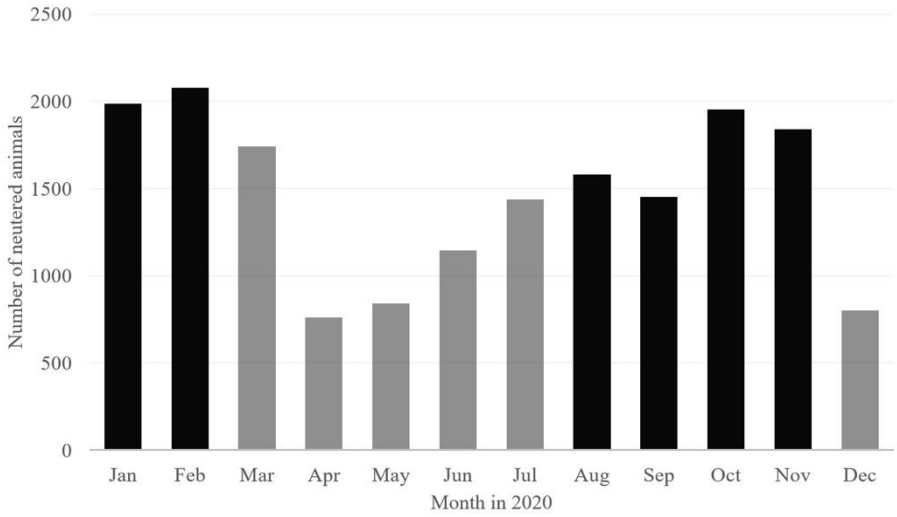

Figure 3 The monthly data of neutered dogs and cats between COVID lockdown months (grey) and non-lockdown months (black) in BMA neuter clinics during 2020.

Discussion

The data for this study were sourced from the Veterinary Public Health Division, Department of Health, The Bangkok Metropolitan Administration (BMA), Thailand, spanning 15 years (2009-2023). A substantial number comprising 337,590 dogs and cats were analyzed, shedding light on the perspectives of pet owners and shelter volunteers concerning the species and gender preferences in surgical sterilization in Bangkok, Thailand. It is noteworthy that, post-2010, there was an increasing likelihood of cats being neutered much more frequently than dogs, and this trend appeared to amplify over time. This is in agreement with previous studies reported in the United States (Faver, 2009; Trevejo *et al.*, 2011), Canada (Perrin, 2006), and New Zealand (Gates *et al.*, 2019; McKay *et al.*, 2009) that cats were likely to be neutered more than dogs. The rise in the global cat population as a popular choice for pets may be the contributing factor. A recent study in Israel also showed that the number of cats counted in 2014 was significantly higher than in 2012 (Gunther *et al.*, 2020). Additionally, differences in the estrous cycle and litter frequency between dogs and cats may influence sterilization rates. While dogs typically experience heat cycles twice a year, cats can enter a cycle every 3-4 weeks. Consequently, cats generally have a higher number of litters per year than dogs, with an average of 1-3 litters for cats (Nutter *et al.*, 2004) compared to 0-2 litters for dogs (Kisiel *et al.*, 2016). Moreover, cats are often easier to transport to veterinary clinics than dogs, possibly contributing to their higher likelihood of being neutered. Our results indicated that careful consideration should be directed toward the national policy of pet sterilization, with a focus on gender differences. Moreover, the growing cat population in society must be more emphasized because the precise count of cats in Thailand, particularly in Bangkok, remains undisclosed due to the absence of a national policy to assess the current populations of both dogs and cats. Although the record of BMA neuter clinics revealed a notable increase in the neutering rate of cats compared to dogs ($p < 0.05$) (Fig.2B), this heightened neutering rate for cats does not necessarily ensure effective population control. Additionally, the global cat population is on the rise, emphasizing the urgency of implementing targeted interventions and policies to address the specific challenges posed by the growing number of cats.

Non-surgical sterilization as an alternative method has been suggested to control the population. From the upward trend in the cat population and the increasing number of cat sterilizations observed in the present study, alternative permanent sterilization methods, such as intratesticular injection, should be considered. Intratesticular injection for sterilization in male animals presents several potential advantages, including cost-effectiveness, a lower risk of anesthesia, and the avoidance of invasive surgical procedures. The efficacy of intratesticular injection using zinc gluconate (Fagundes *et al.*, 2014) or calcium chloride (Jana and Samanta, 2011) in male cats has been demonstrated. However, it is crucial to be aware of limitations, including potential issues such as pain, inflammation, and testicular tissue necrosis post-injection (Forzán *et al.*, 2014), especially when considering the application of this method in large-scale population control. Further studies on novel substances to reduce adverse effects/complications post-intratesticular injection must be conducted. Recently, we developed a novel chemical sterilant, Nanostructured Lipid Carriers (NLC) encapsulated alpha-mangostin (AM-NLC), which can induce apoptosis in the spermatogonium cells of the GC-1 murine spermatogonia cell line and ex vivo feline testis (Yostawonkul *et al.*, 2017). Research on using AM-NLC as an alternative method for non-surgical castration in cats should be further investigated.

Our findings regarding the influence of gender on the participation rates of animals in BMA neuter clinics align with prior research. Consistent with studies conducted in various countries, including the United States (Trevejo *et al.*, 2011), Mexico (Ortega-Pacheco *et al.*, 2007; Kisiel *et al.*, 2016), and Italy (Carvelli *et al.*, 2020), we observed a higher proportion of female dogs undergoing neutering compared to males. Similarly, in

the case of cats, our results mirrored the previous report conducted in New Zealand (McKay *et al.*, 2009), indicating a greater prevalence of neutering among female cats. However, our findings deviate from those reported in the United States, where male cats were more likely to undergo neutering than females (Trevejo *et al.*, 2011). This discrepancy may be attributed to the differences in cultural attitudes toward pet ownership and responsibilities, the effectiveness of education campaigns, and economic factors such as income and accessibility to veterinary services.

Over the fifteen years (2009 - 2023), the number of neutered females was greater than that of males. It might be due to the general attitude and the fact that females give birth to their offspring, and females should be spayed, not males. As a matter of fact, male animals can produce kittens or puppies more than female animals in their life (Kutzler, 2010). In this light, the influence of gender on population control programs in Thailand must be highlighted as a matter of both public and national concern. The significance and benefits of sterilization should be equally emphasized for both genders.

The present study is the first study of the COVID-19 restriction affecting the number of neutered animals in Thailand. Due to COVID-19, most studies on pets investigated the animal welfare and behavior of dogs and cats during restriction. The studies were performed in many countries, such as the United Kingdom (Holland *et al.*, 2021) and Spain (Bowen *et al.*, 2020). The results were similar to decreased animal welfare and altered behavior, such as less walking and more play-training time (Christley *et al.*, 2020). Moreover, the COVID-19 pandemic situation affected pet owners as more challenging to access veterinary care (Powell *et al.*, 2022) and pet supplies such as pet food, cat litter, medication, and others due to business closures temporary from restrictions or interrupted supply chain and shipping delay (Applebaum *et al.*, 2020). Our results showed that, in 2020-2021, the number of neutered dogs and cats decreased significantly compared to the number of neutered animals between 2009 and 2019 (Fig. 1). Although the overall number of dogs and cats residing in Bangkok throughout the studies years (2009-2023) remains unavailable, the consequence of low sterilization rate, combined with the high introduction of new intact animals could result in worsening the overpopulation problem in the near future (Yen *et al.*, 2014; Dias *et al.*, 2015), suggesting the need for ongoing attention to the rabies prevention and population control program, specifically in the vicinity of Bangkok and its neighboring provinces.

In conclusion, the outcomes derived from the analysis of 337,590 dogs and cats attending BMA neuter clinics from 2009 to 2013 indicate that the sterilization rates for both species are influenced by species, gender, and the period of the COVID-19 lockdown. It is essential to note that the demographic characteristics of animals undergoing surgical sterilization in BMA neuter clinics, as part of government services, may vary from those in private clinics. This discrepancy can be attributed to differences in the type of pet owner seeking sterilization services, with BMA clinics offering free sterilization. In contrast, pet owners must pay for the service at private clinics. Therefore, a subsequent study should compare data between these settings to understand the dynamics at play better. Additionally, further investigation into pet owners' decision-making processes is warranted to identify additional factors influencing the likelihood of sterilization. A national policy emphasis should prioritize educating the public about the advantages and benefits of surgical sterilization for both dogs and cats, regardless of gender or species. By raising awareness about the importance of sterilization in controlling pet populations and improving animal welfare, policymakers can encourage greater participation in sterilization programs, ultimately contributing to managing stray animal populations and reducing the burden on animal shelters and rescue organizations.

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