Low Sterilization of Pets Causes Shelter Overpopulation

[1]I. Feng Yen, [1]Shawn Jen-Lung Peng, [2]Wallace Ryan, [3]Chyao Chung-Huai,
[4]Kwong-Chung Tung and [1]Chang-Young Fei
[1]School of Veterinary Medicine, Graduate Institute of Veterinary Medicine,
National Taiwan University, Taipei, Taiwan, ROC
[2]Centers for Disease Control and Prevention, Atlanta, USA
[3]Bureau of Animal and Plant Health Inspection and Quarantine,
Council of Agriculture, Executive Yuan, Taiwan, ROC
[4]Department of Veterinary Medicine, College of Veterinary Medicine,
National Chung Hsing University, Taichung, Taiwan, ROC

Abstract: This study reported the acquisition and the sterilization rate of household dogs surveyed in 2009 at Taiwan. Six modes of dog acquisition were included in the survey: obtained by a friend/relative (42.1%) bought from pet shop (23.7%) found as a stray (21.0%) born by my dogs (6.0%) adopted at animal shelters (3.2%) and others (3.9%). The sterilization rate of household dogs in the survey was 32.7%. Using the data of this survey and others of analogous published study to run regression analysis, a negative correlation was presented between the rate of the acquisition obtained by a friend/relative and the rate of the sterilization rate of household dogs. The regression equation is: $y = -0.3761x + 0.571$; $R^2 = 0.8926$. Results in this report support the recommendations that the sterilization of household dogs can decrease the shelter intake of unpredicted unwanted dogs.

Key words: Household dogs, dogs acquisition, sterilization, shelter, overpopulation

INTRODUCTION

During the last 40 years, the greatest threat to the life of domesticated dogs and cats does not come from infectious diseases but rather from the threat of euthanasia after being abandoned or surrendered to animal shelters (Marsh, 2010). Tens of millions to millions of pets are euthanized each year after being abandoned by their owners (Batson, 2008; Davis et al., 2007; Fielding and Plumridge, 2005; Kass et al., 2001; Marsh, 2010; Tung et al., 2010; Zanowski, 2010). Increases in the number of unwanted dogs may lead to shelter overpopulation which has increased globally during the last 40 years (Marsh, 2010; New et al., 2004). Increases in unwanted dogs and cats, leading to overpopulated shelters introduces the risk of animals being turned away from shelters or owners finding alternative methods for abandoning their pets. This can result in increased stray animal populations, reductions in vaccinataion rates among community animals and introduction of human public health threats such as bites, parasitic diseases and rabies (Reece and Chawla, 2006; Scarlett, 2008; Slater, 2001; Totton et al., 2010).

Tung et al. (2010) indicated that in Taiwan the number of impounded dogs increased from 78,686 dogs in 1999 to 127,023 dogs in 2009 an average annual increase of >6%. During this same time, the number of dogs euthanized in shelters increased synchronously by year (Tung et al., 2010) which exemplifies the serious problem of shelter overpopulation in Taiwan.

Marsh (2010) indicates that the substantial drop in the national shelter euthanasia rate over the past 30 years in United States was associated with a drop in the number of pets taken in by shelters. This strong correlation between shelter intake and euthanasia rates is also reflected in national data in Taiwan (Yen et al., 2013). A successful method of reducing shelter intake and thus reducing unnecessary animal euthanasias has been to increase the sterilization rates of household dogs (Marsh, 2010). In this study, researchers aimed to use statistical data of household dog acquisitions in US, Italy, Dominica and Taiwan to assess the regression between the sterilization rates of household dogs and the rates of the household dog acquired by friends or relatives which implicates the sterilization rate of the household dogs.

MATERIALS AND METHODS

Canine acquisition and sterilization survey: In 2009, a national survey of the acquisition of household dogs and

status of sterilization were investigated in Taiwan by random digit dialing telephone survey using the method by Tung *et al.* (2010). Population based data on pet ownership and household demographics were obtained through a structured questionnaire (Appendix 1). The pre-determined margin of error for all surveys was ±3% points with confidence level was 99% for all surveys. Results of the questionnaire were analyzed using Visual FoxPro Version 6.0 (Tung *et al.*, 2010).

Linear regressive test: The acquisition rate of household dogs obtained by a friend/relative and the sterilization rate of household dogs collected for this study as well as analogous data of other published studies. Simple linear regression is tested by the method by Chatterjee and Hadi (2006).

RESULTS AND DISCUSSION

Methods for dog acquisition: A total of 16,591 valid telephone questionnaires were completed. Among them a total of 2,225 (13.41%) households owned dogs. A total of 3,341 dogs were owned by the 2,225 dog-owning households or an average of 1.5 dogs per household. A simple extrapolation of this dog ownership rate using Taiwan national census data, led to an estimate of 1,565,156 owned dogs in the country. The 32% (32.7%) of owners reported surgically sterilizing their dogs. Among dogs owning households, 73.6% reported that dogs were the only animals in the household, 5.7% own dogs and cats, 18.9% owndogs as well as animals other than cats, 1.7% own dogs, cats and other animals like fishes rodents, etc. Dogs were acquired from a variety of sources as follows: obtained by a friend/relative (42.1%) bought from pet shop (23.7%) found as a stray (21.0%) born by my dogs (6.0%) adopted at animal shelters (3.2%) and others (3.9%) (Table 1).

Table 1: Methods of household dog acquisition, Taiwan 2009

Method of acquisition (n = 2501)	Frequency	Percent
Obtained from a friend/relatives	1,054	42.1
Pet store	593	23.7
Found as a stray	524	21.0
Born by my dogs	151	6.0
Adopted at animal shelter	81	3.2
Others	91	3.9
Total	2,494	100.0

Linear regressive test: The acquisition rate of household dogs obtained by a friend/relative and the sterilization rate of household dogs in this survey as well as analogous data of other published papers are presented in Table 2. Through regression analysis, a negative correlation was observed between the sterilization rates of household dogs and the acquisition rates of dogs obtained by a friend or relative as percent of dogs acquired from friends or relatives increases, canine sterilization rates decrease. The regression equation is $y = -0.3761x + 0.571$; $R^2 = 0.8926$ as shown in Fig. 1.

Intuitively, free-roaming pets arealways considered to be bred from the pets freely roamed in communities, consequently, trap-neuter-return also known abbreviated as TNR (Longcore *et al.*, 2009) is consideredas a humane and more effective alternative to euthanasia policy to solve shelter overpopulation. However, several studies using statistical methods have proved that trap-neuter-return as a sole method of sterilization is not likely significantly to lower shelter euthanasia rate. (Amaku *et al.*, 2010; Andersen *et al.*, 2004; Foley *et al.*, 2005; Schmidt *et al.*, 2009). Sterilization of household dogs and cats can have profound effects on reducing overpopulation of companion animals and shelter overpopulation (Amaku *et al.*, 2009; Handy, 2001; Marsh, 2010) thereby reducing unnecessary shelter euthanasia and reducing public health threats from free-roaming animals (Slater, 2001).
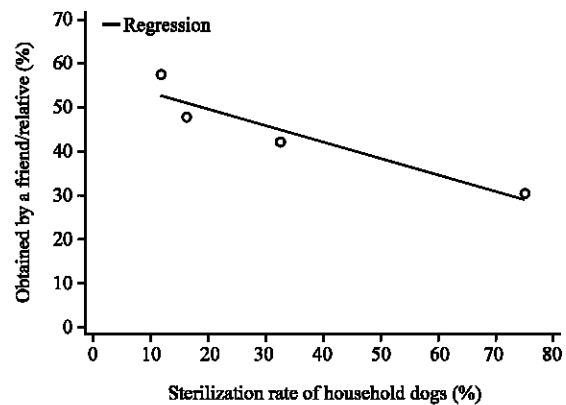

Fig. 1: Regression analysis comparing the sterilization rates of dogs to the rates of household dogs acquired from friends or relatives

Table 2: Analogous published data of the relationship between sterilization rates and acquisition of dogs from a friend or relative

Sterilization rates (X-axis) (%)	Acquisition rates of dogs obtained by a friend or relative (Y-axis) (%)	Resources	Location
12.0	57.4	Davis *et al.* (2007)	Dominica
16.4	47.7	Slater *et al.* (2008)	Italy
32.7	42.1	This survey	Taiwan
75.0	30.0	Kass *et al.* (2013)	USA

Results from this study and supported by similar research (Amaku *et al.*, 2010; Handy, 2001; Marsh, 2010) have found a strong negative correlation between household pet sterilization rates and shelter intake. Household dogs are acquired from a variety of sources. However, the most common way in the world usually is obtained by a friend or relative as a gift: Kass *et al.* (2013) found 30% of household dogs were obtained from friends/relatives in Santa Clara of California; Slater *et al.* (2008) found 47.7% in central Italy; Davis *et al.* (2007) found 35.8% from a neighbor or friend and 21.6% from outside neighborhood in Rosequ, Dominica; Batson (2008) found 39% as a gift from a friend or relative based on information from 62 countries. Plumridge found that the first choice of household dog owners would be to give away their dogs to friends or relatives if the pet was no longer wanted. Based on these reports, it would be a reasonable inference that owners who do not sterilize their pets may be more likely to give the unwanted offspring of their pets to a friend or relative. In support of this inference, this survey found a negative correlation between the rates of acquisition and sterilization of household dogs, combining other analogous published data by Kass *et al.* (2013), Davis *et al.* (2007) and Slater *et al.* (2008). Therefore, rate of household dog obtained from a friend/relative may imply the status of sterilization. Similarly, methods of dog acquisition may present an opportunity for animal advocates and public health officials to introduce interventions to improve sterilization rates of dogs. To increase adoption rates, kennels should direct efforts towards improving the shelter animals' health the priority concern for potential adopting families. Valuation for pet characteristics differs by culture and needs to be taken into account when designing stray management strategies. For example, behavioral quality of stray dogs is the most important characteristic for adoption in the US (Rhodes, 2002); in Italy, the dog's age is given the most weight (Normando *et al.*, 2006). In Taiwan, the health of shelter animals is the most important. Considering the current state of shelter over-crowding (Peng *et al.*, 2012), the lack of open space for exercise or separating trouble animals makes it difficult to keep dogs healthy. Creating special shelters, specifically to keep healthy, adoptable animals transferred from other shelters can help alleviate over-crowding in existing shelters, improve the animal's wellbeing and ensure shelter staff safety.

Prevention of animal abandonment through improved sterilization practices will reduce the number of animals entering a shelter. However, many shelters also adopt out animals. Intuitively, improving practices which promote community members to adopt shelter animals would also reduce overcrowding. The finding that only 3.2% of dogs in this survey were acquired from shelters is profound as compared with Santa Clara, California (Kass *et al.*, 2013). Animal shelters often provide veterinary care including vaccination and sterilization, prior to adoption. Campaigns to increase awareness about the benefit of shelter adoptions may decrease overcrowding and improve sterilization and vaccination rates for dogs in Taiwan.

Reducing stray dog populations and improving canine rabies vaccination rates should be a priority for Taiwan. In 2011, after >50 years being considered rabies-free, a rabies reservoir species enzootic to remote, mountainous regions was discovered (Chiou *et al.*, 2014). With this discovery, the public health implications of dog overpopulation become much more serious. Each year over 55,000 people die from rabies, globally and 98% of these deaths are due to the bite from an infected dog (WHO, 2013). Overpopulation of dogs increases the risk of rabies spillover from the reservoir animal, the ferret badger. In addition, free-roaming dogs may present an increased risk for transmission to the dog owners and the community as free-roaming dogs may be more likely to contact the reservoir rabies species (Scarlett, 2008; Slater, 2001). To further highlight the seriousness of this issue, the wildlife rabies virus variant in Taiwan is closely related to the rabies virus that circulates in dogs (Bourhy *et al.*, 1999; Johnson *et al.*, 2003). Therefore, it may be that this virus variant can more easily transmit between the wildlife reservoir and dogs.

Basic tenets of rabies control include canine rabies vaccination coverage of >70% and population management encompassing high sterilization rates of dogs (Reece and Chawla, 2006; Totton *et al.*, 2010; WHO, 2013). The findings of this survey indicate that only 32.7% of owned dogs were reported to be sterilized. When accounting for stray dogs as well, the percentage of dogs in Taiwan which are sterilized may be much lower. It is important for countries attempting to control rabies to monitor domestic animal populations and place interventions to prevent overpopulation, thereby decreasing the risk of rabies spillover into domestic animals and people.

CONCLUSION

Over the courses of the project, researchers found that there is a negative correlation between the friend/relative acquisition rate and the sterilization rate of household dogs. It also appears that household sterilization may become a very efficient strategy to decrease shelter overpopulation and the resultant unnecessary massive animal euthanasia rates in shelters.

Meanwhile, rabies is a universally fatal disease and is directly related to overpopulation of pets, further study is warranted to determine the most efficient strategies to reduce dog overpopulation and free-roaming dogs as part of Taiwan's national rabies control strategy.

APPENDIX

A. Do you own dogs? □1. Yes □2. No jump to part C

How many dogs do you own? Totally:dogs
(1) male:dogs, neutered:dogs; unneutered:dogs; unknown:dogs
(2) female:dogs, spayed:dogs; unsprayed:dogs; unknown:dogs
Where are dogs from? multiple repondence
□1. borned by my dogs, □2. bought, □3. taken on street, □4. obtained from friends/relatives, ets. □5. adopted from shelter, 6. unknown
How old are your dogs?
(1) years old, dogs
(2) years old, dogs

The way to keep:
(1) always at home:dogs;
(2) always leashed when go out:dogs,
(3) occasionally unsupervised:dogs;
(4) always unsupervised:_____ dogs
(5) How much to spend per dog per month? NTD

B. Dow you own cats? □1. Yes □2. No jump to part D
(6) How many cats do you own? Totally:cats
(1) male:cats, neutered:cats; unneutered:cats; unknown:cats
(2) female:cats, spayed:cats; unsprayed:cats; unknown:cats
7. Where are cats from? multiple respondence
□1. borned by my cats, □2. bought, □3. taken on street, □4. obtained from friends/relatives, ets. □5. adopted from shelter, 6. unknown

8. How old are your cats?
(1) years old, cats
(2) years old, cats

9. The way to keep:
(1) always at home:cats;
(2) always leashed when go out:cats,
(3) occasionally unsupervised:cats;
(4) always unsupervised:_____ cats
10. How much to spend per cat per month? NTD

C. Do you own any other animals other than dogs and cats, like birds, fishes, reptiles, insects, others? (multiple respondence)
□1. Yes
□a. birds_____ □b. fishes_____ □c. reptiles_____
□d. insects_____ □e. others_____

□2. no

D. Basic information of respondences
Gender: □1. male, □2. female
Age: □1. <19 years old □2. 20-29 yo □3. 30-39 yo □4. 40-49 yo □5. 50-59 yo □6. >60 yo □9. refuse to answer
How many people in your house:_____ persons refuse to answer
Education: □1. <6 grade □2. 7~9 grades □3. 10~12 grades □4. college or above □9. refuse to answer

Income per month of whole family:
□1. <30,000 NTD
□2. 30,000~50,000
□3. 50,000~70,000
□4. 70,000~100,000
□5. 100,000~150,000
□6. >150,000

REFERENCES

Amaku, M., R.A. Dias and F. Ferreira, 2009. Canine population dynamics: The potential effect of sterilization campaigns. Rev. Panam. Salud Publica, 25: 300-304 (In Portuguese).

Amaku, M., R.A. Dias and F. Ferreira, 2010. Dynamics and control of stray dog populations. Math. Popul. Stud., 17: 69-78.

Andersen, M.C., B.J. Martin and G.W. Roemer, 2004. Use of matrix population models to estimate the efficacy of euthanasia versus trap-neuter-return for management of free-roaming cats. J. Am. Vet. Med. Assoc., 225: 1871-1876.

Batson, A., 2008. Global companion animal ownership and trade: Project summary, June 2008. https://www.zotero.org/groups/chagasepid8515/items/PHEQZ2 HV.

Bourhy, H., B. Kissi, L. Audry, M. Smreczak and M. Sadkowska-Todys *et al.*, 1999. Ecology and evolution of rabies virus in Europe. J. Gen. Virol., 80: 2545-2557.

Chatterjee, S. and A.S. Hadi, 2006. Simple Linear Regression. In: Regression Analysis by Example, Chatterjee, S. and A.S. Hadi (Eds.). 4th Edn., John Wiley and Sons, New York, pp: 21-45.

Chiou, H.Y., C.H. Hsieh, C.R. Jeng, F.T. Chan, H.Y. Wang and V.F. Pang, 2014. Molecular characterization of cryptically circulating rabies virus from Ferret Badgers, Taiwan. Emerging Infect. Dis., 20: 790-798.

Davis, B.W., K. Alie, W.J. Fielding, M. Morters and F. Galindo, 2007. Preliminary observations on the characteristics of the owned dog population in Roseau, Dominica. J. Applied Anim. Welfare Sci., 10: 141-151.

Fielding, W.J. and S.J. Plumridge, 2005. Characteristics of owned dogs on the island of New Providence, The Bahamas. J. Applied Anim. Welfare Sci., 8: 245-260.

Foley, P., J.E. Foley, J.K. Levy and T. Paik, 2005. Analysis of the impact of trap-neuter-return programs on populations of feral cats. J. Am. Vet. Med. Assoc., 227: 1775-1781.

Handy, G.L., 2001. Impact of Subsidized Program. In: Animal Control Management: A Guide for Local Government, Handy, G.L. (Ed.). International City/County Management Association, Washington DC., USA., pp: 37-38.

Johnson, N., C. Black, J. Smith, H. Un, L.M. McElhinney, O. Aylan and A.R. Fooks, 2003. Rabies emergence among foxes in Turkey. J. Wildlife Dis., 39: 262-270.

Kass, P.H., J.C. New Jr., J.M. Scarlett and M.D. Salman, 2001. Understanding animal companion surplus in the United States: Relinquishment of nonadoptables to animal shelters for euthanasia. J. Applied Anim. Welfare Sci., 4: 237-248.

Kass, P.H., K.L. Johnson and H.Y. Weng, 2013. Evaluation of animal control measures on pet demographics in Santa Clara County, California, 1993-2006. Peer J.,

Longcore, T., C. Rich and L.M. Sullivan, 2009. Critical assessment of claims regarding management of feral cats by Trap-Neuter-Return. Conserv. Biol., 23: 887-894.

Marsh, P., 2010. Replacing Myth with Math: Using Data to Design Shelter Overpopulation Programs. In: Replacing Myth With Math: Using Evidence-Based Programs To Eradicate Shelter Overpopulation, Marsh, P. (Ed.). Town and Country Reprographics, Concord, NH., pp: 1-26.

New, Jr. J.C., W.J. Kelch, J.M. Hutchison, M.D. Salman, M. King, J.M. Scarlett and P.H. Kass, 2004. Birth and death rate estimates of cats and dogs in US households and related factors. J. Applied Anim. Welfare Sci., 7: 229-241.

Normando, S., C. Stefanini, L. Meers, S. Adamelli, D. Coultis and G. Bono, 2006. Some factors influencing adoption of sheltered dogs. Anthrozoos: Multidisciplinary J. Interact. People Anim., 19: 211-224.

Peng, S.J.L., L.Y.T. Lee and A.C.Y. Fei, 2012. Shelter animal management and trends in Taiwan. J. Applied Anim. Welfare Sci., 15: 346-357.

Reece, J.F. and S.K. Chawla, 2006. Control of rabies in Jaipur, India, by the sterilisation and vaccination of neighbourhood dogs. Vet. Rec., 159: 379-383.

Rhodes, R.H., 2002. Euthanasia Training Manual. Humane Society of the United States, Washington, DC.

Scarlett, J.M., 2008. Interface of epidemiology, pet population issues and policy. Prev. Vet. Med., 86: 188-197.

Schmidt, P.M., T.M. Swannack, R.R. Lopez and M.R. Slater, 2009. Evaluation of euthanasia and Trap-Neuter-Return (TNR) programs in managing free-roaming cat populations. Wildlife Res., 36: 117-125.

Slater, M.R., 2001. The role of veterinary epidemiology in the study of free-roaming dogs and cats. Prev. Vet. Med., 48: 273-286.

Slater, M.R., A. Di Nardo, O. Pediconi, P.D. Villa, L. Candeloro, B. Alessandrini and S. Del Papa, 2008. Cat and dog ownership and management patterns in central Italy. Prev. Vet. Med., 85: 267-294.

Totton, S.C., A.I. Wandeler, J. Zinsstag, C.T. Bauch, C.S. Ribble, R.C. Rosatte and S.A. McEwen, 2010. Stray dog population demographics in Jodhpur, India following a population control/rabies vaccination program. Prev. Vet. Med., 97: 51-57.

Tung, M.C., C.Y. Fei, J.T. Chiang, C.H. Chou and Yeh et al., 2010. Surveys of dog populations in Taiwan from 1999 to 2009. J. Chin. Soc. Anim. Sci., 39: 175-188.

WHO, 2013. National programs for dog rabies control. WHO Technical Report Series No. 982, WHO Expert Consultation on Rabies, pp: 63-77.

Yen, I.F., H.L. Lin, D.J. Lan, T.W. Chang, T.W. Chang, K. Pan and C.Y. Fei, 2013. Statistical study of the association between shelter canine intakes and euthanasia from 2001 to 2011 in Taiwan. Thai. J. Vet. Med., 43: 137-141.

Zanowski, G.N., 2010. The true costs of euthanasia in animal shelters: A comprehensive examination. Int. J. Liability Scient. Enquiry, 3: 291-319.