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## Statistical Study of the Association between Shelter Canine Intakes and Euthanasia from 2001 to 2011 in Taiwan

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I-Feng Yen, Hsiu-I Lin, Dang-Jie Lan, Ting-Wei Chang, Kai Pan, and Chang-Young Fei

## Statistical Study of the Association between Shelter Canine Intakes and Euthanasia from 2001 to 2011 in Taiwan

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### *Abstract*

This study used Pearson correlation test to analyze statistical correlation between shelter canine intake and number of dogs euthanized in municipal animal shelters in 20 counties/cities in Taiwan from 2001 to 2011. Data of animal shelters were official data provided by the Council of Agriculture, the competent authority of the Animal Protection Act in Taiwan. Among the 20 counties/cities in Taiwan, Hualien County, Penghu County, Keelung City, and Chiayi County were excluded from this study due to incomplete data. Pearson correlation test was used to analyze the data of other 16 counties/cities from 2001 to 2011. Among these 16 counties/cities, excluding New Taipei City, there was a very significant correlation between shelter canine intake and number of dogs euthanized ( $p < 0.001$ ) and the correlation efficient of the result was positive. This suggested that the number of dogs euthanized was subject to shelter canine intake. The research findings suggest that to decrease the number of dogs euthanized, reducing the number of shelter canine intake is the way to start.

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**Keywords:** animal shelter, dogs, euthanasia, shelter canine intake, stray dogs, Taiwan

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## บทคัดย่อ

### การศึกษาความสัมพันธ์ทางสถิติระหว่างจำนวนของสุนัขในสถานสงเคราะห์และสุนัขที่ถูกการุณยฆาตในประเทศไต้หวัน ระหว่างปี 2001-2011

I-Feng Yen<sup>1,2</sup> Hsiu-I Lin<sup>2</sup> Dang-Jie Lan<sup>1,5</sup> Ting-Wei Chang<sup>1,5</sup> Kai Pan<sup>3</sup> Chang-Young Fei<sup>1,5\*</sup>

การศึกษานี้ใช้การทดสอบความสัมพันธ์เพียร์สันเพื่อวิเคราะห์ความสัมพันธ์ทางสถิติระหว่างจำนวนของสุนัขในสถานสงเคราะห์และจำนวนสุนัขที่ถูกการุณยฆาต จากสถานสงเคราะห์เทศบาลใน 20 มณฑล/เมืองในประเทศไต้หวัน ระหว่างปี ค.ศ. 2001-2011 ข้อมูลสถานพักพิงสัตว์ข้อมูลเป็นข้อมูลทางการโดยสภาการเกษตร ตามอำนาจของพระราชบัญญัติคุ้มครองสัตว์ในไต้หวัน จากมณฑล/เมืองในไต้หวันจำนวน 20 มณฑล ยกเว้น Hualien Penghu Keelung และ Chiayi ซึ่งถูกตัดออกจากการศึกษานี้เนื่องจากข้อมูลที่ไม่สมบูรณ์ เมื่อใช้การทดสอบความสัมพันธ์เพียร์สันเพื่อวิเคราะห์ข้อมูลของทั้ง 16 มณฑล/เมือง ในช่วงปี 2001-2011 จาก 16 มณฑล/เมืองไม่รวมเมืองไทเปใหม่ พบมีความสัมพันธ์อย่างมีนัยสำคัญมากที่สุดระหว่างจำนวนสุนัขในสถานสงเคราะห์และจำนวนสุนัขที่ถูกการุณยฆาต ( $p < 0.001$ ) โดยมีลักษณะความสัมพันธ์เชิงบวก ซึ่งเห็นว่าจำนวนสุนัขที่ถูกการุณยฆาตขึ้นกับจำนวนสุนัขในสถานสงเคราะห์ ผลการวิจัยชี้ให้เห็นว่าการลดจำนวนการุณยฆาตอาจจะเริ่มจากการจำนวนสุนัขในสถานสงเคราะห์

**คำสำคัญ:** สถานสงเคราะห์สัตว์ สุนัข การุณยฆาต สุนัขในสถานสงเคราะห์ สุนัขจรจัด ไต้หวัน

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## Introduction

A large number of dogs and cats are euthanized at animal shelter all over the world annually, and it is a fact that people are unwilling to face (Rowan and Williams, 1987; Wenstrup and Dowidchuk, 1999; Peng et al., 2012). Although animal protection groups endeavor to decrease the number of animals euthanized, shelter overpopulation is still an existing problem around the world. The main cause for this problem has not been clarified yet by empirical analysis (Marsh, 2010). Since the 1970s, the State of California in the US has stipulated that both municipal and private animal shelters have to provide pet management data to the competent authority quarterly. The data should include species, age, gender, sterilization status, method of disposition, etc. (California Code of Regulations, Title 17, Section 2606.4 (a) (California Code of Regulations, 2008). The long-term analyses on these scientific data provide scientific explanations to previous records of many animal shelters (New, Jr. et al., 2000; Kass et al., 2001; Scarlett, 2008). Such a transformation has turned the characteristics of shelter study from speculative myth to positivist math. Based on the studies of shelter issues, the following eight scientific and empirical results have been obtained: (1) The euthanasia rate in U.S. animal shelters has been greatly reduced during

the past 30 years; (2) Because of the decline in shelter intake rates, there is an obvious drop in shelter euthanasia rates over the past 30 years; (3) Communities with low pet sterilization rates tend to have relatively high shelter intake rates; (4) Communities with relatively high poverty rates tend to have higher shelter intake rates; (5) Shelters that sterilize intact pets prior to their release tend to have lower future intake rates; (6) Because of the possible breeding before sterilization, the rate at which the sterilization of female cats and dogs beyond the optimal age greatly affects the reproductive rate of the household pet population in the US; (7) In order to overcome shelter overpopulation in a community, the optimal allocation of resources depends on how effectively money is spent as well as how productively human resources are used; (8) Shelter overpopulation requires a diversity of detailed solutions in order to solve complicated shelter management problems. This study intends to investigate the correlation between canine intake in the municipal animal shelters and the number of dogs euthanized in 20 counties/cities in Taiwan from 2001 to 2011. This study is expected to provide empirical examples for the advanced concept of "replacing myth with math", and discuss the possible reasons of shelter overpopulation.

### Materials and Methods

**Data collection:** There are 20 counties/cities in Taiwan and the competent authority is the Council of Agriculture (Phipps, 2005; Animal Legal and Historic Center, 2008). The Animal Protection Act was promulgated and enforced on November 4, 1998, making Taiwan the 54<sup>th</sup> country in the world to put animal protection into legislation. After two year of construction and operation of municipal animal shelters after legislation, the government members in 20 counties/cities started to make formal records since 2001. The data analyzed in this study were the official data provided by the Council of Agriculture. The data from municipal shelters in 16 counties/cities of 20 counties/cities in Taiwan were analyzed. However, data from four counties/cities (Hualien County, Penghu County, Keelung City and Chiayi City) were not involved because of incomplete records.

Unfortunately, the data from private animal shelters are unavailable in Taiwan (Tung et al., 2010<sup>b</sup>). All the private shelters implement the non-kill policies (Lin and Fei, 2011). In addition, Taiwan has not stipulated laws for private animal shelters to report data of shelter intake/exit to the competent authority to date. Only municipal animal shelters in Taiwan are entitled to perform animal euthanasia.

**Data analysis:** Statistical analysis was performed using IBM SPSS Statistics 20. In order to understand whether the canine intake rate in shelters were associated with euthanasia rate, this study used Pearson correlation test (Weiss, 2008) to analyze the correlation between the annual number of shelter canine intake and dogs euthanized in municipal animal shelters of all counties/cities in Taiwan from 2001 to 2011. The level of significance was set at  $p < 0.05$ . The sign and magnitude of the correlation efficient also demonstrated the direction and the power of the association.

### Results and Discussion

There were significantly positive associations between the number of shelter canine intake and dogs euthanized among 15 counties/cities ( $p < 0.001$ ) (Table 1). Only one result from the data of New Taipei City demonstrated non-significant but still positive association. The results suggested that the number of dogs euthanized was subject to shelter canine intake. The number of shelter canine intake and dogs euthanized in various animal shelters in the counties/cities from 2001 to 2011 are specified in Fig 1.

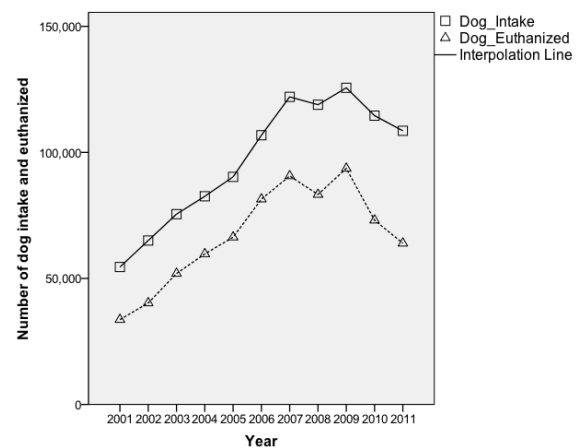
This report analyzed the correlation between the number of shelter canine intake and dogs euthanized in all county/city animal shelters in Taiwan from 2001 to 2011; significantly positive associations between these two variables were found in the majority of counties/cities.

The record demonstrated on Table 2 presents the categorical recording method in the twenty

municipal animal shelters in Taiwan. From the data of this table, it was understood that analytic parameters of this study included two parts: (1) the number of dogs entering shelters and (2) the number of dogs exiting shelters. The former part included number of captured by animal control officers, returned after adoption and relinquished by the owners; the latter part included the number of euthanasia, adoption, reclamation, natural death, run-away, and others (New, Jr. et al., 2000; Salman et al., 2000; Peng et al., 2012;). Some long-stay dogs stayed at the shelters because of failure of adoption and reclamation by their owners. However, no matter the reason why these dogs enter or stay in these municipal animal shelters, they will later be euthanized. The reason of this situation may be due to the high popularity of dogs in Taiwan. According to Tung's study in 2010, the majority of pets in Taiwan are dogs. From his study, he found that there were 33.4% of the families in Taiwan kept dogs as pets; and every one hundred people kept 6.8 household dogs. Although previous studies were not aware, dogs are very common species in animal shelters as well as free roaming

**Table 1** Statistical analysis of canine intake and euthanasia numbers in municipal animal shelters in 16 Taiwan cities/counties from 2001 to 2011

Cities/counties	Pearson correlation test
New Taipei City	$r = 0.137; p = 0.688$
Taipei City	$r = 0.951; p < 0.001$
Taichung City	$r = 0.983; p < 0.001$
Tainan City	$r = 0.969; p < 0.001$
Kaohsiung City	$r = 0.880; p < 0.001$
Yilan County	$r = 0.967; p < 0.001$
Yaoyuan County	$r = 0.948; p < 0.001$
HsinChu County	$r = 0.920; p < 0.001$
Miao County	$r = 0.982; p < 0.001$
ChangHua County	$r = 0.928; p < 0.001$
Nantou County	$r = 0.996; p < 0.001$
Yunlin County	$r = 0.976; p < 0.001$
Chiayi County	$r = 0.900; p < 0.001$
Pingtung County	$r = 0.995; p < 0.001$
Taitung County	$r = 0.934; p < 0.001$
HsinChu City	$r = 0.884; p < 0.001$
Nation of Taiwan (total data)	$r = 0.958; p < 0.001$



**Figure 1** Scatter plot of canine intake and euthanasia numbers in municipal animal shelters in 16 Taiwan cities/counties from 2001 to 2011

animals in urban areas. The Animal Protection Act in Taiwan was promulgated on November 4, 1998. Animal control officers have been capturing stray animals (or free roaming animals) on streets legally since 1999. The density of urban roaming dogs in Taiwan decreased from 2.70 dogs per hundred people in 1999 to 0.37 dogs per hundred dogs in 2009. Non-stop capturing policies of animal control officers reduce the chances of breeding of stray dogs (Tung et al., 2012<sup>b</sup>). Consequently, here are several main sources of dogs entering municipal animal shelters in Taiwan: (1) Household dogs relinquished by owners; (2) Abandoned household dogs captured by animal control officers on the streets. The reasons for household dogs relinquished by owners in Taiwan are similar to many countries in the world: Busy lifestyle of owners, illness of dogs, moving houses, allergy concern, financial problems, age issue, refractory behaviors such as barking, biting, careless urination, etc. (Patronek et al., 1996; New, Jr. et al., 2000; Salmon et al., 2000; Fuh et al., 2012).

The U.S. scholars have started to suggest successful management in overpopulation problems in stray animals since the 1970s (Patronek et al., 1996; Wenstrup and Dowidchuk, 1999; New, Jr. et al., 2000; Salmon et al., 2000; Marsh, 2010; Fuh et al., 2012).

Therefore, it is necessary to replace non-professional and mythical speculation with empirical data. According to our research study, the reason why the Trap-Neuter-Release (TNR) policy implementation failed in Taiwan might be because of small numbers of stray animals on the streets, though direct evidences were not aware. In addition, previous research also demonstrated that TNR was inefficient for stray animals' population control (Amaku et al., 2010).

Rowan and Williams (1987) had studied the official data of animal shelters in Los Angeles City from 1970 to 1983 and found the relationship between number of sterilization in dogs and dogs entering the shelters. They concluded that the higher the sterilization rate of licensed dogs in a city, the lower the shelter canine intake rate. They also found the negative association between the sterilization rate of licensed household dogs and shelter canine intake rate. Furthermore, the same study suggested that the more licensed household dogs being sterilized, the fewer dogs being relinquished or captured to animal shelters. Therefore, implementation of pet registration and sterilization in household dogs may be effective approaches in reducing canine intake in animal shelters. Reducing overpopulation problems in

**Table 2** Municipal animal shelter data in 2011 from 20 Taiwan counties/cities. ACO: animal control officer; Dog entering: ACO captured + relinquished + returned + others; Dog existing: reclaimed + adopted + natural die + euthanized; Total: dog entering + dog existing.

Cities/Counties	ACO captured	Relinquished	Returned	Others	Dog entering	Reclaimed	Adopted	Natural die	Euthanized	Dog existing	Total
New Taipei City	83.15%	16.03%	0.83%	0.00%	15444	6.39%	12.81%	17.98%	62.83%	13674	29118
Taipei City	83.51%	13.49%	3.01%	0.00%	6821	9.79%	40.62%	31.72%	17.87%	7223	14044
Taichung City	67.29%	23.25%	2.49%	6.96%	8463	5.90%	16.17%	18.37%	59.56%	8387	16850
Tainan City	78.71%	21.01%	0.27%	0.00%	12806	1.88%	22.01%	9.37%	66.73%	12589	25395
Kaohsiung City	64.25%	20.37%	2.41%	12.98%	9094	3.00%	16.67%	49.47%	30.86%	8973	18067
Yilan County	78.48%	17.35%	0.00%	4.16%	4299	1.60%	12.75%	3.21%	82.44%	4118	8417
Taoyuan County	88.45%	7.59%	0.62%	3.34%	9856	2.96%	28.26%	11.16%	57.63%	9796	19652
HsinChu County	87.73%	12.27%	0.00%	0.00%	2421	0.94%	25.81%	9.86%	63.39%	2445	4866
Miaoli County	95.08%	4.21%	0.00%	0.71%	3233	0.63%	12.10%	27.94%	59.33%	3157	6390
Changhua County	91.09%	7.56%	1.13%	0.22%	5490	0.72%	12.65%	38.49%	48.14%	5440	10930
Nantou County	79.75%	19.85%	0.40%	0.00%	6221	2.32%	3.58%	11.54%	82.56%	6204	12425
Yunlin County	99.55%	0.45%	0.00%	0.00%	2685	0.63%	31.83%	0.34%	67.20%	2680	5365
Chiayi County	99.89%	0.11%	0.00%	0.00%	4446	0.32%	18.90%	32.50%	48.28%	4354	8800
Pingtung County	88.73%	9.60%	0.02%	1.65%	6105	1.27%	2.05%	1.23%	95.45%	6243	12348
Taitung County	97.31%	2.69%	0.00%	0.00%	3426	0.18%	2.10%	3.17%	94.55%	3909	7335
Hualien County	90.95%	7.84%	0.55%	0.67%	3280	0.85%	12.78%	10.88%	75.50%	3310	6590
Penghu County	87.95%	10.80%	0.00%	1.25%	1676	8.86%	29.87%	56.65%	4.62%	519	2195
Keelung County	94.11%	3.08%	0.00%	2.81%	2172	5.25%	26.34%	23.26%	45.15%	877	3049
HsinChu City	68.27%	31.27%	0.46%	0.00%	1311	0.88%	37.23%	0.00%	61.89%	1472	2783
Chiayi City	75.45%	24.04%	0.51%	0.00%	990	4.55%	44.44%	16.67%	34.34%	990	1980
Nation	82.92%	13.91%	0.89%	2.28%	110239	3.20%	17.78%	18.25%	59.22%	108040	218279

animal shelters may be expected through the same method. However, more data are needed for confirmation of this expectation.

Because our study demonstrated that canine shelter intake and euthanasia rate had significantly positive association, reducing canine shelter intake is the effective way to reduce euthanasia rate. Neutering and spaying pet dogs may be suggested to decrease the number of canine shelter intake. Further study will be required, to prove their effectiveness

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