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THE FOUNDATION FOR INTERDISCIPLINARY RESEARCH AND EDUCATION PROMOTING ANIMAL WELFARE

Cross-Program Statistical Analysis of Maddie's Fund Programs

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Introduction

The size, scope, and rigorous data collection standards of Maddie's Fund programs presents an unprecedented opportunity to analyze the impact of spay/neuter and adoption programs. This report statistically analyzes some of these impacts, including how spay/neuter rates affect shelter intake, how discount spay/neuter surgeries affect non-discount spay/neuter surgeries, and how no-kill adoption programs affect animal control adoptions.

The Relationship Between Spay/Neuter Programs and Shelter Intake

A tremendous amount of money and effort has been put into spay/neuter efforts nationwide. Yet surprisingly, there have been no statistical tests of spay/neuter programs to prove or refute whether they actually work to reduce shelter admissions and euthanasia. There have been some prominent success stories. Some of these examples do include detailed data demonstrating a decline in shelter deaths in conjunction with an aggressive spay/neuter program. However, these case studies, while impressive, cannot be taken as conclusive evidence of the value of spay/neuter programs. They are anecdotal in nature and do not present an unbiased test of spay/neuter programs. Spay/neuter programs have been tried in many places across the country and the world. These programs have met with a wide range of success. Some places, like New Hampshire, have seen a dramatic reduction in intake and shelter deaths while other places

have not. The problem with using examples as evidence of the benefits of spay/neuter programs is that only the success stories are used and the cases where benefits failed to materialize are generally ignored. Therefore, to demonstrate that spay/neuter programs systematically reduce the killing of animals at shelters requires statistically testing an unbiased sample of communities.

Spay/neuter programs have also been credited for the reduction in shelter deaths in the past few decades in the United States. There is reason to believe that this may be true. For example, kittens and puppies make up a much smaller portion of intake than they did a few decades ago. Also, it just makes sense that less fertile animals would lead to fewer births and therefore fewer homeless pets. However, once again, there is no conclusive proof that spay/neuter programs were responsible, nor any way to determine the portion of the decline that was due to spay/neuter programs versus other factors. In addition, the effects of the spay/neuter programs themselves cannot be easily separated from the effects of education and changing public perceptions regarding spay/neuter.

Data from Maddie's Fund programs presents an ideal opportunity to statistically test the effectiveness of spay/neuter programs. The data has been refined to use consistent definitions. The communities being funded are national in scope. And the effects can be tested in an unbiased manner without *a priori* excluding any communities based on success.

If spay/neuter programs do have an effect of shelter deaths, this impact would occur by reducing intake. Therefore, the most direct way to test the effect of spay/neuter programs is to compare spay/neuter rates to shelter intake. However, this in itself presents difficulties.

One way to statistically compare spay/neuter to intake is to look at the change in spay/neuter procedures during Maddie's Fund programs and compare this to the change in intake during the programs. However, the regions with the strongest spay/neuter programs also tend to be stronger in other aspects of Maddie's Fund community programs such as promoting adoptions. All other things being equal, there is a tendency for intake to go up when a community makes an announcement they are planning to go "no kill" or otherwise plan to drastically reduce the rate at which they kill animals at shelters. This may be due to the public feeling more comfortable turning in animals since they feel the risk of death for these relinquished animals is reduced. Adoption programs can also increase intake by increasing the population of animals that may later be relinquished, although the rates of animals returned to shelters suggests that this number is probably not very large. These effects, which tend to increase intake, could mask the intake-decreasing effects of spay/neuter programs.

In addition, the impact of spay/neuter programs can take many years. The effects of the programs will also be diffused over these years, with no single year necessarily getting the brunt of the impact. In fact, research by FIREPAW suggests that the full impact of an increase in spay/neuter rates on intake may be spread over more than ten years, even if the spay/neuter increase takes place immediately (Frank, 2004).

Due presumably to both the presence of competing factors and the diffused impact of spay/neuter procedure changes, it was decided that the change in spay/neuter procedures was not the best variable for analysis.

An alternative focus is to analyze the level of spay/neuter procedures rather than the change in spay/neuter procedures. Since the size of the communities analyzed varied

considerably, the spay/neuter rate per thousand people is more appropriate for analysis than the raw spay/neuter level. However, even if after adjusting for population, there are still problems with using levels. The spay/neuter rate per thousand people can be broken mathematically into the number of cats and dogs in homes times the percentage of dogs and cats that are sterilized or:

Spay/neuter rate = animals per 1,000 people   x   percent sterilized

Similarly, the intake rate per thousand people is equal to the number of cats and dogs in homes times the percentage of dogs and cats that are relinquished to shelters or that become homeless (assuming all homeless animals are picked up[1]) or:

Intake rate = animals per 1,000 people   x   percent relinquished or lost to street

As these two equations show, the intake rate and the spay/neuter rate have a common factor—namely the animal ownership/guardianship rate per 1,000 people. Intake rates and spay/neuter rates will both be high or low based on the rate of animal ownership/guardianship in the population. This common factor would cause a positive relationship between the two variables. However, if spay/neuter procedures have their intended effect, they will reduce intake, causing a negative relationship between the two variables. Therefore, once again, we have two types of relationships between spay/neuter

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[1] To simplify the explanation, it was assumed here that all animals abandoned or lost to the streets eventually get picked up at the shelter. This is not strictly true, nor is it necessary for this to be true for our point to be correct. The math simply becomes more complicated if we properly model the stray population.

rates and intake which move in opposite directions. The presence of a confounding variable can mask the effect of spay/neuter rates on intake rates.

Fortunately, there is a method for countering the presence of a confounding variable in comparing the intake rate and spay/neuter rate. The number of animals per thousand people is unknown in each community. However, there are a number of variables that may be used in explaining the animal ownership rate per thousand people. In theory, if the number of animals per thousand people can be fully explained statistically by other variables, then including those variables in a regression as independent variables along with the spay/neuter rate is a possible solution. Including these variables would remove this confounding relationship when analyzing the impact of spay/neuter rates on intake rates. Adding other relevant variables might also help to explain the percent of animals that are relinquished or lost to the street outside of the impact of spay/neuter procedures, thus further isolating the effect of spay/neuter procedures.

For example, the American Veterinary Medical Association's U.S. Pet Ownership & Demographic Sourcebook (2002) indicates that homeowners are about 25% more likely to have pets than renters. Maddie's Fund data analyzed by FIREPAW data likewise show that communities with a higher homeownership rate tend to have higher intake and higher spay/neuter rates per thousand people. The Pet Ownership & Demographic Sourcebook also indicates that people with bachelor's degrees are more likely to have pets. Once again, Maddie's Fund data is consistent with this, with higher intake rates being seen in communities with a higher percentage of people having bachelor's

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The simplification is useful for making the positive relationship between intake and spay/neuter more obvious.

degrees[2]. When these and other relevant demographic factors are included in the

analysis, then other sources of variation in intake are accounted for, allowing the impact

of spay/neuter surgeries to more effectively be isolated.

Table 1 shows the results of a regression with intake per thousand people as the

dependent variable. Intake was from animal control and no-kill organizations combined

after accounting for transfers between organizations. Each county in Maddie's Fund

community programs was used as a separate data point. However, counties with very

small population and intake tended to have very large annual variations in intake and

were therefore excluded. Data used were for the last program year available (more

specifically, the program year ending in 2003). Data for earlier years were not included

because these observations may not be considered independent of the later data for the

same community. However, regressions for the baseline period and for all periods

combined yielded similar results, with all showing a significant reduction in intake at

higher spay/neuter rates.

A number of demographic factors were found to be significantly related to intake in

Maddie's Fund communities. Faster growing communities had lower intake per person.

Communities with more young children (under five) tended to have higher intake.

Communities with more older people (over sixty-five) tended to have lower intake.

Communities that had a higher percentage of white people tended to have higher intake,

as did communities with more college graduates. Communities with more people in

poverty had higher intake. Communities with higher levels of employment relative to the

population size and communities with faster growing employment both tended to have

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[2] There may be conflicting trends here, since people with more education may be less likely to relinquish
animals, however they are also more likely to have animals in their home, which seems to be the dominant

higher intake. Communities with a higher home ownership rate tended to have higher

intake. Communities with larger average household size tended to have lower intake per

person[3]. All of the above factors were statistically significant.

Table 1: Regression Results for Intake Rate

	Parameter	Standard Error
Intercept	-415.5	69.9 **
Population Growth	-0.18	0.06 **
Percent of Population Under 5 Years Old	12.18	2.41 **
Percent of Population Over 65 Years Old	-2.60	0.39 **
Percent of Population that is White	1.51	0.32 **
Percent of Population that graduated college	3.54	1.38 *
Percent of Population below poverty threshold	5.67	0.80 **
Employment/Population	0.94	0.17 **
Employment Change	0.32	0.06 **
Density (population/area)	0.0039	0.0032
Home Ownership Rate	3.21	0.49 **
Household Size	-48.1	7.97 **
Dog dummy variable	3.26	2.55
Spay/Neuter rate	-0.57	0.11 **
Spay/Neuter rate--dogs only	-0.16	0.11

R-Square=0.9317
N=32

Note: "*" indicates variable is statistically significant; "**" indicates variable is highly significant.

Dog and cat intake were examined separately in the regression[4]. There was not a

significant difference between dog and cat intake, though dog intake was slightly higher.

The spay/neuter effect also tended to be stronger (i.e. reduce intake more) for dogs,

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effect here.

[3] It is important to keep in mind here that the measure used is intake per person, *not* intake per household.
Larger average household size implies fewer households for the same number of people. Therefore, even if
larger households are more likely to have animals (as suggested by the US Pet Population and
Demographic Sourcebook which is based on pet "ownership" per *household*), pets per person could still
decline as household size goes up.
[4] Due to a lack of separate dog-cat data in Alabama, this program is excluded from the regression shown.
However, a separate regression that includes Alabama data but does not distinguish cats from dogs was run,

though once again this was not quite statistically significant. But the most important

result was that after isolating these other factors, higher spay/neuter rates were associated

with lower intake rates. This result was highly statistically significant ($p < 0.0001$),

suggesting it is highly unlikely that this result is due to random chance.

Although it is always possible that this result is not a causal relationship (i.e. the two

are correlated but spay/neuter procedures does not cause reduced intake), the fact that the

sources of most other intake variation were removed does improve the likelihood that the

relationship is a direct link, and not due to outside factors. The coefficient for the

relationship was -0.57 for cats and -0.72 for dogs. This suggests that if spay/neuter does

in fact cause the reduction in intake, then each additional spay/neuter procedure in a

community leads to between ½ and ¾ of an animal less in intake. The actual costs will

vary by community, but if the subsidized portion of a low-cost spay/neuter procedure is

about $50, and the public's cost to shelter an average animal is $100, then the low-cost

spay/neuter program would more than pay for itself.

It should be noted that the real causal relationship between spay/neuter and intake may

be even stronger than that shown in the regression. As previously discussed, there are

competing factors causing both a positive and negative relationship between spay/neuter

and intake. It is quite possible that the indirect positive relationship has not been fully

accounted for by adding demographic factors. Therefore, even though a negative

relationship was found, the remaining portion of the indirect positive relationship will

dilute the negative causal relationship, leading to a lower value observed (i.e. less

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with similar demographic results. The regression also showed a significant spay/neuter effect on reducing
intake.

negative) for the coefficient. In other words, a spay/neuter procedure may quite possibly

lead to a larger reduction in intake than the amount suggested by the statistical analysis.

The finding of a significant relationship between spay/neuter and intake is

encouraging and very important. Logically, the animal welfare community assumes there

is a relationship between spay/neuter and intake and spends many millions of dollars

based on this assumption. This is the first public confirmation of a statistical relationship

that cannot be dismissed as anecdotal or as a single, unique case. Nevertheless, some

caveats should be made regarding these results. First, all of the data in this analysis

comes from Maddie's Fund program communities. These communities are not chosen at

random. It is possible that something unusual in these communities affects the results

and that they are not generalizable to other communities. Second, although there are

good theoretical grounds to hypothesize a causal relationship, the statistical tests used

here cannot prove causation—only that there is a statistical relationship.

Still, it is a positive development to see that the data shows a systematic relationship

across communities between intake and spay/neuter rates, with higher spay/neuter rates

being associated (and possibly causing) lower intake rates. As the data available from

Maddie's Fund programs grows, evidence of this relationship will likely grow even

stronger.

The Relationship between Discount and Regular Spay/Neuter

Even if spay/neuter is effective at reducing intake, it still is a valid question whether the methods currently used to increase spay/neuter rates are effective. More specifically, one of the most commonly utilized techniques for increasing spay/neuter rates is to offer discount or even free spay/neuter procedures. Often these offers are limited in scope, with only households of verifiable low income allowed to receive the discount. Maddie's Fund Community Programs also use some form of discount or voucher for spay/neuter procedures to reach program goals.

There is no doubt that people do participate in these discount programs. However, in the past, opponents of subsidized spay/neuter programs have argued that cost does not stop people from spaying/neutering their animals. Therefore, subsidized programs just cause people to switch to the low-cost provider, reducing the number of spay/neuter procedures performed by private veterinarians[5]. Often these arguments have come from veterinarians who have seen low-cost spay/neuter as unfair competition. However, recently the conflict between the veterinary community and subsidized spay/neuter programs has subsided somewhat in recent years. This has been in large part due to the increased use of targeting for low-cost spay/neuter programs. This targeting is primarily used so that resources are focused on people who truly are in need of financial assistance. However they also have the secondary effect of reducing the competition between low-cost spay/neuter programs and veterinary practices for the same clients.

Just as there have not been any publicly available statistical tests of the effectiveness of spay/neuter at reducing intake, there has also not been any statistical testing of the

effect of discount spay/neuter programs on regular spay/neuter procedures. Maddie's

Fund data presents an unusual opportunity in this regard since the community programs

require record keeping of spay/neuter procedures on the majority of veterinarians in the

region.

Table 2 shows the results of a regression across communities comparing regular

spay/neuter procedures to discount procedures. This analysis was once again performed

at the county level. The percent growth between the baseline period and the final period

available was used for both spay/neuter variables. As indicated, there is a significant (p

=0.03) *positive* relationship between discount procedures and regular procedures. In

other words, when discount procedures rise, regular procedures also tend to rise. The

implication is that rather than sabotaging regular procedures, discount spay/neuter

programs may actually help to increase regular procedures.

Table 2: Regression for Growth in Regular Spay/Neuter Procedures[6]

	Parameter	Standard Error
Intercept	0.67	4.13
Growth in Discount Procedures	2.60	1.12 *
Dog Dummy Variable	3.07	5.08

Typically, aggressive discount spay/neuter programs must do more than simply offer a

cheap price in order to attract large numbers of customers. These programs also must use

heavy marketing to promote their program and attract the public. Often these marketing

campaigns will not only sell the low price of the program, but will also actively promote

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[5] For example, see MacKay (1993) for this line of argument against subsidized spay/neuter.
[6] Once again the regression as shown does not include Alabama since data for dogs and cats was not separated. However, regressions that included Alabama with dogs and cats combined also failed to show a negative relationship (i.e. they showed a positive relationship or no significant relationship).

the benefits of spay/neuter procedures. These marketing campaigns might have the secondary effect of inspiring people who are not financially eligible for the discount program to get their animals spayed/neutered at a private practice veterinarian. This could cause the observed rise in regular procedures in the presence of aggressive discount spay/neuter programs.

A variety of other regression equation specifications were also tried in an effort to define the relationship between discount procedures and regular procedures. In some cases, a variety of demographic factors were included. In other cases, change variables were defined using differences or log differences rather than growth rates. In some cases, a significant positive relationship was found. In other cases, no significant relationship was found. However, regardless of the specification, a significant negative relationship was never found between discount procedures and regular procedures. In other words, there is no evidence that discount spay/neuter programs hurt regular spay/neuter procedures, and some evidence that they may in fact help to promote regular procedures.

Of course, the effect of discount spay/neuter programs could easily depend on how those programs are designed. Although Maddie's Funds spay/neuter program parameters are determined and managed by a lead organization in each region, they all generally have strong limitations to keep the programs focused on financially needy pet guardians. A more loosely defined program that allows financially-able persons to participate may have more of a tendency to cannibalize regular procedures in the region. In addition, it should once again be acknowledged that the data examined here was all for Maddie's Fund programs. It is possible that other communities may respond differently.

The Relationship between No-Kill and Animal Control Adoptions

Similar to the subsidized spay/neuter controversy, some animal control organizations have accused no-kill adoption programs of sabotaging their own efforts. Hypothetically, *if* there is a fixed number of people in a community willing to adopt an animal, then the more effort no-kill organizations make at adopting their animals, the less potential customers that are left for animal control. Of course, this depends on the unlikely assumption that the market for shelter animals is fixed. Most pets come from sources other than adoption, and good marketing campaigns can entice people to adopt who would have otherwise purchased their pet from another source[7]. In addition, the number of pets people keep is not fixed. A sympathetic story or an instantaneous bond at a public event can cause people to take in an additional animal who otherwise never would have. Therefore, animal welfare organizations do not necessarily need to take business from each other in order to raise adoptions.

An additional argument that has been used by some animal control organizations is that "competing" organizations take the most adoptable animals out of their shelters thereby making it harder for animal control to adopt animals. But this is not necessarily true. And even if it were true, if the mission of animal control is to improve the welfare of the animals in the community, then any adoptions that lead to a reduction in euthanasia should be viewed as a positive occurrence.

It is also possible that no-kill adoptions may help animal control adoptions. Like discount spay/neuter programs, no-kill adoptions may generate enough positive publicity

for adoptions in general that all organizations in the region benefit from the increase.

Maddie's Fund data allows us to test the relationship between no-kill and animal control

adoptions. Once again, though there has been discussion on this topic there is no publicly

available statistical data documenting any relationship.

No statistically significant relationship was found between no-kill adoptions and

regular adoptions (see Table 3). The regression shown here includes a dummy variable

Table 3: Regression for Growth in Animal Control Adoptions[8]

	Parameter	Standard Error
Intercept	-4.44	19.72
Growth in No-Kill Adoptions	-10.71	10.94
Dog Dummy Variable	24.96	24.87

for dogs and is based on the growth rate in the last year compared to the baseline period.

However, a wide variety of regression specifications were tested in an effort to establish a

relationship between no-kill adoptions and animal control adoptions. There was no case

in which a statistically significant relationship was found. Therefore, if a negative

relationship exists at all between animal control and no-kill adoptions, it is too weak to be

detected from the data compiled by Maddie's Fund programs so far.

Once again, some caveats should be added. It is not possible statistically to

conclusively demonstrate the lack of a relationship. Even though no relationship was

found, it is possible that a statistically significant relationship would be found with a

larger data set or different methods. In addition, it should again be noted that results here

use only data from Maddie's Fund programs.

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[7] See Frank (2004) for some evidence suggesting that people are willing to switch sources.
[8] Once again the regression as shown does not include Alabama since data for dogs and cats was not separated. However, regressions that included Alabama with dogs and cats combined also failed to show a statistically significant relationship.

Program Success

All Maddie's Fund community programs raised adoptions and have been successful so far in their ultimate goal of reducing shelter deaths (see Figure 1). Healthy animal deaths have also gone down in all but one program. In four of five programs, intake declined.
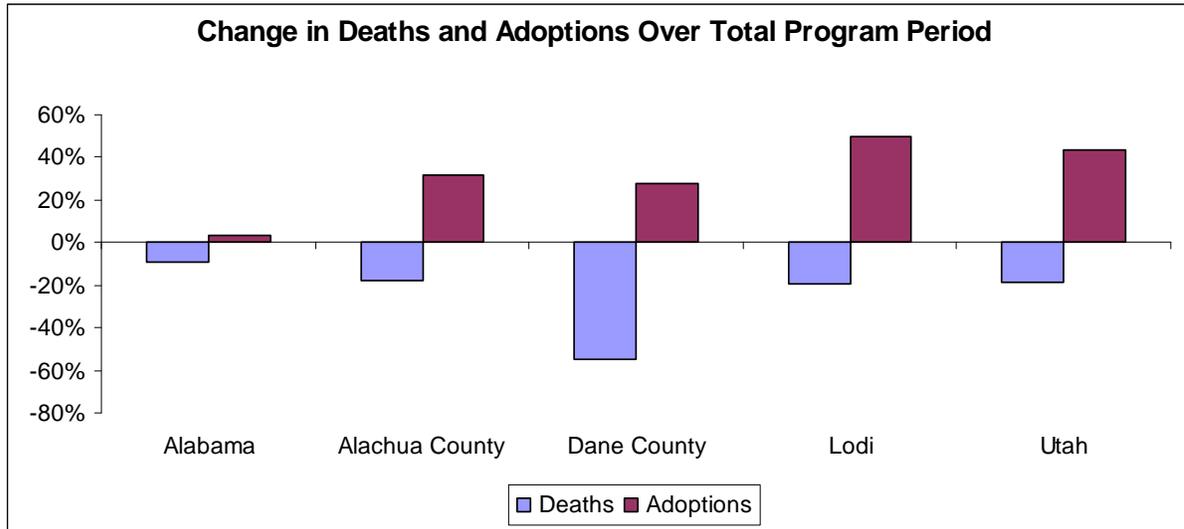
Change in Deaths and Adoptions Over Total Program Period

Figure 1

In two of four programs that have data available, no-kill adoptions and animal control adoptions both increased, while in two programs, animal control adoptions declined, partially offsetting the increase in no-kill adoptions. This once again suggests no clear relationship between no-kill adoptions (which were the primary focus of Maddie's Fund programs promoting adoption), and animal control adoptions.

The data across community programs demonstrates the success of Maddie's Fund programs at reducing shelter deaths. The statistical analysis here also shows an inverse relationship between spay/neuter rates and intake rates. There is also no evidence that discount spay/neuter programs cannibalize regular procedures nor that no-kill adoptions hurt animal control adoptions. In fact, there is some statistical evidence that well

designed discount spay/neuter programs may help to increase the number of regular

spay/neuter procedures as well.

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