

Estimation of the dog and cat population in the State of São Paulo

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Keywords

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Abstract

Objective

To estimate the total dog and cat population with owners in order to enable better planning of the control actions against diseases involving these animals.

Methods

The study was carried out in the non-metropolitan regions of the State of São Paulo, Brazil, from May to December 2002. Forty-one municipalities and 100 census tracts were surveyed. These were selected by probabilistic stratified cluster sampling in two stages. The strata were formed by grouping the municipalities according to their populations and living conditions. The Pasteur São Paulo Technique was used to obtain data on the canine population. This technique was developed to estimate and classify dogs according to their degree of dependence and restriction.

Results

Almost 53% of the 20,958 households visited owned a dog, and the average was 1.6 dogs per household. A total of 4,624 cats were found, concentrated in 12.6% of the households. The results indicate a dog/inhabitant ratio of 1:4.0 and a cat/inhabitant ratio of 1:16.4.

Conclusions

The animal/inhabitant ratios were much higher than expected. Incorporation of these ratios into evaluations of the vaccination campaign against rabies has revealed more realistic coverage patterns, thus leading to renewed discussion of the vaccination targets for municipalities. An association was observed between the size of the municipality or its inhabitant's living conditions and the level of restrictions on dogs.

INTRODUCTION

Information on the occurrence, distribution and characteristics of specific diseases enable identification of different epidemiological situations and the prevention and control options that can be adopted by health authorities. Within the field of zoonoses, the measures applicable involve humans and animals, thus giving rise to a broader range of intervention possibilities for avoiding, controlling or decreasing the damage caused by diseases such as rabies, visceral leishmaniasis and others in which the transmission cycle necessarily involves some type of animal.

Two epidemiological situations can be indicated as capable of delineating prevention and control actions in distinct manners: situations involving animals that are considered to be wild or that have a low level of contact with people; and situations involving domesticated animals that closely live together with humans and are adapted to their social organizations. Dogs and cats fall into this latter group practically all around the world. Other animals may also be included, depending on the culture in each locality or country.¹⁹

It is of fundamental importance to know the size of

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the feline and canine population, so that the planning of actions aimed at protecting and preserving human and animal health and the evaluation of the results obtained can be more effective. In relation to dogs, the two factors that are most important for defining their survival must also be evaluated: their level of dependence on humans in relation to food and shelter, and the level of restrictions placed on their free movement outside of the home. Two methods have basically been utilized for obtaining estimates of the dog population. The first utilizes domestic inquiries, surveys of data from vaccination services, surveys via telephone or other means of contact with dog owners.^{10,14,16} These types of survey have the limitation of identifying only the proportion of the dog population that have owners and can be located by means of addresses. Ownerless dogs, without homes and without people who consider themselves responsible for them, are not included in this model.

Other studies utilize the capture and recapture method, which is directed towards estimating the sizes of mobile populations in open areas. The animals are tagged at successive times, so as to identify their entry into the count and exclude those that have already been tagged.^{1,7} This method has been widely utilized, although it is complicated to implement. A further limitation is that it presents general estimates, without any possibility of classifying the animals, considering that the method does not discriminate between the different degrees of restriction and protection.

Because of such difficulties, the first phase of the present study consisted of a search for a new alternative for estimating and classifying the canine population. With the creation of the Pasteur São Paulo Technique (PSPT), a fast-acting tool that is easy to apply and inexpensive has become available.¹¹

The objective of the present study was to estimate the total size of the canine population in the non-metropolitan regions of the State of São Paulo, Brazil, in conformity with the World Health Organization (WHO) classification,²¹ and also to estimate the population of cats with owners. Through this study, it was intended to provide backing for the planning and evaluation of actions for preventing zoonoses.

METHODS

The study was developed in the non-metropolitan regions of the State of São Paulo. This area includes 606 municipalities out of the 645 that exist in the State, with a human population of around 20 million.

Considering the hypothesis that there would be an association between the frequency of occurrence of dogs, the size of the municipality and the living conditions of the human population, the municipalities were grouped into strata according to the number of inhabitants in the urban area of the municipality (less than 10,000; 10,000 to 30,000; 30,000 to 100,000; and more than 100,000) and according to the São Paulo Index of Social Responsibility (*Índice Paulista de Responsabilidade Social* – IPRS).

IPRS was created by the Foundation for the State Statistical Data Analysis System (*Fundação Sistema Estadual de Análise de Dados Estatísticos* – Seade), and it brings together the municipalities of the State of São Paulo in five groupings according to their common characteristics of municipal wealth, longevity and schooling: 1) municipalities that are regional centers and have high economic development; 2) economically dynamic and with low social development; 3) low social development and healthy; 4) low economic development and in social transition; 5) low economic and social development.* Among the different indicators of living conditions, this index was chosen because it was drawn up using data from the 2000 demographic census.

Two-stage sampling was applied to each stratum, to perform a draw among the municipalities and, within these, census tracts that would respectively form the primary and secondary sampling units. To accomplish the survey, all the homes in the census tracts drawn were included in the sample and, to count the dogs, all the streets within the limits of these census tracts.

The draw selected 41 municipalities and 100 census tracts, distributed into 18 strata (Table 1 and Figure 1). The sampling fraction utilized in each stratum was:

$$f = \frac{a}{A} \times \frac{b}{B_i}$$

where a and b , respectively, were the numbers of the municipalities and census tracts drawn; A was the number of municipalities within the stratum; and B_i was the number of census tracts in the municipality i . The number of census tracts drawn was determined as a function of the size of the municipality, such that one, two, three and seven census tracts were drawn in municipalities with less than 10,000, 10,000 to 30,000, 30,000 to 100,000 and more than 100,000 inhabitants, respectively.

The municipalities were drawn with constant probability, after ranking by the Regional Health

*Fundação Sistema Estadual de Análise de Dados – SEADE. Índice Paulista de Responsabilidade Social. Available at URL: <http://www.seade.gov.br/producao/iprs/pdf/oiprs.pdf> [October 18, 2005]

Table 1 - Number of municipalities and census tracts drawn, according to strata defined by the size of the municipality and the São Paulo Social Responsibility Index (Índice Paulista de Responsabilidade Social - IPRS). Non-metropolitan regions of the State of São Paulo, 2002.

IPRS	Municipalities				Total	Census tracts				Total
	<10	Size (in thousands of inhabitants) 10-30	30-100	>100		<10	Size (in thousands of inhabitants) 10-30	30-100	>100	
1	1	2	2	3	8	1	4	6	21	32
2	1	2	4	1	8	1	4	12	7	24
3	5	3	1	-	9	5	6	3	-	14
4	4	2	1	1	8	4	4	3	7	18
5	5	2	1	-	8	5	4	3	-	12
Total	16	11	9	5	41	16	22	27	35	100

Directorate. With this sampling design, it was sought to select municipalities dispersed throughout the non-metropolitan regions of the State of São Paulo that were within the ambit of as many Regional Health Directorates as possible. In the second stage, to compensate for the inclusion of a large number of small-sized municipalities, it was established that the number of census tracts drawn would be inversely proportional to the size of the municipalities, so as to decrease the differences in the ratio of resident population to sampled population, in the different strata.

The estimate of the canine population was done by means of the PSPT, which includes two stages: a visit to homes to apply the questionnaire and hand over dog collars, and the counting of dogs outside of the homes.¹¹ The dogs were classified as: dogs with owners and totally restricted; dogs with owners and partially restricted; dogs without a defined owner or neighborhood dogs; and dogs with no owner. The estimate of the number of cats was obtained by home inquiry. The municipalities were surveyed between May and December 2002.

The field activities were performed by adolescents who were students within the public elementary and high school networks, accompanied by university-level supervisors with survey experience. The survey involved 1,857 students and six supervisors. In each municipality, the students were selected by the school and trained by the supervisors.

Two days of work were done in each census tract: one four-hour period for the training, two periods for the inquiry and the fourth period for performing the dog count outside of the homes.

The questionnaire applied was composed of highly summarized modules that enabled identification of the home, the interviewee and each dog or cat. In relation to the animals, information was obtained on their age,

sex, vaccinations and, in the case of female dogs, the number of litters during the preceding year. For dogs only, information on the degree of restriction and dependence was requested.

The WesVar software was utilized for the data analysis. This took into consideration the complex nature of the sampling design: the drawing of clusters and utilization of weighting.²⁰ The weighting was introduced to compensate for the differences in probability of selecting the census tracts, and it was determined according to the inverse of the sampling fraction for each stratum.

To estimate the variance, the census tracts were taken as the primary sampling units, because of the small number of municipalities.⁹ Moreover, when there were two strata containing only one census tract, they were joined together.^{8,18} The Jackknife replication technique was utilized, which made it possible to obtain estimates of variance with bias within tolerable limits, even with a small number of primary sampling units.² To study the associations between variables, Chi-square tests were performed, with correction of the Pearson statistics by measurements of the effect of the design.²⁰

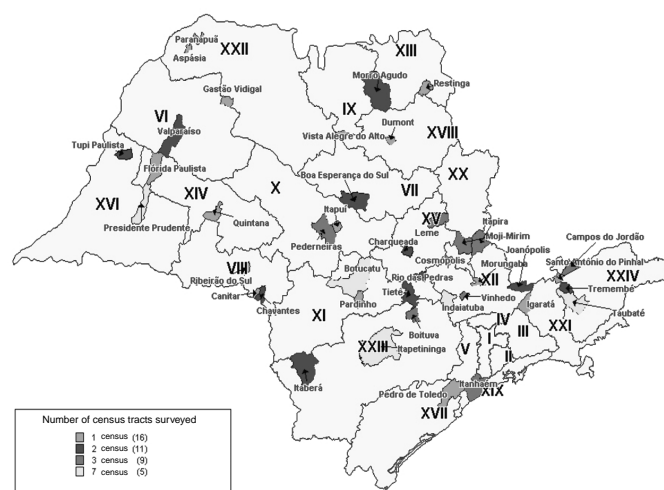


Figure - Municipalities included in the sample for the study "Estimation of the dog and cat population in the State of São Paulo", 2002.

Table 2 - Number of inhabitants per dog and 95% confidence interval, according to size of municipality and the São Paulo Social Responsibility Index (Índice Paulista de Responsabilidade Social - IPRS). Non-metropolitan regions of the State of São Paulo, 2002.

Size of municipality (thousands of inhabitants)	1	2	IPRS 3	4	5	%	Total 95% CI
<10	6.1	4.5	5.2	3.6	3.3	4.3	3.8-4.9
10 a 30	4.7	3.9	3.8	4.0	3.8	4.0	3.4-4.6
30 a 100	5.0	3.4	4.4	3.6	3.3	4.0	3.5-4.4
+100	3.8	4.5	-	4.0	-	3.9	3.4-4.3
Total							
%	4.1	3.9	4.3	3.7	3.4	4.0	3.7-4.2
95% CI	3.5-4.6	3.4-4.4	3.6-4.9	3.5-3.9	2.9-3.9	3.7-4.2	

RESULTS

During the inquiry stage, 29,337 buildings were surveyed, corresponding to 20,958 homes. The non-response rate, due to homes being locked up or refusal by the occupants to answer the questionnaire, was 8%. In the blocks surrounding the census tracts drawn, a further 36,057 homes were visited to identify the presence of dogs and hand over dog collars. Visiting 65,394 buildings was justified by the need to tag all the animals.

In more than half of the homes in the census tracts drawn (52.5%), the occupant said he or she had a dog. In 3.5%, individuals who cared for some dog in the neighborhood were identified. The mean number of dogs per home with dogs was 1.6.

Taking into consideration both stages (the inquiry and counting in the street) 19,235 dogs were found. The ratio between resident population and dog population was one dog for every four inhabitants. Table 2 shows the mean numbers of inhabitants for each dog found, according to size and IPRS of the municipalities surveyed. No statistically significant differences were detected between the municipalities grouped according to these categories. However, the tests carried out may have low power, considering that the sample was not designed with this objective.

Out of the total number of dogs surveyed, 92.7%

had a defined owner, 1.2% were neighborhood dogs and 6.1% were ownerless. This distribution was not the same for the different strata of the municipalities, and an association was recorded between the classification of the dogs and the size of the municipality ($p < 0.001$). The results indicate the existence of greater relative frequency of ownerless dogs in small municipalities, and also lower percentages of totally restricted animals. The living conditions of the inhabitants of the municipalities were also shown to be associated with the classification of the dogs ($p < 0.011$) (Table 3).

With regard to cats, 4,624 animals were found, concentrated in 12.6% of the homes. This was a lower percentage than was observed for dogs. The mean number of cats per home was 1.8. The human/cat ratio was 16.4 and the distribution according to size of municipality and IPRS is indicated in Table 4. No statistically significant differences were presented.

DISCUSSION

A variety of studies have shown that the dimensions of urban agglomerations define some of the characteristics of the social lives of humans and animals.^{5,14,19} Large-sized urban centers present greater differentiation in terms of locomotion, transportation, use of social equipment and appropriation of space among their residents than what is observed in centers of lower population density. Indicators that spe-

Table 3 - Percentage of dogs according to restriction and dependence categories, in relation to size of municipality. Non-metropolitan regions of the State of São Paulo, 2002.

Indicator		Classification				Total
		Restricted	Semi-restricted	Neighborhood	Ownerless	
Size (thousands of inhabitants)	<10	47.9	40.0	2.2	9.8	100.0
	10-30	63.8	28.6	1.0	6.5	100.0
	30-100	54.7	37.2	1.3	6.8	100.0
	>100	67.6	26.9	0.9	4.6	100.0
	IPRS					
	1	64.6	30.4	0.8	4.2	100.0
	2	62.9	29.4	1.3	6.4	100.0
	3	58.8	33.9	0.6	6.6	100.0
	4	52.9	35.6	2.1	9.3	100.0
	5	63.9	29.3	1.3	5.5	100.0
Total	%	60.7	32.0	1.2	6.1	100.0
	95% CI	57.9-63.6	29.2-34.8	0.8-1.5	5.3-6.9	-

Table 4 - Number of inhabitants per cat and 95% confidence interval, according to size of municipality and the São Paulo Social Responsibility Index (Índice Paulista de Responsabilidade Social - IPRS). Non-metropolitan regions of the State of São Paulo, 2002.

Size of municipality (thousands of inhabitants)	1	2	IPRS 3	4	5	Total %	95% CI
<10	19.2	13.4	10.9	12.0	13.7	11.8	7.7-15.8
10 a 30	16.9	26.6	16.8	13.9	8.9	15.4	13.3-17.5
30 a 100	19.2	16.4	22.1	17.1	10.8	17.3	13.9-20.8
>100	16.8	21.7	-	18.8	-	17.4	14.4-20.4
Total %	17.3	19.3	16.1	16.3	10.8	16.4	
95% CI	14.3-20.3	15.2-23.4	12.7-19.5	12.8-19.8	7.7-14.0	14.8-18.1	

cifically take into consideration the health, education and income of a city's inhabitants enable the narrowing of the differences that have become established within the web of social relationships between the individuals of a population.

The results obtained reinforce the importance of utilizing categories that bring into view the differences between the distinct segments of the animal population, thus returning to questions that have a bearing on the epidemiology of diseases. Considering the level of contact between humans and dogs and cats described in most countries around the world, which is extremely close, continuous and intense, the choice of indicators for enabling the construction of such categories necessarily comes down to some of the many indicators of the living conditions of the human population. Among these are the size of municipality and the IPRS.

In evaluating the ratios between humans and dogs or cats, it was not possible to identify differences related to the size of the municipality and the living conditions of its residents. However, when the canine population was analyzed according to degrees of restriction, some differences emerged. In relation to the size of the municipality, there was an increase in the situation of restriction as the size of the cities increased. With regard to the IPRS, there were differences in restrictions between the different groupings of municipalities due to the composition of this indicator, but without identification of tendencies. The findings relating to the classification of dogs according to the size of the urban agglomeration and the IPRS indicated the possibility that the relationships may have been nonlinear and may have consisted of events made up of chains of complex interactions that would require further investigation.

The human/dog ratio found in the present study was 4.0. This is very different from the estimate of one dog per eight inhabitants put forward by the National Health Foundation (*Fundação Nacional de Saúde*), or even from the proportion of one dog per

seven inhabitants recommended by WHO for emerging countries.^{12,22} Although most studies done in different countries have recorded ratios of between 1:6 and 1:10, there is wide variation in the results, reaching a low of 1:26, in Miacatlán, Mexico.^{4,10,13,15} The intense interaction between dogs and humans can also be show by the finding that there were dogs in more than half of the homes surveyed, a pattern that has also been observed in other studies.^{6,10,16,19}

The finding of a much larger number of dogs than the figure utilized for distributing vaccines and calculating the vaccinal coverage for the State led the Pasteur Institute, the body responsible for the Rabies Control Program, to review its planning as early as the year 2003. A gradual increase in the population of dogs and cats to be vaccinated was established, such that within three years the coverage target established by WHO would be reached.

The classification of dogs through the PSPT opens up a new possibility for municipalities to evaluate the impact of their actions, by making it possible to estimate the numbers of neighborhood and ownerless dogs that were not covered by disease prevention measures. The findings relating to ownerless dogs are smaller in scale than what has been observed in some other areas, such as Tunisia, Philippines and other South American countries, in which a variety of techniques have been utilized simultaneously in order to obtain estimates.^{3,19}

For dogs with owners, it is probable that veterinary services can be obtained in the event of disease and for vaccinations, and that food and shelter are available. This leads to the supposition that this group carries lower risk for the human population. However, the care given to these animals varies greatly and the degree of restriction is one reflection of these differences. In this sense, the semi-restricted dogs are a segment presenting risk, because of the contact they have with ownerless and neighborhood dogs, which are more exposed to diseases, and because of their simultaneous interaction with other dogs with own-

ers.¹⁹ The results obtained from the present study indicated that the most frequent classification is related to restricted dogs (60.7%). However, given the epidemiological importance of the group of semi-restricted dogs, the percentage found (32.0%) cannot be considered small.

With regard to the number of dogs with owners, the contribution brought by the present study is the possibility of estimating the numbers of these animals in municipalities of the State of São Paulo, for the first time. With information that is even more fragmented than what was obtained in relation to the vaccinal coverage for dogs, the existing estimates for cats are based either on very restricted samples or on the behavioral characteristics of the animals or owners.

The ratio of one cat for every 16 people in the present study shows the size of the problem faced by the vaccination services and for adequately planning for rabies control. In the State, laboratory results relating to rabies diagnoses have shown increasing percentages of positive cases among cats. The proximity of cats to humans and other animals in domestic surroundings makes it possible to estimate the poten-

tial risk that they represent. The small number of epidemiological studies in the literature regarding the dynamics, ecology and control of dog and cat populations have shown the difficulties in evaluating the zoonosis risks and assessing public health policies in different situations.¹⁷ Moreover, analyses that incorporate the socioeconomic differences in the spaces inhabited by humans and animals are even rarer and require multidisciplinary groups to accomplish them. The results from studies with such characteristics, such as the present one, expand the possibilities for finding out about aspects of human/animal relationships from different angles.

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