Population estimate of dogs and cats, domiciled or semi-domiciled, from the urban region of a town in the Midwest region of Brazil

Estimativa populacional de cães e gatos, domiciliados e semidomiciliados, da região urbana de um município na região Centro-Oeste do Brasil

Estimación de la población de perros y gatos, domiciliados o semi-domiciliados, de la región urbana de un municipio de la región Medio Oeste de Brasil

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Abstract

The aim of this study was to estimate the population size of dogs and cats domiciled and semi-domiciled in the urban area of the city of Jataí, Goiás, Brazil, highlighting some features of these animals, like sex and mobility. An observational descriptive sample survey was used and households were randomly selected for the study. In total, 385 households were visited, with 1215 residents. Of the households, 63.63% had at least one dog and 11.17% had at least one cat. The dog: human ratio was 1:2.92 and cat: human ratio was 1:11.79. In relation to the canine population (416), 37.02% were male (5.29% neutered and 31.73% non-neutered) and 62.98% were female (9.37% neutered and 53.60% non-neutered). The feline population was 103 animals, 39.80% were male (14.60% neutered and 31.47% non- neutered) and 46.60% were female (18.86% neutered and 37.08% non-neutered). In relation to street access, 32.93% of dogs and 84.46% of cats were semi-domiciliary. The estimated population of canines and felines domiciled and semi-domiciled in the urban region of the city of Jataí, in 2018, was 3.605 and 8.323, respectively. These results highlight the need to implement strategies for population control associated with actions to raise awareness about responsible animal custody.

Keywords: Canine; Feline; Population control.

Resumo

A estimativa populacional de cães e gatos é de fundamental importância para estudos sobre o controle da superpopulação dessas espécies, além do planejamento de programas em saúde pública. O objetivo deste estudo foi estimar o tamanho populacional de cães e gatos domiciliados e semidomiciliados na área urbana da cidade de Jataí, Goiás, Brasil, por meio de estimativa populacional, destacando algumas características desses animais, dentre estas, sexo e controle de mobilidade. Foi realizado um estudo observacional descritivo do tipo de levantamento amostral, por meio de sorteio de domicílios para aplicação dos questionários. Foram visitados 385 domicílios, totalizando 1215 moradores. 63,63% dos domicílios possuíam pelo menos um cão e 11,17% possuíam pelo menos um gato. A razão cão: humano foi de 1:2,92 e a razão gato: humano foi de 1:11,79. Em relação à população canina (416),

37,02% eram machos (5,29% castrados e 31,73% não castrados) e 62,98% eram fêmeas (9,37% castrados e 53,60% não castrados). A população felina foi de 103 animais, 39,80% eram machos (14,60% castrados e 31,47% não castrados) e 46,60% eram fêmeas (18,86% castrados e 37,08% não castrados). Alguns tutores não sabiam responder sobre o sexo dos felinos. Em relação ao acesso à rua, 32,93% dos cães e 84,46% dos gatos eram semidomiciliados. A população estimada de caninos e felinos domiciliados e semidomiciliados, na região urbana da cidade de Jataí, Goiás, em 2018, foi de 33.605 e 8.323, respectivamente. Esses resultados ressaltam a necessidade de implantação de estratégias para controle populacional associadas às ações de conscientização sobre a guarda responsável de animais.

Palavras-chave: Canino; Felino; Controle populacional.

Resumen

La estimación poblacional de perros y gatos es de fundamental importancia para los estudios sobre el control de la superpoblación de estas especies, además de la planificación de programas de salud pública. El objetivo de este estudio fue estimar el tamaño poblacional de perros y gatos domiciliados y semi-domiciliados en el casco urbano de la ciudad de Jataí, Goiás, Brasil, mediante una estimación poblacional, destacando algunas características de estos animales, entre ellas, el sexo y el control de la movilidad. Se realizó un estudio observacional descriptivo del tipo de encuesta por muestreo mediante el sorteo de hogares para aplicar los cuestionarios. Se visitaron 385 hogares, totalizando 1215 residentes. El 63,63% de los hogares tenía al menos un perro y el 11,17% tenía al menos un gato. La relación perro: humano fue 1: 2,92 y la relación gato: humano fue 1: 11,79. En relación a la población canina (416), el 37,02% eran varones (5,29% esterilizados y 31,73% no esterilizados) y el 62,98% eran hembras (9,37% esterilizados y 53,60% no esterilizados). La población felina fue de 103 animales, el 39,80% eran machos (14,60% castrados y 31,47% no castrados) y el 46,60% eran hembras (18,86% castrados y 37,08% no castrados). Algunos tutores no supieron responder sobre el sexo de los gatos. En cuanto al acceso a la calle, el 32,93% de los perros y el 84,46% de los gatos eran semidomisos. La población estimada de caninos y felinos domiciliados y semi domiciliados en la región urbana de la ciudad de Jataí, Goiás, en 2018, fue de 33.605 y 8.323, respectivamente. Estos resultados resaltan la necesidad de implementar estrategias de control poblacional asociadas a acciones de sensibilización sobre la custodia responsable de los animales.

Palabras clave: Canino; Felino; Control de poblaciones.

1. Introduction

The overpopulation of dogs and cats is a reality faced by the vast majority of Brazilian cities, causing serious inconvenience for the inhabitants, either due to occurrence of zoonoses, or due to mistreatment caused by the increasing number of abandoned animals. Among zoonotic diseases, rabies, leishmaniasis, toxoplasmosis and larva migrans can be mentioned. There is also proliferation of parasites such as fleas, ticks and mites that cause scabies, infection of microorganisms such as fungi and bacteria, worms, in addition to aggressions, traffic accidents, waste pollution, noise pollution and other disturbances (Bortoloti & D'Agostino, 2007; Diaz et al., 2018; Arruda et al., 2019).

Considering that the increase in the population of pet animals is related to their high reproductive capacity, failure to comply with the concepts of responsible guarding and population indifference to the problem, public policies should be implemented seeking to reduce the overpopulation while teaching health education (WHO, 1990; Lima & Luna, 2012).

Knowing the actual size of the population of dogs and cats of a city is essential to implement effective measures in order to find balance of these species and humans. Hence, data about the reality the studied location is also necessary, such as: number of males and females, stratification between species, animal access to the street and number of neutered and non-neutered animals (Catapan et al., 2015; Oliveira- Neto et al., 2018).

Several methods were researched to quantify dogs and cats in a determined locality and most studies were based on population estimation from a given sample (Alves et al., 2005; Domingos et al., 2007; Canatto et al., 2012; Capello et al., 2015; Trapp et al., 2015; Diaz et al., 2016; Özen et al., 2016; Mauti et al., 2017).

Jataí is a town located in the southwest of the State of Goiás, in the Midwest Region of Brazil. According to the IBGE classification, which considers the number of inhabitants, it can be categorized as an average class V city (between 50-100 thousand inhabitants). Jataí, like the vast majority of Brazilian cities, still does not have its own population control policies for dogs and cats and sees, every day, an increasing number of abandoned animals.

Given the growing demand for the control of these animals and the need for data about the population of dogs and cats, this study sought to estimate the size of the population of dogs and cats domiciled and semi-domiciled in the urban region of Jataí, Goiás, as well as some characteristics of these animals and their guardians. These steps are considered fundamental to establish efficient public policies, both for public health and animal welfare.

2. Methodology

The study was made in the town of Jataí, Goiás, Brazil, from March to July 2018 and characterized as a prospective and observational sample survey, using the methodology of Catapan et al. (2015). After defining the sample size and choosing the households, an in loco visit was made to apply an observational survey questionnaire. This study was approved by the Research Ethics Committee of the Federal University of Goiás-Goiânia/2018, under the number 2.520.645.

The field work team was composed of eight veterinarians and eleven undergraduate vet students. The researchers worked in pairs during the interviews, wearing lab coats and identification badges. Training with the application of the questionnaire was conducted with the team, to avoid biased answers. Regarding this study, questions were made about the presence of dogs and/or cats in the house and when the answer was positive, the tutors were questioned about the species, quantity and sex of the animals (neutered or not), reproductive control and animal mobility. The interviewers were instructed to indicate whether there was a physical barrier at the house. To participate in the research, the respondent necessarily had to be over 18 years old and sign the free and informed consent form, approved by the Research Ethics Committee of the Universidade Federal de Goiás.

Sample calculation was based on the formula:

$$n_0 = \frac{1}{E_0^2}$$

Where n_0 is the first approximation of the sample size and E_ (0) is the tolerable sample error, followed by the formula:

$$n = \frac{N.n_0}{N + n_0}$$

Where n is the sample size and N is the population size. Jataí is a town located in the southwest region of the State of Goiás, in Brazil. According to estimates by the Brazilian Institute of Geography and Statistics (IBGE), it has a population of 98.128 inhabitants (IBGE, 2016). Thus, for a sampling error of 5%, the recommended sample was 400 households, which were distributed proportionally to the number of buildings in each neighborhood of the urban area, using data provided by the technical department of the town.

After defining the number of households per neighborhood, we proceeded to randomly select the blocks, using a specific website (sorteador.com.br), stipulating that the house visited

would always be located in the tenth lot of the block. In case there were no buildings (residential or commercial), absence of residents or refusal to participate in the survey, the interviewers went to the lot on the left until the questionnaire was applied.

The statistical analysis of this study was executed in two phases using the R software in the RStudio integrated development environment (Version 1.0.143 - © 2009-2016, RStudio, Inc.). Initially, the distributions of the answers to each question in the questionnaire were presented, using descriptive statistics (percentage and frequency).

Then, to infer response patterns, a multiple correspondence analysis was performed (function "MCA" of R package "FactoMineR"). MCA is characterized by being an exploratory multivariate analysis that uses the basic concept of chi-square to standardize the frequencies of the variables and form a basis for correspondences (interrelationships) between categorical variables (Greenacre, 2010).

In order to avoid an imbalance in the distribution of responses, the option "did not answer" concerning the purpose of ownership was not included in the MCA; data on respondents who did not own pets were also excluded; and the option "other" with the option "mobility control" on how to prevent unwanted offspring was grouped within "other". With this adjustment in the database, a matrix was built, containing the answers to the questionnaire (Table 1), and transformed into a Burt table ("burt" function of R package "GDAtools"), which is represented by the product multiplying the inverse of the data matrix with the matrix itself.

3. Results and Discussion

The sample was defined according to the one proposed by Catapan *et al.* (2015), as the calculation generated a workable sample. In addition, the same authors justified the impossibility of carrying out an animal census, thus opting to use population sampling of the town São José dos Pinhais-PR to estimate the population of dogs and cats. Thus, it was considered the appropriate methodology, because, with the sample number and subsequent draw, it was possible to cover areas with different socioeconomic profiles, in addition to guaranteeing a homogeneous territorial distribution.

Similar to the study by Canatto *et al.* (2012), this study considered both residences and commercial establishments as households. This was necessary because some neighborhoods in Jataí have a predominance of businesses over residences. Therefore, commercial

establishments were also counted to avoid a biased estimation, since it could overestimate the population of dogs and cats when searching only residences.

Table 1. Nine sample questions and their possible answers, from the original questionnaire, which were used for multiple correspondence analysis. Jataí, Goiás, Brazil, 2018.

Questions		Possible answers
Physical barrier on site?	physical.barrier	Absent
		Present
Dogs in the household	male	Neutered
		Non-neutered
		n/a*
	female	Neutered
		Non-neutered
		n/a*
Street access of dogs	canine	Accessible
		Not accessible
		n/a*
Cats in the household	male	Neutered
		Non-neutered
		n/a*
	female	Neutered
		Non-neutered
		n/a*
Street access of cats	feline	Accessible
		Not accessible
		n/a*
What do you do to avoid unwanted offspring?	unwanted.offspring	Neutering
		Contraceptive
		Separation
		Other
		Nothing

*n/a: Not applicable. Source: The authors.

The training of the team guided the researchers in conducting the questions and avoiding induced responses, like Alves *et al.* (2005) and Langoni *et al*. (2011). However, some doubts arose in the team during the field work, being immediately resolved by phone calls or messages, showing that, despite the training, the constant management of the team was important.

It was applied 400 questionnaires, however, 15 were excluded from statistical analysis, due to the lack of signature of the terms or inconsistencies in the answers. Thus, 385 questionnaires and households were considered, totaling 1,215 residents and an average of 3.15 people per household. In commercial establishments (17/385) the number of residents was not counted.

In 63.63% of households visited, the residents claimed to have at least one dog, with similar values as described by Domingos *et al.* (2007) in Campo Grande-MS (64.7%) and by Langoni *et al.* (2011) in Botucatu-SP (66.7%), which demonstrates a population preference for dogs over cats. The preference for dogs over cats can be explained by several reasons, among which are the greater ease of communication between dogs and humans, the greater perception of protection and companionship that dog guardians think they have, explaining a greater social role of the dog, in addition to justifications such as guard and companionship for children (Dahás *et al.,* 2013).

In the households visited, a total of 416 dogs were reported, and the dog: human ratio was 1:2.92. The proportion was similar to that found by Alves *et al.* (2005) and by Catapan *et al.* (2015), in towns of the interior of São Paulo and São José dos Pinhais-PR, respectively. Thus, the importance of the population estimation made in this study was clear, since WHO (1990) recommended the dog: human ratios from 1:6 to 1:0 for emerging countries, and the one found in this study was superior. The same fact was observed for the feline population, cat: human ratio of 1:11.79, which, despite being smaller than the canine, also showed higher values than most studies compared here. A comparison of animal: human ratios are listed in Table 2.

Considering that the WHO (1990) recommendation is 1:6 and that, the lower this ratio, the greater the number of animals per person, the values found for the urban region of Jataí (one dog for every 2.92 people) highlight the need for developing population control programs. Hence, the attitudes of tutors toward their animals must be taken into account, including mobility and reproductive control; location specificities; and programs to encourage responsible guarding, with the aim of reducing these populations in the medium and long term, also minimizing the environmental and health impacts resulting from canine and feline

overpopulation (Canatto *et al.,* 2012; Dias *et al*., 2013; Catapan *et al.,* 2015, Arruda *et al*., 2019).

Table 2. Comparison of dog: human and cat: human ratios in some studies made in Brazil between 2004 and 2018.

Author/ Location	Ratio	
	Dog: human	**Cat: human**
Dias *et al.* (2004)/ Taboão da Serra-SP	**1:5.14**	**1:30.57**
Alves *et al.* (2005)/ SP	**1:4**	**1:16.4**
Magnabosco (2006)/ São Paulo-SP	**1:7.28**	**1:29.49**
Domingos *et al.* (2007)/ Campo Grande-MS	**1:3.00**	**-**
Silva *et al.* (2010)/ Barbacena-MG	**1:4.62**	**1:19.54**
Canatto *et al.* (2012)/ São Paulo-SP	**1:4.34**	**1:19.33**
Domingues (2012)/ Pelotas-RS	**1:2.00 ***	
Catapan *et al.* (2015)/ São José dos Pinhais-PR	**1:2.47**	**1:15.32**
Trapp *et al.* (2015)/ Jarapitã-PR	**1:4.6**	**1:21.5**
Junqueira (2017)/ GO	**1:3.1**	**1:10.8**
Obtained data (2018)/ Jataí-GO	**1:2.92**	**1:11.79**

*Ratio animal: human. Source: The authors.

In relation to felines, a total of 103 cats were found, and the cat: human ratio was 1: 11.79. This data was close to that cited by Catapan *et al.* (2015) and Alves *et al.* (2005), who found the ratios of 1: 15.32 and 1: 16.4, respectively. There was also an extremely small number of households with cats, concentrated in only 43 households (11.17%).

The prejudice against felines is cultural and historical, and seems to persist in the population of Jataí. Martins *et al.* (2013) also observed the preference for dogs in their studies. However, international studies showed a higher number of felines in homes, different from national results which shows larger canine populations. Cats tends to be the main pets in the world, however, in Jataí, Goiás, this inversion has not yet been observed. In Brazil, Silva *et al.* (2010) suggested that a predilection for cats was due to the verticalization of cities, with smaller family structures and more hectic lives, leading to a preference for more independent animals and Nolêto *et al.* (2017) stated that 43.75% of cat guardians reported the independence of their animals as the main characteristic. The smaller number of households with cats may reflect the indifference of the population toward this species, in addition to the

preference for dogs. The frequent complaint about wandering felines was also noted, which further increased the perception of this prejudice.

The classification of canine and feline populations is described in Table 3. With regard to the total number of dogs (416), 62.98% (262) were females and 37.02% (154) males; 5.29% (22) were neutered males, 31.73% (132) non-neutered males, 9.37% (39) neutered females and 53.60% (223) non-neutered females. As for the total of cats (103), 46.60% (48) were females, 39.80% (41) males and for 13.59% (14) of felines, the interviewee was unable to answer, either because they are puppies or because they do not have direct contact with the animals. Among the cats with known sex (89), 14.60% (13) were neutered males, 31.47% (28) non-neutered males, 18.86% (15) neutered females and 37.08% (33) non-neutered females. Many cats do not have a direct relationship with their guardians, using the house as a source of food and shelter, making some not even considered to belong to that home.

Table 3. Classification of domiciled and semi-domiciled dogs and cats from the observational survey applied in loco, in Jataí - GO, regarding gender and reproductive capacity. Jataí, Goiás, Brazil, 2018.

Species	Male			Female		
	Neutered	Non-neutered	Total	Neutered	Non-neutered	Total
Canine	22	132	154	39	223	262
	5.29%	31.73%	37.02%	9.37%	53.60%	62.98%
Feline	13	28	41	15	33	48
	14.60%	31.47%	39.8%	18.86%	37.08%	46.60%

Source: The authors.

Regarding the 245 interviewees with dogs, 14.69% (36/245) had non-neutered females and males in the same household; 33.33% (12/36) reported using contraceptives to avoid unwanted offspring, 33.33% (12/36) separation, 8.33% (3/36) neutering, 5.56% (2/36) other and 19.44% (7/36) nothing. As for the 43 feline guardians, 20.93% (9/43) of them had non-neutered females and males in the same household; of these, 33.33% (3/9) reported using contraceptives to avoid unwanted offspring, 33.33% (3/9) neutering, 11.11% (1/9) separation, 11.11% (1/9) other and 11.11% (1/9) nothing. The proportion of owners who use contraceptives and separation to avoid unwanted offspring within the household was the same for both species. However, there was a higher percentage of dog tutors who reported doing nothing for the reproductive control of their animals. These data are extremely relevant for

studies on population dynamics, since non-neutered animals are able to reproduce, also considering that female dogs and cars are pluriparous and have short pregnancies, being able to generate several and numerous offspring.

The numbers found regarding gender in the canine population were close to the data of Molento *et al.* (2007) (41.5% females and 58.5% males). The feline population data was similar to the results by Trapp *et al.* (2015) (44.2% females and 55.8% males). The data of the male-female ratio is important for planning population control as well as surveying the costs of surgical sterilization and projecting population dynamics.

In this work, the access of the animals to the streets was questioned. The animals that were allowed access to the street were considered semi-domiciled, which are completely dependent animals with semi-restricted access, as described by WHO (1990). This description was similar to that proposed by Langoni *et al.* (2011) and different from the definition used by Canatto *et al.* (2012) who classified the access as restricted, semi-restricted or free.

For data collection on street access, the questions were directed by species, and the interviewees stated that for canines (416), 66.10% (275) of them were domiciled, 32.93% (137) were semi-domiciled and 0.96% (4) did not answer. For the total of cats (103), 84.46% (87) were semi-domiciled and 15.54% (16) were domiciled. The percentages of animals with access to the street was higher than those found by Canatto *et al.* (2012), who reported such behavior for 64% of dogs and 42.5% of cats.

It should be noted that the semi-domiciled animals may be the main cause of the increased number of stray animals, since they have food and protection, but with freedom of access to the street and a greater possibility of unwanted offspring (Martins *et al.,* 2013). In addition, these animals can cause disturbances on the streets (for example, messing with rubbish and getting involved in traffic accidents) and also favor the transmission of diseases, including those of zoonotic potential, through unwanted contact with other animals (Domingos *et al*., 2007; Langoni *et al*., 2011).

This behavior may be related to the habit of residents to allow their animals to go out without using guides and collars, so that they can "walk" and do their needs, as observed in other studies (Domingos *et al*., 2007; Langoni *et al*., 2011; Martins *et al*., 2013). And, despite not being one of the questions in this study, there was frequent reporting of abandoned litters of dogs and cats, and it can be assumed that most of them are the result of unwanted offspring, coming from animals with street access, which mate indiscriminately.

The multiple correspondence analysis (MCA), showed significant correspondences between the answers of the questionnaire that were interpreted as correct, incorrect or neutral,

and from these interpretations three patterns of response were observed: positive, negative and mixed (Table 4). It is worth mentioning that the correspondence formed by "n/a" responses (not applicable) were not presented.

Table 4. Examples of significant correspondences presented by the multiple correspondence analysis, from the observational survey applied in loco, in Jataí - GO. The acronyms of the questions and possible answers are presented in sequence and separated by a dash (answer_question). Jataí, Goiás, Brazil, 2018.

Correspondences		Interpretation	Answer patterns
physical.barrier_absent	unwanted.offspring_nothing	Incorrect	Negative
neutered_male.dog	neutered_female.dog	Correct	Positive
	unwanted.offspring_neutering	Correct	
non.neutered_male.dog	unwanted.offspring_nothing	Neutral	Neutral
neutered_female.dog	unwanted.offspring_neutering	Correct	Positive
non.neutered_female.dog	unwanted.offspring_contraceptive	Neutral	Positive
	unwanted.offspring_separation	Correct	
neutered_male.cat	neutered_female.cat	Correct	Mixed
	feline_accessible.street	Neutral	
	feline_inaccessible.street	Correct	
	unwanted.offspring_neutering	Correct	
non.neutered_male.cat	non.neutered_female.cat	Incorrect	Mixed
	feline_accessible.street	Incorrect	
	feline_inaccessible.street	Correct	
neutered_female.cat	feline_accessible.street	Neutral	Mixed
	unwanted.offspring_neutering	Correct	
non.neutered_female.cat	feline_accessible.street	Incorrect	Mixed
	feline_inaccessible.street	Correct	
	unwanted.offspring_contraceptive	Neutral	

Source: The authors.

The positive response pattern may indicate that tutors practice important actions toward the well-being of their pets, as they are associated with reproductive and mobility control. The negative and mixed patterns may suggest that a part of the sample population is still unaware or does not apply the concepts of responsible custody. These attitudes need to be

addressed in other contexts to direct educational actions and assess how much economic and cultural factors influence the way society cares for its animals.

In 2016, the Superintendence of Health Surveillance of the State of Goiás launched a memorandum with goals for the state's rabies vaccination campaign. In this, a number of 15,374 canines and 1,537 felines were reported, which would correspond to 80% of the population, urban and rural, estimated for Jataí-GO. Taking into account the ratios found in this study, human: dog of 1: 2.92 and human: cat of 1: 11.79, the estimated population of dogs and cats domiciled and semi-domiciled in the urban region of Jataí-GO in the year 2018 was 33.605 and 8.323 respectively. It was possible to verify a canine and feline population 74% and 333% greater than that found in the vaccination campaign.

These data highlight the importance of characterizing each region where population control programs are to be instituted, in addition to assessing the real scope of rabies vaccination campaigns and other health education actions.

4. Conclusions

With the present study it was possible to conclude that the estimated population of dogs and cats domiciled and semi-domiciled in the urban region of Jataí, Goiás, Brazil, in the year of 2018, was 33.605 and 8.323, respectively, with prevalence of non-neutered females in both species. As for mobility, the percentage of felines with street access was higher than the canines.

The ratio between human, dog and cat populations was 2.92 and 11.79, respectively. These values were higher than those indicated by the World Health Organization for emerging countries, showing that the estimation for each city must be made carefully, in order to acquire data about the population and apply health programs.

Based on these data, health and environmental education strategies can be designed, with the aim of improving the relationship between humans and their animals, as well as planning population control programs.

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