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Prevalence of Heart Disease in Dogs and Cats Treated in the Region of Marilia-Sao Paulo during the Period from 2019 to 2023

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ABSTRACT

Heart diseases correspond to 10% of the attendances in the medical clinic of dogs and cats, which demonstrates the importance of the specialty along with the clinical diagnostic and therapeutic routine. Thus, the present study aimed to determine the prevalence of heart diseases in dogs and cats in the region of Marilia/SP in the period from 2019 to 2023. For this, a database of echocardiographic reports was used referring to two specialized services in the area, identifying and collecting the definitive diagnosis of heart diseases, the species, race, sex, age and body weight of the patients. Medical records that did not have the data cited were excluded. The results accounted for 1813 reports in total, with 16.5% (n=299) excluded and 83.5% (n=1514) evaluated. In this context, 97.6% (n= 1477) were medical records of dogs and 2.4% (n=37) of cats, identifying female dogs in 53.9% (n=796) and feline males in 59.5% (n=22) as the main carriers of heart diseases. Canine acquired heart diseases accounted for 96.1% (n=1420) and congenital 3.9% (n=57), with the most prevalent breed the Poodle 21.5% (n=318), with mean age and body weight of 11.6±3.2 years and 8.3±7.4 kg of weight, respectively; mitral and tricuspid valve endocardiosis (acquired) accounted for 93.3% (n=1379) and patent ductus arteriosus with 1.3% (n=20) (congenital) were the most incident. Among felines, 56% (n=37) had heart disease and 44% (n=29) had no cardiac alterations, with 81% (n=30) having acquired cardiomyopathies and 19% (n=7) congenital, with a predominance of mixed breed in 67.5% (n=25), with a mean age of 8.4±5.3 years and mean body weight of 3.6±0.9 kg. Feline hypertrophic cardiomyopathy was diagnosed in 64.9% (n=24) and atrial septal defect in 5.4% (n=2) of the cases. The data obtained and presented made it possible to determine the prevalence of heart diseases in the study period, in relation to species, breeds, body weight and age.

Keywords: occurrence, heart disease, canines, felines, years.

Prevalência das Cardiopatias em Cães e Gatos Atendidas na Região de Marília-São Paulo durante o Período de 2019 a 2023

RESUMO

As cardiopatias correspondem a 10% dos atendimentos na clínica médica de cães e gatos, o que demonstra a importância da especialidade junto a rotina clínica diagnóstica e terapêutica. Assim, o presente trabalho visou determinar a prevalência das cardiopatias em cães e gatos na região de Marília/SP no período de 2019 a 2023. Para isso, utilizou-se um banco de dados de laudos ecocardiográficos referente a dois serviços especializados na área, identificando e coletando o diagnóstico definitivo das cardiopatias, a espécie, raça, sexo, idade e peso corporal dos pacientes. Os prontuários que não possuíam os dados citados foram excluídos. Os resultados contabilizaram 1813 laudos no total, com 16,5% (n=299) excluídos e 83,5% (n=1514) avaliados. Nesse contexto, 97,6% (n= 1477) eram prontuários de cães e 2,4% (n=37) de gatos, identificando as fêmeas caninas em 53,9% (n=796) e machos felinos em 59,5% (n=22) como os principais portadores de cardiopatias. As cardiopatias adquiridas caninas representaram 96,1% (n=1420) e as congênitas 3,9% (n=57), com a raça mais prevalente o Poodle 21,5% (n=318), com idade e peso corporal médios de 11,6±3,2 anos e 8,3±7,4 kg de peso, respectivamente; a endocardiose de válvula mitral e tricúspide (adquirida) representou 93,3% (n=1379) e a persistência do ducto arterioso com 1,3% (n=20) (congênita) foram as mais incidentes. Nos felinos, 56% (n=37) apresentavam cardiopatas e 44% (n=29) eram ausentes de alterações cardíacas, sendo 81% (n=30) portadores de cardiomiopatias adquiridas e 19% (n=7) congênitas, predominando os sem raça definida (SRD) em 67,5% (n=25), com idade média de 8,4±5,3 anos e peso corporal médio de 3,6±0,9 kg. A cardiomiopatia hipertrófica felina foi diagnosticada em 64,9% (n=24) e a comunicação interatrial em 5,4% (n=2) dos casos. Os dados obtidos e apresentados possibilitaram a determinação da prevalência das cardiopatias no período estudado, em relação as espécies, raças, peso corporal e idade.

Palavras-chave: ocorrência, cardiopatas, caninos, felinos, anos.

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INTRODUCTION

The increasing life expectancy of dogs and cats is driving preventive veterinary care, the advancement of specialties in relation to diagnostics and therapeutics, as well as high-quality nutrition. Facts that have promoted the increase in the diagnosis of canine heart diseases, currently occupying about 10% of the medical routine in dogs and cats, with myxomatous mitral valve disease (MMVD) the most frequent (Lucina *et al.,* 2020). Retrospective studies are important to understand racial patterns and predispositions, map the occurrence and strengthen the importance of early diagnosis, aiming to promote appropriate therapies and quality of life for patients with heart diseases (Oliveira *et al.*, 2011; Santos, 2014; Keene *et al.,* 2019; Lucina *et al.,* 2020).

A retrospective study analyzed 854 Doppler echocardiographic examinations of dogs at UFMG and found 6% of congenital heart diseases, with ventricular septal defect (31.4%) being the most common (Castro *et al.*, 2009). In Lisbon, between 1989 and 2010, 203 congenital heart malformations were diagnosed, with aortic stenosis (41.8%), pulmonary stenosis (17.6%), PDA (15.3%) and interventricular/interatrial septal defects without the most frequent (Silva, 2010). A subsequent study revealed in the analysis of 976 dogs the ventricular septal defects (VSD), PDA, subaortic and pulmonary stenosis the most diagnosed congenital heart diseases, representing 7.9% (Oliveira *et al*., 2011). Umbelino and Larsson (2015) analyzed 78 dogs with congenital heart disease (CHD) and found a predominance of German Shepherd, Poodle and Yorkshire breeds in 93.6%, with the most common CHD PDA in 47%, subaortic stenosis in 15.3%, pulmonary stenosis in 10.6% and aortic stenosis in 8.4%; dogs under 12 months of age were 44.9%.

Between 2000 and 2016, Argenta *et al.* (2018) analyzed 7,903 necropsy reports at their university, in which 8.7% (n=685) of the dogs had cardiovascular diseases and 3.9% (n=27) had congenital heart diseases, with atrial septal defect being the most frequent with 23.3%, predominating in males 71.4%, with a median age of five months and purebreds such as English Bulldog, German Spitz and Boxer; on the other hand, 28.6% of the identified cases had combined heart diseases such as PDA and ventricular

defect associated with atrial septal defect. Previously, Serrano (2012) evaluated 808 dogs submitted to echocardiography between 2003 and 2012, identifying 715 animals with cardiac alterations, with pulmonary stenosis representing 6.4% of the cases (n=46), with a higher incidence in males (55%, n=25) than females (45%, n=21); and the most affected breeds were Boxer (35%, n=16), Cocker Spaniel (15%, n=7) and Newfoundland (10%, n=5).

In relation to acquired heart diseases, unlike congenital heart diseases, the involvement is much greater in animals with older ages, asymptomatic or with clinical signs of congestive heart failure (CHF), which can lead to death. This justifies the importance of early diagnosis in order to promote greater patient survival (Lima *et al.,* 2021). Freitas *et al.* (2020) analyzed 1668 dogs, of which 94.7% (n=1580) had acquired heart disease diagnosed by echocardiography, reporting the highest occurrence in females 57.1% (n=902) and mixed-breed dogs 33.1% (n=523), followed by the Poodle breed with 14.1% (n=223). The most affected age group was 11 to 15 years with 52.3% (n=826) and the most prevalent heart disease was MMVD in 93.5% (n=1477), followed by myxomatous degeneration of the tricuspid valve (MDTV) with 45.3% (n=716) and dilated cardiomyopathy in 2.3% (n=36). Borges *et al.* (2016) observed that endocardiosis increases with age, with a prevalence of 4.8% in dogs up to 1 year, 27.5% between 1 and 4 years and 67.7% between 4 and 15 years; About 60% affect the mitral valve, 10% the tricuspid valve, and 30% both valves. Malta *et al.* (2015) evaluated 6000 clinical records at a university veterinary hospital between 2007 and 2012, identifying 111 cases of heart diseases, with endocardiosis the most prevalent in 77% (n=86), with carrier dogs ranging from 4 to 18 years predominating females, mixed breed with small to medium breed size representing 30.2% (n=26), followed by the Poodle with 24.4% (n=21), Pinscher 20.9% (n=18) and Dachshund 6.9% (n=6). In turn, in the study by Franco *et al.* (2016) on the determination of left atrial volume in healthy dogs and dogs with mitral valve disease, it was found that among the 81 dogs with mitral endocardiosis, 56% (n=45) were of the Poodle breed, 21% (n=17) of the Pinscher breed, dogs without defined breed made up 13% (n=11), the Shih-tzu and Lhasa Apso breeds with 4% each (n=3) and Cocker Spaniel represented 2% (n=2), with males prevalent in 53% (n=43). The most affected age group was 8.7 to 11 years and the average weight was 9.7±4.5 kg.

Dilated cardiomyopathy (DCM) is the second most common acquired heart disease in dogs, accounting for 10% of veterinary cardiological diagnoses (Egenvall *et al.,* 2006), compromising large and giant breeds, such as Doberman, Newfoundland, Portuguese Water Dog, Great Dane, Cocker Spaniel, and Irish Wolfhound (Harmon; Lamb; Leach, 2017). In Europe, IDCD is equally prevalent among males and females in 58.8% of Doberman carriers. In the USA, the prevalence of CMD is 45% and in Canada 63%, with a mean age at diagnosis of 5 and 7 years, although dogs can be diagnosed as early as 2 years (Wess et al., 2017). In arrhythmogenic right ventricular cardiomyopathy (VCM), dogs are between 6 and 12 years old, with a higher prevalence in males (58%) than in females (42%) (Kienle; Kittleson, 1998). Although the most common breed is the Boxer, it is also observed on a smaller scale in other canine breeds and domestic felines (Carvalho *et al.,* 2018). Rare cases have been reported in breeds such as Shar-Pei (Ocarino *et al.,* 2011), English Bulldog (Santilli *et al.,* 2009), and Chinese Crested Dog (Karlstam, 2009).

In felines, feline hypertrophic cardiomyopathy (HCM) is the most common cardiovascular disease, accounting for approximately 15% of the cat population. Its high prevalence makes it a major area of interest in veterinary research on feline heart disease (Moizes; Silva, 2021). A study carried out in the North and Vale do Itajai/SC region, analyzed 74 echocardiographic reports and medical records of cats between 2017 and 2019, with the most frequent cardiomyopathy the hypertrophic phenotype with 61.9%, in felines over eight years old, males 54% and mixed breed with 63.5% (Barroso *et al.,* 2020).

In a veterinary establishment in the city of Usaquén (Bogota), 2,574 felines were evaluated, identifying the presence of heart disease in 1.4% (n=35) of these animals, 49% (n=17) females and 51% (n=18) males. The most identified heart disease was feline HCM, with 31.4% (n=11) of the cases. However, no congenital diseases were found in this species in the study in question, also reporting the age group with the highest intake, with 28.6% (n=10) between 5 and 8 years of age (Hernández; Pedroza, 2009).

Thus, due to the development of veterinary cardiology in the diagnostic and therapeutic context of dogs and cats in Brazil, the present study aims to analyze the prevalence of the main heart diseases diagnosed in dogs and cats treated in the region

of Marilia/SP during the period from 2019 to 2023.

METHODOLOGY

For the execution of this work, a database referring to echocardiographic reports performed on dogs and cats from two private veterinary establishments with specialized service in the area of veterinary cardiology in the region of Marilia/SP, from January 2019 to December 2023, was used. Data regarding the diagnoses of congenital and acquired heart diseases in dogs and cats, as well as data from the review composed of species, sex, age, breed and body weight were also collected. However, medical records that did not present a confirmed diagnosis of heart disease or incomplete data regarding the review were excluded from the present study.

The data were tabulated and submitted to the recommended statistical analysis in order to determine the prevalence of heart diseases diagnosed in relation to the species, race, age, sex and body weight of the patients treated in the period mentioned above. For this, the chi-square methodology was used, thus verifying the relationship between categorical variables and there is a significant difference ($p<0.05$) between the results identified.

RESULTS

After analyzing the database, a total of 1813 echocardiographic reports performed in the period from 2019 to 2023 in dogs and cats were identified. Among this number, 96.4% were from the medical records of dogs (n= 1747) and 3.6% of cats (n=66). 55% females (n=960) and 45% males (n=787) of the canine species, with 48.5% females (n=32) and 51.5% (n=34) males of the feline species. However, 16.5% (n=299) of the reports did not present the diagnosis of heart disease, remaining 83.5% (n=1514) of the reports to be analyzed

Regarding the evaluation of the canine species, of the 1747 medical records evaluated, 84.5% (n=1477) had a diagnosis of heart disease (congenital or acquired)

and 15.5% (n=270) were normalized or had other diagnoses (Table 1).

Table 1: Prevalence of congenital and acquired heart diseases diagnosed in dogs from 2019 to 2023 in Marilia/SP (Rubira, 2024).

PATHOLOGIES	CONGENITAL	ACQUIRED
MMVD/MDTV		93.4% (n=1379)
DCM		2.5% (n=37)
PDA	1.3% (n=20)	
Aortic stenosis	0.7% (n=10)	
CIV	0.5% (n=8)	
Pulmonary stenosis	0.5% (n=7)	
Tetralogy of Fallot	0.3% (n=4)	
ARVCM		0.3% (n=4)
VM and VT dysplasia	0.2% (n=3)	
PLCVC	0.2% (n=3)	
VM dysplasia	0.06% (n=1)	
ASD	0.06% (n=1)	

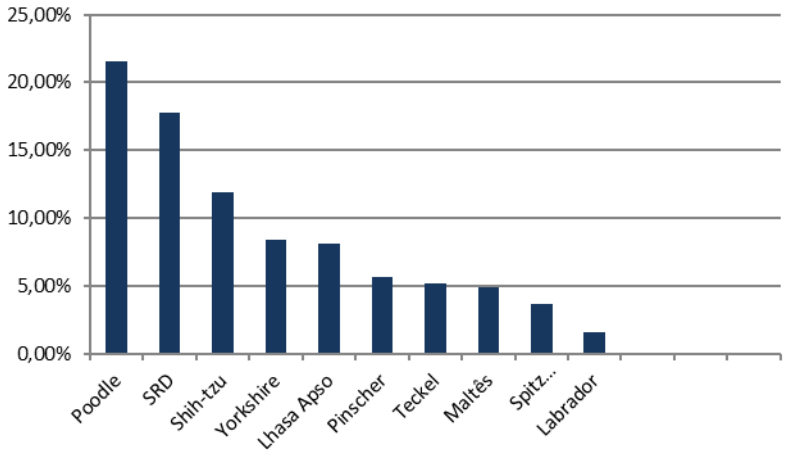
ASD: Atrial septal defect; DCM: Dilated Cardiomyopathy; ARVC: Arrhythmogenic Right Ventricular Cardiomyopathy; MV dysplasia: Mitral valve dysplasia; MV and VT dysplasia: Mitral and Tricuspid Valve Dysplasia; MMVD/MDTV Myxomatous Mitral and/or Tricuspid Valve Disease; PDA: Ductus Arterious Persistence; PLCVC: Persistence of the Left Cranial Vena Cava

Regarding sexual predisposition, the prevalence was significant between the sexes of the canine species ($p<0.05$) as described in Table 2.

Table 2: Prevalence of congenital and acquired heart diseases between the sexes of the canine species (Rubira, 2024).

	FEMALES	MALES	*P*
CONGENITAL	59.6% (n=34)	40.3% (n=23)	p<0.05
ACQUIRED	53.7% (n=762)	46.3% (n=658)	p<0.05

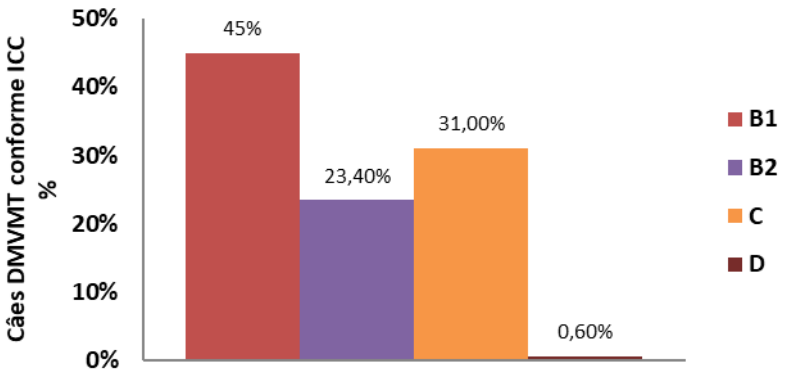
The 10 breeds of canines with the highest predisposition to heart disease were listed in the study, namely: Poodle 21.5% (n=318), mixed breed 17.8% (n=263), Shih-tzu 11.9% (n=176), Yorkshire 8.4% (n=124), Lhasa Apso 8.1% (n=120), Pinscher 5.7% (n=84), Dachshund 5.1% (n=76), Maltese 4.9% (n=72), German Spitz 3.7% (n=54) and Labrador 1.6% (n=24) (graph 1). The mean age of dogs with heart disease was 11.6±3.2 years and average weight was 8.3±7.4 kg.



Graph 1: Predisposition of breeds diagnosed with congenital and acquired heart diseases in the period from 2019 to 2023 in the city of Marilia (Rubira, 2024).

In general, Myxomatous Degeneration of the Mitral and/or Tricuspid Valve prevailed in 93.4% (n=1379) of heart diseases during the study period. Regarding the breeds, the Poodle represented 22.4% (n=309), the mixed breeds with 18.2% (n=251), the Shih-tzu breed with 12.5% (n=172), Yorkshire with 9% (n=124), Lhasa Apso with 8.6% (n=119), Pinscher with 5.9% (n=82), the Dachshund breed with 5.2% (n=72), Maltese 5.1% (n=71), German Spitz 3.3% (n=45), Fox Paulistinha 1.6% (n=22) and other breeds 8.1% (n=112). Females prevailed with 54.4% (n=750) compared to males with 45.6% (n=629) ($p<0.05$), with a mean age of 11.9±2.8 years and a mean weight of 7.5±5.7 kg.

Due to the unification of the data, it became possible to identify the prevalence of dogs with MDTV according to the CHF staging, with class B1 prevalent in 45% (n=621); B2 with 23.4% (n=322); C with 31% (n=428) and D with 0.6% (n=8) (graph 2).



Graph 2: Prevalence of canines affected by Mitral and Tricuspid Valve Endocardiosis according to CHF staging (ACVIM) in Marilia/SP between 2019 and 2023 (Rubira, 2024).

Class B1 dogs were more prevalent in females in 62.1% (n=386) than males, with five breeds most affected, the Poodle with 18.7% (n=116), the mixed breeds with 18.5% (n=115), the Shih-tzu with 14% (n=87), the Yorkshire with 10% (n=62) and the Lhasa Apso with 7.9% (n=49). The mean age was 11.4±3 years and the mean weight was 8.5±7 kg among the dogs in this ICC class. In class B2, females were again more prevalent than males with 54% (n=174), the Poodle breed was identified in 24.2% (n=78), followed by mixed breeds with 16.5% (n=53), Shih-tzu in 12.4% (n=40), Lhasa apso in 10.6% (n=34) and Yorkshire in 9.3% (n=30); and the average age of the dogs was 12.1±2.7 years and the average weight was 7.0±4.4 kg.

In turn, in class C, the prevalence was for males (56.3% (n=241) and females at 43.7% (n=187), with 25.7% of Poodle dogs (n=110), 19.2% mixed breeds (n=82), 10.5% Shih-tzu (n=45), 8.4% Lhasa apso (n=36) and 7.5% Yorkshire (n=32). All with an average age of 12.6±2.4 and an average weight of 6.6±3.9 kg. Class D prevailed again in males in 62.5% (n=5), the Poodle breed with 62.5% (n=5) of the cases, followed by the Pekingese, mixed breeds and Maltese breeds with 12.5% (n=1) each; and mean age of 12±2.3 years and mean body weight of 5±1.9 kg.

Dilated cardiomyopathy (DCM) was the second most attended acquired heart disease in the study period, representing only 2.5% (n=37) in dogs, with the Labrador Retriever breed presenting 35.1% (n=13) of the cases, the mixed breeds with 16.2% (n=6), the Golden Retriever with 8.1% (n=3), the Boxer with 8.1% (n=3), the Beagle

with 5.4% (n=2), Bull Terrier in 5.4% (n=2), German Shepherd in 5.4% (n=2); Cocker Spaniel in 2.7% (n=1), Cane Corso in 2.7% (n=1), American Pit Bull in 2.7% (n=1); Saluki with 2.7% (n=1), Rottweiler with 2.7% (n=1) and the Bernese breed also with 2.7% (n=1). However, in relation to gender, males represented 73% (n=27) and females 27% (n=10) ($p<0.05$), with a mean age of 9.4±3.1 years and a mean weight of 33.4±11.8 kg. Arrhythmogenic right ventricular cardiomyopathy (CAVD) was present in only 0.27% (n=4) of the 1477 dogs evaluated with heart disease, with 75% (n=3) in Boxer dogs and 25% (n=1) in Golden Retrievers. The sex ratio was 50% (n=2) for females and males, with a mean age of 9.2±0.8 years and body weight of 31.2±2.4 kg.

In the cases of congenital heart diseases, these represented 3.86% (n=57) of the 1477 total reports evaluated in the canine species. Females were prevalent in 59.6% (n=34), with the most affected breeds including the Poodle 15.8% (n=9), German Spitz 15.8% (n=9); French Bulldog 10.5% (n=6), mixed breeds 10.5% (n=6), Pug 10.5% (n=6), Bull Terrier 7% (n=4), Shih-tzu 7% (n=4), Dachshund 7% (n=4), Golden Retriever 5.3% (n=3), Pinscher 3.5% (n=2), Cavalier King Charlie Spaniel 1.7% (n=1), Lhasa Apso 1.7% (n=1), Maltese 1.7% (n=1), Newfoundland 1.7% (n=1). The mean age was 4.5±3.8 years and the mean weight was 9.5±10 kg.

Patent ductus arteriosus (PDA) was the most commonly diagnosed, with 35% (n=20) occurring 95% (n=19) in females and 5% (n=1) in males ($p<0.05$), with the German Spitz breed the most affected in 40% (n=8) followed by the Poodle breed with 30% (n=6), the Dachshund with 20% (n=4), the Lhasa Apso and Shih-tzu with 5% (n=1), respectively. The mean age was 6.4±4.4 years and mean weight was 5.4±4 kg.

Aortic stenosis was the second most evident with 17.5% (n=10) of the cases of congenital heart disease in dogs, affecting 30% (n=3) of the Pug and Bull Terrier breeds and 20% (n=2) of the Golden Retriever breed and mixed breeds dogs. In this heart disease, 90% (n=9) of the dogs were males, with a mean age of 3.8±2.3 years and a mean weight of 19.5±10.6 kg. The ventricular septal defect (VSD) prevailed in 14% (n=8) of the dogs, with 87.5% (n=7) in females and 12.5% (n=1) in males. The Pug breed together with the French Bulldog represented 37.5% (n=3) each, 12.5% (n=1) went to the Maltese breed and the Shih-tzu respectively. The mean age of the dogs was 2.1±3.0 years and mean weight was 6.5±2.7kg.

Valve malformations such as mitral valve dysplasia (MVD) affected 1.7% (n=1)

of dogs with congenital heart diseases, with only one 1-year-old female Cavalier King Charlie Spaniel weighing 5.9 kg. Tricuspid-associated weaning (TVD) represented 5.3% (n=3) of the 57 dogs, with 100% (n=3) in males and 33.3% (n=1) of German Spitz, 33.3% (n=1) of Golden Retriever and 33.3% of Newfoundland (p>0.05). The mean age of these dogs was one year and the average weight was 24.1±23.0 kg. Tetralogy of Fallot represented 7% (n=4) of the dogs with 100% (n=4) of males, 50% (n=2) of the Poodle breed, 25% (n=1) mixed breeds and 25% (n=1) of the Shih-tzu breed; with an age of 4.5±2.1 years and an average weight of 4.4±0.2 kg. Persistence of the left cranial vena cava (CVV) was identified in 5.3% (n=3), with two mixed breeds dogs representing 66.7% and one Poodle dog representing 33.3%. Females were most affected with 66.7% (n=2), with a mean age of 8.3±1.2 years and a mean weight of 5.6±1.5 kg.

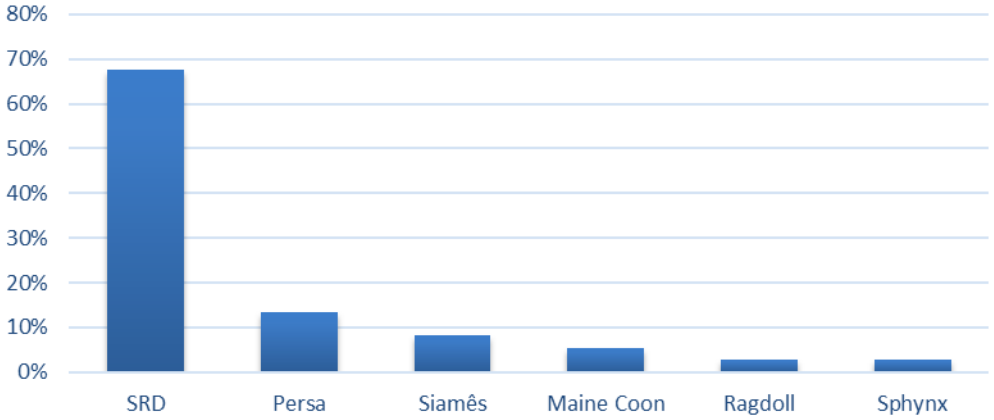
Pulmonary valve stenosis (PE) accounted for 12.3% (n=7) of the cases, with males representing 57.1% (n=4) and females 42.9% (n=3) (p<0.05). The affected number of identified breeds was 42.9% (n=3) for French Bulldogs, 28.6% (n=2) for Pinschers and 14.3% (n=1) for Shih-tzu and Bull Terriers. The mean age was 3.4±2.8 years and mean weight was 9.8±7.2 kg. Ending the congenital heart diseases in dogs, the Atrial Septal Defect (ASD) represented 1.7% (n=1), with female, mixed breeds at one year of age, weighing 2 kg.

In the evaluation of the feline species, 66 animals were identified with echocardiographic reports performed, with 56% (n=37) having heart diseases and 44% (n=29) not presenting cardiac alterations. Thus, 81% (n=30) had acquired heart diseases and 19% (n=7) had congenital heart diseases. Males predominated significantly in relation to females, showing 59.5% (n=22) and 40.5% (n=15) respectively, as shown in Table 3.

Table 3: Prevalence of congenital and acquired heart diseases between the sexes of the feline species in the city of Marilia between 2019 and 2023 (Rubira, 2024).

	FEMALES	**MALES**	***P***
CONGENITAL	57.1% (n=4)	42.9% (n=3)	P<0.05
ACQUIRED	36.7% (n=11)	63.3% (n=19)	p<0.05

Regarding feline breeds identified with heart disease, mixed breeds predominated with 67.6% (n=25), followed by Persian 13.5% (n=5), Siamese 8.1% (n=3), Maine Coon 5.4% (n=2), Ragdoll 2.7% (n=1) and Sphynx 2.7% (n=1) (Graph 3). The mean age was 8.4**±5.3 years and mean weight was 3.6±0.9** kg.



Graph 3: Prevalence of felines diagnosed with heart disease in the region of Marilia/SP between 2019 and 2023 (Rubira, 2024).

The most prevalent acquired heart disease in felines was hypertrophic phenotype cardiomyopathy (HCM), prevailing in 80% (n=24) of the reports. The breeds identified were mixed breeds with 66.6% (n=16), Persian with 12.5% (n=3), followed by Siamese (n=2) and Maine Coon with 8.3% (n=2), Ragdoll with 4.2% (n=1). Males predominated in relation to females ($p<0.05$) with 66.6% (n=16) and 33.3% (n=8), respectively; with a mean age of 8.9**±4.7** years and a body weight of 3.8±0.9 kg. Subsequently, restrictive phenotype cardiomyopathy (CMR) came with 16.6% (n=5), with 80% (n=4) of mixed breeds cats, followed by the Siamese breed with 20% (n=1) ($p<0.05$). Again, males were more affected with 60% (n=3), mean age of 11.2±4.5 years and mean body weight of 3.4±0.8 kg. Arrhythmogenic right ventricular cardiomyopathy (ARVD) was diagnostic in only 3.3% (n=1) of the cases of acquired heart disease, with an 18-year-old female Persian weighing 3.9 kg.

The reports with a diagnosis of congenital heart diseases in felines accounted for 19% (n=7), with females predominating in relation to males with 57.1% (n=4). Mixed breeds accounted for 71.4% (n=5), followed by Persian and Sphynx breeds with 14.3% (n=1) each. The mean age was 3.4**±3.6** years and the mean weight was

3.8±0.8kg. Atrial septal defect (ASD) accounted for 28.6% (n=2) of the cases of congenital heart disease, with 50% (n=1) of the mixed breeds felines and 50% (n=1) of the Sphynx breed; with 100% (n=2) females, mean age of 1.5**±0.5** years and body weight of 2.7±0.4 kg. In turn, Aortic Stenosis was also identified in 28.6% (n=2), with 100% (n=2) females and mixed breed, with an average age of 2.5±0.5 years and an average weight of 4.6±0.4kg.

Concluding the congenital heart diseases, ventricular septal defect (VSD), Mitral Valve Dysplasia (MVD) and PDA were identified in 14.3% (n=1) of the cats for each heart disease, with the first diagnosis in a 12-year-old Persian feline weighing 4.1 kg. MVD was identified in a male feline, mixed breeds with 1 year of age and weighing 3.7 kg; the classic PDA was identified in a 3-year-old male mixed breeds weighing 3.8 kg.

DISCUSSION

The results obtained, when compared with data already published, made it possible to observe the prevalence in the diagnosis of heart diseases in dogs and cats. In the study carried out by Freitas *et al.* (2020), there was a predominance of heart diseases in females, with emphasis on the mixed and Poodle breeds, as well as in the present study. Also according to the study by Freitas *et al.* (2020), most dogs with acquired diseases were aged between 11 and 15 years; These data reinforce that age is a determining factor in acquired diseases, since the mean age of dogs affected by heart disease was 11.6±3.2 years and the mean weight was 8.3±7.4 kg in the present study, a fact that has been rarely reported in the available literature.

Keene *et al.* (2019) describe that MDTV is the most prevalent heart disease in dogs, similar to our study. The same authors report that endocardiosis occurs 1.5 times more often in males. Differently, it was identified in the present study where females were the most affected. In addition, racial predisposition is a characteristic of degenerative valve disease, as demonstrated in the present study, with the Poodle breed being the most affected. In contrast, in the study by Guerra, De Sá and Correia (2019), more than half of the dogs diagnosed with VMMD were mixed breeds. In turn, Lima *et al.* (2021) cited that 50% were mixed breeds and 48.9% were medium-sized. In

the study carried out by Franco *et al.* (2011) he again mentions the Poodle breed with a prevalence of 52%, followed by the Pinscher breed with 20% of involvement, Dachshund with 12%, Fox Terrier 6% and mixed breed dogs with 10% of involvement, with the age range between 9 and 13 years and weight between 5 and 7 kg, corroborating the authors mentioned above, in another relevant study by Franco, Pereira and Camacho (2011) repeatedly refers to the incidence of the Poodle breed (50%), followed by the Pinscher breed (20%), Dachshund (12%) and mixed breed dogs (18%), aged between 8 and 11 years and weighing between 2 and 7 kg. These results reinforce the high prevalence of the disease in small and medium-sized dogs.

Advanced age is a relevant risk factor in TMMD, our data show a mean age of 11.9±2.8 years, which is similar to the data cited by Keene et al. (2019), which report the prevalence of the disease increasing sharply with age, with up to 85% of small breed dogs showing evidence of valve injury around 13 years of age; as well as Lima et al. (2021) pointed out a higher incidence among dogs aged 11 to 14 years. In the work of Jung (2019) it was possible to classify his sample according to the CHF staging, with most dogs belonging to group B1, followed by groups C, D and B2, in addition to identifying an average weight of 6.9±4.7 kg. On the other hand, Franco et al. (2016) revealed the prevalence of class B2 at 44.4% (n=36), followed by class C with 30.9% (n=25) and B1 with 24.7% (n=20). Results from Jung (2019) corroborate the present study, with class B1 prevailing and followed by class C, B2 and D; and average weight of 7.5±5.7 kg.

In the present study, only 2.5% of the dogs had dilated cardiomyopathy, a value similar to that found by Freitas et al. (2020) with 2.3%. The present analysis identified the Labrador Retriever breed being the most affected, with males prevailing. Results that were similar to those presented by Jeyaraja et al. (2019) where males of the same breed predominated, with an age of 5.7±0.1 years. In our study, the mean age was 9.4±3.1 years, as also cited by Tidholm et al. (2001) and Wess et al. (2017).

CAVD was identified in only 0.3% of dogs with acquired heart diseases, which can be justified by being a heart disease of arrhythmogenic potential with the diagnosis established by Holter electrocardiography (Pereira, 2011). The breed most predisposed to this pathology is the boxer, as well as the study by Carvalho et al. (2018) that identified this breed as the most predisposed to CAVD. In the study by

Filho (2018), the average age of 7.2±2.0 years of the Boxer dogs attended, an average weight of 31.7±5.5 kg and a higher occurrence in females. In the present study, the same age and body weight were observed, but the involvement of males and females was the same.

Of the dogs with heart disease, 3.9% had some congenital heart disease, with the persistence of the ductus arteriosus (PDA) being the most prevalent with predominance in females, as well as in the research by Umbelino and Larsson (2015) on congenital heart diseases. Also, according to Broaddus and Tillson (2010), the breeds most predisposed to this condition include Toy Poodle, Dwarf German Spitz, German Shepherd and Bichon Frisé. The findings corroborate the present study, which identified the German Spitz as the most affected breed of PDA cases, followed by the Poodle. In addition, dogs with a mean age of 6.4±4.4 years and a mean weight of 5.4±4.0 kg had a higher prevalence. This pattern is divergent from the result of the study obtained by Rodrigues and Ambrósio (2019) who observed dogs undergoing surgery for PDA, with an average age of 8.5± 7.1 months and an average weight of 6.8±7.5 kg.

Aortic stenosis was the second most prevalent congenital heart condition, in line with Umberlino and Larsson (2015), who also classified this condition as the second most common. In the present study, the Pug and Bull Terrier breeds were the most affected, followed by the Golden Retriever and mixed breeds, with most male dogs with an average age of 3.8±2.3 years and an average weight of 19.5±10.6 kg. The data corroborate Abbot (2006), who identified the Bull Terrier as the breed most affected by this condition. However, this finding contrasts with the study by Argenta, Pavarini and Driemeier (2018), in which they reported that in the animals diagnosed with aortic stenosis, the vast majority were females, with the Dachshund being the most prevalent breed and with an average age of 3.1 years

Ventricular septal defect is considered the fourth most common congenital heart disease (Oliveira et al., 2011), with a predisposition in breeds such as Yorkshire, Poodle, and Brazilian Terrier (Larsson, 2019). However, in the present study, this condition was identified as the third most frequent, with a higher incidence in the Pug and French Bulldog breeds, with a mean age of 2.1±2.9 years and a mean weight of 6.5±2.7 kg. Weight and mean age are scarce in the literature for comparison with

those obtained in the present study.

In a study conducted by Castro et al. (2009) in dogs with cardiac alterations identified on Doppler echocardiography, 0.5% had tricuspid dysplasia and 0.1% had mitral valve dysplasia. However, the prevalence of sex, breed, age and weight of the animals were not identified. Similarly, in the present study, 1.7% of the dogs were affected by mitral valve dysplasia (MVD) in a single female Cavalier King Charlie Spaniel breed. In the study by Brambilla et al. (2020), 3.9% of dogs were identified with mitral valve dysplasia, with males being more affected and higher incidence in medium-sized breeds, such as the Bull Terrier and American Staffordshire Terrier breeds, with an average age of 8 months. In the present study, mitral valve dysplasia associated with tricuspid valve dysplasia (TVD) represented 5.3% of dogs with congenital heart disease, with all males, of the German Spitz, Golden Retriever and Newfoundland breeds.

Pulmonary stenosis was the fourth most prevalent congenital alteration in the present study, affecting mainly males and French Bulldogs, with a mean age of 3.4±2.8 years and mean weight of 9.8±7.2 kg. Strickland and Oyama (2016) presented different data compared to those obtained, considering pulmonary stenosis as the third most common congenital disease in dogs. On the other hand, in the breed factor, the findings are in line with Brambilla et al. (2020) who reported the diagnosis of pulmonary stenosis, especially among brachycephalic breeds, such as the French and English Bulldogs. In the study conducted by Santos et al. (2019), the prevalence was of males, similar to the data found in our study; however, the mean age at diagnosis was 2.5 years and the mean weight was 16.6 kg.

Regarding the dogs diagnosed with Tetralogy of Fallot (TOF), all were males, with the most affected breed being the Poodle, followed by mixed breeds and Shitzu, with an age of 4.5±2.1 years and an average weight of 4.4±0.2 kg. In the study by Brambrilla (2020), the average age diverged, with the age of five months being cited, but males prevailing. In addition, the data also contrasted with the study by Smith et al. (2016), where they reported the main breeds affected the English Bulldog, Miniature Poodle, Miniature Schnauzer and White Fur Fox Terrier.

Regarding the persistence of the left cranial vena cava (CVV), Brambilla et al. (2020) identified the condition associated with other heart diseases, with a predominance in males and with a mean age of 6.5 months. According to França

(2016) the main breeds affected are the German Shepherd, Setter and Boston Terrier. In the present study, the data differed from the previously mentioned studies, with the identified PVCCE 5.26% affecting mostly females, of the mixed breed, followed by the Poodle, with an average age of 8.3±1.2 years and an average weight of 5.6±1.5 kg.

Regarding the feline species, 56% of the tests evaluated showed cardiac alterations, with hypertrophic phenotype cardiomyopathy (HCMC) being the most frequent; with the vast majority mixed breeds, followed by the Siamese, Maine Coon, Persian and Ragdoll breeds. In addition, the highest prevalence was in males with a mean age of 8.9±4.7 years. In the work by Barroso et al. (2020), CMFH also affected most of the felines diagnosed, but partially diverged from our results in relation to breeds, with emphasis also on mixed breeds felines, followed by Persian and Scottish Fold breeds, with an average age of 9.5 years and prevalence in males.

Restrictive cardiomyopathy was little prevalent in both samples. In the study carried out by Barroso et al. (2020), only 1.3% of the felines had this condition, with one mixed breeds male being 14.8 years old. In the present study, this cardiomyopathy was observed in 13.5% of the cases, predominating in mixed breed animals and only one Siamese feline, with males prevailing and mean age of 11.2±4.4 years.

Congenital heart disease also varied among surveys. In the study by Barroso et al. (2020) carried out in the state of Santa Catarina, in relation to congenital heart diseases, ventricular septal defect (VSD) in the perimembranous portion stands out, followed by mitral dysplasia, tricuspid dysplasia and aortic stenosis (AS) equally, with a prevalence of females and mixed breed, mean age of 2 years. Data corroborate the data of the present study, in which the highest prevalence in females was evidenced, but with a mean age of 3.4±3.5. In addition, ASD was the most prevalent in the species, with cases of VSD, AS, and Subaortic Stenosis, Mitral Valve Dysplasia (MVD), and PDA also identified in cats, which is close to the data cited in the study by Barroso et al. (2020). The differences found may be related to the reduction of cardiological evaluation in felines compared to the canine species and the low diagnosis of congenital heart diseases in the species, requiring further research focused on the prevalence of heart diseases in felines.

FINAL CONSIDERATION

The present study made it possible to identify and quantify the prevalence of congenital and acquired heart diseases in dogs and cats treated in the five years analyzed in the region of Marilia/SP, as well as to characterize the breeds, sex, age and weight of the affected animals according to the species analyzed. Emphasizing with the results obtained, the importance of early diagnosis of heart diseases in order to promote greater quality of life and longevity in affected patients.

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