

# NATIONAL SURVEY OF CAT TUMORS IN 2019: A RETROSPECTIVE STUDY

## REGISTO ONCOLÓGICO NACIONAL EM GATOS EM 2019: ESTUDO RETROSPECTIVO

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**Resumo:** O cancro é uma das causas de morte mais comuns nos gatos. Para além da importância clínica, os tumores espontâneos em animais de companhia são potenciais modelos para estudos em Oncologia Comparada.

Registos oncológicos são importantes, podendo ser utilizados em estudos epidemiológicos, assim como no delineamento de estratégias profiláticas e terapêuticas. O objetivo deste estudo foi a caracterização da distribuição de tumores felinos em Portugal. Um total de 752 histopatologias felinas registadas em 2019 foram incluídas no estudo. Foi recolhida informação sobre a raça, sexo, idade, tipo de tumor e malignidade e foi ainda realizada análise estatística de forma a detetar eventuais associações entre as diferentes variáveis. Na análise dos resultados foram observados 417 animais com um ou mais tumores, sendo que no total foram registados 475 tumores (63.2%, n=475/752), dos quais 74.7% eram malignos (n=355/475). Os tumores mamários foram os mais prevalentes (43.7%, n= 207/475), incluindo carcinomas (n=158) e adenomas (n=36). No seguimento destes, surgiram os tumores de tecidos moles ou de origem mesenquimatososa (19.6%, n=93/475) e os tumores epiteliais da pele (18.4%, n=87/475), o que difere de estudos publicados noutros países. Tal como foi verificado para os tumores de mama, os tumores de tecidos moles/mesenquimatosos (64,5%, n=60/93) e os tumores epiteliais da pele (18.4%, n=87/475) são maioritariamente malignos. Nos tumores de tecido mole/mesenquimatosos, o lipoma (18.3%, n=17/93) e o fibrossarcoma (17.2%, n=16/93) foram os mais comuns, não obstante de terem sido observados com alguma frequência outros tumores como o mastocitoma, linfoma ou o hemangiossarcoma. Por último, em relação aos tumores epiteliais da pele, o carcinoma das células escamosas foi o mais prevalente (48.3%, n=42/87). A malignidade foi associada com idades mais avançadas (média 10.6±3.4 anos, p<0.001), ao passo que não foram encontradas associações entre raça e tipo de tumor ou a malignidade. Sexo foi associado com o tipo de tumor, visto as fêmeas apresentarem um maior risco para o desenvolvimento de tumores de mama.

Considerando a literatura consultada, este é o primeiro estudo retrospectivo conduzido em Portugal. Tendo em conta a elevada frequência de tumores malignos, um diagnóstico precoce e a avaliação de eventuais nódulos é de grande importância, tanto em casa como na consulta veterinária.

**Palavras-chave:** registo oncológico, gato, tumores epiteliais, tumores mesenquimatosos, tumores de células redondas.

**Abstract:** Cancer is one of the most common causes of death in cats. Besides its clinical importance, small animals with spontaneous tumours are attractive comparative models for Oncologic studies.

Cancer registries are important to provide increased information, which can be used in epidemiological studies and prophylactic and treatment strategies. The aim of this study was to characterize the current distribution of feline tumors in Portugal. A total of 752 feline histopathology records obtained in 2019 were included and data regarding breed, sex, age, type of tumor and malignancy were recorded. Statistical analysis was conducted to detect associations between variables using an alpha value of 0.05. One or more tumours were present in 417 animals, and a total of 475 tumors were reported (63.2%,  $n=475/752$ ), of which 74.7% were malignant ( $n=355/475$ ). Mammary tumors were the most common (43.7%,  $n=207/475$ ), including carcinoma ( $n=158$ ) and adenoma ( $n=36$ ). Mammary tumors were followed in frequency by tumors of the soft/mesenchymal tissue (19.6%,  $n=93/475$ ) and epithelial skin (18.4%,  $n=87/475$ ), which differs from published data in other countries. Similarly, to mammary tumors, soft/mesenchymal (64.5%,  $n=60/93$ ) and epithelial skin tumors (18.4%,  $n=87/475$ ) were also highly malignant. In the soft/mesenchymal tumors, lipoma (18.3%,  $n=17/93$ ) and fibrosarcoma (17.2%,  $n=16/93$ ) were the most common types; nevertheless, other tumors were also frequent, such as mastocitoma, lymphoma and hemangiosarcoma. Finally, in the epithelial skin tumours, the most prevalent was the squamous cell carcinoma (48.3%,  $n=42/87$ ). Tumor malignancy was associated with older ages (mean  $10.6 \pm 3.4$  years,  $p<0,001$ ), whereas no association was obtained between breed and tumor type or tumor malignancy. Sex was associated with tumor type, as females presented a higher risk of developing mammary tumors. To our best knowledge this is the first retrospective study of this type conducted in Portugal. Given the high frequency of malignant tumors, early diagnosis and screening for nodules is of paramount importance, both at home and at veterinary consultations.

**Keywords:** Cancer registry, cat, epithelial tumors, mesenchymal tumors, round cell tumors.

## 1. INTRODUCTION

Cancer registries are essential for cancer control and for prevention strategies. Furthermore, cancer registries can provide data on cancer incidence, survival, mortality, and several possible risk factors. They can be used in cancer research for several purposes, like determining cancer causes and prevention, reveal cancer risk factors, observing cancer evolution in a population and regarding how the prevention, detection and treatment tools

that are used in that population affect cancer incidence<sup>1,2,3</sup>.

In addition, cancer is an important cause of death in cats, posing serious challenges to veterinarians and owners<sup>4</sup>. Most cancers are multifactorial diseases, and thus breed, sex, age and geographical localization are usually considered for a better understanding of the disease and for the development of prophylactic and therapeutic strategies<sup>1,2,9,10</sup>.

Despite this, veterinary cancer registries are scarce<sup>5,6,7,8</sup>, and, to the best of our

knowledge there are no data regarding feline cancer registries in Portugal.

Considering the lack of information, our aim was to characterize the current distribution of feline tumors in Portugal.

## 2. MATERIAL AND METHODS

Data from 2019 feline patient records were obtained from DNATech laboratory, a national wide veterinary laboratory in Portugal. A total of 752 feline histopathology records were included. Data regarding breed, sex, age, type of tumor, malignancy and metastization were analysed.

For histopathological evaluation, a representative portion of the tissue sample was fixed in 10% neutral buffered formalin and was routinely processed for histopathology. 4 $\mu$ m sections were stained with haematoxylin and eosin (H&E) and tumors were classified according to the World Health Organization (WHO) criteria. When necessary, other techniques were performed, such as immunohistochemistry.

All statistical analyses were carried out using the Statistical Package for the Social Sciences for Windows software (SPSS, version 26.0, IBM, Armonk, New York, USA) and a two-tailed *p* value less than 0.05 was considered statistically significant. After testing for normality with Shapiro Wilk test, Mann-Whitney and Fisher's exact test was used to assess the associations between malignancy and age, sex, and breed.

## 3. RESULTS & DISCUSSION

This retrospective study included 752 cats, of which 417 cats (55.5%) were diagnosed with at least one tumor. In total, 475 tumors were included, of which 74.7% (*n*=355/475) were malignant. From the 416 cats, 51 (12.2%) present more than one tumor.

The mean age of the animals was 10.6  $\pm$  0.17 years, being 9.4  $\pm$  0.35 years for cats with benign tumors and 11  $\pm$  0.2 years for cats with malignant tumors (Table 1). In

fact, there was a significant association between older cats and malignant tumors (*p*<0.001), similarly to what was described in a Swiss study<sup>10</sup>.

Most of the tumors were diagnosed in female cats (67%, *n*=279/416), contrasting with male cats that presented 33% of the tumors. Most of the cats were domestic shorthair (90.7%, *n*=365/402), followed by other breeds like Persian (4.2%, *n*=17/402), Siamese (2.2%, *n*=9/402) and Norwegian Forest Cat (1.5%, *n*=6/402).

Mammary tumors were the most common (43.6%, *n*= 207/475). Soft tissues (19.6%, *n*=93/475) and skin (18.3%, *n*=87/475) were the next most common tumor locations, digestive system (4.4%, *n*=21/475) and others including respiratory system (1.3%, *n*= 6/475), bone (0.8%, *n*=4/475), genitourinary system (0.8%, *n*=4/475), endocrine glands (0.2%, *n*=1/475) and accessory structures of the eye (0.2%, *n*=1/475) (Figure 1). This distribution differs from previous results, where skin and soft tissue tumors were the most frequent<sup>5:8</sup>. Additionally, lymphomas were also frequent in surveyed population (9%, *n*=43/475). Considering the digestive system (4.4%, *n*=21/475), tumors in the oral cavity were the most frequent, with the odontogenic fibroma as the most common (23.8%, *n*=5/21). Other tumors diagnosed included intestinal adenocarcinoma (28.6%, *n*=6/21), exocrine pancreas carcinoma (9.5%, *n*=2/21) and adenocarcinoma of salivary glands (9.5%, *n*=2/21). Regarding other tumor locations, this study also found adenocarcinoma in the nasal cavity (1.1%, *n*=5/475), osteosarcoma (0.4%, *n*=2/475) and condrosarcoma (0.2%, *n*=1/475), transitional cell carcinoma (0.2%, *n*=1/475), leiomyoma of the oviduct (0.2%, *n*=1/475), Leydig cell tumor (0.2%, *n*=1/475), thyroid adenoma (0.2%, *n*=1/475) and lacrimal gland adenoma (0.2%, *n*=1/475).

Statistical analysis showed that sex was associated with tumor type (*p*<0.001), since all mammary tumor were diagnosed in female cats. Excluding mammary tumors

from the analysis, no statistically significant differences were found between sex and the type of the tumor ( $p=0.74$ ). Also, we found no association between breed and type of the tumor ( $p=0.74$ ).

Clinicopathological features	Number of animals (%)
<b>Sex</b>	
Female	280 (67%)
Male	138 (33%)
Unknown <sup>a</sup>	57
<b>Breed</b>	
Domestic Shorthair	365 (90.7%)
Persian	17 (4.2%)
Siamese	9 (2.2%)
Norwegian Forest Cat	6 (1.5%)
Maine Coon	1 (0.2%)
British shorthair	1 (0.2%)
Scottish shorthair	1 (0.2%)
Oriental shorthair	1 (0.2%)
Russian blue	1 (0.2%)
Unknown <sup>a</sup>	73
<b>Age (mean ± SD)</b>	
	10.6 ± 0.17 years
<b>Malignancy</b>	
Benign tumor	120 (25.3%)
Malignant tumor	355 (74.7%)

<sup>a</sup>Not considered in the calculation of the percentages neither in the statistical analysis

Table 1. Clinicopathological features of the feline tumors.

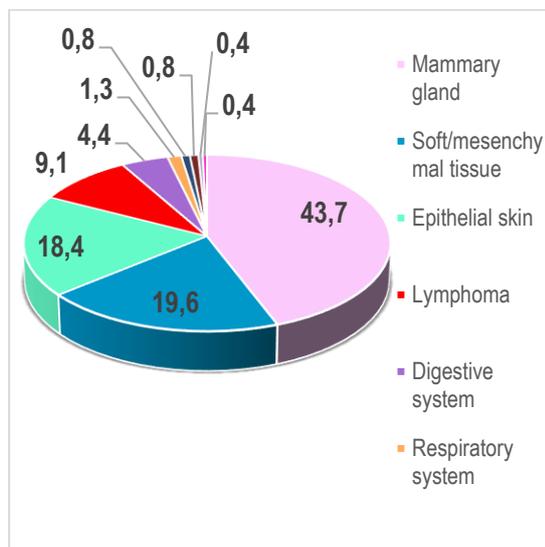


Figure 1: Tumour distribution in cats according to topographical site

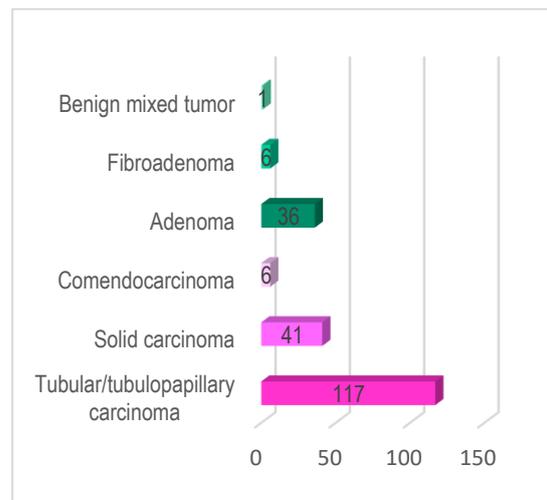


Figure 2: Mammary tumour distribution in cats

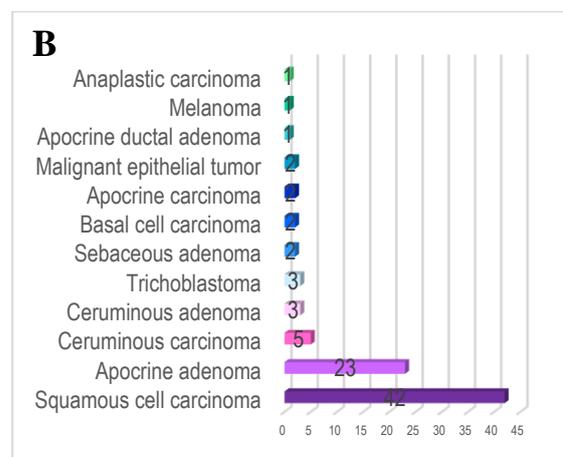
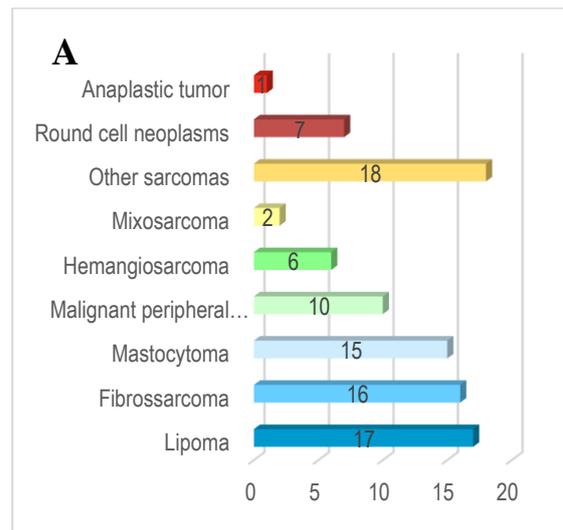


Figure 3: Soft /mesenchymal tissue (A) and epithelial skin (B) tumors distribution.

Legend – Malignant peripheral nervous sheath tumor

#### 4. CONCLUSION

To our best knowledge, this is the first retrospective study conducted in Portugal. The differences found between our results and other publications highlight the importance of local studies, opening new possibilities for different studies, focusing on risk factors, prevention strategies and owner's education, among others. In fact, given the high frequency of malignant tumors in feline patients, early diagnosis and screening for nodules is of paramount importance, both at home and at veterinary consultations.

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