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Prevalence of asymptomatic dermatophytes carrier cats in high population density households in Lavras–MG city

Prevalência de dermatofitose subclínica em gatos domiciliados em alta densidade populacional na cidade de Lavras–MG

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ABSTRACT: Dermatophytosis is a significant zoonosis in the world. This study aimed to investigate the prevalence of asymptomatic dermatophytes carrier cats in high population density households in Lavras (MG) city and to analyze the epidemiological factors associated with this condition. A total of 160 cats were evaluated through coat samples collected by brushing. The coat samples were inoculated in Dermatophyte Test Medium culture. After colony growth, they underwent microscopic analysis to identify dermatophytes. Statistical analysis was performed using the Chi-square test or Fischer's Exact test to assess the association between variables, determining relative risk. Twenty-seven cats (16.9%) were asymptomatic carriers, with the species *Nannizzia gypsea* (66.7%) were the most prevalent. There was a significant association between age and the occurrence of dermatophyte carrier status, with cats over six years old were 1.8 times more likely to occur. Mixed-breed, females, long hair, mature adults and outdoor cats were more prevalent, although there was no significant association with dermatophyte carrier status. Only one owner and their cat had a previous history of dermatophytosis. The prevalence of asymptomatic dermatophytes carrier cats in high population density household in Lavras-MG city was low, with no evidence of harm to animal and human health.

KEYWORDS: dermatophytosis; felines; zoonosis.

RESUMO: A dermatofitose é uma zoonose mundial de grande relevância. O objetivo do estudo foi investigar a prevalência de dermatofitose subclínica em gatos domiciliados em alta densidade populacional na cidade de Lavras (MG) e analisar os fatores epidemiológicos associados à essa condição. Foram avaliados 160 gatos, coletando amostra de pelame por meio de escovação. O material foi depositado em meios de cultura Dermatophyte test médium. Após crescimento das colônias, estas foram submetidas à análise microscópica para identificação dos dermatófitos. Análise estatística foi realizada utilizando teste Qui-quadrado ou Exato de Fischer para avaliar a associação entre variáveis, sendo determinado o risco relativo. Dos animais avaliados, 27 (16,9%) foram portadores assintomáticos, sendo a espécie *Nanizzia gypsea* (66,7%) a mais prevalente. Houve associação significativa entre idade e ocorrência da dermatofitose subclínica, tendo 1,8 vezes mais chance de ocorrer em gatos com mais de seis anos. Animais sem raça definida, fêmeas, de pelame longo, adultos maduros e com acesso a rua foram mais prevalentes para condição, apesar de não haver associação significativa. Um tutor e um animal tinham histórico prévio da doença. A prevalência de dermatofitose subclínica em gatos na cidade de Lavras (MG) foi baixa, não revelando prejuízos à saúde animal e humana.

PALAVRAS-CHAVE: dermatofitose; felinos; zoonose.

INTRODUCTION

The population of cats in Brazilian households has been progressively increasing, with an estimated annual growth of 8.1% since 2013. Currently, the country has approximately 23.9 million of domestic felines (IBGE, 2018). Considering these data, it becomes evident that the human-animal relationship is growing, and consequently, the contact and spread of importance zoonoses to public health. Furthermore, the

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increase in the cat population also directly impacts veterinary practices, where approximately 30-75% of cases involve dermatology (Feitosa, 2014).

Among skin diseases, dermatophytosis is one of the most important (Frymus *et al.,* 2013), representing approximately 30% of feline dermatopathies in Brazil (Larsson e*t al.,* 1997). It is a fungal disease that can range from simple lesions, such as non-pruritic alopecia, to widespread problems with severe secondary infections, impairing the quality of life of animals (Viani, 2015). Furthermore, it has zoonotic potential, putting cat owners at risk. (Moriello, 2014). Transmission occurs mainly through direct contact with a symptomatic or asymptomatic carrier feline (Reis Gomes *et al.,* 2012; Oliveira *et al.,* 2015). Many cats remain with subclinical infection (Frymus *et al.,* 2013), becoming disease reservoirs (Reis Gomes *et al.,* 2012; Oliveira *et al.,* 2015). It is estimated that approximately 17% to 80% of cats are asymptomatic carriers of the *Microsporum canis* dermatophyte (Bodin, 1902; Viani, 2015).

In humans, dermatophytosis affects about 25% of the world's population. It is the second most frequent disease in adults and the third in children under twelve years old (Cavalcanti *et al.,* 2003; Damázio *et al.,* 2007; Zaitz *et al.,* 2010; Viani, 2015). Cats are the main source of infection for their owners and other animals (Cafarchia *et al.,* 2006). In this regard, infected or asymptomatic carrier cats should be identified and treated to ensure disease control and prevention (Moriello *et al.,* 2017). Therefore, conducting continuous research is extremely important to determine the agents involved in cases of dermatophytosis in a region (Costa *et al.,* 2002).

The prevalence of asymptomatic dermatophytes carrier cats has been reported in some states and cities in Brazil, such as São Paulo (Nitta *et al.,* 2016), Paraná (Bier *et al.,* 2013), Rio Grande do Sul (Ferreiro *et al.,* 2014), Florianópolis-SC (Fraga *et al.,* 2017) and Alfenas-MG (Beraldo *et al.,* 2011). However, there is no data available for the Lavras-MG city. Therefore, this article aimed to determine the prevalence and associated risk factors of asymptomatic dermatophytes carrier cats in high population density household in Lavras-MG city, improving to the animal and human health.

MATERIAL AND METHODS

The study was conducted following approval by the Ethics Committee on Animal Use of the Lavras University Center (Lavras-MG), under protocol number 017/2022. A total of 160 owned cats of distinct ages, genders, breed patterns, and neuter states were evaluated in Lavras-MG city between January and July 2023. The inclusion criteria were cats that lived with five or more individuals of the same species and skin lesions free (asymptomatic). Information about each cat were recorded, such as age, gender, breed, neuter status, hair length type, lifestyle (indoor or outdoor), feline leukemia (FELV) and/or feline immunodeficiency virus (FIV) tests and previous history of dermatophytosis. Additionally, reports of owner skin lesions compatible with that disease were also recorded.

The cats underwent a clinical examination to ensure the absence of dermatopathies. Coat samples were collected by brushing technique: a sterile human dental brush was used to brush the entire body of the animal until the bristles were filled with hair (Figure 1). Next, coat samples were inoculated on Dermatophyte Test Medium (DTM) culture (Conclue Dermatofitose®, Ouro Fino Saúde Animal, Cravinhos/SP – Brazil). The culture tubes were partially closed (to maintain the necessary aeration for fungal growth), kept protected from light and stored at a temperature between 15°C and 30°C for further analysis. All procedures, from animal handling to sample collection, were performed while wearing personal protective equipment (gloves and lab coat), ensuring safety of professionals and integrity of the samples.

Change in the color from yellow to red of the culture medium after about three to five days and the appearance of white hyphae indicated the development of dermatophytes. Macroconidias (Figure 2) were collected using acetate tape and fixed on optical microscopy slides. The basic (purple) dye from Rapid Panoptic® (Larboclin Produtos para Laboratórios, Pinhais - PR, Brazil) was used to stain the slides. Microconidias was analysed under an 100x optical objective lens microscope, identifying morphological characteristics compatible with dermatophytes (Quinn *et al.*, 2019): *Microsporum canis* was identified as a spindle-shaped structure, with a rough surface, thick wall and containing up to 15 septations (Figure 3A); *Nannizia gypsea* (previously *Microsporum gypseum*) as a canoe

Source: Personal archive, 2023.
Figure 1. Collection of coat samples by brushing technique using sterile human dental brush.

shape, with a rough surface, thin wall and containing up to six septations (Figure 3B); and *Trichophyton mentagrophytes* in a cigar shape, with a smooth surface, thin wall and containing up to seven septations.

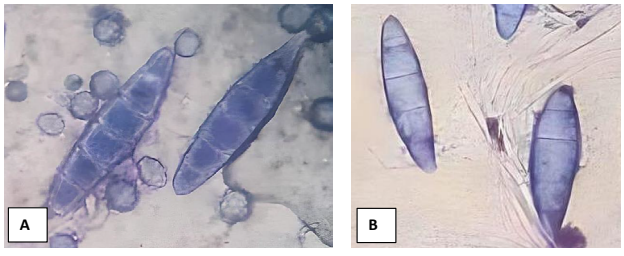
Statistical analysis was performed using GraphPad Prism® 5.0 software. The association between asymptomatic dermatophyte carriers and gender, breed, age, coat type, neuter status and management was determined using the Chi-square test with Yates' continuity correction or Fisher's exact test when at least one category was less than five. The relative risk was calculated with a 95% confidence interval. Statistical significance level was considered as 5% ($p<0.05$).

RESULTS

Of the 160 cats evaluated, dermatophytes were isolated in 27 (16.9%). *Nannizzia gypsea* was the most prevalent specie, being identified in 25 samples (92.7%). *Microsporum canis* was isolated in nine cultures (33.3%) and both species (*Nannizzia gypsea* and *Microsporum canis*) in seven ones (25.9%). There were no microconidia corresponding to *Trichophyton mentagrophytes*.

Source: Personal archive, 2023.

Figure 2. Development of dermatophytes on DTM (Dermatophyte Test Medium), showing the color change from yellow to red of the culture medium with the growth of colonies (white hyphae).



Source: Personal archive, 2023.

Figure 3. Optical microscopy image, showing fungal structures compatible with dermatophytes in coat from an asymptomatic cat. A: *Microsporum canis*, spindle-shaped microconidia with thick walls, containing up to 15 septa. B: *Nannizzia gypsea*, canoe-shaped microconidia, with thin walls, containing up to six septa. 100x objective.

Among asymptomatic dermatophytes carrier cats, the majority were of mixed breed (96%; 26/27), females (63%, 17/27), young adults (52%; 14/27), short hair (59%, 16/27), neutered (96%, 26/27), outdoor (63%, 17/27) and negative or untested for FIV and FeLV (48%, 13/27). The prevalence of asymptomatic infection within each clinical and demographic category was higher in: mixed breed (18%, 26/147) versus Persians (4%, 1/25); females (16%, 16/98) versus males (9%, 10/112); mature adults (30%, 11/36) versus other life ages (kitten: 0%, 0/14; young adult: 15%, 14/194; senior: 8%, 2/24); long hair (20%, 11/55) versus short hair (8%, 16/194); neutered (18%, 26/141) versus intact (3%, 1/37); and outdoor (19%, 10/53) versus indoor (16%, 16/197) (Table 1).

There was no significant association between the asymptomatic carrier status and breed pattern ($p=0.9286$), gender ($p=0.6979$), hair length type ($p=0.5881$), neuter status ($p=0.2020$), lifestyle ($p=0.4602$). Only age showed an association ($p=0.0454$) with cats over six years old. These cats have 1.8 times greater chance of being asymptomatic carriers of the fungus.

One owner reported contracting the zoonosis through direct contact with their cat, which had a previously confirmed disease. This cat had fungal growth in the culture of the current research. Eight cats had a previous history of dermatophytosis according to their owners' reports. In this study, dermatophytes were identified in two of those cats. The study involved 19 households, of which 11 (57.9%) had at least one asymptomatic dermatophytes carrier cat. The data about the prevalence of positive cats in each household are presented in Table 2.

DISCUSSION

The prevalence of asymptomatic dermatophytes carrier cats in high population density households in Lavras-MG city was low. *Nannizzia gypsea* was the most isolated dermatophyte specie. In a nearby city, Alfenas-MG, the reported prevalence was 30% and the most isolated dermatophyte species was *Microsporum canis* (Beraldo *et al.,* 2011). In São Paulo and Paraná states, studies reported prevalences of 83.6% (Nitta *et al.,* 2016) and 95% (Bier *et al.,* 2013), respectively. On the other hand, Rio Grande do Sul state (8.4%) (Ferreiro *et al.,* 2014) and Florianópolis-SC city (3%) (Fraga *et al.,* 2017) have lower prevalence than the current research. The results obtained also differ from other regions of Brazil, where the most frequent species is usually *M. canis* (Ferreiro, 2014). In those cases, *N. gypsea* is considered rare, but it has been demonstrated in asymptomatic cats (Moriello, Debor, 1991; Sparkes *et al.,* 1993; Ferreiro *et al.,* 2014), as in the present study. Although the prevalence of dermatophytes may vary by geographic region, *M. canis* accounts for over 90% of infections in the feline species worldwide (Greene, 2015).

Dermatophytosis occurs more frequently in subtropical and tropical climates. It primarily affects cats living in shelters

or high population density areas and those with outdoor access (Moriello *et al.,* 2017). Although there was no significant association between lifestyle and fungal isolation, the most positive samples were from outdoor cats. Despite have been statistically insignificant, many positive cultures were obtained from long-haired cats, as previously described (Moriello *et al.,* 2017). It may be due to hereditary factors or the greater ease of fungal spore adherence to this hair type (Moriello, 2004). It is believed that long hair provides suitable temperature and humidity for fungal structures to remain protected against desiccation, furthering their spread. Additionally, it may be related to genetics predisposing certain breeds (Sparkes *et al.,* 1993).

Regarding breeds, data in the literature indicate that dermatophytes are more frequently isolated in Persian cats (Balda, Otsuka, Larsson, 2007). The reason for this is not well elucidated. A theory suggests that the predisposition of Persians

Table 2. IAsymptomatic dermatophytes carrier cats per household (n=11) in the Lavras-MG city.

Household	Positive (Total)	%
A	6 (7)	85,7
B	6 (11)	54,4
C	3 (8)	37,5
D	3 (8)	37,5
E	2 (6)	33,3
F	1 (6)	16,7
G	1 (6)	16,7
H	2 (15)	13,3
I	1 (12)	8,3
J	1 (12)	8,3
K	1 (14)	7,1

Table 1. IClinical and demographic characteristics of cats in high population density households in the Lavras-MG city from February to July 2023.

Characteristics	N	Negative culture	Positive culture		
			M. canis	*N. gypsea*	Both
Gender					
Female	99	82	1	13	3
Male	61	51	1	5	4
Breed					
Mixed	147	121	2	17	7
Persian	13	12	0	1	0
Age[1]					
kitten	7	7	0	0	0
Young adult	104	90	2	8	4
Mature adult	36	25	0	8	3
Senior	13	11	0	2	0
Hair					
Long	55	44	1	7	3
Short	105	89	1	11	4
Lifestyle					
Outdoor	53	43	1	7	2
Indoor	107	90	1	11	5
Neuter status					
Neutered	141	115	2	18	6
Intact	19	18	0	0	1
FIV/FeLV					
FIV/FeLV negative	70	57	0	9	4
FIV positive	9	8	0	1	0
FeLV positive	0	0	0	0	0
Untested	81	68	2	8	3
Total (%)	160 (100)	133 (83,1)	2 (1,2)	18 (11,3)	7 (4,4)

FIV: Feline Immunodeficiency Virus; FeLV: Feline Leukemia Virus.
[1]Feline life age, according to Quimby *et al.* (2021).

to dermatophytosis may be related to the fact that these cats are often kept in high population density, which would facilitate the spread of the fungus (Cafarchia *et al.,* 2006). Even though all the felines analyzed belonged to high population density households, the most affected cats were mixed breed, followed by Persians. These results diverge from the other studies mentioned earlier. However, they are consistent with the research by Rego (2017), where 75.6% of cats diagnosed with dermatophytosis were mixed breed. Such data are also consistent with previous studies that demonstrated the absence of breed predisposition for the disease (Moriello *et al.,* 2017).

There was no significant sexual predisposition, as observed by Betancourt *et al.*, (2009). However, it was observed that females were more prevalent, in contrast to some studies that highlighted males (Cavalcanti *et al.,* 2003; Cafarchia *et al.,* 2006). The authors related male susceptibility to higher production of sebaceous secretion. In the current research, the result obtained is probably due to the predominance of females in the evaluated sample, as observed for other clinical and demographic characteristics. Therefore, the prevalence was considered within each category to avoid influence from the number of animals obtained.

Only age showed a significant association with the carrier status. Cats over six years old had 1.8 times more chances of being asymptomatic dermatophyte carriers. According to Dieckmann *et al.* (1998), asymptomatic carriers are predominantly adults. On the other hand, Gambale *et al.* (1993) isolated dermatophytes in asymptomatic cats of all ages. Although clinical disease is much more common in kittens (Balda; Otsuka; Larsson, 2007), no cat was positive in this life age. It is likely that the asymptomatic carrier status is more prevalent in adult cats due to their robust immunity, which can control the infection. In kittens, the immune system is not fully established, thus predisposing to the manifestation of clinical signs.

Immunity plays a crucial role in understanding dermatophytosis dynamics, especially in immunocompromised felines with a retroviral infection (Ribeiro, 2005). In this study, only one FIV-positive cat exhibited dermatophyte growth in the culture. Half of the cats were not tested for FIV/FeLV. This made it impossible to assess the association of asymptomatic dermatophyte carrier status with retroviruses, representing a limitation of this research. Another limiting factor is that, although the brushing method is effective, false-negative results could have occurred if the samples were not collected properly or inoculated correctly into the culture medium (Di Mattia *et al.,* 2018). Furthermore, although the DMT medium is practical, effective and yields rapid results, it has limitations. One of them is the low sporulation capacity of dermatophytes in this culture medium (Chengappa; Pohlman, 2016). In the absence of *Trichophyton* spp. growth, the use of auxotrophic tests is indicated (Chengappa; Pohlman, 2016), but it was not performed in this study. Moreover, some contaminating fungi may exhibit colony morphology like dermatophytes and cause a change in the color of the DTM (Kaufmann *et al.,* 2016). However, it did not influence the results of the current research, because all colonies were confirmed under the microscope. On the other hand, fungal colonies coalesced, making it impossible to quantify them and consequently recommend therapy for infection control (Moriello *et al,* 2017). Nevertheless, it was observed that the asymptomatic dermatophytes carrier status has little importance regarding dissemination of infection, as only one owner and one cat had a confirmed previous diagnosis of dermatophytosis. This fact may be related to *N. gypsea* being the most prevalent species, which does not exhibit zoophilic characteristics.

CONCLUSION

The prevalence of asymptomatic dermatophyte carrier cats in high population density households in Lavras-MG city was low. Age was identified as an associated risk factor, with cats over six years old having 1.8 times more chances of presenting that condition. Although dermatophytes were present, the interaction between cats and their owners did not result in significant dissemination of the disease. Furthermore, the condition did not cause detrimental effects on the animal´s health. Therefore, further studies are needed to assess the real need for treatment for asymptomatic dermatophyte carrier cats and the importance of this condition for public health.

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