



Isolation of Dermatophytes from the Hair Coat of Healthy Persian Cats without Skin Lesions from Commercial Catteries Located in São Paulo Metropolitan Area, Brazil

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ABSTRACT

Background: The study of the epidemiological chain of dermatophytosis, particularly those related to zoophilic fungi, is extremely important because of its frequent occurrence, the high infectivity of the agent, and its anthroponotic character. In all latitudes, asymptomatic cats are considered the main reservoirs and sources of dermatophyte infection. The study aimed to characterize the frequency of dermatophyte infection and the potential risk of microsporic infection to the owners and to possible buyers of apparently healthy Persian cats from commercial catteries of São Paulo, Brazil.

Materials, Methods & Results: Fur samples were obtained from 61 clinically healthy Persian cats, which were devoid of typical cutaneous lesions and had negative results in Wood's lamp examination. The average age of the cats was 37.7 months; 18 (29.5%) of them were males and 43 (70.5%) were females. The cats were from commercial catteries located in the metropolitan region of São Paulo state capital. Samples were obtained using the technique of Mariat & Adam using a square (25 cm²) of sterile carpet rubbed across the surface of the hair-coat and skin. People who had close contact with the animals were asked whether they had had typical ringworm lesions in the recent past or at the time of sample collection. The material collected was pressed onto Petri dishes containing agar supplemented with chloramphenicol and cycloheximide. The Petri dishes were handled under sterile conditions and incubated at 25°C for up to 21 days. There was evident fungal growth in 83.6% of the samples, and the only dermatophyte isolated was *Microsporum canis*. The results were analyzed using the chi-square test in order to verify possible associations between variables (sex and age range) and the frequency of dermatophyte infection in dermatologically healthy animals. However, there was no statistical difference regarding sexual predisposition (P value = 0.139) and age (P value = 0.224) regarding the asymptomatic dermatophyte carriers. Of the 18 people who had close contact with infected cats, eight (44.4%) claimed to have presented with typical *tinea corporis* lesions in the past and three (16.7%) said that they had such skin lesions at the time of harvest of the cat fur. There were no people who claimed to have been in contact with other species.

Discussion: In Brazil, fungal infections represent up to 8.7% of skin diseases in children, and *tinea capitis* caused by *Microsporum canis* is the most common superficial mycosis in this age group. Its interspecies transmission has been reported for decades. Approximately 50% of individuals exposed to symptomatic or asymptomatic cats acquire the disease. In up to 70% of families with infected cats, at least one family member may develop the disease. Among domestic cats, the Persian breed is most often cited as prone to spreading dermatophytes. In the study, there was fungal growth in 83.6% of the samples, and only *M. canis* was isolated. Among the people who had contact with the cats, 44.4% and 16.7% had typical *tinea corporis* lesions in the past and at the time of the interview, respectively. However, it is speculated that the rate of infection may have been higher in the humans in contact with these cats, since there may have been some hesitation and fear by the people interviewed in reporting the occurrence of characteristic skin lesions, either as a way of preserving the cattery reputation, or to spare the embarrassment in declaring oneself as infected, which is sometimes viewed negatively. The results demonstrate the potential infectivity, pathogenicity, and risk of microsporic infection in buyers of apparently healthy cats from commercial catteries located in the metropolitan region of São Paulo.

Keywords: dermatophytosis, cats, epidemiology, Persian, *Microsporum canis*, *tinea*.

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INTRODUCTION

The study of the epidemiological chain of dermatophytosis, particularly those related to zoophilic dermatophytes, is quite important because of its frequent occurrence, the high infectivity of the agent, and its anthroponotic character [21,28,54,57]. Dermatophytosis is a superficial fungal infection that affects keratinized or semi-keratinized portions of the tegument [27]. Dermatophytes are classified into three groups (zoophilic, geophilic, and anthropophilic) based on their preferred habitats [22]. In humans, 15% of cases of ringworm (tinea) are of zoonotic origin, and the vast majority of these are acquired from contact with cats [28,52]. Dogs and cats are considered important reservoirs and sources of dermatophyte infection for other animals and humans [3,10,40].

In all latitudes, asymptomatic cats are considered the main reservoirs and sources of dermatophyte infection, especially of *Microsporum canis*. Among domestic cats, the Persian breed is most often cited as prone to spreading dermatophytes [20,39,52]. Ringworm infections in domestic cats, especially asymptomatic Persian cats, are associated with their potential role as a reservoir and disseminator of zoonotic infections. This study aims to characterize the frequency of dermatophyte infection in these animals and the potential risk of infection of human contacts, including the possible buyers of apparently healthy cats from commercial catteries in São Paulo, Brazil.

MATERIALS AND METHODS

Fur samples were obtained from 61 clinically healthy Persian cats. The average age of the animals was 37.7 months, 18 (29.5%) of them were males and 43 (70.5%) were females. The cats came from commercial catteries located in the metropolitan region of São Paulo state capital (Latitude: 23° 32' 51" S - Longitude: 46° 38' 10" W).

All of the owners of the catteries enrolled agreed to the inclusion of their animals in the project, and signed a consent form. There were also informed that the project (No. 2764/2012) was in line with the ethical principles of animal experimentation established by the Ethics Commission on Animal Use (CEUA), Faculty of Veterinary Medicine and Animal Science, University of São Paulo (USP-FMVZ).

During the examination, the owners were asked whether they or other people in close contact with the

cats had presented with skin lesions (with or without pruritus, alopecia, dyschromia, crust of distinct configurations, etc.) suggestive of dermatophyte infection in the last 90 days or at the time of visit to the property.

The animals were previously identified and subjected to anamnesis and the following examinations: physical, otologic, and dermatologic, including the Wood's lamp examination. Only animals devoid of soft tissue injuries, negative to the Wood's lamp examination, and without apparent systemic disease were included in the study. Samples were obtained using the technique of Mariat & Adam [34] using a square (25 cm²) of sterile carpet rubbed across the skin and hair coat surface.

After harvesting, the squares of sterile carpet were rewrapped in the original aluminized envelope, and, within 24 h, sent to the Dimorphic Pathogenic Fungi Laboratory of the Institute of Biomedical Sciences in the University of São Paulo (ICB-USP). The carpets were pressed onto Petri dishes, which contained Sabouraud agar supplemented with chloramphenicol (0.05 mg / mL) and cycloheximide (0.4 mg / mL) [Mycosel™ Agar BBL™], under sterile conditions and incubated at 25°C for up to 21 days.

Identification of dermatophytes was performed by macroscopic analysis of the morphology of the colonies and microscopic observation of the macroconidia. In cases when identification by both colony morphology and macroconidia characteristics was inconclusive, the giant colony technique followed by microscopic examination by morphological microcultivation in blade was performed [11,27].

Statistical analysis

Statistical analysis was performed using Minitab software, version 16, with a *P* value < 0.05. The results were analyzed using the chi-square test in order to verify possible associations between variables (sex and age range) and the frequency of dermatophytes isolated in dermatologically healthy animals.

RESULTS

Of the 61 apparently healthy cats, as assessed by physical and otodermatologic examination, 51 (83.6%) were positive for mycological growth from the hair coat, which is characteristic of asymptomatic carriers. No dermatophytes were isolated from the hair coats of the remaining 10 healthy cats (nine females and one male).

Microsporium canis was the only fungal species isolated. Of the 18 owners or other human contacts of the mycologically positive cats, eight (44.4%) had already presented, according to their own reports, with typical lesions of ringworm (*tinea corporis*) and three (16.7%) had typical skin lesions at the time of sample collection from the cats. There were no people who claimed to have been in contact to other species. We did not observe a statistically significant difference (P value = 0.139) between the sexes of asymptomatic fungal spore carriers. There was no statistically significant difference (P value = 0.224) between the ages of the asymptomatic carriers.

DISCUSSION

In dermatology, epidemiological surveys indicate that mycoses are among the most common zoonoses [16,37]. They are considered the third most frequent skin disease in children up to 12 years old and one of the most prevalent ones in the adult population [25,43].

In Brazil, fungal infections can represent up to 8.7% of skin diseases in children [44], and tinea capitis caused by *Microsporium canis* is the most common superficial mycosis in this age group [5,17,19,49]. Interspecies transmission has been reported for decades [46,57,52]. In humans, 15% of cases of ringworm infections (tinea) are of zoonotic origin, and the vast majority of these are acquired from contact with cats [26,28,47,52].

The information collected from human contacts from the catteries included in this study revealed that more than 40% of these people had had dermatophytic skin lesions previously, and another 16% had evolving dermatophytic lesions at the time of the interview. These percentages characterize the infectivity and pathogenicity of *Microsporium canis* for infected contacts and even more for susceptible individuals [37,39]. However, it is speculated that a higher percentage of infection in human contacts may exist, since there may have been some hesitation and fear by the people interviewed in referring to the occurrence of characteristic skin lesions, either as a way to preserve the cattery reputation, or to spare the embarrassment in declaring oneself as infected.

The percentages herein disclosed are consistent with the vast majority of published studies. Approximately 50% of the people exposed to infected,

symptomatic or asymptomatic, cats acquire the disease. Moreover, between 30% and 70% of families with infected cats may have at least one family member that develops the disease [46,52]. In Europe, *M. canis* was isolated in 53.6% and 36.4% of asymptomatic cats and dogs, respectively, who lived with owners diagnosed with *tinea corporis* [10].

Studies in Brazil [7,48] involving dogs and cats and their owners affected by dermatophytosis found that 34.2% to 66.7% of cats or dogs were positive for dermatophytes, and the fungus *M. canis* was the most prevalent. A high correlation between infected owners and the presence of canine and feline contacts was observed [49].

Many apparently healthy animals, free of soft tissue injuries, can be dermatophyte carriers. Numerous published studies support this assertion [40,52,54,55]. Table 1 shows a compilation of investigation results regarding cats devoid of skin lesions that were eventually found to be carriers of dermatophytes. In Brazil, it is assumed that between 8.4% and 30% of the feline population carries dermatophytes without exhibiting obvious skin lesions [13,18,21,30].

In this study, all samples were obtained from animals from commercial catteries in São Paulo. The percentage of occurrence of dermatophytes in asymptomatic Persian cats was 83.5%. The high prevalence of asymptomatic carriers of dermatophytes, as evidenced in this study, can presumably be related to strains of low virulence perpetuated in these commercial catteries. The enzymatic activity of keratinophilic fungi such as *Microsporium canis* is cited as an important virulence factor of dermatophytes and may be related to the variability in clinical presentation and the prevalence of dermatophytosis [23,33,36,56].

The zoophilic fungus *M. canis* was the single agent isolated from the samples of this study, corroborating with the available literature. Absence of *Trichophyton* spp. and *M. gypseum* in the samples may be related to limited contact of the enrolled cats with the typical reservoir hosts and with environments contaminated by these fungi [4,8,21,41,50,58,59]. There was no statistical association of sex or age with the predisposition to the infection, although previous reports in literature indicate greater predisposition for young animals and males [2,9,54].

Table 1. Compiled results of past investigations involving cats without skin lesions, by geographical location, percentage of carrier animals and dermatophyte species in the world.

Continent	Author/year	Country	Sample	Asymptomatic carriers (%)	Dermatophyte (%)
America	Zaror <i>et al.</i> (1985)	Brazil	104	88,5	88,5% MC
	Ferreiro <i>et al.</i> (2014)	Brazil	191	8,4	5,8% MC; 2,6% MG
	Lima <i>et al.</i> (2016)	Brazil	50	22	#
	Moriello & deBoer (1991)	United States	172	9,3	87,5% TR
	Boyanowski <i>et al.</i> (2000)	United States	200	5,5	91% MC; 1% TM
	López-Martínez (1986)	Mexico	100	26,0	100% MC
	López <i>et al.</i> (2012)	Argentina	37	10,8	***
	Betancourt <i>et al.</i> (2009)	Chile	50	***	60% M.C
Europe	Cafarchia <i>et al.</i> (2006)	Italy	248	28,2	23.4% MC; 2.4% TT; 1.6% MG; 0.8% TA
	Romano <i>et al.</i> (1997)	Italy	173	49,7	85,4% MC; 3,5% TM; 1,2% MG
	Duarte <i>et al.</i> (2010)	Portugal	136	29,5	42,5% MC; 37,5% % TM; 20% TV
	Sparkes <i>et al.</i> (1994)	United Kingdom	181	2,2	100% MC
	Quaife & Womar (1982)	United Kingdom	45	36,0	100% MC
	Patel <i>et al.</i> (2005)	United Kingdom	169	5,3	3,3% MC; 3,3% TM; 22,2% TT;
Oceania	Baxter (1973)	New Zealand	200	39,0	92% MC
	Woodgyer (1977)	New Zealand	199	19,0	6,55 MC; 7,5% TT; 2,5% TA; 2,5% MK
Asia	Ilhan <i>et al.</i> (2016)	Turkey	264	7,1	4.1% TT; 1.1% TG; 1.1% MN; 0.7% Tm
	Alpun & Ozgur (2009)	Turkey	100	11	100% MC
	Shokohi & Naseri (2006)	Iran	100	4,0	75% MG; 25% TM

#Not informed. MG= *Microsporium gypseum*; MC= *Microsporium canis*; MK= *Microsporium cookei*; MN= *Microsporium nanum*; TR= *Trichophyton rubrum*; TM= *Trichophyton mentagrophytes*; TV= *Trichophyton verrucosum*; TA= *Trichophyton ajelloi*; TT= *Trichophyton terrestre*.

Unusually, there is no information available in the literature regarding only Persian cats as asymptomatic carriers, which limits the comparison with the results obtained in this study.

Among domestic cats, the Persian breed is most often cited as prone to spread dermatophytes. Several hypotheses were formulated to explain this predisposition. Among these, it was suggested that the extremely long and abundant hair coat, genetic factors, and intrinsic characteristics of the fungi may be involved [2,34,37]. The typical long hair coat of Persian cats may predispose them to fungal infection since the fungal propagules would be able to stay in the fur more easily, thus remaining much more protected from mechanical removal during licking [2,29,39,50,54].

In one of the few existing studies involving only exposition cats, considering those as fully racially defined, developed by British researchers [50], it was reported that 35% of the cats with long hair coat were

carriers of *Microsporium canis*. The study does not refer to the total number of animals evaluated, but in all 22 cats with short hair coats, no dermatophytes were isolated. The authors suggested that the higher predisposition of long hair coat cats to the infection is associated with conditions of creation and management, and that it is possible that excessive combing and brushing of the fur of these exposition animals may produce an electrostatic effect with an electric charge buildup that would attract arthrospores from environmental fungi and other felines. Given that these animals usually live among other cats and are often taken to exhibitions, some authors add that this contact with other felines could be a reason why a highly infectious agent such as *Microsporium canis* could easily disseminate [54].

Animals kept in shelters or commercial catteries are cited as more prone to being asymptomatic carriers of ringworm because of the environment and sanitary management [35]. The stress due to the high population density, pregnancies, successive lactations,

and frequent participation in exhibitions is also a predisposing factor [50,52].

Under stressful conditions, cats are known to reduce the innate behavior of self-cleaning by licking, thus decreasing the mechanical removal of arthroconidia and restricting the distribution of sebaceous material, and limiting the action of its known properties [12,13,41,42].

CONCLUSION

Fungal growth was evident in 51 (83.5%) of the Persian cats, and only *Microsporum canis* was isolated. Among the human contacts, 8 (44.4%) and 3 (16.7%) had experienced in the past or had presumptive tinea corporis lesions during the sample collection, respectively.

Therefore, there is a high possibility of ringworm transmission to humans and animals exposed to

the source of infection, such as cats purchased from such catteries, especially when these are introduced into the property without prior submission to physical and other examinations.

MANUFACTURER

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Declaration of interest. The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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