

## DERMATOPHYTE AGENTS IN THE CITY OF SÃO PAULO, FROM 1992 TO 2002

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### SUMMARY

Dermatophytosis are superficial mycoses caused by fungi that can invade stratum corneum and keratinized tissues. In order to study the frequency of dermatophytes species and the clinical manifestations caused by these fungi, in São Paulo, SP, Brazil, the authors analyzed cultures isolated at the Mycology Laboratory from a selected population (15,300 out-patients of the Hospital das Clínicas, Department of Dermatology, Faculty of Medicine of University of São Paulo) from January 1992 to June 2002.

The most prevalent dermatophyte was *Trichophyton rubrum* (48.7%), followed by *Microsporum canis* (20.9%), *Trichophyton tonsurans* (13.8%), *Trichophyton mentagrophytes* (9.7%), *Epidermophyton floccosum* (4.1%), and *Microsporum gypseum* (2.5%). These agents determined more than one clinical manifestation, i.e., tinea corporis (31.5%), tinea capitis (27.5%), tinea unguium (14.8%), tinea cruris (13.9%), tinea pedis (9.9%), and tinea manuum (1.9%). Clinical variants of dermatophytosis and their relationship to the etiologic agents were studied and the results were compared to those obtained in previous studies in other regions of Brazil and in other countries.

**KEYWORDS:** Dermatophytosis; Dermatophyte; Tinea; Selected population; Frequency.

### INTRODUCTION

Dermatophytes are a group of fungi that, during their parasitic life, utilize keratin as a substrate, infecting the skin, hairs and nails and thereby cause superficial mycoses in humans and animals<sup>51</sup>. They are universally distributed and may be categorized as geophilic, zoophilic and anthropophilic depending on their natural habitat<sup>2,20,43</sup>. According to the morphological characteristics of the aleuriospores they are classified in three anamorphic genera: *Trichophyton*, *Epidermophyton* and *Microsporum*<sup>11</sup>. Teleomorphs of dermatophytes are classified in the genus *Arthroderma*<sup>16</sup>.

During the evolution of dermatophytes, more species have evolved a dependency on human infection than on any other species of animals. This probably is a result of our soft "naked" stratum corneum, the wearing of clothing and shoes and our gregarious behavior<sup>45</sup>.

Dermatophytosis are fungal infections commonly occurring in tropical countries, often representing a public health problem. The distribution and frequency of dermatophytosis and their etiologic agents vary according to the geographic region studied, the socio-economic level of the population, the time of study, the climatic variations, the presence of domestic animals, and age<sup>45</sup>.

This study investigated the frequency of dermatophyte species and the clinical variants of dermatophytosis in São Paulo City, São Paulo, Brazil, during the period from 1992 to 2002.

### MATERIALS AND METHODS

A total of 15,300 cases of superficial mycotic infections were diagnosed during the period from January 1992 to June 2002. Specimens were collected from ambulatory patients attended in the Mycology Laboratory of Department of Dermatology of Hospital das Clínicas. Skin, nail scrapings, and broken hairs were clarified in 10% potassium hydroxide plus dimethyl sulfoxide for microscopic examination. Cultures were performed only when asked by the clinician. The specimens were inoculated on slant tubes of Sabouraud-dextrose agar with chloramphenicol and cycloheximide (Mycobiotic agar, Difco), and incubated at room temperature for two weeks or more and discarded.

The identification of dermatophytes was based on the macro and microscopic characteristics of their colonies grown on routine medium or special medium for diagnosis.

Six clinical variants were considered: tinea capitis, tinea corporis, tinea cruris, tinea manuum, tinea pedis, and tinea unguium.

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## RESULTS

All the mycological exams carried out on 15,300 patients with clinically suspected dermatophytosis were positive, but only 655 dermatophyte strains were recovered. Reduced number of isolates may be explained by the small number of requisition for cultures, bacterial contamination of clinical specimens, cases of chronic dermatophytosis with a long time therapy or therapy control. In the study of bacterial contamination of primary isolates, it was found that the major species isolated with dermatophytes were *Pseudomonas aeruginosa*, which showed inhibitory properties on the growth of species of dermatophytes<sup>21</sup>.

Among the species isolated, *T. rubrum* was the most frequent (48.7%), followed by *M. canis* (20.9%), *T. tonsurans* (13.8%), *T. mentagrophytes* (9.7%), *E. floccosum* (4.1%), and *M. gypseum* (2.5%) (Table 1).

**Table 1**

Epidemiological classification of dermatophytes species isolated at Mycology Laboratory (from January 1992 to June 2002)

Groups	Agents	Cultures	%	Total	%
Anthropophilic	<i>T. rubrum</i>	319	(48.7)	501	(76.4)
	<i>T. tonsurans</i>	91	(13.8)		
	<i>T. mentagrophytes</i>	64	(9.7)		
	<i>E. floccosum</i>	27	(4.1)		
Zoophilic	<i>M. canis</i>	137	(20.9)	137	(20.9)
Geophilic	<i>M. gypseum</i>	17	(2.5)	17	(2.5)

As shown in table 2, among the clinical variants, tinea corporis comprised 31.9% of cases, while tinea capitis was observed in 27.5% of cases, tinea unguem was involved in 14.8%, tinea cruris in 13.9%, tinea pedis in 9.9% and tinea manuum in 1.9%. Regarding correlation of the clinical variant with the etiological agent, results indicated that the major agent of tinea capitis was *M. canis* (65.0%), followed by *T. tonsurans* (28.3%). Tinea corporis was predominantly caused by *T. rubrum* (69.4%), followed by *T. tonsurans*, *M. canis*, and *T. mentagrophytes* (8.6%, 7.2% and 6.2%). In tinea cruris cases, *T. rubrum* was the most prevalent

(67.0%), followed by *E. floccosum* (18.7%). *T. rubrum* prevailed on the hands (61.5%), followed by *T. tonsurans* (15.3%). The main etiological agent of tinea pedis and tinea unguem was *T. rubrum* (56.9% and 67.0%, respectively), followed by *T. mentagrophytes* (30.7% and 18.5%, respectively).

Of the patients studied, 377 (57.5%) were male and 278 (42.4%) female, and in the majority of them the clinical features but not the age was recorded. As shown in the table 3, a correlation of frequency of clinical variants and sex, it was found a significant prevalence of tinea corporis (59.8%), tinea cruris (80.2%), tinea pedis (64.6%) and tinea manuum (69.2%) in male sex than in females. A frequency of tinea unguem, with 59.7% predominated in females but in tinea capitis the frequency is the same in both sexes.

**Table 3**

Clinical variants according to the sex of the patients

Clinical variant	Sex				Total
	Male		Female		
	No.	%	No.	%	
tinea corporis	125	59.8	84	40.1	209
tinea capitis	89	49.4	91	50.5	180
tinea unguem	39	40.2	58	59.7	97
tinea cruris	73	80.2	18	19.7	91
tinea pedis	42	64.6	23	35.3	65
tinea manuum	9	69.2	4	30.7	13
Total	377	57.5	278	42.4	655

## DISCUSSION

In the last decade (1992 to 2002), six dermatophyte species were detected as dermatophytosis agents in São Paulo City: *T. rubrum*, *T. mentagrophytes*, *M. canis*, *E. floccosum*, *T. tonsurans*, and *M. gypseum*. The predominance of *T. rubrum* (48.7%) represents a worldwide trend and the present data are consistent with those reported in studies carried out in the South, Southeast, Center-West and Northeast regions of Brazil<sup>8,12,13,14,28,29,30,38,46,47</sup>.

Studies conducted in European countries, United States of America,

**Table 2**

Frequency of clinical variants and distribution of dermatophyte species

Clinical variant	Dermatophyte species												Total %	
	<i>T. rubrum</i>		<i>M. canis</i>		<i>T. tonsurans</i>		<i>T. mentagrophytes</i>		<i>E. floccosum</i>		<i>M. gypseum</i>		No.	%
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
tinea corporis	145	69.4	15	7.2	13	8.6	13	6.2	8	3.8	10	4.8	209	31.9
tinea capitis	3	1.7	117	65.0	51	28.3	6	3.3	-	-	3	1.7	180	27.5
tinea unguem	65	67.0	2	2.1	9	9.3	18	18.5	1	1.0	2	2.1	97	14.8
tinea cruris	61	67.0	1	1.1	5	5.5	6	6.6	17	18.7	1	1.1	91	13.9
tinea pedis	37	56.9	1	1.5	6	9.2	20	30.7	-	-	1	1.5	65	9.9
tinea manuum	8	61.5	1	7.7	2	15.3	1	7.7	1	7.7	-	-	13	1.9
Total Dermatophytes sp. %	319	48.7	137	20.9	91	13.9	64	9.7	27	4.1	17	2.6	655	

Mexico and Argentina, also confirm the higher percentage of isolation of *T. rubrum*<sup>10,15,23,34,35</sup>. This is an anthropophilic fungus perfectly adapted to human keratinized tissues causing a mild chronic inflammation and rarely infects animals<sup>49</sup>. There have been only a few reports of its isolation from animals (cats, dogs, calves)<sup>22,37,43,50,52</sup>. Transmission of *T. rubrum* probably occurs directly from humans to animals<sup>26</sup>. The frequency of this agent increases with the process of urbanization, leading to its predominance as an agent causing dermatophytosis in large urban centers<sup>42</sup>.

Since 1965, *T. rubrum* has become the predominant species, being more frequent than *M. canis* and being isolated from as many as 65.5% of dermatophytosis cases in São Paulo<sup>14,29,46</sup>. In the present study, this percentage was decreased to 48.7%, but the species persists as the leading agent.

The prevalence of the zoophilic fungus *M. canis* has been decreased in developed countries and in most of the states of Brazil<sup>14,29,30,46</sup>. It is a species adapted to domestic animals such as dogs, cats, cattle or horses which can infect persons who have contact with these animals in the domestic environment<sup>24,42</sup>. It is responsible for most scalp infections, being the predominant agent detected at this region in most studies<sup>12,13,14,15,18</sup>. In the present study it was the second most frequent species, in agreement with the trend reported in a previous study conducted in São Paulo<sup>46</sup> and in European studies conducted in Spain, Greece and Italy<sup>9,35,39</sup>. In other regions, the frequency of *M. canis* varies, with the species being the third most frequent one in Rio Grande do Sul and Goiás (Brazil) and Argentina<sup>12,13,15,31</sup>, and being present at reduced percentages in Colombia and in the Amazon region<sup>6,40,41</sup>.

*T. tonsurans* is an anthropophilic dermatophyte brought to the American continent by Spanish and Portuguese colonizers, which causes epidemics in schools, day-care-centers and asylums. *T. tonsurans* is a cosmopolitan fungus that causes an endoctrin infection of hair and its distribution is worldwide. In the present study, *T. tonsurans* was the third most frequent species, predominantly causing lesions on the scalp. In South region of Brazil, *T. tonsurans* was rarely isolated<sup>29,30,31,32,48</sup>, although it was responsible for microepidemics in Rio Grande do Sul<sup>33</sup>. In the North and Northeast regions, this agent is the most prevalent in scalp infections<sup>4,6,40,41</sup>. When it finds favorable environmental conditions it becomes settled as an endemic species. *T. tonsurans* is most commonly found in Central and Southern Europe, U.S.S.R. and Central and South America<sup>24</sup>. In the United States, the fungus predominates in scalp infections<sup>23,25,54</sup>. Infections in humans are often acquired from contact with animals, environment or person-to-person spread<sup>24</sup>.

*T. mentagrophytes* can be both anthropophilic and zoophilic. The fungus is cosmopolitan<sup>1</sup> and is one of the most common dermatophytes infecting man and animals. Infections in humans are often acquired to contact with soil and domestic animals or others, such as cattle, horses and birds<sup>17</sup>.

*T. mentagrophytes* was the fourth species most frequently detected in the present study, mainly involving hands and nails. In other Brazilian studies carried out at different times, this species was the second most common<sup>8,12,13,31,32,36</sup> and occasionally predominated in tinea pedis ("athlete's foot")<sup>8,12,13,31,32,36</sup>.

*Epidermophyton floccosum* is an anthropophilic fungus, ubiquitous<sup>1</sup>

which attacks the skin and nails of man. Infections are more common in the tropics affecting males and children<sup>7</sup>. Animal infections are rare<sup>2,51,53</sup>.

*E. floccosum* in our study was the fifth most frequent species of dermatophytes and was the predominant cause of tinea cruris. In Western Europe this species is a major cause of tinea cruris and tinea pedis. Its frequency has been decreasing unlike the increasing incidence of *T. rubrum*, although data from Italy showed that it is still a prevalent agent among the dermatophytosis<sup>9</sup>.

*Microsporium gypseum* is a geophilic fungus found worldwide, frequently isolated from soil, and being seldom detected as an agent of superficial mycoses that commonly infect humans<sup>1</sup>. It is relatively rare in the United States, United Kingdom and Germany, but common in South America<sup>1</sup>.

*M. gypseum* frequency was the least and observed mainly in cases of tinea corporis. Tinea pedis and tinea manuum are seen commonly, but tinea unguium is rare.

In the present study, no other agents such as *Trichophyton violaceum*, *Trichophyton verrucosum* or *Trichophyton schoenleinii* were isolated, confirming a trend observed in the latest studies carried out in São Paulo<sup>14,46</sup>. Except for tinea capitis, *T. rubrum* was the dermatophyte most frequently isolated in all the variants of infection: tinea corporis (69.4%), tinea cruris and tinea unguium (67.0%), tinea manuum (61.5%), and tinea pedis (56.9%). It is interesting to note that in regions of low urbanization the frequency of *T. rubrum* is lower and may even be nonexistent, as is the case for the Amazon region<sup>40,41</sup>, confirming once again the predominance of this anthropophilic fungus in urban centers.

About tinea corporis, the second most frequent agent is *T. tonsurans* (8.6%), followed by *M. canis* (7.2%) and *T. mentagrophytes* (6.2%).

Infection with *M. canis* is more frequent in the scalp (65.0%), followed by *T. tonsurans* (28.3%). This frequency is maintained in most regions of Brazil, except for the Amazon region and some Northeastern cities, where *T. tonsurans* is the most common agent<sup>4,40,41</sup>. The frequency of tinea capitis increases with poverty, malnutrition, crowding, and large families with precarious hygiene habits, as found in developing countries<sup>5</sup>.

Ringworm of the nails is recorded worldwide, almost many species has been implicated in this infection, the common ones are *T. rubrum*, *T. mentagrophytes*, *E. floccosum* and to lesser extent, *T. tonsurans* and *T. violaceum*<sup>55</sup>.

In the present study *T. rubrum* (67%) prevailed, followed by *T. mentagrophytes* (18.5%). This same order was detected in tinea pedis, with respective frequencies of 56.9% and 30.7%. These values agree with those reported in the literature<sup>12,13,14,15,28,29,30,31,32,46,48</sup>.

*T. rubrum* predominated in the inguinal region (67.0%), followed by *E. floccosum* (18.7%), both being anthropophilic agents prevailing in the areas covered by clothing, a fact that makes environmental transmission more difficult.

In conclusion, our data show a predominance of *T. rubrum* over the remaining agents in all body regions, except for the scalp, where *M.*

*canis* predominated. This may be explained by urbanization, which leads to a predominance of anthropophilic fungi as etiologic agents of dermatophytosis because of their better adaptation to human keratinized tissues; the agents may also require a longer time before a cure can be obtained by treatment compared to other zoophilic and geophilic agents<sup>27</sup>.

Dermatophytosis occur more frequently in the genital area of males than in female patients due to the use of tight clothes that give rise a local maceration and obstruction by the scrotum<sup>45,53</sup>. Another site affected more frequently in males are feet and nails caused by the use of nylon stocking and shoes for a long time in a day.

Prevalence of dermatophyte infections may change as a result of many factors, including human migratory patterns, climatic alterations and new therapies<sup>1</sup>, but none of these can adequately explain the current increase of some species like *T. rubrum* and *T. mentagrophytes*.

## RESUMO

### Agentes de dermatofitoses na Cidade de São Paulo no período de 1992 e 2002

Dermatofitoses são infecções fúngicas superficiais causadas por agentes capazes de produzir lesões em tecidos queratinizados. Com o intuito de avaliar a epidemiologia e etiologia das infecções causadas por dermatófitos, em pacientes de Ambulatório do Departamento de Dermatologia do Hospital das Clínicas de São Paulo, SP, Brasil, foram analisados os resultados de culturas realizadas pelo Laboratório de Micologia deste Departamento da Faculdade de Medicina da Universidade de São Paulo, no período de janeiro de 1992 a junho de 2002.

O dermatófito isolado com maior frequência foi o *Trichophyton rubrum* (48,7%), seguido por *Microsporum canis* (20,9%), *Trichophyton tonsurans* (13,8%), *Trichophyton mentagrophytes* (9,7%), *Epidermophyton floccosum* (4,1%) e *Microsporum gypseum* (2,5%). Esses agentes foram responsáveis por diferentes formas clínicas: tinea corporis (31,9%), tinea capitis (27,5%), tinea unguium (14,8%), tinea cruris (13,9%), tinea pedis (9,9%) e tinea manuum (1,9%). Foi analisada a relação, entre as formas clínicas da dermatofitose e os seus respectivos agentes etiológicos, comparando-se os nossos dados com os de estudos semelhantes, em diversas regiões do país e do mundo.

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