

# Epidemiological survey of dermatophytosis in Tehran, Iran, from 2000 to 2005

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## ABSTRACT

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**Background:** Cutaneous fungal infections are common in Tehran, Iran, and causative organisms include dermatophytes, yeasts and non-dermatophyte molds. The prevalence of superficial mycosis infections has risen to such a level that skin mycoses now affect more than 20–25% of the world's population, making them the most frequent form of infection. **Aims:** Our aim was to determine the prevalence of superficial cutaneous fungal infections especially dermatophytosis in our Medical Mycology Laboratory in the Pasteur Institute of Iran, Tehran. **Methods:** A total of 17,573 specimens were collected from clinically suspected tinea corporis, tinea cruris, tinea capitis, tinea faciei, tinea pedis, tinea manuum and finger and toe onychomycosis from 2000 to 2005. Patients were referred to our laboratory for direct examination, fungal culture and identification. The incidence of each species was thus calculated. **Results:** Dermatophytes remain the most commonly isolated fungal organisms, except from clinically suspected finger onychomycosis, in which case *Candida* species comprise >7% of the isolates. Epidermophyton floccosum remains the most prevalent fungal pathogen and increased incidence of this species was observed in tinea cruris. *Trichophyton tonsurans* continues to increase in incidence. **Conclusion:** This study identifies the epidemiologic trends and the predominant organisms causing dermatophytosis in Tehran, Iran. These data can be used to ascertain the past and present trends in incidence, predict the adequacy of our current pharmacologic repertoire and provide insight into future developments. Consideration of the current epidemiologic trends in the incidence of cutaneous fungal pathogens is of key importance to investigational effort, diagnosis and treatment.

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## INTRODUCTION

Surveillance for fungal infections is important to define their burden and trends, to provide the infrastructure needed to perform various epidemiological and laboratory studies, and to evaluate interventions. Surveillance systems require the following basic elements: a clear case definition, a defined population, mechanisms for reporting, analyzing and disseminating the data and incentives to conduct surveillance. For fungal diseases, each one of these elements presents distinct challenges.<sup>[1]</sup> Cutaneous fungal infections can be caused by dermatophytes, yeasts and non-dermatophyte molds, although dermatophytes cause most of the cutaneous fungal infections.

The dermatophytes are a group of closely related fungi

that have the capacity to invade the keratinized tissue (skin, hair and nails) of humans and other animals to produce an infection, dermatophytosis, commonly referred to as ringworm.<sup>[2]</sup> Infections are generally restricted to the skin and they do not penetrate the deeper tissue or organs of immunocompetent hosts.<sup>[3]</sup> The aim of the present study was to determine the prevalence of cutaneous mycosis, especially dermatophytosis. Accurate assessment of the prevalence and etiologic agent is desirable to estimate the size of the therapeutic problem and to prevent the transmission and spread of such infections with adequate measures.

## METHODS

A total of 17,573 patient samples, including nail clippings, subungual debris, hair and skin scrapings

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were collected at our laboratory from March 2000 through March 2005. Specimens were obtained from clinically suspected fungal infections especially dermatophytosis of various body sites - trunk, groin, head and scalp, face, hand, toe and finger nails. All collected specimens were analyzed by direct microscopy and culture. Microscopic examination of these specimens was carried out in potassium hydroxide solution (20%) with dimethyl sulfoxide (4%). These specimens were cultured on Sabouraud glucose agar with chloramphenicol and Sabouraud glucose agar with chloramphenicol and cycloheximide. Cultures were incubated at 25°C for up to 28 days and checked twice weekly for growth. Negative cultures were confirmed after 4 weeks of no growth. Identification of dermatophyte isolates was on the basis of microscopic morphology, urea testing, growth on Trichophyton agars and hair perforation assays.<sup>[4]</sup> Non-dermatophyte molds were identified by microscopic morphology. The data collection form included questions about age, sex, number of siblings, residence, hair-loss history for other siblings and income level.

## RESULT

In the present study, 40.47% of the patients were male and 59.53% were female. The anthropophilic dermatophytes made up 92% of the dermatophytosis isolates [Tables 1 and 2]. The most frequent dermatophytes isolated were *Epidermophyton floccosum* (32%), *Trichophyton rubrum* (26%) and *T. mentagrophytes* (19.9%). The other anthropophilic dermatophytes included *T. tonsurans* (11.7%), *T. violaceum* (1.8%) and *T. schoenleinii* (0.7%) [Table 1]. The zoophilic dermatophytes made up 7.74% of the isolated fungi, 86% of them were *T. verrucosum* and the other 14% included *Microsporum canis*. Of the geophilic dermatophytes, *M. gypseum* was the only species isolated in our study [Table 2]. Correlation of the isolates to the sites of infections is given in Tables 2 and 3. The most frequent body sites affected by the dermatophytes were sole and toe webs (29.8%), the groin (26.4%) and body (13.6%). From fingernail debris, 812 isolates were obtained. From infected toenail debris, 654 isolates were obtained [Tables 2 and 3]. Analysis of combined (fingernail- and toenail-derived)

Table 1: Frequency of dermatophytes isolated from 2000 to 2005

Dermatophyte	2000	2001	2002	2003	2004	2005	Total	%
<i>E. floccosum</i>	247	221	200	206	271	314	1459	32
<i>T. rubrum</i>	183	159	158	176	186	318	1180	26
<i>T. mentagrophytes</i>	127	232	122	124	148	151	904	19.9
<i>T. tonsurans</i>	6	15	46	117	165	182	531	11.7
<i>T. verrucosum</i>	50	34	48	56	48	66	302	6.6
<i>T. violaceum</i>	20	12	11	6	20	12	81	1.8
<i>M. canis</i>	11	14	3	3	11	8	50	1.1
<i>T. schoenleinii</i>	6	4	4	-	5	11	30	0.7
<i>M. gypseum</i>	1	2	2	-	-	4	9	0.2
Total	651	693	594	688	854	1066	4546	100

Table 2: Frequency of dermatophytes isolated with respect to the site of infections

Site effected	Trunk and other sites of the body	Groin	Sole and toe webs	Toenail	Fingernail	Hands	Hair and scalp	Total
Dermatophytes								
<i>T. tonsurans</i>	398	11	9	4	6	20	83	531
<i>T. rubrum</i>	91	142	621	262	52	12		1180
<i>E. floccosum</i>	178	1145	125	1	1	9		1459
<i>T. mentagrophytes</i>	33	46	723	68	19	15		904
<i>T. violaceum</i>	3	1		2		3	72	81
<i>T. verrucosum</i>	62		8	3	4	211	14	302
<i>T. schoenleinii</i>					2		28	30
<i>M. canis</i>	5					17	28	50
<i>M. gypseum</i>	6	1				2		9
Dermatophyte (no growth)	6		34	214	257		32	543
Total	782	1346	1520	554	341	289	257	5089

**Table 3: Frequency of non-dermatophytes isolated with respect to site of infection**

Site effected	Trunk and other sites of the body	Groin	Sole and toe webs	Toenail	Fingernail	Scalp	Total
<b>Organisms</b>							
<i>C. albicans</i>	26	34	46	17	109		232
<i>Candida</i> sp (non- <i>C. albicans</i> )	44	79	87	38	289		537
<i>Candida</i> (no growth)	12	36	18	15	59		140
<i>P. ovale</i>						184	184
<i>M. furfur</i>	343	113					456
<i>A. fumigatus</i>				9	4		13
<i>A. flavus</i>				7	3		10
<i>A. terreus</i>				2			2
<i>A. niger</i>				1			1
Acremonium				6	2		8
<i>Fusarium</i> spp				4	2		6
Scopulariopsis				1			1
Geotrichum					2		2
Trichosporon		1			1		2
Total	425	263	151	100	471	184	1594

data identified *T. rubrum* as the predominant causative agent of dermatophytic onychomycosis, with an incidence of 73.9%. *Candida* species were responsible for 38% of all cases of onychomycosis and were more likely to be isolated from fingernail infections. Non-dermatophyte molds accounted for 3% of nail infections, with *Aspergillus* species being the most common pathogen. From hair- and scalp-derived tissues, 257 isolates were obtained. *T. violaceum* was the most common etiological agent of tinea capitis cases in the present study. *E. floccosum* was the most common dermatophyte isolated from the groin, with an incidence of 85%. The predominant isolate from body- and face-derived tissues was *T. tonsurans*. Although several species of dermatophytes were isolated, the predominant pathogens were *E. floccosum*, *T. rubrum* and *T. mentagrophytes*. The incidence of *T. tonsurans* increased during the study period, comprising 0.92% of the isolates in 2000 and increasing to 19.32% in 2004. Yearwise frequency of dermatophytosis and non-dermatophyte fungal infections is given in Table 4.

## DISCUSSION

Outbreak investigations are an important and challenging component of public health.<sup>[1]</sup> Careful investigation of outbreaks has increased our understanding of fungal diseases, their sources and modes of transmission and the risk factors for infections and, in so doing, has resulted in design of improved control measures for those infections. In the present study from Iran, *E. floccosum* and *T. rubrum* were reported to be the most common causative agents in Tehran from 2000 to 2005. Mycological examination was positive in 38% of the samples. This positive rate is slightly superior to that reported in similar studies.<sup>[5,6]</sup> The incidence of dermatophytosis increased more than 1.5-fold during the study period, fueled by the upward trends in the incidence of *T. tonsurans*.

Eight hundred twelve isolates were obtained from fingernail debris. Analysis of combined (fingernail- and toenail-derived) data identified *T. rubrum* as

**Table 4: Frequency of skin infections among patients suspected of fungal infections, attending the Medical Mycology Department of the Pasteur Institute of Iran**

Year wise subjects	2000	2001	2002	2003	2004	2005	Total	%
Dermatophytosis	692	751	629	816	1009	1192	5089	28.9
Non-dermatophytosis	159	271	270	242	257	395	1594	9.1
Fungal infections (total)	851	1022	899	1058	1266	1587	6683	38
Attending patients	2211	2494	2427	2835	3535	4071	17,573	100

the predominant causative agent of dermatophytic onychomycosis, with an incidence of 71.5%. Two hundred fifty-seven isolates were obtained from hair- and scalp-derived tissues. *T. tonsurans* was the most commonly isolated pathogen, with 32.3% from scalp and hair infections. *E. floccosum* was the most commonly isolated pathogen of the groin, with an incidence of 71.2%. This dermatophyte has been recorded in most parts of the world.<sup>[7,8]</sup> Analysis of finger and toe onychomycosis in this study showed an inverse relationship between *T. rubrum* and *Candida* species. *Candida* species have high incidence in finger onychomycosis and *T. rubrum* has a relatively low incidence. In toe onychomycosis, the opposite is true.

*T. tonsurans* was the most common etiologic agent isolated from the trunk (50.9%). Although several species of dermatophytes were isolated, the predominant pathogens in the present study were *E. floccosum*, *T. rubrum*, *T. mentagrophytes* and *T. tonsurans*. It is well known that different body areas are involved by different dermatophytes. According to our study, *T. rubrum* was the most frequently isolated dermatophyte on feet and toenail and then trunk and groin of middle-aged males. Recently, numerous authors reported similar findings.<sup>[9-12]</sup>

In our study, most of the infections due to *T. rubrum* were found in adults, which was consistent with the observations of Desai and Bhat<sup>[6]</sup> and Ng *et al*<sup>[13]</sup> Adults had a higher susceptibility to *T. rubrum* infections than children. *T. rubrum* was also the predominant dermatophyte of all finger and toe onychomycosis and tinea pedis in each of the 5 years analyzed.

In our study, 75.3% of the fingernail isolates failed to grow. In Clyton's study<sup>[14]</sup> of onychomycosis, 66% of the samples from toenails and 73% of the samples from fingernails had no growth, whereas the fingernail samples are somewhat less and toenail samples are more than our recovery rate. These investigations can be very unrewarding as fewer than 50% of the nail infections are KOH negative and less than half of the KOH-positive infections are culture positive.<sup>[15]</sup>

*T. mentagrophytes* had the third-highest frequency. It was isolated from 19.9% of the cases. The most frequent clinical manifestation was the intertriginous form. The prevalence of tinea pedis was higher in men than in women. The result is in agreement with those of Aste *et al*.<sup>[16]</sup> In the present study, the prevalence of

tinea pedis was higher in the 16–60 age group than in the 0–15 and 61 and above age groups. In this study, the simultaneous presence of onychomycosis (toenail) and tinea pedis was found in 30.35% of the subjects and *T. rubrum* was the most frequent etiological agent.

*T. tonsurans* ranked fourth in frequency and was isolated from tinea corporis and tinea capitis. The main feature of *T. tonsurans* epidemic in Iran was that almost all the patients participated in wrestling. An epidemic has also been reported in Japanese judo participants over the last few years, following the epidemic in the United States and in Europe.<sup>[17-21]</sup> At present, *T. tonsurans* is the most common cause of tinea capitis in the United States.<sup>[22,23]</sup> Canada and Europe have seen a dramatic increase of tinea capitis due to *T. tonsurans* since 1990,<sup>[24,25]</sup> a major epidemic in the past. Previously, sporadic outbreaks of the infections had occurred over the past few decades. Up to 30% of the children are asymptomatic carriers of *T. tonsurans*.<sup>[3]</sup> A recent study of children in the greater Cleveland area found *T. tonsurans* to be the main etiologic agent, whereas *M. audouinii* and *M. canis* were predominant in other areas.<sup>[9]</sup>

*T. verrucosum* was isolated from 6.6% of the cases. The result is similar to that of Khosravi *et al*<sup>[26]</sup> and Felahati *et al*,<sup>[27]</sup> who found that *T. verrucosum* caused 11.5 and 4.7% of all dermatophytosis in Iran respectively. However, Sinski and Flourais<sup>[28]</sup> found that the incidence of this dermatophyte among patients in the United States from 1979 to 1981 was less than 1%. We think that the main transmission mode of *T. verrucosum* infection is represented by animal-acquired infection.

Many children with tinea corporis had been in contact with other infected children, either within their family or at school. The increasing incidence of *T. tonsurans* is the major cause of tinea corporis and also the most common cause of tinea capitis.

The frequency of fungal infections varies with seasons. The highest number of cases of tinea pedis and tinea cruris occurred in the summer months, while tinea capitis, tinea corporis and tinea unguium occurred in the spring and winter months.

The anthropophilic fungus *T. violaceum* was isolated from 1.8%. In fact, *T. tonsurans* followed by *T. violaceum*, *T. schoenleinii* and *M. canis* are the preponderant etiological agents of tinea capitis in

Tehran. In the recent years, *T. violaceum* was the most common cause of tinea capitis in Iran.<sup>[27,29,30]</sup> Living conditions, large family size and close contact, either directly or by sharing facilities, including combs and towels, is common between family members in low socioeconomic strata people in South and South East of Tehran and rural areas<sup>[29]</sup> and may facilitate transmission. The prevalence of tinea capitis is closely related to socioeconomic status and life style and commonly occur under poor hygienic conditions.<sup>[29,31,32]</sup> Tinea capitis is mainly a disease of the infant, children and young adolescents, usually involving African American or Hispanic pre-schoolers.<sup>[8]</sup> The isolation rate of *T. schoenleinii* and *M. gypseum* (0.7 and 0.2%, respectively) has remained low. A similar low isolation rate is present in European countries<sup>[9,11,12,33]</sup> as well as in South America<sup>[34,35]</sup> and Asia.<sup>[20,26,36]</sup>

An important fact that should be discussed is the low isolation rate (0.7 and 0.2%) and disappearance of *T. schoenleinii* and *M. gypseum*. Approximately 10 years ago, infections with *T. schoenleinii* were considerably more frequent in Iran.<sup>[29]</sup> In the present study, anthropophilic dermatophytes were the main causative agent of dermatomycosis. Our findings are in agreement with recent observations of several workers,<sup>[7-34]</sup> who have reported a significant rise in the incidence of infections due to anthropophilic dermatophytes (*T. tonsurans*) and a decreasing importance of the zoophilic dermatophyte *M. canis*<sup>[3]</sup> in childhood tinea capitis. *M. canis*, the major animal-associated fungus causing dermatophytosis in humans, had a low isolation rate (1.1%) in this study. Iranian people are Muslims, they do not keep dogs as pets, and therefore have reduced chances of exposure to *M. canis* infections, which explains the low isolation rate (1.1%) of *M. canis* in Iranian people.

Measures for prevention of these fungal infections should be based on maintenance of local resistance to infection by individual care and hygiene. Further investigation over the course of several years will be needed to determine whether these changes reflect a continuing trend. The fluctuations recorded in the etiology of dermatophytosis are believed to be due to changes in the environment, human migration pattern, newer therapies, the pathogen and the host relationship.<sup>[29]</sup> This work identifies both annual changes and even broader trends in the incidence of cutaneous fungal pathogens that span or even extend beyond the length of this study. Monitoring the

incidence of these fungal species enables the detection of emerging organisms and is an indicator for the assessment of the adequacy of current pharmacologic regimens. This study highlights a common problem in many areas of the world<sup>[33,35-40]</sup> and suggests that further measures regarding public health and personal hygiene must be undertaken in order to reduce the risk of dermatophytosis. In particular, greater and more-efficient sanitary control should be implemented in communal environments.

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