Prevalence of Superficial Dermatophyte Fungal Infections in a Tertiary Care Hospital in Fez, Morocco: An 8-Year Retrospective Study

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Receive date:13/8/2024
Revise date:17/9/2024
Accept date:30/10/2024
Publish date:5/11/2024
Keywords:
Dermatophytes – Dermatophyties - tinea capitis - onychomycosis.

Background and study aim: Superficial mycoses are a frequent reason for consultation in clinical practice. They are mainly caused by filamentous fungi, dermatophytes, which have an affinity for the keratin present in the skin and appendages. The aim of our study was to analyze the epidemiological and clinical characteristics of superficial dermatophytes diagnosed in our hospital.
Patients and Methods: This was a retrospective descriptive study carried out in the Parasitology-Mycology laboratory of the Hassan II University Hospital in Fez, including patients referred for mycological sampling over an 8-year period from January 2016 to December 2023. Identification of the different species responsible for dermatophytitis was based on observation of the macroscopic and microscopic aspects of the colonies.
Results: Of the 5530 mycological samples taken during the study period, 621 were confirmed positive for dermatophytes. The average age of our patients at the time of diagnosis was 47.2 years, with a predominance of women. Onychomycosis was the most common clinical form (88%), followed by scalp ringworm (9,17 %). Trichophyton rubrum was the most common species isolated in culture, accounting for 86,34 % of cases (n = 536).
Conclusion: A better understanding of the epidemiological data on dermatophytes is an essential element in improving the diagnostic and therapeutic management of these increasingly frequent mycotic infections.

INTRODUCTION

Superficial mycoses are common skin infections encountered in clinical practice. The most implicated causative agents are dermatophytes, filamentous microscopic keratinophilic and keratinolytic fungi belonging to the class Ascomycetes and the genera *Epidermophyton*, *Trichophyton*, and *Microsporum*. However, the species involved vary depending on geographical regions, socio-economic conditions, and lifestyle habits [1].

Clinically, dermatophyte infections primarily affect keratinized tissues such as skin, hair, and nails, causing varied presentations like erythematous plaques, scaling, pruritus, and sometimes hair loss or nail dystrophy [1]. Risk factors include warm and humid climates, overcrowding, poor hygiene, immunosuppression, and frequent contact with infected humans or animals [1, 2]. Consequently, three groups are distinguished according to their ecology: anthropophilic species, zoophilic species, and geophilic or telluric species.

The objective of this study is to identify the epidemiological and mycological profile of superficial dermatophyte mycoses diagnosed at the Parasitology-Mycology laboratory of Hassan II University Hospital in Fez.

PATIENTS/MATERIALS AND METHODS

1. Study population: This is a descriptive retrospective study conducted at the Parasitology-Mycology laboratory of Hassan II University Hospital in Fez, including all patients referred for mycological sampling of the skin, nails, or hair over an 8-year period from January 2016 to December 2023. For all patients, age, gender, lesion location, referring department, direct examination results, and isolated species were recorded in a register.
2. Sampling material: To collect samples from suspicious lesions, sterile equipment was used, including Vidal curettes or scrapers, vaccinostyles, swabs, scissors, and tweezers. Samples were collected in sterile Petri dishes.
3. Sampling procedures:

a. Onychomycoses: Sampling is preceded by disinfection of the nail, followed by cutting the nail plate up to the junction between the diseased and healthy nail. The sample is then collected by scraping with a curette or vaccinostyle. The sampling method varies depending on the anatomically affected area.

b. Scalp ringworm: Sampling is preceded by an examination of the scalp under a Wood's lamp. Broken hairs are collected from the periphery and on the alopecia plaques using tweezers, while scales are collected by scraping with a curette or vaccinostyle.

c. Cutaneous lesions: Cutaneous lesions are scraped with a curette, scraper, or blunt scalpel at the periphery of the lesion, on the inflammatory border. Oozing lesions are sampled using a sterile swab.

4. Mycological diagnosis:

a. Direct examination: This examination is mandatory and essential, performed immediately after sampling, and can confirm the mycotic origin of the clinical lesion. Its result can be communicated to clinicians within a few hours. Direct examination between slide and coverslip is performed:

After dissociation of scales and nail fragments in 30% aqueous potassium hydroxide or a chlorazol black solution,

After clarification of hair and hairs in chloral-lactophenol, the examination specifies the type of hair parasitism. This is followed by microscopic observation under x10 and x40 magnifications.

b. Culture: Three isolation media were used: simple Sabouraud medium, Sabouraud-chloramphenicol (SA) medium, and Sabouraud-chloramphenicol-actidione (SCA) medium. These media are presented as agar poured into tubes. Inoculation was performed by depositing the pathological product at several distinct points on the agar surface using a sterile loop. The cultures were then incubated in an oven at 27°C and 37°C. Culture observations were made as early as 48 hours, then three times a week for up to 4 to 6 weeks before declaring a negative culture.

c. Identification of the culture product: The identification of obtained colonies was based on three main criteria: growth rate, as well as the macroscopic and microscopic appearance of the colonies. Macroscopic examination of cultures evaluated the appearance of the colonies both on the front and back, as well as the possible presence of a diffusible pigment in the agar. Microscopic examination of cultures searched for mycelial filaments and specific characteristics, by spreading the colonies between slide and coverslip in lactophenol blue using transparent adhesive cellophane (scotch test). The presence of a dermatophyte on the culture media associated with that of regular septate mycelial filaments confirms the diagnosis of dermatophytosis.

RESULTS

During the study period, a total of 5,530 mycological samples were performed, 57% of these cases were superficial in location, and 621 cases of superficial dermatophyte mycoses were confirmed, with a prevalence of 20.5%. The average age of our patients was 47.2 years, with extremes ranging from 1 to 96 years. The male-to-female ratio was 0.61, with women being more affected at a rate of 62%. Over these 8 years, the study of the annual incidence of superficial dermatophyte mycoses revealed two peaks in 2018 and 2022. However, a very low rate was observed in 2020 (Figure 1).

The majority of patients referred to the Parasitology-Mycology laboratory for

mycological sampling were outpatients (90%); the rest were mainly referred by the Dermatology (39 cases), Pediatrics (20 cases), and Endocrinology (4 cases) departments.

Among the 621 cases of dermatophytosis in which the etiological agent was isolated, anthropophilic species were the most frequently identified. *Trichophyton rubrum* ranked first with 86.17% of cases (n=536), followed by *Trichophyton violaceum* with 3.21% (n=20) and *Epidermophyton floccosum*. *Trichophyton soudanense* and *Trichophyton schoenleinii* were also found, each with a prevalence of less than 1%.

Among the zoophilic species, *Microsporum canis* was the most common with 5.94% of cases (n=37). *Microsporum gypseum*, a telluric species, was also found with a prevalence of less than 1% (Table 1, Figure 2).

Clinically, onychomycoses were the most common superficial mycoses, with 538 positive samples, accounting for 86.63% of cases. They were primarily localized to toenails in 81.80% of cases, and to fingernails in only 4.83% of cases (Table 2). The most frequent clinical presentation of onychomycoses was distal-lateral localization, with a prevalence of 56%. Onychomycoses were more prevalent in women, accounting for 64.5% (347 cases) compared to 35.5% (191 cases) in men. *Trichophyton rubrum* was by far the most isolated species, identified in 508 cases (94.4%), followed by *T. mentagrophytes* var. *interdigitale* in 9 cases (Table 3).

Scalp ringworm ranked second among diagnosed superficial mycoses, with a rate of 9.17% of cases (n=57) (Table 2). The most affected age group was between 1 and 13 years, with a predominance of males. Frequent contact with animals was reported in 30 cases, while adults were affected in only 19.7% of cases.

Direct examination was positive in 71.9% of cases (n=48) and showed endo-ectothrix hair parasitism in 33 cases and endothrix in 13 cases. Culture was positive for all 57 cases and allowed the isolation of 5 species of dermatophytes, with *Microsporum canis* leading (n=29 cases), representing 50.8% of all scalp ringworm cases, followed by *Trichophyton violaceum* (n=19 cases), representing 33.3%, including 3 cases of the *glabrum* variety. *Trichophyton verrucosum* and *Trichophyton mentagrophytes* were each identified in 4 cases, and finally, *Trichophyton schoenleinii* was noted in 1 case (Figure 3).

Regarding dermatophytosis of glabrous skin, we recorded 26 cases during our study period, accounting for 4.20% of all positive samples (Table 2). The most represented dermatophyte was *Trichophyton rubrum*, found in 12 cases, representing 48% of the cases (Figure 4).

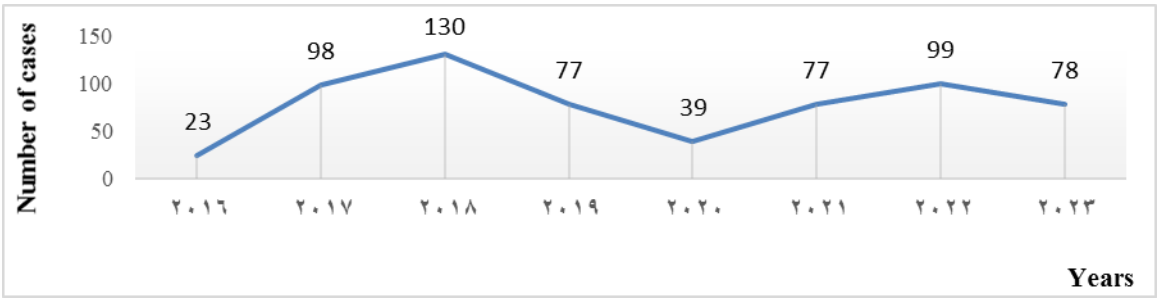

Figure 1: Annual incidence of superficial dermatophyte mycoses.

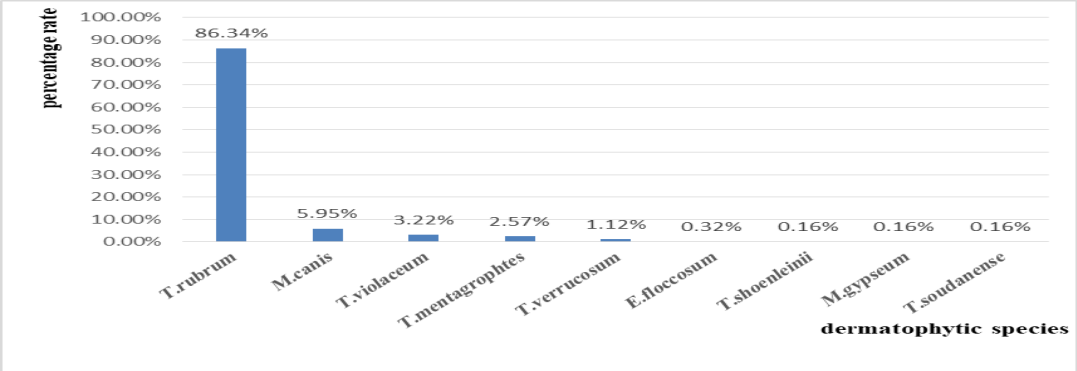

Figure 2: Distribution of species by frequency (T*: Trichophyton*, M: *Microsporum*)

Table 1: Distribution of isolated dermatophyte species

Species	Number	Frequency (%)
Trichopyhton rubrum	536	86, 34%
Microsporum canis	37	5,95%
Trichophyton violaceum	20	3,22%
Trichophyton mentagrophytes	16	2,57%
Trichophyton verrucosum	7	1,12%
Epidermophyton floccosum	2	0,32%
Trichophyton soudanense	1	0,16%
Trichophyton schoenleinii	1	0,16%
Microsporum gypseum	1	0,16%

Table 2: Distribution of mycoses by location

Location	Number of cases	Frequency (%)
Toes	508	81,80%
Fingernails	30	4,83%
Scalp	57	9,17%
Hairless skin scales	26	4,20%

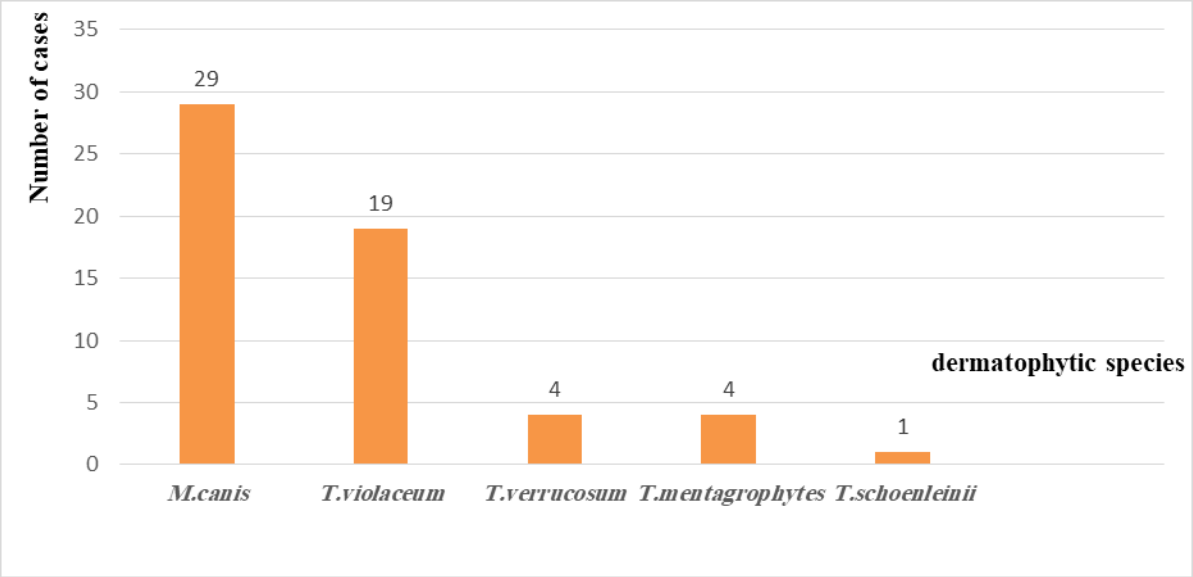

Figure 3: Distribution of isolated species in scalp culture (T: Trichophyton, M: Microsporum**)**

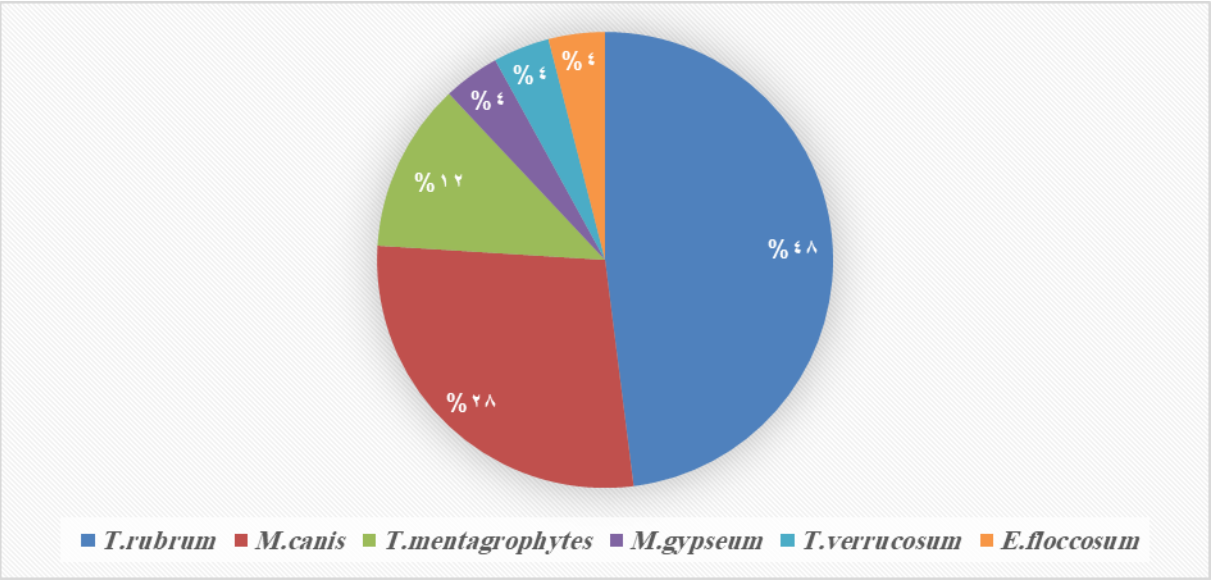

Figure 4: Distribution of isolated species in skin (T: Trichophyton, M: Microsporum)

Table 3: Distribution of isolated dermatophyte species by sampling site

Genus	species	Fingernails (number)	Toenail (number)	Hair (number)	Hairless Skin (number)	Total (number)
Trichophyton	*Rubrum*	29	494	-	12	535
	mentagrophytes	1	8	4	3	16
	Violaceum	-	1	19	-	20
	Verrucosum	-	2	4	1	7
	schoenleinii	-	-	1	-	1
	soudanense	-	1	-	-	1

Microsporum	***Canis***	**-**	**2**	**29**	**7**	**38**
	gypseum	**-**	**-**	**-**	**1**	**1**
Epidermophyton	***floccosum***	**-**	**1**	**-**	**1**	**2**
Total (number)		**30**	**509**	**57**	**25**	**621**

DISCUSSION

Superficial fungal infections are among the most common infections worldwide, potentially affecting 20% to 25% of the global population. Their incidence continues to rise, although the distribution of dermatophytoses varies according to geographical and socioeconomic factors, leading to a diversity of isolated fungal strains [1]. Dermatophytoses constitute the majority of superficial fungal infections [2].

Dermatophytes are filamentous fungi belonging to three genera: *Microsporum*, *Trichophyton*, and *Epidermophyton*. They have an affinity for keratin and invade the stratum corneum of the epidermis, hair, and nails, but they never affect mucous membranes. Transmission occurs through contact with contaminated tissues (hair, scales), especially when there is epidermal damage. Infectious species are transmitted interpersonally (anthropophilic), between animals and humans (zoophilic), and between soil and humans (geophilic).

In this study, our results reveal a relatively high prevalence of dermatophytosis, with a positivity rate of 20.5% among all mycological samples. In Morocco and North Africa, these infections seem to be favored by hot and humid climates, poor hygiene conditions, low socioeconomic status, and the trivialization of symptoms by patients, leading to diagnostic and therapeutic delays. Literature reports that certain cultural practices, such as frequenting traditional baths (hammams), deeply rooted in Moroccan culture, may increase the rate of dermatophytosis [3]. Our results are consistent with those in the literature, notably in Dakar with a rate of 19.8% [4], though higher prevalence rates have been reported, such as in Rabat, Morocco, with a positivity rate of 54.48%, Tunisia (59.60%), France (63.10%), and Turkey (70%) [5, 6, 7, 8].

The annual incidence of superficial dermatophytoses showed two peaks in 2018 and 2022. However, a significant decline was observed in 2020, most likely due to the COVID-19 pandemic, owing to lockdowns and the consequent reduction in the number of received samples.

In our study, onychomycosis was the most frequently encountered clinical presentation, with a rate of 88%. These were localized to the toenails in 81.63% of cases and to the fingernails in 30 patients, representing 4.83% of positive onychomycosis cases. This phenomenon, also observed by other authors, may be explained by the slower growth of toenails, which reduces the elimination of the fungus [3]. In comparison, fingernail growth is 2 to 3 times faster (3 mm/month), facilitating quicker fungal elimination [9]. Additionally, toenail onychomycosis is often associated with wearing closed shoes. In Western countries, where sports are more prevalent, the incidence of onychomycosis can reach 15% of the general population, whereas it is only 2% to 3% in less economically developed countries. Among the 538 patients with confirmed dermatophyte onychomycosis, 64% were female. This female predominance, also reported by other authors, may be explained by the greater concern for aesthetics and functional discomfort expressed by women, motivating their consultation. These results are consistent with those of a study conducted at Avicenne Hospital in Rabat in 2020 and at Mohammed IV University Hospital in Oujda in 2019 [5, 10].

The most common clinical presentation of onychomycosis in our study was distal-lateral

localization, with a prevalence of 56%. Similar results were found in a study conducted in the Indian subcontinent, where the prevalence of distal-lateral onychomycosis was 47% [11]. *Trichophyton rubrum* was by far the most isolated species in the nails, with a rate of 86.17%. These results are consistent with other studies, particularly those conducted in Marrakech, Morocco, where the rate was 81% [12], in France with rates varying between 50% and 70% [13], and in Tunisia with a rate of 96.9% [14].

Scalp tinea remains a major public health problem in developing countries, particularly in Morocco. Traditionally, these infections are more common among school-aged and preschool children [10], as confirmed in our series, where the most affected age group was between 1 and 13 years. Boys were more frequently affected, which may be explained by their greater contact with domestic animals, who are often asymptomatic carriers, and the easier contamination of short hair by spores [15]. Furthermore, adults are less affected, representing only 19.7% of cases. The rarity of infection in adults may be attributed to the fungistatic properties of triglycerides present in sebum and sex hormones [16].

The analysis of our results and those from other studies conducted in Morocco shows a change in the etiological profile of scalp tinea. Indeed, most Moroccan studies, as well as those from the Maghreb and many countries around the Mediterranean, show a significant increase in microsporic tinea [10, 17]. This is consistent with our study, where *Microsporum canis* was the dominant species, displacing *T. violaceum* (33.3%), with a frequency ranging from 45.6% in the study conducted at the Parasitology-Mycology Laboratory at CHU Hassan II in Fez in 2020 to 49.1% in our study [18]. This remarkable emergence of *M. canis* can be explained by changing habits in Morocco, with improved hygiene conditions and increased cohabitation with pets such as cats and dogs [19].

Dermatophytosis of glabrous skin, accounted for 4.2% of all superficial mycoses in our series, consistent with the study by Kalu EI, which reported a rate of 5.8% [20]. This lower sampling rate compared to other sites may be explained by the empirical antifungal treatment initiated by clinicians in cases of typical herpes circiné without recourse to mycological sampling.

Although *Trichophyton rubrum* represents 48% of the isolates from glabrous skin in our study, zoophilic transmission should be suspected, as *Microsporum canis* was isolated in 28% of cases, a rate similar to those reported in the literature [20]. Dermatophytosis remains superficial, but local (application of corticosteroids) or systemic immunosuppression should be monitored, as it can lead to subcutaneous involvement and complicate diagnosis. Nevertheless, the majority of affected children do not have underlying immunosuppression.

CONCLUSION:

Superficial mycoses are among the neglected diseases according to the WHO. They are a common reason for consultation in routine medical practice. The results of our study are in line with the literature, demonstrating the great diversity and evolution of species responsible for superficial dermatophytoses. However, due to their frequency, chronicity, and recurrent nature, these conditions pose a real challenge in terms of management. Dermatophytosis can be clinically suspected, but given the differential diagnoses that can mimic a dermatophyte infection, it is essential to confirm the diagnosis through mycological examination and precisely identify the responsible species to initiate appropriate treatment, not forgetting the family and animal investigation.

Conflict of interest: none

Funding: None Author funded

Conflict of Interest: None.

Ethical consideration: The study was carried out in a manner consistent with the ethical principles of the Declaration of Helsinki**.**

Author contribution: We declare that all listed authors have made substantial contributions to all of the following three parts of the manuscript:

- Research design, or acquisition, analysis or interpretation of data;

- drafting the paper or revising it critically;

- approving the submitted version.

We also declare that no-one who qualifies for authorship has been excluded from the list of authors.

HIGHLIGHTS:

- **Dominance of *Trichophyton rubrum***: *Trichophyton rubrum* was identified as the most frequently isolated species, particularly in onychomycosis cases.
- **Emergence of *Microsporum canis***: A notable increase in *Microsporum canis* infections was observed, especially in scalp ringworm among children.
- **Impact of socio-sultural practices**: The study highlights the influence of local socio-cultural practices, such as the use of traditional baths (hammams), on the prevalence of dermatophytosis in Morocco.

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Cite as: ADADI, S., JARNIGE, K., KFAL, Y., Ben-saghroune, H., TLAMCANI, Z. Prevalence of Superficial Dermatophyte Fungal Infections in a Tertiary Care Hospital in Fez, Morocco: An 8-Year Retrospective Study. *Afro-Egyptian Journal of Infectious and Endemic Diseases*, 2024;14(4):460-469. doi: 10.21608/aeji.2024.312189.1405