

Assessing the Epidemiology of Dermatophytosis and Onychomycosis in the South of Ireland (2012-2024)

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Abstract

Aim

To analyse the prevalence of dermatophyte species from 2012 to 2024 in Cork, Ireland; and to assess regional trends.

Methods

A retrospective laboratory database analysis was conducted at Bon Secours Hospital, Co. Cork. Following ethical approval in July 2023, all dermatological mycology samples referred from January 2012 to January 2024 were reviewed. Samples were analysed microscopically and macroscopically for fungal identification. All data was analysed using SPSS version 28.

Results

Of 2,270 samples, 723 (31.8%) were positive for fungal infection, with 623 (27.4%) identified as dermatophytes. Anthropophilic species predominated, representing 87% of dermatophyte cases (542 out of 623). *Trichophyton rubrum* showed a significant increase from 60 of 130 cases (46%) in 2012–2015 to 110 of 135 cases (81.5%) in 2020–2024 ($p < 0.0001$). *Candida Species* declined from 32 of 130 cases (25%) to 12 of 135 cases (9%) over the same period ($p < 0.0001$).

Discussion/Conclusion

Trichophyton rubrum is now the leading dermatophyte in Co. Cork. These trends align with global data and underscore the growing need for national fungal surveillance, treatment updates, and investigation into emerging antifungal resistance. Further regional comparisons and patient-level analyses are recommended.

Introduction

The skin is the body's largest organ, serving as a protective layer against multiple pathogens¹. The World Health Organization (WHO) has ranked skin diseases as the fourth most common cause of non-fatal morbidity worldwide², posing a serious public health concern. A European population-based survey revealed fungal infection to be among the highest reported skin conditions in the preceding year^{3,4}.

The majority of fungal infections are due to a class of species known as dermatophytes, also called *tinea* or *ringworm*⁵. This is a group of filamentous fungi that invade keratinized tissues such as skin, hair, and nails⁵. Furthermore, these species have three primary classes, according to their ecological niches. Firstly, Anthropophilic species are transmitted from humans through the shedding of hair or skin of infected individuals⁶.

Secondly, Zoophilic species are mainly transmitted through animals and finally, Geophilic species are primarily found in soil⁶. Remarkably, it is cited that Zoophilic species produce a stronger inflammatory skin reaction than Anthropophilic species⁷, which highlights the complexity of infections associated with different dermatophyte classes. Additionally, Anthropophilic species predominate globally as the main cause of dermatophyte infections⁵. They exhibit preferences for specific body sites and an association with specific age groups⁸. Of note, trends of dermatophytes differ significantly across the globe⁹, however, *Trichophyton rubrum*, predominates worldwide as the most common species implicated in skin and nail infections¹⁰.

It is vital to note that the prevalence of dermatophytes is influenced by a wide range of factors including the pathogen's virulence factors, the host's genetics and immune status, occupation, animal contact, and lifestyle choices⁸. Moreover, environmental factors including demographic or socioeconomic changes, temperature, humidity, and hygiene practices are also linked to the development of an infection¹¹.

Notably, the Irish contribution to the prevalence of dermatophyte infections has been limited, with only one study published in 2022 in the Midwest of Ireland¹² and no studies in the last 20 years in the Southern region. It is essential to analyse the trends of dermatophytes to better understand the evolving landscape of these common fungal diseases. In addition, with the global rise of antifungal resistance, particularly *Trichophyton* species, understanding local dermatophyte trends is essential to inform targeted public health interventions and antifungal stewardship strategies.

Therefore, the aim of this study is to conduct a comprehensive retrospective analysis of all dermatological mycology samples referred to Bon Secours Hospital over a 12-year period (2012–2024). The specific objectives are to determine the prevalence and distribution of different classes and species of dermatophytes during this time, thereby contributing valuable

data to the evolving understanding of fungal epidemiology in Ireland.

Methods

This was a retrospective laboratory database study using records from the Mycology Laboratory at Bon Secours Hospital, Co. Cork, covering the period from January 2012 to January 2024. The dataset included samples submitted from external sources such as general practice clinics, dermatology clinics, hospital inpatient services, and outpatient departments for suspected fungal skin, hair, or nail infections. Samples referred for non-dermatological fungal conditions were excluded. Additionally, demographic variables such as patient age and gender were not available in the laboratory database. To account for potential repeat submissions from the same individual, each sample was treated as independent because the Laboratory Information Management System (LIMS) database did not reliably allow patient-level linkage across multiple submissions.

Bon Secours Hospital provides centralized microbiology services for University Hospital Limerick and community healthcare practices in Co. Cork. All relevant mycology results were retrieved from the Laboratory Information Management System (LIMS, DXC Technologies). Fungal identification was conducted in accordance with national mycology laboratory protocols, including direct microscopy with potassium hydroxide (KOH) and culture on appropriate agar media for up to four weeks. Species identification was based on macroscopic and microscopic morphology.

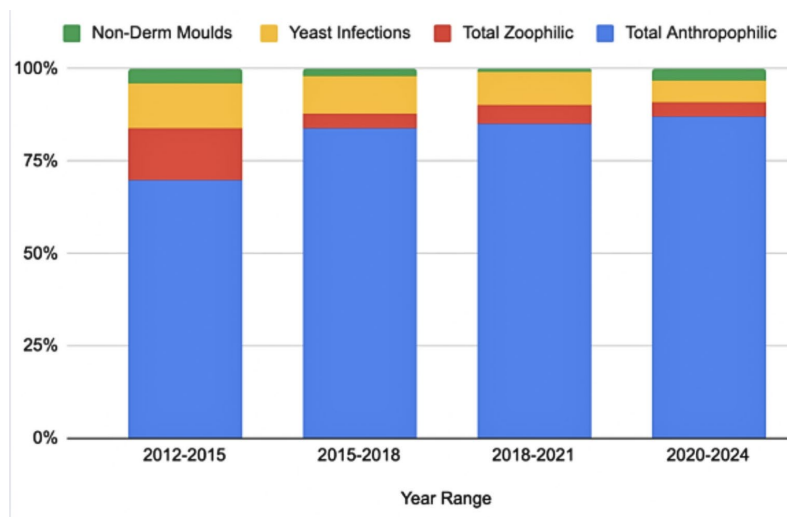
Only skin and nail specimens were included in the final analysis. Data were classified according to the International Mycological Association Fungal Classification System. Dermatophytes were further categorized into anthropophilic, zoophilic, and geophilic species. Yeasts and non-dermatophyte moulds were grouped by genus. Samples were also categorized by year and by source of referral. For temporal analysis, the study period was divided into four equal three-year intervals.

All data were anonymised and stored on a password-protected Microsoft Excel file accessible only to the research team. Statistical analysis was performed using Microsoft Excel and SPSS version 28. Simple linear regression was used to analyse trends in species prevalence over time. A p-value of <0.05 was considered statistically significant. All analyses were reviewed by the study supervisor and a statistician at Bon Secours Hospital.

Ethical approval was obtained from both the Bon Secours Hospital Ethics Committee and the University College Cork Research Ethics Committee.

Results

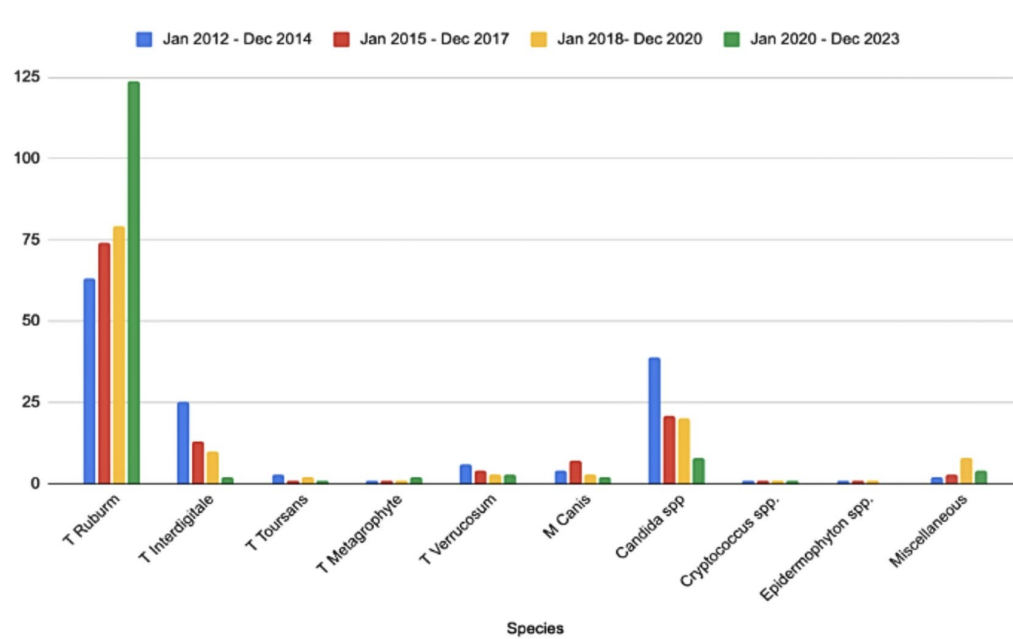
In the 12-year period, 2,270 samples were referred to the microbiology lab for a suspected fungal infection, 723 (31%) were positive for fungi, of which 623 were dermatophytes. The major source of the samples originated from general practice clinics (88%) with hospital outpatient and inpatient samples accounting for 9% and 3% respectively. Skin scrapings accounted for the majority of the origin of fungal infections, 63.4% (458) followed by nail scrapings at 26% (165). Anthropophilic species accounted for 73% of infections in 2012-2015, and 84% from 2015-2024. Moreover, total Zoophilic infections decreased from 16% in 2012-2015 to 5% from 2012-2024 while yeasts and non-dermatophyte moulds stayed consistent throughout the study period at 7% and 4% respectively, as illustrated in Graph 1.



Graph 1: Breakdown of Fungal Classes over 2012-2024

Dermatophytes Implicated in Skin Infections

Trichophyton rubrum increased in frequency from 46% in 2012-2015 to 81.5% in 2020-2024 ($p < 0.0001$). Conversely, *Candida Species* decreased from 25% in 2012-2015 to 9% in 2020-2024 ($p < 0.0001$). Similarly, the frequency of *Trichophyton interdigitale* decreased from 18% in 2012-2015 to 1.3% in 2020-2024 ($p < 0.0001$). The frequency of other species remained consistent during the study period, with non-significant fluctuation depending on the year and sources considered ($p > 0.05$), as shown in Graph 2.



Graph 2: Fungal Species Distribution in Skin Samples 2012-2024

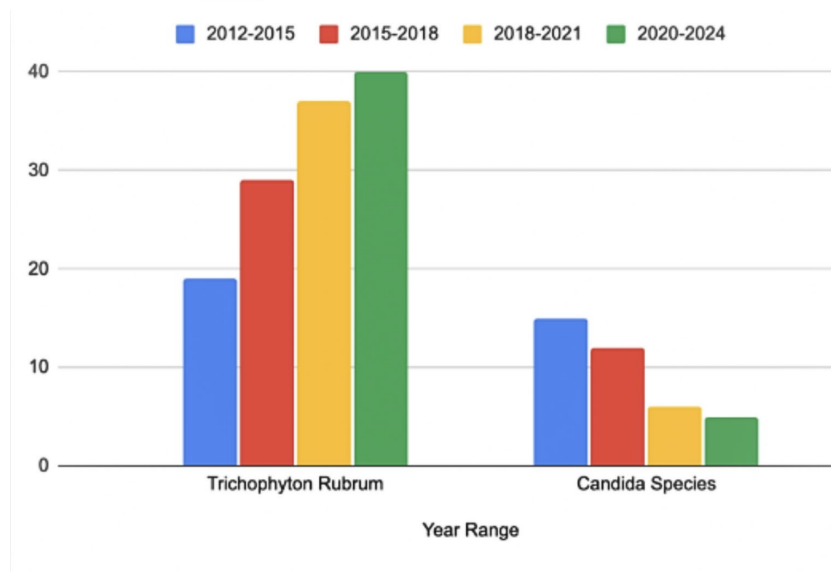
To further assess the linear trends over time, we conducted simple linear regressions with associated p values, the slope coefficients (B), and 95% confidence interval for B, which indicates an increase or decrease of cases per year (%). This is highlighted in Table 1.

Species	Cases (n)	%	B (95%CI)% /year	P
<i>Trichophyton rubrum</i>	380	82.96%	0.731 (0.664/1.027)	<0.001
<i>Trichophyton interdigitale</i>	38	8.296%	-0.312 (-0.154/-0.246)	<0.001
<i>Trichophyton tonsurans</i>	19	4.148%	-0.041(-0.120/-0.411)	<0.001
<i>Trichophyton verrucosum</i>	12	2.620%	-0.045 (0/-0.143)	0.193
<i>Trichophyton violaceum</i>	8	1.746%	0.048 (0/-0.118)	0.141
<i>Microsporum canis</i>	1	0.218%	-	-
Total	458	100		

Table 1: Prevalence of dermatophyte species in skin samples and results of simple linear regression (2012–2024) in Bons Secours Hospital, Cork, Ireland. B: Slope Coefficient of Simple Linear Regression (SPSS Version 28); CI: Confidence Interval

Dermatophytes Implicated in Onychomycosis

In terms of onychomycosis, 165 specimens were found of which 36 cases were isolated in 2012-2015, 41 cases in 2015-2018, 43 cases in 2018-2021 and 45 cases in 2021-2024. *Trichophyton rubrum* accounted for the majority of cases. Moreover, out of the 165 specimens, dermatophytes accounted for 123 cases while candida species accounted for 42 cases. Since 2012, *Trichophyton rubrum*'s isolation rate has increased from 52% to 87% ($p < 0.0001$). Conversely, *Candida species* decreased from 45% to 10% ($p < 0.0001$). Other species implicated in onychomycosis account for less than 2% of infections and they include, *Trichophyton interdigitale*, *Trichophyton verrucosum*, *Trichophyton violaceum*, *Trichosporum pullulans*, *Aspergillus Complex*, and *Fusarium Species*. Therefore, Graph 3 shows the prevalence of *Trichophyton rubrum* and *Candida species* only.



Graph 3: Dermatophyte Distribution in Nail Samples over 2012-2024

Rare Species Isolated During the Study Period

Throughout the study period 2012-2024, less common dermatophytes were isolated. These include *Aspergillus versicolor* complex, *Epidermophyton floccosum*, *Trichophyton violeceum*, and *Trichophyton verrucosum* which were isolated from skin, hair, or nail samples.

Discussion

Over the 12-year period, we observed a consistent rise in Anthropophilic species, particularly *Trichophyton rubrum*, while Zoophilic infections declined. This trend is consistent with previous Irish data from the Midwest¹² and reflects broader European patterns¹³. The high adaptability of Anthropophilic species and Ireland's humid climate likely contribute to their dominance.

Trichophyton rubrum emerged as the most common species in both skin and nail infections, showing a marked increase from 2012 to 2024. Its chronic course and resilience to treatment may explain this persistence. A relative stagnation in its detection between 2016–2021 may reflect referral bias during a period when only recalcitrant cases were submitted to laboratories due to staffing constraints¹⁴. This likely underestimated the actual community prevalence. Furthermore, the sharp increase of *Trichophyton rubrum* in 2023 coincides with the lifting of COVID-19 restrictions and increased use of communal facilities like gyms and pools, as well as international travel, factors known to facilitate transmission¹⁵. As an Anthropophilic species, *Trichophyton rubrum* can be transmitted easily through direct skin contact with infected individuals or indirectly via contaminated personal items such as towels, socks, or footwear¹⁴. In addition, its ability to cause chronic, often asymptomatic infections

allows for prolonged carriage and recurrent transmission within households and communities¹⁵. Environmental factors, including Ireland's temperate and humid climate, likely promote fungal survival and spread¹². Moreover, lifestyle changes such as increased urbanization, use of occlusive footwear, and a growing elderly population with comorbidities such as diabetes may have further contributed to its rising prevalence¹².

In addition, *Candida Species*, though initially the second most common cause of onychomycosis, showed a marked decline over time. Remarkably, *Microsporum canis* was more prevalent in the Midwest of Ireland¹². In contrast, countries like Germany, Spain, and France reported an increase in *Trichophyton interdigitale* and *Trichophyton tonsurans*^{16,17,18}. The differing patterns observed between Ireland and continental Europe may be attributed to variations in population demographics, migration trends, and climate¹⁷. Ireland's temperate maritime climate, combined with consistent humidity, creates an environment conducive to the persistence of *Trichophyton rubrum*, whereas warmer, drier climates elsewhere favour *candida* species¹².

Of note, *Trichophyton indotineae*, while not detected in our study, is rapidly emerging in India¹⁸, Southeast Asia¹⁸, and parts of Europe¹⁹, with cases of resistance to Terbinafine becoming widespread¹⁹. Itraconazole appears to be the most effective treatment option currently²⁰. Similarly, *Trichophyton mentagrophyte* has become endemic in parts of India and China²⁰ and has been linked to inappropriate antifungal-steroid combinations, resulting in treatment-resistant strains²⁰.

Additionally, *Trichophyton tonsurans* has gained significance across Europe, especially in paediatric tinea capitis, with rising incidence in nurseries and schools²¹. While zoophilic agents such as *Trichophyton benhamiae* are also increasingly reported in Germany and France due to pet ownership, particularly guinea pigs²².

Globally, the changing distribution of dermatophytes is influenced by factors such as travel, migration, lifestyle changes, pet exposure, and inappropriate antifungal use. As antifungal resistance rises, the need for national surveillance programs, clinician education, and updated treatment protocols is vital.

Importantly, this study has several limitations. Firstly, it was conducted at a single centre, which may limit generalisability to the wider Irish population. The retrospective design and reliance on laboratory referrals may underestimate community-level prevalence, as only treatment-resistant cases are typically submitted. Secondly, clinical data, such as patient demographics, comorbidities, disease severity, hair samples, and treatment outcomes, were unavailable for correlation. Finally, variations in sampling or diagnostic methods over the 12-year period may also have influenced detection rates. Despite these limitations, this study offers valuable insights into the evolving epidemiology of dermatophyte infections in the southern region of Ireland.

Declarations of Conflicts of Interest:

None declared.

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