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Diversity and Prevalence of Dermatophytes in Azerbaijan

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Abstract: This study investigates the diversity, seasonality, and prevalence of dermatophytes in various regions of Azerbaijan. A two-year retrospective study was conducted, during which a total of 177 isolates were identified based on macroscopic and microscopic characteristics. The most frequently detected species was *Trichophyton tonsurans* (44.5%), which was more commonly observed among males aged 25 to 40 (37.2%). Regional and seasonal variations in species distribution were also noted. Considering the limited data available on dermatophytes in Azerbaijan, these findings contribute to a better understanding of their epidemiology in the South Caucasus region and may provide valuable insights for clinicians.

Keywords: *Epidermophyton*, Dermatofytes, Dermatophytosis, *Microsporum*, *Trichophyton*

Azerbaycan'da Dermatofitlerin Çeşitliliği ve Yayılma Yoğunluğu

Öz: Bu çalışmada Azerbaycan'ın çeşitli bölgelerinde dermatofitlerin çeşitliliği, mevsimselliği ve yaygınlığı incelenmiştir. Makroskopik ve mikroskopik özelliklere dayanarak gerçekleştirilen iki yıllık retrospektif bir araştırma kapsamında toplam 177 izolat tanımlanmıştır. En sık karşılaşılan tür *Trichophyton tonsurans* (%44.5) olup, özellikle 25–40 yaş arası (%37.2) erkeklerde daha yaygın olarak gözlemlenmiştir. Türlerin dağılımında bölgesel ve mevsimsel farklılıklar da tespit edilmiştir. Azerbaycan'da dermatofitlerle ilgili mevcut bilgi eksikliği göz önüne alındığında, elde edilen bulgular Güney Kafkasya bölgesindeki dermatofitlerin epidemiyolojisinin daha iyi anlaşılmasına katkı sağlamakta ve klinisyenler için faydalı bilgiler sunmaktadır.

Anahtar kelimeler: *Epidermophyton*, Dermatofitler, Dermatofitozis, *Microsporum*, *Trichophyton*

Introduction

Dermatophytes represent a group of molds that infect keratinized tissues such as the skin, hair, and nails, leading to dermatophytosis (Ekin et al., 2019). These fungi rank among the most prevalent causes of superficial skin infections across the globe (Rosalie et al., 2021). Despite their superficial nature, these infections can pose a greater risk in immunocompromised individuals (Bryan et al., 2024). These infections seldom result in severe health outcomes, yet they often cause prolonged discomfort, with annual treatment costs reaching billions of dollars (Schaechter et al., 2016). Common symptoms include pruritus, flaking, hair loss, annular skin lesions, and nail thickening with discoloration. The clinical presentation differs based on the pathogen involved, the host's immune status, and the location of the infection (Murray et al., 2020).

These fungal infections are more prevalent in tropical and subtropical regions due to high humidity and warm climates (Shishira et al., 2022). The World Health Organization reports that about one in four people worldwide are affected by these infections (Puja et al.,

2023). Similarly, recent data show a rising incidence of fungal infections in Azerbaijan, especially in its capital, Baku (Karimov et al., 2024).

Dermatophytes are generally classified into three principal genera: *Trichophyton*, *Epidermophyton*, and *Microsporum*. *Microsporum* species mainly target the skin and hair; *Epidermophyton* infects the skin and nails; while *Trichophyton* species have the capacity to affect all three — hair, skin, and nails (Qarayev & Bayramli, 2019). Precise identification of the dermatophyte species is crucial, since clinical manifestations can differ based on the specific organism responsible (Alex et al., 2022).

Worldwide, most cases of dermatophytosis are attributed to *Trichophyton* species—an anthropophilic genus with the ability to infect various body sites. Nonetheless, the distribution of other pathogenic species shows considerable variation depending on geographic location, anatomical site, age, sex, socioeconomic conditions, and underlying health conditions. In tinea capitis cases globally, the main anthropophilic fungi are *T. violaceum* Sabour. ex E. Bodin 1902 and *T. tonsurans* Malmsten 1848, whereas species of *Microsporum* tend to be zoophilic. However, significant geographic variations exist: *T. violaceum* and *M. canis* E. Bodin ex Guég. 1902 dominate in North Africa; *T. violaceum* and *M. audouinii* Gruby 1843 in South Africa; *T. tonsurans* is the most prevalent in the United States; and in Thailand, *T. rubrum* (Castell.) Sabour. 1911 and *T. mentagrophytes* (C.P. Robin) Sabour. 1895 are the primary causative agents.

Furthermore, the prevalence of pathogenic species is continuously evolving because of migration, globalization, climatic influences, transmission pathways, and alterations in lifestyle (Julia et al., 2025).

The identification of the most frequently encountered dermatophytes relies on their colony morphology and microscopic characteristics, observed after a two-week incubation period on Sabouraud dextrose agar (SDA) at 25°C. *Trichophyton* species are distinguished by producing smooth-walled, cylindrical macroconidia and distinctive microconidia. Colony appearance of *T. mentagrophytes* can vary between cottony and granular textures, with both types typically exhibiting abundant clusters of spherical microconidia resembling bunches of grapes at the tips of branched hyphae. Spiral hyphae are commonly seen in primary isolates (Figure 1.1). A characteristic colony of *T. rubrum* displays a white, cotton-like surface with a deep red pigment on the reverse that does not diffuse. Its microconidia are small and shaped like pears (pyriform). Meanwhile, *T. tonsurans* produces flat colonies with a powdery or velvety texture, showing a reddish-brown color on the underside; its microconidia are predominantly elongated (Figure 1.2).

Microsporum species are generally identified by their multicellular macroconidia, which have spiny (echinulate) walls. In this genus, both macroconidia and microconidia occur individually rather than in clusters. *M. gypseum* E. Bodin 1902 develops light brown, powdery colonies and produces thin-walled macroconidia composed of 4–6 cells. On the other hand, *M. canis* forms white, cotton-like colonies with a bright yellow underside and thick-walled macroconidia containing 8–15 cells, featuring curved or hook-shaped tips.

Epidermophyton floccosum (Harz) Langeron & Miloš. 1930, the only pathogenic species in its genus, produces only macroconidia. These macroconidia are smooth-walled, club-shaped (clavate), consist of 2–6 cells, and typically appear in small groups (Walsh et al., 2018).

Although dermatophytes are widely prevalent, scientific research on these fungi is still limited, and epidemiological data remain inadequate. In Azerbaijan, the diagnosis of dermatophytosis frequently relies only on clinical examination because of the scarcity of mycology laboratories. This study aims to assess the species diversity and prevalence of dermatophytes across different regions of the country. Analyzing infection cases according to gender, age, and other demographic factors will aid in the implementation of sanitary, epidemiological, and preventive strategies to control the spread of infectious skin diseases within the population (Alma et al., 2025).

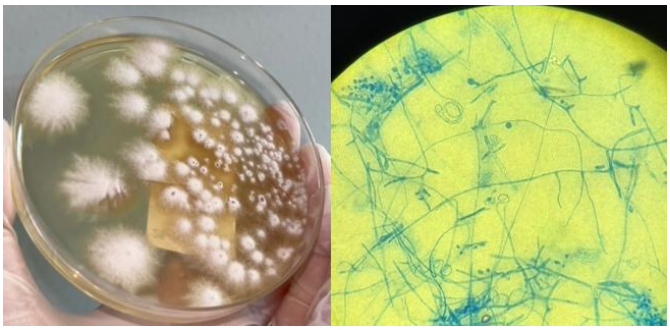

Figure 1.1. *T. mentagrophytes*

Figure 1.2. *T. tonsurans*

Material and Metod

This research involved fungal cultures processed at the Referans Clinical Laboratory Center (Baku) between 01.01.2023 and 01.01.2025.

To ensure sample integrity and prevent contamination, skin, hair, and nail specimens were collected in sterile containers. For the isolation of fungal colonies under standard conditions and to achieve more accurate identification, samples were inoculated onto Sabouraud CAF agar (Liofilchem) and incubated at 25°C for three weeks in a thermostat. In culture-positive samples, fungal colonies were evaluated both macroscopically and microscopically.

Macroscopic evaluation included assessment of colony characteristics such as color, surface texture, and pigmentation. For microscopic examination, samples were prepared using the cellophane tape method and stained with lactophenol cotton blue to enhance visualization of fungal structures. Preparations were then evaluated under a microscope.

The identification of dermatophyte species was carried out based on colony morphology, pigmentation, and microscopic characteristics, using standard mycological references, including Larone's Medically Important Fungi: A Guide to Identification (Walsh et al., 2018).

The obtained data were retrospectively analyzed using the laboratory's electronic information system.

Results

Based on the findings of the two-year investigation, 177 out of 506 fungal cultures (35%) were found to be positive. This result indicates a notably high prevalence of dermatophytosis among the examined specimens. Dermatophytosis was observed more frequently in males. Of the positive samples, 93 (52%) belonged to male patients, and 84 (48%) to female patients. Species of the genus *Trichophyton* accounted for 91% of all positive fungal cultures, confirming that *Trichophyton* was the main etiological agent of dermatophytosis during the study period. Dermatophytes of the genus *Microsporum* made up 8% of the positive cases, while *Epidermophyton* species were detected in only 1%, suggesting that *Epidermophyton* was rarely encountered in the studied population.

In total, the following dermatophyte species were identified: Trichophyton tonsurans (77), Trichophyton spp. (31), Trichophyton megninii (28), Trichophyton rubrum (13), Trichophyton mentagrophytes (6), Trichophyton terrestre Durie & D. Frey 1957 (3), Trichophyton verrucosum E. Bodin 1902 (3), Microsporum ferrugineum M. Ota 1921 (6), Microsporum spp. (4), Microsporum canis (2), Microsporum nanum C.A. Fuentes 1956 (2), Microsporum gypseum (1), and a single isolate (0.5%) of Epidermophyton floccosum (Table 1).

According to the results of the study, different distribution patterns of dermatophyte species were observed across various age groups.

Dermatophytes belonging to the genus *Microsporum* were predominantly identified in patients aged 1–18 years. This observation indicates that *Microsporum* infections are more frequently seen among children and adolescents. This may be attributed to underdeveloped personal hygiene habits, immature immune systems, and increased close contact in communal environments such as schools and kindergartens.

Table 1. Distribution of dermatophytes isolated from fungal cultures

Dermatophyte pathogens	%
T. tonsurans	44.5
T. spp	16.3
T. megninii	15.8
T. rubrum	8.3
T. mentagrophytes	3.3
T. terrestre	1.6
T. verrucosum	1.6
M. ferrugineum	3.3
M. spp	2.1
M. canis	1.1
M. nanum	1.1
M. gypseum	0.5
E. floccosum	0.5
Total	100

On the other hand, species of the genus *Trichophyton* were more commonly isolated from adult individuals aged 25–40 years. This age group typically engages more actively in occupational and social activities and, as a result, experiences more frequent interpersonal contact. Such factors may contribute to the higher prevalence of *Trichophyton* infections in this demographic.

A particularly noteworthy finding was the detection of a dermatophyte from the genus *Epidermophyton* in only one patient—a 13-year-old boy from Guba. This suggests that *Epidermophyton* was extremely rare within the scope of this study and appeared to be limited to isolated, individual cases (Figure 2).

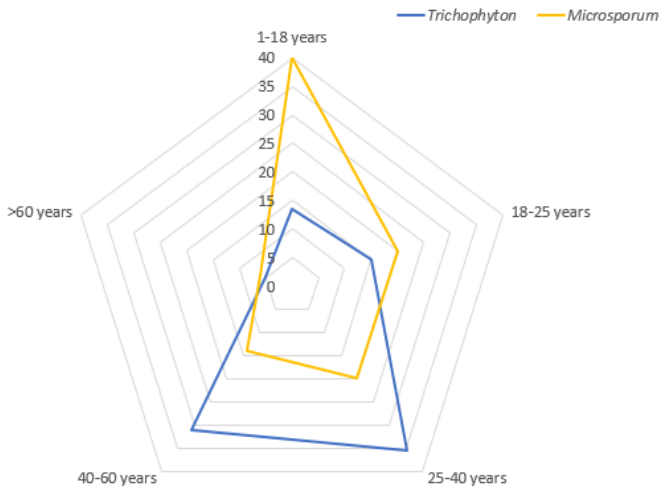

Figure 2. Prevalence of dermatophytes by age group

Within the scope of this investigation, the regional origin of 506 clinical specimens enabled the determination of geographical distribution patterns of dermatophyte infections. Of these, 390 samples (76%) originated from Baku, 43 (9%) from Lankaran, 34 (7%) from Guba, 9 (2%) from Ganja, 9 (2%) from Gabala, 9 (2%) from Aghstafa, and 5 (1%) from Khachmaz.

By region, *Trichophyton* spp. was identified in 124 samples from Baku, 18 from Lankaran, 10 from Guba, 5 from Aghstafa, 4 from Gabala, 3 from Ganja, and 1 from Masalli. *Microsporum* spp. were found in 13 samples from Baku and 2 from Guba, while *Epidermophyton* was isolated in a patient from Guba.

These findings indicate that clinical consultations and laboratory diagnostics for dermatophytosis are predominantly concentrated in the capital, whereas such cases are relatively scarce in regional areas. This may be explained by the more extensive laboratory infrastructure, advanced diagnostic capacity, and the presence of specialized healthcare institutions in Baku.

The present analysis showed that although dermatophyte infections were observed in all studied regions, their intensity and species diversity varied significantly by location. These differences may be attributed to diverse social, climatic, and hygienic conditions, as well as disparities in access to medical services.

The dominance of Baku likely reflects both a higher incidence of infection and greater diagnostic potential.

Overall, these data contribute to a better understanding of the epizootic status and geographical distribution of dermatophytoses in the country and establish a critical foundation for future region-specific preventive and educational strategies.

The results of the analysis indicate monthly variations in the prevalence of dermatophytoses. In 2023, the highest number of dermatophyte infections was recorded in December (Figure 3.1). This may be explained by factors such as lower temperatures during winter months, prolonged stays in enclosed environments, and the use of thick and synthetic clothing, which can create a moist and poorly ventilated environment on the skin, thereby promoting fungal growth. In contrast, the highest number of cases in 2024 was observed in May (Figure 3.2). Rising temperatures and increased sweating during the spring season—especially in areas such as the feet, body, and scalp—create favorable conditions for the proliferation of dermatophytes.

Additionally, increased visits to public spaces such as gyms, swimming pools, and other communal facilities during this period may further elevate the risk of transmission.

These observations demonstrate that dermatophytoses tend to increase during certain months and that this trend is closely linked to climatic conditions and lifestyle factors. Strengthening preventive measures in line with seasonal changes, enhancing public awareness, and promoting hygiene practices may play a crucial role in reducing the incidence of infections

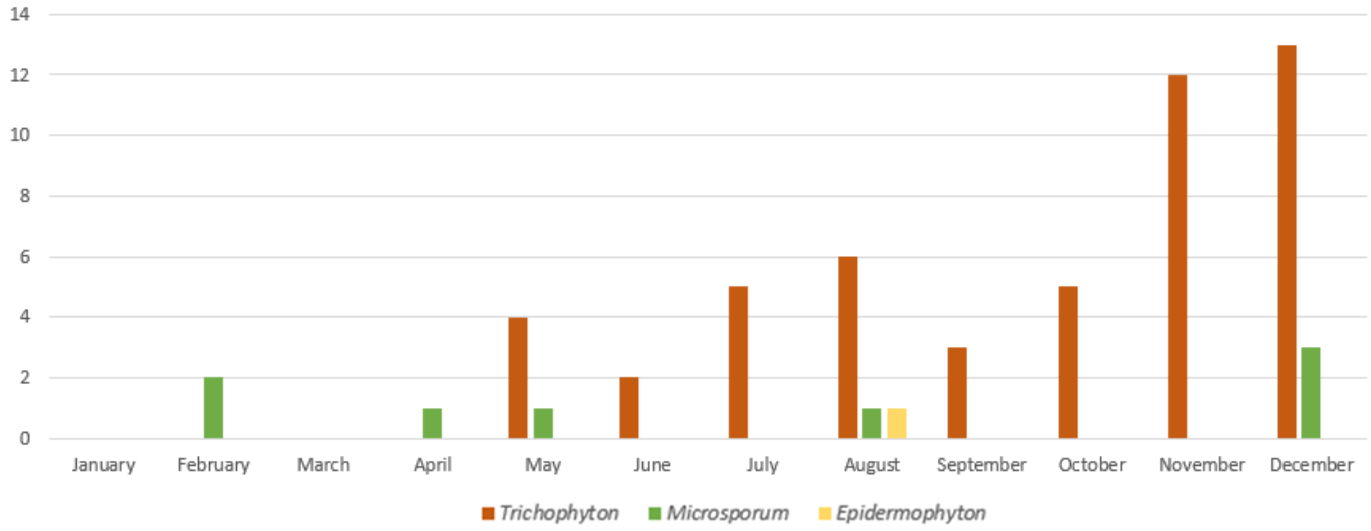

Figure 3.1. Monthly distribution of dermatophytes in 2023

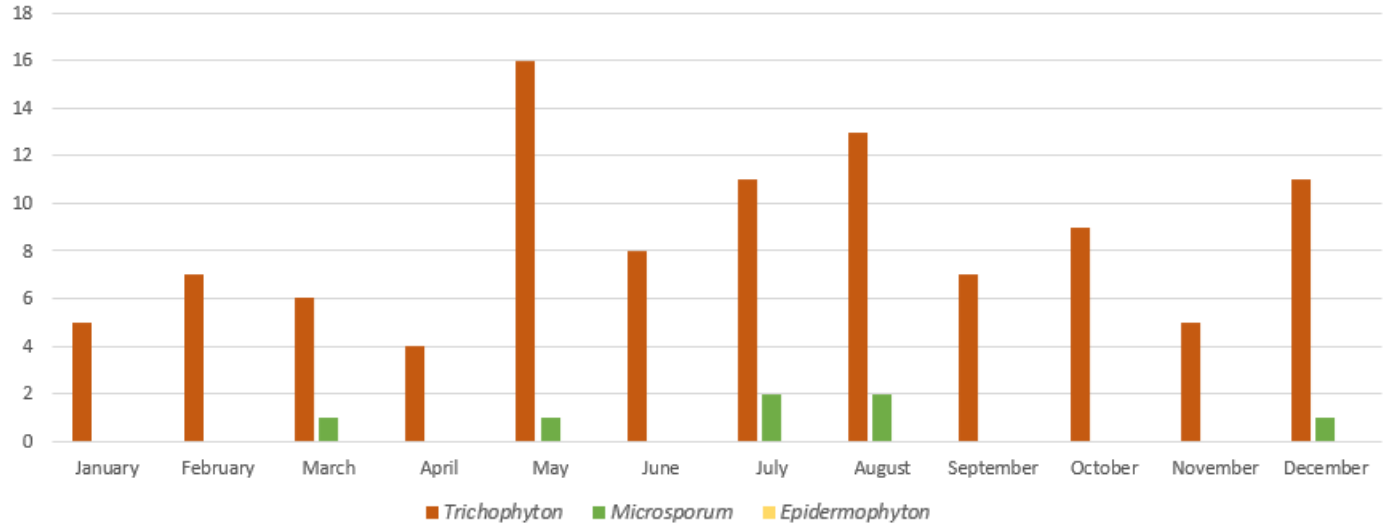

Figure 3.2. Monthly distribution of dermatophytes in 2024

Discussions

In the present study, fungal elements were detected in 35% of clinical samples, which closely corresponds to the findings of Ekin et al. (2019), who reported a detection rate of 36% among a similar cohort. This consistency reflects the stability of dermatophytosis epidemiological characteristics in the Eastern Mediterranean and South Caucasus regions, where climatic and socio-hygienic conditions are comparable. The moderate detection rate may be attributed to improved population hygiene, earlier consultations with dermatologists, and widespread use of topical antifungal medications.

The proportion of male patients in this study was 52%, aligning with the results of Bakhtawar et al. (2021) (52%), but lower than figures reported by Kadnur et al. (2022) (70.8%), Julia et al. (2024) (66.1%), and Saeed et al. (2022) (58.4%). The consistently higher male susceptibility is traditionally linked to occupational exposure, increased physical activity, profuse sweating, and the habitual use of closed footwear. In Azerbaijan, cultural and social practices such as shared use of public baths, gyms, and sports facilities may further promote anthropophilic transmission.

Analysis of fungal isolates revealed a predominance of the genus *Trichophyton* (91%), followed by *Microsporum* (8%) and *Epidermophyton* (1%). These findings are consistent with Ekin et al. (2019) from Turkey, where *Trichophyton* accounted for 94.7% of isolates and *Microsporum* for 5.3%, with no *Epidermophyton* detected. The overwhelming predominance of *Trichophyton* species likely reflects their biological advantages, including high sporulation capacity, environmental resilience, and the ability to survive on keratin-rich substrates.

The most frequently isolated species in this study was *T. tonsurans* (44.5%), which is increasingly recognized as one of the leading etiological agents of superficial mycoses. This aligns with observations from Germany (Julia et al., 2025), where *T. tonsurans* represented 67.6% of all dermatophyte isolates. However, regional variability persists: *T. mentagrophytes* was the dominant species in Saeed et al. (2022) (29%), while *M. canis* was most frequently isolated in Kazakhstan (73.7%) (Alma et al., 2025). The high prevalence of *T. tonsurans* in Azerbaijan may suggest persistent intra-household transmission and insufficient control measures in community-based settings. From a demographic perspective, individuals aged 25–40 years were most frequently affected (37.2%), mirroring the trend observed by Saeed et al. (2022), who reported the highest prevalence among those aged 25–44 years (31.6%). The predominance in this age group reflects higher levels of social and occupational activity, which can facilitate dermatomycosis transmission. A single case of *Epidermophyton* was isolated from a 13-year-old, indicating limited circulation of this genus among younger individuals, in contrast with reports from Saudi Arabia (Bashayer et al., 2021), where *Epidermophyton* was predominant among adolescents aged 10–19.

Seasonality emerged as a notable epidemiological factor. While Balamuruganvelu et al. (2019) reported a peak prevalence during summer months (35.8%), our study observed the highest number of positive samples in December and May. This pattern likely reflects Azerbaijan's climatic characteristics—cold, humid winters and mild springs—which promote optimal conditions for fungal persistence on skin surfaces. Seasonal changes in clothing and skin moisture levels may also contribute to these trends, emphasizing the need to tailor preventive measures to local environmental and behavioral patterns.

Despite growing interest in dermatophyte infections, they remain relatively underexplored in the global context. Bryan et al. (2024) noted significant epidemiological and clinical knowledge gaps, particularly in low- and middle-income countries. The findings presented here help bridge this gap by expanding current knowledge of dermatophyte prevalence in the Caucasus region and laying the groundwork for a future national database.

Certain limitations of this study should be acknowledged. Species identification was primarily based on morphological methods, which may compromise accuracy compared to molecular techniques. Additionally, the study was geographically limited, preventing a full national assessment of dermatophyte distribution. Future research should incorporate molecular diagnostic tools and extend sampling to underrepresented regions of the country.

Overall, the results demonstrate that the prevalence and taxonomic diversity of dermatophytes in Azerbaijan are influenced by a combination of demographic, environmental, and socio-behavioral factors. The predominance of *T. tonsurans* underscores the need for precise species-level diagnostics and improved laboratory capacity. These findings can inform the development of targeted surveillance, prevention, and public health strategies to control dermatophytosis in the region.

Author contributions

The authors have equal contribution.

Conflicts of interest

The authors declare no competing interests.

Ethical Statement:

It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited (Zibeyda GAMBAROVA, Hayat ALIYEVA).

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