Macedonian pharmaceutical bulletin, **71** (2) 43 - 51 (2025)
ISSN: 1857-8969
DOI: 10.33320/maced.pharm.bull.2025.71.02.005
Original scientific paper

Mycological profile of dermatomycoses i Macedonian patients

Gordana Mirchevska[1*], Emel Dauti Jahja[1], Sanja Kostova-Ilieva[1], Nadica Krsteva[1], Aleksandra Kacarska[2], Marija Kostovska-Micevska[1], Elena Trajkovska-Dokic[1], Zorica Zafirovik[3]

[1]*Institute of Microbiology and Parasitology, Faculty of Medicine, Ss. Cyril and Methodius University in, Skopje, "50 Divizija" 6, 1000 Skopje, Republic of North Macedonia*
[2]*Institute for the Public Health of the Republic of North Macedonia, "50 Divizija" 6, 1000 Skopje, Republic of North Macedonia*
[3]*University Clinic for Dermatology, Clinical Campus Mother Theresa, "Vodnjanska 17", 1000 Skopje, Republic of North Macedonia*

Received: January 2025; Accepted: May 2025

Abstract

Dermatomycoses are among the most common skin conditions that present a major public health problem. The aim of this study was to retrospectively analyse the mycological profile of dermatomycoses during a 6-year period (2017-2022). Specimens from 674 patients (384 nails 244 skin scrapings and 46 hair specimens) with dermatomycoses were examined. The specimens were evaluated with conventional mycological methods at the Institute of Microbiology and Parasitology, Skopje.

Forty-seven percent of the samples were found to be culture positive. Samples from females were positive more frequently (192/317) than in males (125/317). The commonest age group was 11-20 years. The most prevalent etiological agents were non-dermatophyte molds-56% (178/317), followed by yeasts in 30% (96/317), and dermatophytes in 13.6% (43/317). Almost 61% percent of the positive findings originated from nail specimens (192/317), 38% from skin scrapings (121/317), and 1.3% from hair specimens (4/317). Onychomycoses were caused by non-dermatophyte molds in 67% (128/192). Yeasts were identified in nail samples in 30% (57/192). Dermatophytes were agents of onychomycoses in 3.7% (7/192). Skin infections were caused by non-dermatophyte molds in 41.3% (50/121). Yeasts were identified in skin scrapings in 32% (39/121). Dermatophytes caused skin infections in 26.4% (32/121). Only 4 hair specimens were positive for dermatophytes.

Our study reflects an increasing role of non-dermatophyte fungi as a causative agent of dermatomycoses, replacing dermatophytes. Clinicians' awareness that molds can be contaminants of specimens, along with request for consecutive specimens can help in etiological diagnosis of dermatomycoses, leading to successful treatment and prevention of disease recurrence.

Key words: dermatomycoses, molds, yeasts, dermatophytes

Introduction

Dermatomycoses are one of the commonest infections affecting humans worldwide. The World Health Organization (WHO) estimates that 20–25% of people globally have a superficial mycotic infection (Grover et al., 2003). Although fungal infections are not life-threatening infections, they are a significant public health problem due to their morbidity, frequent recurrence and/or chronic

*email: gordmir@yahoo.com

duration. They also cause cosmetic disfigurement, that in turn contribute to significant psychological problems in affected patients (Hazarika et al., 2019). The prevalence of these infections has risen in many countries worldwide, and has a great importance both in developed and developing countries. The main reasons for the increased incidence are comorbidities and prolonged use of immunosuppressive and anticancer drugs, as well as indiscriminate use of antibiotics. Type of population with different lifestyles, contact with pets, swimming in contaminated pools, migration as well as climatic changes contribute to this increase. Superficial mycoses involve the keratin structures of the skin, hair and nails. Etiological agents of superficial fungal infections can be dermatophytes, yeasts and/or nondermatophyte molds (Khadka et al., 2010). The dermatophytes produce an infection called dermatophytosis, also known as tinea (Bongomin et al., 2017). They produce inflammatory response deep in the skin, intense itching, and cosmetically poor appearance. Clinically, superficial mycoses can be classified depending on the involved part of the body, like tinea capitis, tinea corporis, tinea cruris, tinea pedis, tinea barbae and tinea unguium. Skin infections can sometimes be caused by nondermatophytic fungi and these infections are known as dermatomycoses. Infections of the hair and nails are known as piedra and onychomycosis, respectively (Khadka et al., 2010). An accurate diagnosis with identification of fungi responsible for skin infections, at species level, is important for epidemiological studies. It is also crucial for effective antifungal management, which could lead to more favorable clinical outcome.

The aim of this study was to retrospectively analyse the mycological profile of dermatomycoses in patients treated in different dermatology outpatient departments, over a 6-year period.

Material and methods

Study population, period, inclusion and exclusion criteria

The laboratory based study was conducted over a period of 6 years (2017-2022) at the Institute of Microbiology and Parasitology, Faculty of Medicine, Skopje, Republic of North Macedonia. During this period, specimens from 674 patients (384 nail specimens, 244 skin scrapings and 46 hair specimens) with clinically suspected dermatomycoses, were examined. Exclusion criteria for not including specimens in the study was previous antifungal treatment of patients. The clinical specimens were collected from the edge of the affected skin lesions. Hair specimens were obtained by plucking procedure, which has been performed after selecting the infected area and removing at least 5 hairs. Nail specimens were collected by scrapping of the nail area that showed clinical signs of fungal infection. All specimens were collected in sterile petri dishes or transported between two clean glass slides taped together.

The specimens were evaluated with conventional mycological methods (culture and direct microscopy) at the Laboratory for diagnosis of mycoses at the Institute of Microbiology and Parasitology, Faculty of Medicine, Skopje. All samples were inoculated on a standard mycological media for support of fungal growth (Sabouraud's dextrose agar with chloramphenicol and cycloheximide or chromogenic medium for fungi) and then incubated at 35°C up to 3 weeks. The cultures were examined daily during the first week, and then three times a week, and were declared negative if no growth was obtained until the end of the third week. All cultures were analyzed both, macroscopically and microscopically. Preliminary identification of the etiological agents was based on the colony texture of grown colonies on the fungal medium, growth rate, and pigmentation of the front and the reverse side of the culture. Final identification was based on microscopic features of the fungi, after examination of the fungi with the lactophenol cotton blue mounts, using cellophane tape preparation, for detailed investigation of presence of macroconidia and/or microconidia, or other typical morphological forms of different fungal agents. The morphology of the fungal elements of rare fungi was compared to color atlas of reference text books.

Results and discussion

674 specimens from patients with clinically suspected dermatomycoses, were examined. Out of all received samples, 384 (57%) were nails, 244 (36%) skin samples, and 46 (7%) were hair samples. Forty-seven percent (317/674) of the examined samples were found to be culture positive. All culture positive samples were positive with microscopy as well.

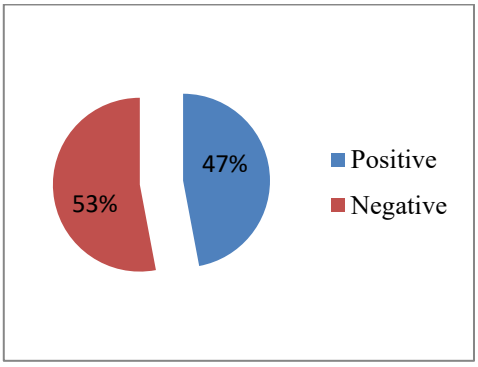

Fig. 1. Positivity of fungal cultures in all patients

Almost 61% of the positive findings originated from nail specimens (192/317), 38.2% from skin scrapings (121/317), and in 1.3% of the hair specimens, fungi were also confirmed (4/317).

Table 1. Number of examined and culture proven dermatomycoses

Type of specimen	Total cases examined	Total positive specimens	Number of specimens with identification of fungal pathogens *N* (%)		
			Single growth	Mixed growth *N* (%)	No growth *N* (%)
Skin	244 (36%)	121 (38.2%)	105 (33.1%)	16 (5.1%)	123 (50.4%)
Hair	46 (7%)	4 (1.3%)	4 (1.3%)	0 (0%)	42 (91.3%)
Nail	384 (57%)	192 (60.6%)	152 (48%)	40 (12.6%)	192 (50%)
			261 (82.3%)	56 (17.7%)	
Total	674 (100%)	317 (47%)	317 (47%)		357 (53%)

Table 2. Age and sex distribution of patients with positive findings

Age in years	Males N (%)	Females N (%)	Total N (%)
0–10	3 (2.2%)	2 (1.1%)	5 (1.6%)
11–20	42 (31.3%)	50 (27.3%)	92 (29%)
21–30	17 (12.7%)	25 (13.6%)	42 (13.3%)
31–40	13 (9.7%)	21 (11.5%)	34 (10.8%)
41–50	16 (11.9%)	17 (9.3%)	33 (10.4%)
51–60	14 (10.5%)	33 (18%)	47 (14.8%)
>60	29 (21.6%)	35 (19%)	64 (20.2%)
Total	134 (42.3%)	183 (57.7%)	317 (100%)

Specimens originating from female patients were positive more frequently (183/317) than from male patients (134/317).

Regarding age, the most common age group in patients with dermatomycoses was 11-20 years, followed by age group over 60 years.

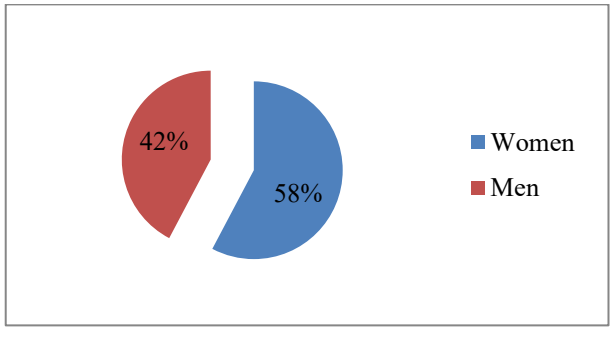

Fig. 2. Positivity of fungal cultures according to gender

The most common etiological agents of dermatomycoses in our study were non-dermatophyte molds - 56% (178/317), followed by yeasts in 30% (96/317), and dermatophytes in 13.6% (43/317) of cases.

Skin infections were caused by non-dermatophyte molds in 41.3% (50/121). The non-dermatophyte molds recovered from skin scrapings were as follow: *Curvularia* species 20% (10/50), *Aspergillus fumigatus* 10% (5/50), *Aspergillus niger* 6% (3/50), *Scopulariopsis* species 6% (3/50), *Aspergillus* species 6% (3/50) and *Onychocola* species 6% (3/50), *Aspergillus flavus* - 4% (2/50), *Fusarium* species 4% (2/50), and with one isolate of *Cladophialophora* and *Paecilomyces* species 2% (1/50). The molds could not be identified by microscopy in 34% of the positive skin scrapings (17/50). Yeasts were identified in skin scrapings in 32% (39/121). Among the yeasts, non-*albicans Candida* were more common 54% (21/39), as compared to *Candida albicans*, which were identified in 33% (13/39). Other, non-*Candida* yeasts recovered from positive samples were *Trichosporon* species, which were identified in 10.3% (4/39), and

Geotrichum species, identified in 2.6% (1/39). Dermatophytes were etiological agents of skin infections in 26.4% (32/121), represented by *Trichophyton* species with 56.3% (18/32), followed by *Microsporum* species with 40.6% (13/32). *Epidermophyton floccosum* was identified in one specimen (3.1%).

Onychomycoses were caused by non-dermatophyte molds in 67% (128/192). The non-dermatophyte causes of the nail infections, in order of frequency, were: *Fusarium* species 15% (19/128), *Aspergillus flavus* 12.5% (16/128), *Scopulariopsis* species 12% (15/128), *Aspergillus niger* 8.6% (11/128), *Aspergillus fumigatus* 6.3% (8/128), *Cladosporium* species 5.5% (7/128), *Curvularia* species 4.7% (6/128), *Paecilomyces* species 3.9% (5/128), *Alternaria* species 3.1% (4/128), *Penicillium* species 1.6% (2/128), and with one isolate of *Phoma* species, *Scytallidium* and Mucor species 0.8% (1/128). The molds could not be identified in 22% of the positive nail samples (28/128). Yeasts were identified in positive nail samples in 30% (57/192). *Candida albicans* was detected in 52.6% of the positive nail specimens. Dermatophytes were agents of onychomycoses in only 3.7% (7/192), represented by *Trichophyton* species with 71% (5/7), followed by *Epidermophyton* species with 28.6% (2/7).

Regarding hair infections, we found four hair specimens to be positive for dermatophytes during the evaluated period, represented by *Microsporum* species in each positive sample.

Fungal skin diseases are extremely common, with nearly a billion people worldwide estimated to suffer from dermatomycoses (Bongomin et al., 2017). The prevalence of dermatomycoses has risen in many countries worldwide, and has a great importance both in developed and developing countries. Since long-term treatment may be necessary in some cases, it is important to identify the fungus that is causing the dermatomycosis both for epidemiology and treatment.

Dermatomycoses were registered in 47% (317/674) of the analyzed samples in our study. In contrast to our results, a lower prevalence of dermatomycoses in a study from India in 2015 was registered (27.6%) (Lakshmanan et al., 2007). In the study by Veer and collaborators from Aurangabad, India, dermatomycoses of nails were seen in 48.86% of cases which is similar to the results in our study (Veer et al., 2007). We found nails as the commonest (61%) site of superficial fungal infection followed by skin (38.2%) and hair (1.3%). In contrast to our data, in 2015, Lakshmanan had found skin as the commonest site of superficial infection, followed by nails and hair (Lakshmanan et al., 2007).

Regarding the age of affected patients, the age group of 11-20 years had the highest prevalence of dermatomycoses in our study, followed by age group over 60. Similar to our study, a high prevalence in the younger age group was found in another study conducted in Gangtok, Sikkim, in 2009 by Adhikari et al. (2009). Probable reasons for increased incidence in younger population could be exposition of young adults to more physically demanding indoor or outdoor activities and shoe wearing habits. Results from the study of Gamage, the most commonly affected age group was 61-80 years, which is similar to our study, where this age group was on the second place for positive findings (Gamage et al., 2020). Also, Velez et al. (1997), and Mercantini et al. (1996), reported higher prevalences among adults over 50 years of age. Probable explanation for increased incidence of dermatomycoses in older population in these studies, is the fact that the risk for dermatomycoses increases with age, sometimes due to diabetes mellitus or peripheral vascular arterial disease, chronic insufficiency of venous system, polyneuropathies of diverse etiologies, as well as repeated nail trauma and longer fungal exposure from the environment. Increased prevalence of chronic diseases resulting from aging, increased use of immunosuppressive drugs and subsequent immunosuppression, have also significantly attributed to increased incidence of dermatomycoses.

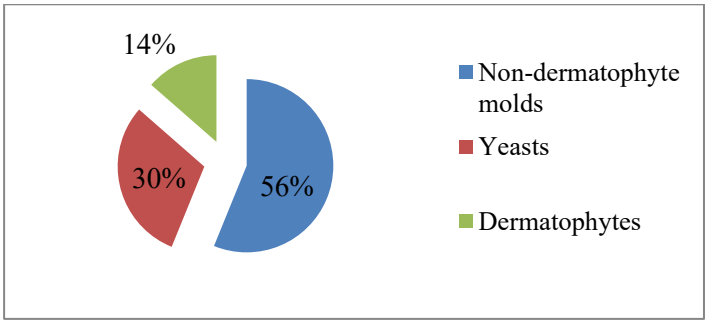

Fig. 3. Distribution of fungi in the etiology of dermatomycoses

Table 3. Distribution of fungal isolates in different samples

	Organisms	Skin	Hair	Nail
Molds	*Curvularia species*	10/50 (20%)	—	6/128 (4.7%)
	Aspergillus fumigatus	5/50 (10%)	—	8/128 (6.3%)
	Aspergillus niger	3/50 (6%)	—	11/128 (8.6%)
	Scopulariopsis species	3/50 (6%)	—	15/128 (12%)
	Aspergillus species	3/50 (6%)	—	—
	Onychocola species	3/50 (6%)	—	—
	Aspergillus flavus	2/50 (4%)	—	16/128 (12.5%)
	Fusarium species	2/50 (4%)	—	23/128 (18%)
	Cladophialophora species	1/50 (2%)	—	—
	Paecilomyces species	1/50 (2%)	—	5/128 (3.9%)
	Non-identified molds	17/50 (34%)	—	28/128 (22%)
	Cladosporium species		—	7/128 (5.5%)
	Alternaria species		—	4/128 (3.1%)
	Penicillium species		—	2/128 (1.6%)
	Phoma species		—	1/128 (0.8%)
	Scytallidium species		—	1/128 (0.8%)
	Mucor species		—	1/128 (0.8%)
Yeasts	*Candida albicans*	13/39 (33%)	—	30/57 (52.6%)
	Non-albicans Candida	21/39 (54%)	—	27/57 (47.4%)
	Trichosporon species	4/39 (10.3%)	—	—
	Geotrichum species	1/39 (2.6%)	—	—
Dermatophytes	*Trichophyton* species	18/32 (56.3%)	—	5/7 (71%)
	Microsporum species	13/32 (40.6%)	4/4 (100%)	—
	Epidermophyton floccosum	1/32 (3.1%)	—	2/7 (28.6%)
	Total	121 (38.2%)	4 (1.3%)	192 (60.6%)

Literature data demonstrate that prevalence rates of dermatomycoses regarding sex are highly variable. In many studies, superficial fungal infections have been reported to be more common in males than in females, especially at younger ages (Oke et al., 2014). Our study demonstrates higher prevalence among male patients (31.3%) than in female patients (27.3%) (for age group 11-20 years), and prevalence of 21.6% for males and 19% for females (for age group over 60 years), which is similar to the results of the studies from Gamage et al. (2020) and Suruchi Bhagra et al. (2014), who demonstrate highest prevalence among males, who were affected more than females. The reason could be that males are less concerned about hygiene compared to females, and also have more frequent contact with playmates. In contrast, results from another 20-year study from Ireland, a female predominance was registered (57.2%) (Powell et al., 2022). In our study, higher prevalence of dermatomycoses among female patients was registered only in the 51–60 age group. Brilhante and coworkers (Brilhante et al., 2005) demonstrated that females are more affected than males, while Ahuja (Ahuja et al., 2011) and Satpathi (Satpathi et

al., 2013) reported that males are more prone to onychomycosis than females. In the study which was conducted by Garg (Garg et al., 2004) and Veer (Veer et al., 2007), males were also infected more than females. The increased prevalence of onychomycosis in men could be due to nail trauma and more common use of occlusive footwear. Other reasons could be that men are more likely to play sports and have a prolonged physical activity and increased perspiration which lead to the development of these infections. The explanation for higher prevalence of dermatomycoses among female patients in the age group 51–60, could be due to their bigger concern about their appearance and health compared to men (Costa-Orlandi et al., 2012). Women also more frequently immerse fingers in water during homework, leading to macerated nail cuticles along with use of manicure tools in beauty salons, which could not be previously properly disinfected. All these reasons could contribute to development of fungal infections, especially to nails and skin.

Regarding etiology of dermatomycoses, the most common etiological agents in our study were non-dermatophyte molds-56% (178/317), followed by yeasts in 30% (96/317), and dermatophytes in 13.6% (43/317) in all cases. Similar results were presented in the study of Ravinder, who presented 36.1% of non-dermatophyte molds, followed by dermatophytes 13.8% and yeasts in 8.6% in the examined specimens (Ravinder et al., 2015). Studies conducted by Lakshmanan (Lakshmanan et al., 2015) and Patel (Patel et al., 2010) in Gujarat (India) also showed an increased prevalence of non-dermatophyte molds. Non-dermatophytic molds accounted for 84% of the total culture-positive fungal infection in the study of Jaishi, with nails and skin being the most affected region (Jaishi et al., 2022). However, in the study by Lone in Kashmir, India, the most common organisms were dermatophytes (61.66%), followed by non-dermatophyte molds (31.66%) and yeasts (6.66%) (Lone et al., 2013). Greater prevalence of dermatophytes as the etiological agents of dermatomycoses was shown by Kaur (Kaur et al., 2007) in 2007, Sayed (El Sayed et al., 2006) in Lebanon, and Aghamirian (Aghamirian et al., 2010) in Iran. Yeasts were the most common agents of dermatomycoses in a Canadian study obtained in 2000 by Gupta (Gupta et al., 2000) and in another Greek study in 2002 performed by Koussidou (Koussidou et al., 2002). Non-dermatophyte dermatomycosis is difficult to diagnose, given that non-dermatophyte molds are common contaminants in the mycology laboratory. However, they are considered as pathogenic when they are positive both in microscopy and in culture or if the same isolate is obtained on consecutive culture. Not finding dermatophytes in culture and histology could serve as additional criteria to help make a diagnosis of non-dermatophyte dermatomycosis. To avoid contamination of the specimens, a proper collection technique and a proper training of the responsible personnel for collection of samples need to be provided. Laboratory biosafety precautions by the laboratory while processing the samples is necessary to avoid the growth of laboratory contaminants. Gupta proposed that at least 3 of the mentioned criteria should be satisfied in order to make a diagnosis of non-dermatophyte onychomycosis (Gupta et al., 2012).

In our study, we have isolated the following non-dermatophyte molds in nail specimens: *Fusarium species* was detected in (18%), followed by *Aspergillus flavus* - 12.5%, *Scopulariopsis* species - 12%, *Aspergillus niger* – 8.6% and *Aspergillus fumigatus* 6.3%. Among the less frequent non-*Aspergillus* molds, we demonstrated *Cladosporium* species (5.5%), *Curvularia* species (4.7%), *Paecilomyces* species (3.9%), *Alternaria* species (3.1%), *Penicillium* species (1.6%), and with one isolate of *Phoma* species, *Scytallidium* and *Mucor* species (0.8%) in our patients' specimens. The prevalence of non-dermatophyte molds isolated from onychomycosis in various parts of the world ranges between 1.49 and 33.5% (Moreno et al., 2010, Bonifaz et al., 2007). This difference may be due to differences in the geographical distribution of non-dermatophyte molds, diagnostic criteria and different methods for diagnosis. In the study by Kaur (Kaur et al., 2007) and Grover (Grover et al., 2003), the commonest isolate was *Aspergillus niger*. In another study from Iran, by Mikaeili and Karimi (Mikaeili et al., 2013), *A.flavus* - 12 (37.5%), *A.niger* - 8 (25.0%), and *A.fumigatus* - 4 (12.5%) were the most prevalent species. Veer (Veer et al., 2007) have also demonstrated presence of non-dermatophyte molds in the nail specimens of their patients. Among these fungi, *Aspergillus* species was the most prevalent species followed by *Scopulariopsis* species (16.66%), *Alternaria* species (16.66%), *Fusarium* and *Curvularia* species (8.3%). Almost all studies from Iran demonstrate that *Aspergillus flavus* was the most common non-dermatophyte mold, except for Khosravi (Khosravi et al., 2001), Bassiri-Jahromi (Bassiri-Jahromi et al., 2009), and Aghamirian (Aghamirian et al., 2009) that isolated *Scopulariopsis brevicaulis, Acremonium* species, and *Aspergillus niger*, respectively.

Yeasts were etiological agents of onychomycoses in our patients in 30% (57/192), with *Candida albicans* being the more frequent isolate (52.6%), followed by non-*albicans Candida* species (47.4%). Gerami shoar (Gerami shoar et al., 2002) also isolated *C.albicans* as the most prevalent species among patients with onychomycosis in Tehran. Soltani (Soltani et al., 2015) reported 56.4% of onychomycosis in Tehran, demonstrating yeasts as the most common pathogens isolated from patients (71.4%), followed by non-dermatophytic molds (17.1%) and dermatophytes (11.5%). Chadeganipour (Chadeganipour et al., 2010) reported 39.8% of the occurrence rate of onychomycosis with *C.albicans still as* the most prevalent yeast (84%). Dermatophytes were agents of onychomycoses in our study in 3.7% (7/192), represented by *Trichophyton* species with 71% (5/7), followed by

Epidermophyton species with 28.6% (2/7). Asadi reported 18.9% of onychomycosis in Kashan, Iran between 2001 and 2003 (Asadi et al., 2009). They showed *Trichophyton violaceum* as the most prevalent species among isolates. In the study that was carried out by Mikaeili (Mikaeili et al., 2013) in the western part of Iran, *C.albicans, T.rubrum* and *A.flavus* were the most prevalent yeast, dermatophyte, and non-dermatophytic mold, respectively.

Data of mycological investigation of skin scrapings in our patients demonstrate presence of non-dermatophyte molds in 41.3% (50/121), yeasts were identified in 32% (39/121), and dermatophytes were etiological agents of skin infections in 26.4% (32/121). The non-dermatophyte molds recovered from skin scrapings were as follow: *Curvularia* species - 20% (10/50), *Aspergillus fumigatus* - 10% (5/50), *Aspergillus niger* - 6% (3/50), *Scopulariopsis* species - 6% (3/50), *Aspergillus* species - 6% (3/50) and *Onychocola* species - 6% (3/50), *Aspergillus flavus* - 4% (2/50), *Fusarium* species - 4% (2/50), and with one isolate of *Cladophialophora* and *Paecilomyces* species - 2% (1/50). The molds could not be identified in 34% of the positive skin scrapings (17/50). The study of Hazarika demonstrate non-dermatophyte molds being the etiological agents of dermatomycoses in 14.51% (Hazarika et al., 2019). A study on superficial mycoses in northeast India by Grover found the non-dermatophyte molds to be 33.01% and yeast to be 28.3% of the fungal isolates, which are comparable to our study (Grover et al., 2003). The commonest isolate among the non-dermatophyte molds was *Fusarium* species, followed by *Aspergillus species*. Glover also detected *Cladosporium* species, *Penicillium* species and *Scopulariopsis* species (Grover et al., 2003).

Among the yeasts as causative agents of skin infections in our patients, non-*albicans Candida* were more common - 54% (21/39), as compared to *Candida albicans*, which were identified in 33% (13/39). Similar data were demonstrated by Costa-Orlandi (Costa-Orlandi et al., 2012) who presented 50 % of positive cultures from dermatology specimens caused by *Candida* species with *Candida parapsilosis* being the most representative (40.24 %), followed by *Candida tropicalis* (20.73%). Subspecies identification of non-*albicans Candida* isolates in our study was not performed due to insufficient resources for automated identification of dermatological isolates. Other, non-*Candida* yeasts recovered from positive samples were *Trichosporon* species -10.3% (4/39), and *Geotrichum* species - 2.6% (1/39). Dermatophytes were etiological agents of skin infections in 26.4% (32/121), represented by *Trichophyton* species with 56.3% (18/32), followed by *Microsporum* species with 40.6% (13/32). *Epidermophyton floccosum* was identified in one specimen (3.1%).

Conclusion

The epidemiology of dermatomycoses is a complex issue that is influenced by a variety of factors. This study provides an overview of the epidemiology of fungal cultures of skin, nail and hair samples in Macedonian patients over a 6-year period. Results from this study revealed that 11-20 years age group had the highest prevalence of dermatomycoses. Furthermore, higher prevalence was registered among male patients (31.3%). The most common etiological agents in the study were non-dermatophyte molds - 56% followed by yeasts in 30% and dermatophytes in 13.6% of all positive specimens. More than 60% percent of the positive findings originated from nail specimens, 38% from skin scrapings and 1.3% were confirmed in hair specimens. The demonstration of non-dermatophyte molds, besides dermatophytes and yeasts, in hair, nail and skin specimens in our study has reemphasized the increasing role of non-dermatophyte molds, previously thought to be common laboratory or environmental contaminants, as causative agents of dermatomycoses, replacing the dermatophytes that have always been considered as the only agents of dermatomycoses.

Our study had some limitations that may affect the accuracy of the results. One limitation is related to sampling method. This study was conducted on 674 specimens from patients with clinically suspected dermatomycoses, who visited dermatology departments over 6 year period. Therefore, the sampling method may not be representative of the broader population. Additionally, this study did not include individuals who may have had dermatomycoses, but did not seek medical advice, which may underestimate the real prevalence of dermatomycoses in Macedonian patients. We were also limited in providing information on clinical details of dermatomycoses, the socioeconomic status or other demographic characteristics, which may be relevant to understanding the distribution and real prevalence of dermatomycoses. Finally, there was an inability of follow-up of patients, as it was difficult to trace the patients.

Monitoring the epidemiology of dermatomycoses is important in identifying likely sources of infections, identifying potential outbreaks, and helping guide empirical treament. Dermatologists' awareness that non-dermatophyte molds sometimes can be contaminants of specimens, along with request for consecutive specimen analysis, can help in determination of the etiological diagnosis of dermatomycoses, leading to successful treatment and prevention of disease recurrence.

References

Adhikari, L., Das Gupta, A., Pal, R., Singh, T.S., 2009. Clinico-etiologic correlates of onychomycosis in Sikkim. Indian J. Pathol. Microbiol. 52(2), 194-197. https://doi.org/10.4103/0377-4929.48915PMID: 19332910.

Aghamirian, M.R., Ghiasian, S.A., 2010. Onychomycosis in Iran: epidemiology, causative agents and clinical features. Nihon Ishinkin Gakkai Zasshi 51(1), 23-29. https://doi.org/10.3314/jjmm.51.23 PMID: 20185868.

Ahuja, S., Malhotra, S., Charoo, H., 2011. Etiological agents of onychomycosis from a tertiary care hospital in central Delhi, India. Indian J. Fundam. Appl. Life Sci. 1(2), 11-14. http://www.cibtech.org/jls.htm

Ameen, M., 2010. Epidemiology of superficial fungal infections. Clin. Dermatol. 28(2), 197-201. https://doi.org/10.1016/j.clindermatol.2009.12.005.

Asadi, M.A., Dehghani, R., Sharif, M.R., 2009. Epidemiologic study of onychomycosis and tinea pedis in Kashan, Iran. Jundishapur J. Microbiol. 2, 61-64.

Bassiri-Jahromi, S., Khaksari, A.A., 2009. Epidemiological survey of dermatophytosis in Tehran, Iran, from 2000 to 2005. Indian J. Dermatol. Venereol. Leprol. 75(2), 142-147. https://doi.org/10.4103/0378-6323.48658.

Bhagra, S., Ganju, S.A., Kanga, A., Sharma, N.L., Guleria, R.C., 2014. Mycological pattern of dermatophytosis in and around Shimla hills. Indian J. Dermatol. 59(3), 268-270. https://doi.org/10.4103/0019-5154.131392

Bonifaz, A., Cruz-Aguilar, P., Ponce, R.M., 2007. Onychomycosis by molds. Report of 78 cases. Eur. J. Dermatol. 17(1), 70-72. https://doi.org/10.1684/ejd.2007.0092

Bongomin, F., Gago, S., Oladele, R.O., Denning, D.W., 2017. Global and Multi-National Prevalence of Fungal Diseases-Estimate Precision. J. Fungi (Basel) 3(4), 57. https://doi.org/10.3390/jof3040057

Brilhante, R.S., Cordeiro, R.A., Medrano, D.J., Rocha, M.F., Monteiro, A.J., Cavalcante, C.S., Meireles, C.E.F., Sidrim, J.J.C., 2005. Onychomycosis in Ceará (Northeast Brazil): epidemiological and laboratory aspects. Mem. Inst. Oswaldo Cruz 100(2), 131-135. https://doi.org/10.1590/s0074-02762005000200005

Chadeganipour, M., Nilipour, S., Ahmadi, G., 2010. Study of onychomycosis in Isfahan, Iran. Mycoses 53(2), 153-157. https://doi.org/10.1111/j.1439-0507.2008.01679.x PMID: 19298358.

Costa-Orlandi, C.B., Magalhães, G.M., Oliveira, M.B., Taylor, E.L., Marques, C.R., de Resende-Stoianoff, M.A., 2012. Prevalence of dermatomycosis in a Brazilian tertiary care hospital. Mycopathologia 174(5-6), 489-497. https://doi.org/10.1007/s11046-012-9576-1

El Sayed, F., Ammoury, A., Haybe, R.F., Dhaybi, R., 2006. Onychomycosis in Lebanon: a mycological survey of 772 patients. Mycoses 49(3), 216-219. https://doi.org/10.1111/j.1439-0507.2006.01224.x

Gamage, H., Sivanesan, P., Hipler, U.C., Elsner, P., Wiegand, C., 2020. Superficial fungal infections in the department of dermatology, University Hospital Jena: A 7-year retrospective study on 4556 samples from 2007 to 2013. Mycoses 63(6), 558-565. https://doi.org/10.1111/myc.13077

Garg, A., Venkatesh, V., Singh, M., Pathak, K.P., Kaushal, G.P., Agrawal, S.K., 2004. Onychomycosis in central India: a clinicoetiologic correlation. Int. J. Dermatol. 43(7), 498-502. https://doi.org/10.1111/j.1365-4632.2004.02125.x

Gerami Shoar, M., Zomorodian, K., Emami, M., Tarazoei, B., Saadat, B., 2002. Study and identification of the etiological agents of onychomycosis in Tehran, capital of Iran. Iran. J. Public Health 31, 100-104.

Grover, S., Roy, P., 2003. Clinico-mycological profile of superficial mycosis in a hospital in North-East India. Med. J. Armed Forces India 59, 114-116. https://doi.org/10.1016/S0377-1237(03)80053-9

Grover, S., 2003. Clinico-mycological evaluation of onychomycosis at Bangalore and Jorhat. Indian J. Dermatol. Venereol. Leprol. 69(4), 284-286.

Gupta, A.K., Jain, H.C., Lynde, C.W., Macdonald, P., Cooper, E.A., Summerbell, R.C., 2000. Prevalence and epidemiology of onychomycosis in patients visiting physicians' offices: a multicenter Canadian survey of 15,000 patients. J. Am. Acad. Dermatol. 43(2 Pt 1), 244-248. https://doi.org/10.1067/mjd.2000.104794

Hazarika, D., Jahan, N., Sharma, A., 2019. Changing Trend of Superficial Mycoses with Increasing Nondermatophyte Mold Infection: A Clinicomycological Study at a Tertiary Referral Center in Assam. Indian J. Dermatol. 64(4), 261-265. https://doi.org/10.4103/ijd.IJD_579_18

Jaishi, V.L., Parajuli, R., Dahal, P., Maharjan, R., 2022. Prevalence and Risk Factors of Superficial Fungal Infection among Patients Attending a Tertiary Care Hospital in Central Nepal. Interdiscip. Perspect. Infect. Dis. 2022, 3088681. https://doi.org/10.1155/2022/3088681

Kaur, R., Panda, P.S., Sardana, K., Khan, S., 2015. Mycological Pattern of Dermatomycoses in a Tertiary Care Hospital. J. Trop. Med. 2015, 157828. https://doi.org/10.1155/2015/157828

Kaur, R., Kashyap, B., Bhalla, P., 2007. A five-year survey of onychomycosis in New Delhi, India: epidemiological and laboratory aspects. Indian J. Dermatol. 52(1), 39-42. https://doi.org/10.4103/0019-5154.31923

Khadka, S., Sherchand, J.B., Pokharel, D.B., Pokhrel, B.M., Mishra, S.K., Dhital, S., Rijal, B., 2016. Clinicomycological Characterization of Superficial Mycoses from a Tertiary Care Hospital in Nepal. Dermatol. Res. Pract. 2016, 9509705. https://doi.org/10.1155/2016/9509705 PMID: 28003819; PMCID: PMC5143727.

Khosravi, A.R., Mansouri, P., 2001. Onychomycosis in Tehran, Iran: prevailing fungi and treatment with itraconazole. Mycopathologia 150(1), 9-13. https://doi.org/10.1023/A:1011028730323.

Koussidou, T., Devliotou-Panagiotidou, D., Karakatsanis, G., Minas, A., Mourellou, O., Samara, K., 2002. Onychomycosis in Northern Greece during 1994-1998. Mycoses 45(1-2), 29-37. PMID: 11856434.

Lakshmanan, A., Ganeshkumar, P., Mohan, S.R., Hemamalini, M., Madhavan, R., 2015. Epidemiological and clinical pattern of dermatomycoses in rural India. Indian J. Med. Microbiol. 33(Suppl), 134-136. https://doi.org/10.4103/0255-0857.150922

Lone, R., Bashir, D., Ahmad, S., Syed, A., Khurshid, S., 2013. A study on clinico-mycological profile, aetiological agents and diagnosis of onychomycosis at a government medical college hospital in Kashmir. J. Clin. Diagn. Res. 7(9), 1983-1985. https://doi.org/10.7860/JCDR/2013/5969.3378

Mecantini, R., Marsella, R., Moretto, D., 1996. Onychomycosis in Rome, Italy. Mycopathologia 136, 25-32.

Mikaeili, A., Karimi, I., 2013. The Incidence of Onychomycosis Infection among Patients Referred to Hospitals in Kermanshah Province, Western Iran. Iran. J. Public Health 42(3), 320-325.

Moreno, G., Arenas, R., 2010. Other fungi causing onychomycosis. Clin. Dermatol. 28(2), 160-163. https://doi.org/10.1016/j.clindermatol.2009.12.009

Oke, O.O., Onayemi, O., Olasode, O.A., Omisore, A.G., Oninla, O.A., 2014. The Prevalence and Pattern of Superficial Fungal Infections among School Children in Ile-Ife, South-Western Nigeria. Dermatol. Res. Pract. 2014, 842917.

https://doi.org/10.1155/2014/842917
Patel, P., Mulla, S., Patel, D., Shrimali, G., 2010. A Study of Superficial Mycosis in South Gujarat Region. Natl. J. Community Med. 1(2), 85-88. https://njcmindia.com/index.php/file/article/view/1996
Powell, J., Porter, E., Field, S., O'Connell, N.H., Carty, K., Dunne, C.P., 2022. Epidemiology of dermatomycoses and onychomycoses in Ireland (2001-2020): A single-institution review. Mycoses 65(7), 770-779. https://doi.org/10.1111/myc.13473
Satpathi, P., Achar, A., Banerjee, D., Maiti, A., Sengupta, M., Mohata, A., 2016. Onychomycosis in Eastern India - study in a peripheral tertiary care centre. J. Pak. Assoc. Dermatol. 23(1), 14-19. https://www.jpad.com.pk/index.php/jpad/article/view/255.
Soltani, M., Khosravi, A.R., Shokri, H., Sharifzadeh, A., Balal, A., 2015. A study of onychomycosis in patients attending a dermatology center in Tehran, Iran. J. Mycol. Med. 25(2), e81-e87. https://doi.org/10.1016/j.mycmed.2015.03.007
Veer, P., Patwardhan, N.S., Damle, A.S., 2007. Study of onychomycosis: prevailing fungi and pattern of infection. Indian J. Med. Microbiol. 25(1), 53-56. https://doi.org/10.4103/0255-0857.31063
Vélez, A., Linares, M.J., Fenández-Roldán, J.C., Casal, M., 1997. Study of onychomycosis in Córdoba, Spain: prevailing fungi and pattern of infection. Mycopathologia 137(1), 1-8. https://doi.org/10.1023/A:1006874303991

Резиме

Миколошки профил на дерматомикозите кај македонските пациенти

Гордана Мирчевска[1*], Јахја Емел Даути[1], Сања Костова-Илиева[1], Надица Крстева[1], Александра Кацарска[2], Марија Костовска-Мицевска[1], Елена Трајковска-Докиќ[1], Зорица Зафировиќ[3]

[1]Институт за микробиологија и паразитологија, Медицински факултет, Универзитет „Свети Кирил и Методиј“, ул. 50та дивизија 6, 1000 Скопје, Република Северна Македонија
[2]Институт за јавно здравје на Република Северна Македонија, ул. 50та дивизија 6, 1000 Скопје, Република Северна Македонија
[3]Универзитетска клиника за дерматологија, Клинички кампус Мајка Тереза, ул. Водњанска 17, 1000 Скопје, Република Северна Македонија

Клучни зборови: дерматомикози, мувли, квасници, дерматофити

Дерматомикозите се меѓу најчестите кожни заболувања кои претставуваат голем јавно здравствен проблем.

Целта на оваа студија беше ретроспективно да се анализира миколошкиот профил на дерматомикозите во период од 6 години (2017-2022). Испитани се примероци од 674 пациенти (384 струганици од нокти, 244 струганици од кожа и 46 влакна) со дерматомикози. Примероците беа евалуирани со конвенционални миколошки методи на Институтот за микробиологија и паразитологија, Скопје.

Четириесет и седум проценти од примероците беа позитивни на културата. Примероците од жени беа позитивни почесто (192/317) отколку кај мажите (125/317). Најчеста возрасна група беше 11-20 години. Најраспространети етиолошки агенси беа недерматофитните мувли-56% (178/317), следено од квасниците со 30% (96/317) и дерматофити во 13,6% (43/317). Речиси 61% од позитивните наоди потекнуваа од струганици од нокти (192/317), 38% струганици од кожа (121/317) и 1,3% кај влакна (4/317). Онихомикозите беа предизвикани од не-дерматофитни мувли во 67% (128/192). Квасниците беа идентификувани во ноктите во 30% (57/192). Дерматофитите беа агенси на онихомикозите во 3,7% (7/192). Инфекциите на кожата биле предизвикани од не-дерматофитни мувли во 41,3% (50/121). Квасници беа идентифицирани од струганици од кожа во 32% од примероците (39/121). Дерматофитите беа агенси на инфекции на кожата во 26,4% (32/121). Само 4 примероци коса беа позитивни за дерматофити.

Нашата студија ја одразува зголемената улога на не-дерматофитните габи како предизвикувачки агенс на дерматомикозите, заменувајќи ги дерматофитите. Свеста на лекарите дека мувлите можат да бидат загадувачи на примероците, заедно со барањата за последователни примероци може да помогне во етиолошката дијагноза на дерматомикозите, што ќе доведе до успешно лекување и спречување на повторување на болеста.