

A Retrospective Study of Dermatomycosis Causative Agents in Vilnius University Hospital Santaros Clinics

Jonas Žvirgždas¹
Silvija Kiverytė^{2,3}
Algimantas Paškevičius^{1,2}
Paulius Jacevičius³

Summary

Introduction. According to the data of Centre for Communicable Diseases and AIDS of Lithuania 15699 cases of dermatophytosis were diagnosed in 2014–2018 year period.

The aim of this study was to perform a retrospective analysis of dermatomycosis cases.

Materials and methods. A retrospective analysis of five-year period was performed at Vilnius University Hospital Santaros Clinics Centre of Laboratory Medicine. There were 3165 positive clinical samples tested. Fungal species were identified by MALDI-TOF method (direct transfer-formic acid preparation and ethanol-formic acid extraction), morphological and microscopic characteristics.

Results. Number of positive dermatomycosis cases overall decreased in 2005–2018 year period. Fungal infections of the skin and its derivatives were more common in women and were caused mainly by yeasts. The most common dermatophyte species identified was *Trichophyton rubrum*, which was more likely to cause infections in men. Female fingernails were more frequently affected. In men lesions of both limbs were more common. Dermatophytes were the most common cause of lesions of the toenails, skin and scalp, while lesions of fingernails and nails of both limbs were more frequently caused by yeasts. The type of fungus depended on the age of the patients, dermatophytes were more common within the age group of up to 12 years old, yeast – within females over 65 years and non-dermatophytes within the 21–49 and 50–64 age groups.

Conclusions. Dermatomycosis was more frequent in female patients. In samples of female patients *Candida* yeasts were more common and females more often had damaged fingernails. The most frequent causative agent was *T. rubrum*, which was more common in male cases. The most resistant to fluconazole was *C. glabrata*, to itraconazole and ketoconazole – *C. albicans*. Ethanol-formic acid extraction method provides better identification results.

Lay summary. As Vilnius University Hospital Santaros Clinics is one of the largest hospitals in Lithuania, the results of the study reflect the epidemiological situation of dermatomycoses in a large part of the country's population.

Keywords: epidemiology, clinical mycology, MALDI-TOF mass spectrometry, *Trichophyton rubrum*, *Candida parapsilosis*.

¹Nature Research Centre, Laboratory of Biodeterioration Research
E. mail: jonas.zvirgzdas@gamtc.lt

²Vilnius University Hospital Santaros Clinics, Centre of Laboratory Medicine
Laboratory of Microbiology

³Vilnius University Faculty of Medicine

1. INTRODUCTION

Superficial fungal infections are widespread all over the world. According to other studies conducted around the world about 20–25% of world's population is affected by these infections, and that is not only a cosmetic problem, but also it can affect patient's life quality and lead to psychological discomfort, social exclusion and discrimination.

The calculated risk to get superficial fungal infection once in a lifetime is about 10–20%. In Europe dermatomycoses account for almost half of all superficial infections, and in the USA ranks second after acne [1]. Effective treatment of these infections can reduce the incidence of disease in the population, the duration of disease in patients, and the chances of transmission and spread of infection.

Millions are spent on treating these infections every year, but people still suffer from superficial fungal infections. Successful treatment of these conditions requires a long-term treatment, which can last up to a year. Even after a long course of treatment, complete recovery or clinical (nail cleansing) and microbiological (negative result of microscopy and microbiological culture) recovery may not be achieved [2].

In recent decades the incidence of dermatophytosis and other fungal infections worldwide has increased, with many cases of recurrent infection and chronic disease.

One of the most common forms of infection is onychomycosis (infection of the nails). This condition has relatively recently been recognized as an infection requiring attention and clinical intervention to cure it. This was probably due to a lack of effective therapy. With the advent of drugs such as terbinafine (1996) and ciclopirox (1999), the focus on the diagnosis and treatment of onychomycosis has begun to increase. Positive changes were noticed during treatment, and mycological recovery and disappearance of cosmetic problems was achieved in many patients. However, even with the advent of new therapies, patients still seek medical attention for problems caused by onychomycosis only when the pain or other symptoms caused by the infection can no longer be ignored. Early onset of the disease is rarely recognized by patients or physicians themselves, and the importance of early treatment is rarely assessed. Very often infections recur and cause a variety of symptoms.

Over the last decade, research into the pathogenesis of onychomycosis has led to a better understanding of potential infectious agents. In 2014, treatment with new surface active drugs was started and attention was again focused on the diagnosis and treatment of onychomycosis and other superficial fungal infections [3].

The prevalence of dermatomycosis, pathogens causing infection and the predominant anatomical localization of infection vary with geographical location and a wide range of environmental and cultural factors. Fungal infectious agents grow best at temperatures between 25 and 28 degrees of Celsius, which is why warm and humid conditions on the surface of the human skin provide excellent conditions for the development of infection. For these reasons, superficial fungal infections are more prevalent in tropical climates and are favored by the use of closed, unbreathable clothing. Likewise, the prevalence of these infections is higher in socio-economically poor communities with high population density and poor hygiene [4].

This review attempts to summarize current epidemiological trends for superficial fungal infections in Vilnius University Hospital Santaros Clinics. Its main focus is on infections of the skin and its adnex caused by dermatophytes, yeasts and non-dermatophytes.

2. MATERIALS AND METHODS

A retrospective analysis of five-year period (2014–2018) was performed at Vilnius University Hospital Santaros Clinics (VUH SC). The investigation was performed at the Laboratory of Microbiology (LM), Centre of Laboratory Medicine (CLM). There were 3165 positive clinical samples analyzed. Sabouroud dextrose agar (Liofilchem, Italy), Corn meal agar

(Liofilchem, Italy) and Dermatophyte test medium agar (Becton Dickinson, USA) mediums were used to isolate infectious agents of superficial mycoses. Fungal species were identified by MALDI-TOF method (Bruker, USA). Morphological and microscopic characteristics were determined following the handbooks [5–6].

During the study period 16149 microbiological cultures and 19286 microscopic examinations were carried out at VUH SC CLM LM. Total of 3165 positive patients' nail, skin, hair, dandruff cultures cases were selected and used for further analysis.

3. RESULTS

3.1. Number of dermatomycosis cases in Lithuania in 2005–2018

Data on dermatomycosis from the Centre for Communicable Diseases and AIDS was analysed. It was observed that the number of positive cases of dermatomycosis decreased from 6624 cases to 2756 cases in the period of 2005–2018 (Fig. 1) [7].

3.2. Number of microbiological cultures and microscopic examinations in 2014–2018 year period

Microscopically positive were 1550 (49%) out of 3165, 907 (28.6%) were microscopically negative and 708 (22.4%) were not microscopically examined.

Analysing the 2014–2018 year data, an increase in numbers of microbiological cultures from 2319 to 4110, and numbers of microscopic examinations from 3163 to 5043, in 2014 and 2018 respectively, was observed (Fig. 2).

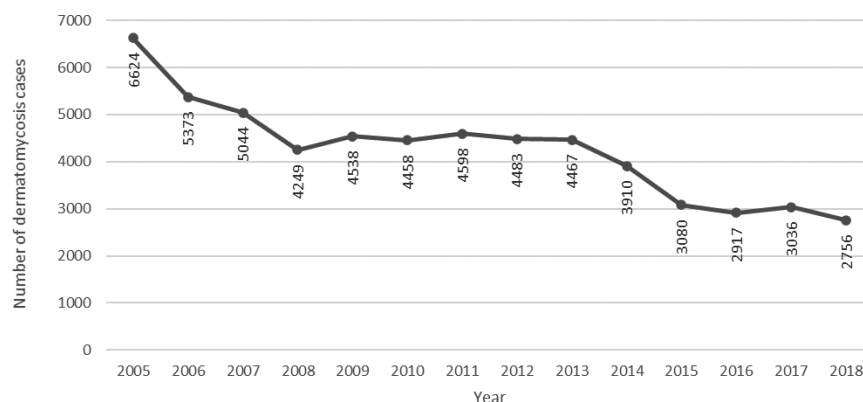


Fig. 1. Number of dermatomycosis cases in Lithuania in 2005–2018 (data obtained from the Centre for Communicable Diseases and AIDS)

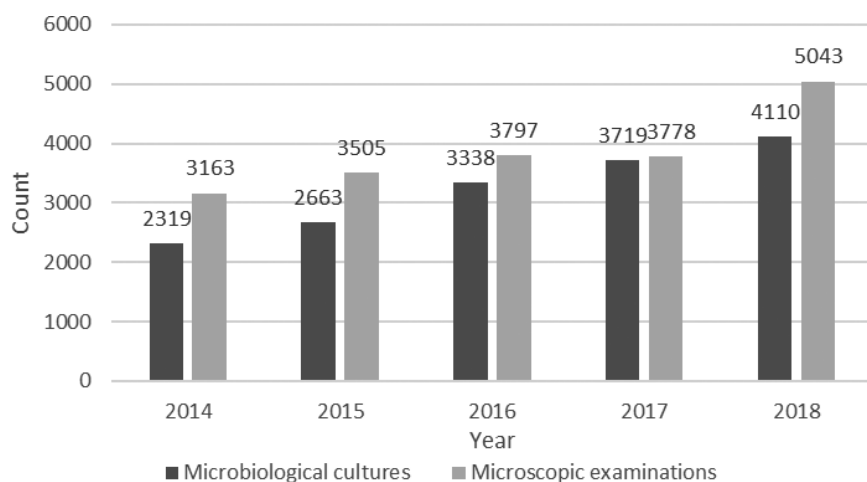


Fig. 2. Number of microbiological cultures and microscopic examinations in 2014–2018 period

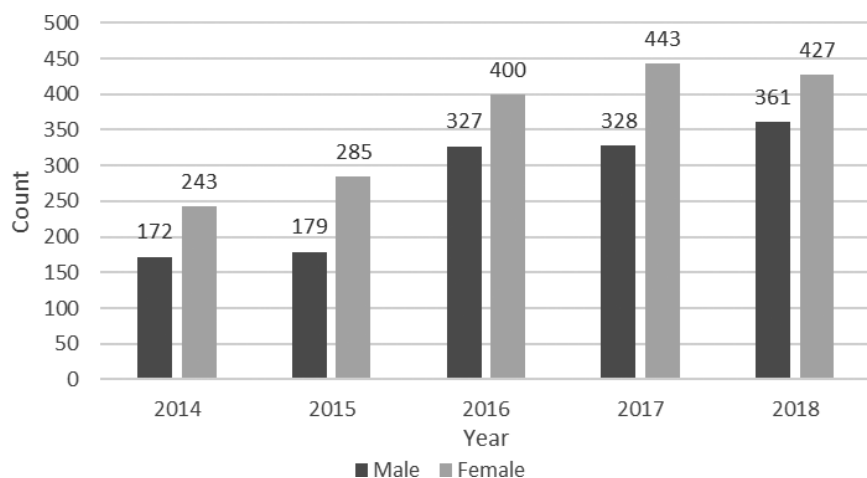


Fig. 3. Gender distribution in different years of the study

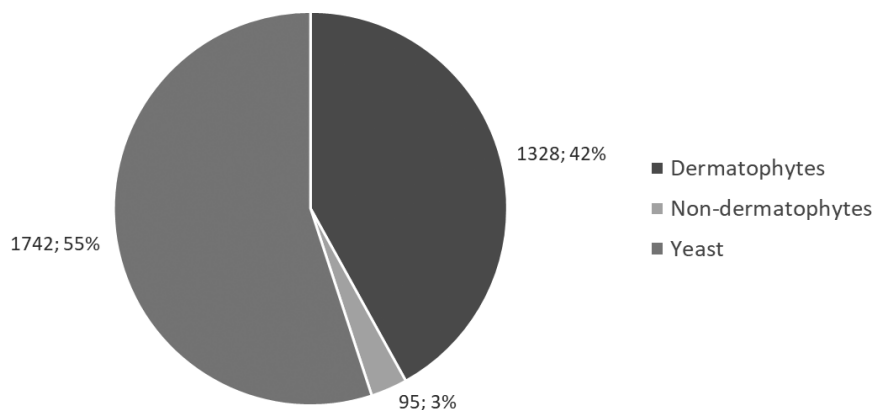


Fig. 4. Distribution of fungal types (abs. v., %)

Table 1. Distribution of fungal types by gender of patients (abs.v. and %)

Type of fungi	Gender		Total
	Male	Female	
Dermatophytes	746	582	1328
	56.20%	43.80%	100.00%
Non-dermatophytes	56	39	95
	58.90%	41.10%	100.00%
Yeasts	565	1177	1742
	32.40%	67.60%	100.00%
Total	1367	1798	3165
	43.20%	56.80%	100.00%

3.3. Gender and age distribution

Analysis revealed that male accounted 43.2% (1367) and female – 56.8% (1798) of the cases. The mean age of the patients was 49.2 (± 17.5) years, with a minimum age of 1 year and a maximum of 91 years. The mean age of men was 48.2 (± 17.6) years and that of women 50 years (± 17.4). Throughout the study, the number cases was higher in women than in men (Fig. 3).

3.4. Distribution of fungal types

From all 3165 positive samples yeasts constituted the major part of the fungi detected (1740, 55%) (Fig. 4).

3.5. Distribution of fungal types by gender of patients

Statistically significant differences were found between the sex of the patients and the type of fungi grown in microbiological culture. Dermatophytes (746; 56.2%) and non-dermatophytes (56; 58.9%) were more likely to cause infections in men, and yeast (1177; 67.6%) in women ($p < 0.05$) (Table 1).

3.6. Distribution of fungal species

A total of 57 different fungal species were identified over the period of 2014–2018, the composition which is shown in Table 2. The most common fungal species was *Trichophyton rubrum* (1226, 38.7%), followed by *Candida* spp. (671, 21.2%), *Candida parapsilosis* (481, 15.2%), *C. albicans* (332, 10.5%), *C. tropicalis* (89, 2.8%), and *Microsporum canis* (42, 1.3%) were less frequent.

3.7. Distribution of fungal species by gender of patients

Of the most commonly fungal species grown in microbiological culture, *T. rubrum* was found to be statistically significantly more common in male cases (694, 50.8%) and *Candida* spp. (477, 26.5%), *C. parapsilosis* (304, 16.9%), *C. albicans* (266, 14.8%), *C. tropicalis* (48, 2.7%) – in female cases ($p < 0.05$) (Table 3).

Table 2. Distribution of fungal species (abs.v. and %)

Fungal species	Number of microbiological cultures (abs. v.)	Number of microbiological cultures (%)
<i>Trichophyton rubrum</i>	1226	38.74
<i>Candida spp.</i>	671	21.20
<i>Candida parapsilosis</i>	481	15.20
<i>Candida albicans</i>	332	10.49
<i>Candida tropicalis</i>	89	2.81
<i>Microsporum canis</i>	42	1.33
<i>Candida glabrata</i>	34	1.07
<i>Rhodotorula mucilaginosa</i>	33	1.04
<i>Trichophyton spp.</i>	33	1.04
<i>Pichia kudriavzevii</i>	29	0.92
<i>Aspergillus niger</i>	23	0.73
<i>Candida guilliermondii</i>	19	0.60
<i>Scopulariopsis brevicaulis</i>	19	0.60
<i>Aspergillus fumigatus</i>	15	0.47
<i>Candida lusitanae</i>	13	0.41
<i>Trichophyton interdigitale</i>	13	0.41
<i>Candida zeilanoide</i>	9	0.28
<i>Paecilomyces lilacinus</i>	8	0.25
<i>Aspergillus flavus</i>	7	0.22
<i>Aspergillus versicolor</i>	7	0.22
<i>Trichophyton mentagrophytes</i>	6	0.19
<i>Penicillium spp.</i>	5	0.16
<i>Rhodotorula spp.</i>	5	0.16
<i>Trichophyton tonsurans</i>	5	0.16
<i>Aspergillus spp.</i>	4	0.13
<i>Candida metapsilosis</i>	3	0.09
<i>Trichosporon mucoides</i>	3	0.09
<i>Candida inconspicua</i>	2	0.06
<i>Candida pararugosa</i>	2	0.06
<i>Debaryomyces hansenii</i>	2	0.06
<i>Microsporum spp.</i>	2	0.06
<i>Yarrowia lipolytica</i>	2	0.06
<i>Aspergillus candidus</i>	1	0.03
<i>Aspergillus sydowii</i>	1	0.03
<i>Aspergillus terreus</i>	1	0.03
<i>Candida allociferri</i>	1	0.03
<i>Candida boidinii</i>	1	0.03
<i>Candida catenulata</i>	1	0.03
<i>Candida duobushaemulonii</i>	1	0.03
<i>Candida intermedia</i>	1	0.03
<i>Candida ortopsilosis</i>	1	0.03
<i>Candida saitoana</i>	1	0.03
<i>Candida sphaerica</i>	1	0.03
<i>Cladosporium spp.</i>	1	0.03
<i>Fusarium oxysporum</i>	1	0.03
<i>Fusarium solani</i>	1	0.03
<i>Hanseniaspora uvarum</i>	1	0.03
<i>Lodderomyces elongisporus</i>	1	0.03
<i>Metschnikowia pulcherrima</i>	1	0.03
<i>Scopulariopsis spp.</i>	1	0.03
<i>Trichophyton violaceum</i>	1	0.03
<i>Torulaspora delbrueckii</i>	1	0.03
<i>Wickerhamomyces anomalus</i>	1	0.03
Total	3165	100.00

3.8. Distribution of fungal types by age groups

There was a relationship between patient age groups and the type of fungi grown in the microbiological culture. Dermatophytes species were more common within the age group of up to 12 years ($p < 0.05$), yeast species in the age group over 65 years ($p < 0.05$), and non-dermatophyte species in age groups of 21–49 years and 50–64 years ($p < 0.05$) (Table 4).

3.9. Distribution of fungal species according to the localization of the lesion

There was also a relationship between the fungal species and the localization of the lesion. Fungi of the genus *Candida* were more likely to cause fingernail lesions (*C. albicans* – 197, 31.7%, *C. parapsilosis* – 124, 19.9%, unspecified *Candida spp.* – 235, 37.8%), *Trichophyton* – toenail lesions (1135, 49.8%), and other fungal species (35, 42.7%) mostly caused scalp lesions. Skin lesions of various localities (39, 48.1%) and lesions of nails of both limbs (21, 34.4%) were most frequently caused by fungi of the genus *Trichophyton* ($p < 0.05$) (Table 5).

3.10. Distribution of lesion sites by gender of patients

Statistically significant differences were found between male and female lesion localization. Female fingernails were more frequently affected than men fingernails (509, 81.8% vs. 113, 18.2%). Also, males were more likely to have lesions on both limbs (34, 55.7%). The frequency of lesions of toenails, skin and scalp was similar for both genders ($p < 0.05$) (Table 6).

3.11. Distribution of lesion sites by patient age groups

Differences were found between patient age and localization of the lesion site. Toenails were most affected in the 50–64 age group, hand nails in the 21–49 age group, both limbs over 65, hairy scalp and body skin up to 12 years age group. However, no statistical significance was found for these results ($p > 0.05$) (Table 7).

Table 3. Distribution of fungal species by gender of patients (abs.v. and %)

Fungal species	Gender		Total
	Male	Female	
<i>Trichophyton rubrum</i>	694	532	1226
	50.80%	29.60%	38.70%
<i>Candida spp.</i>	233	477	710
	17.00%	26.50%	22.40%
<i>Candida parapsilosis</i>	177	304	481
	12.90%	16.90%	15.20%
<i>Candida albicans</i>	66	266	332
	4.80%	14.80%	10.50%
<i>Candida tropicalis</i>	41	48	89
	3.00%	2.70%	2.80%
<i>Trichophyton spp.</i>	29	29	58
	2.10%	1.60%	1.80%
<i>Microsporum canis</i>	23	21	44
	1.70%	1.20%	1.40%
<i>Scopulariopsis brevicaulis</i>	16	4	20
	1.20%	0.20%	0.60%
<i>Rhodotorula mucilaginosa</i>	15	23	38
	1.10%	1.30%	1.20%
<i>Aspergillus spp.</i>	14	7	21
	1.00%	0.40%	0.70%
<i>Pichia kudriavzevii</i>	12	17	29
	0.90%	0.90%	0.90%
<i>Aspergillus niger</i>	11	12	23
	0.80%	0.70%	0.70%
<i>Candida glabrata</i>	10	24	34
	0.70%	1.30%	1.10%
<i>Aspergillus fumigatus</i>	8	7	15
	0.60%	0.40%	0.50%
<i>Candida guilliermondii</i>	7	12	19
	0.50%	0.70%	0.60%
Other fungi*	11	15	26
	0.80%	0.80%	0.80%
Total	1367	1798	3165
	100.00%	100.00%	100,00%

**Cladosporium spp.*, *Debaryomyces hansenii*, *Fusarium oxysporum*, *Fusarium solani*, *Yarrowia lipolytica*, *Paecilomyces lilacinus*, *Penicillium spp.*, *Trichosporon mucoides*, *Torulaspora delbrueckii*, *Wickerhamomyces anomalus*.

Table 4. Distribution of fungal types by age groups (abs.v. and %)

Types of fungi	Age groups (years)					Total
	Up to 12	13–20	21–49	50–64	Over 65	
Dermatophytes	50	39	620	386	232	1327
	64.10%	45.30%	44.60%	40.60%	35.30%	42.00%
Non-dermatophytes	1	0	47	32	15	95
	1.30%	0.00%	3.40%	3.40%	2.30%	3.00%
Yeasts	27	47	723	533	410	1740
	34.60%	54.70%	52.00%	56.00%	62.40%	55.00%
Total	78	86	1390	951	657	3162
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

3.12. Distribution of fungal types according to the location of lesion sites

A statistically significant relationship was observed between fungal type and lesion localization. Lesions of the toenails (1137, 49.9%), body skin (47, 58.0%) and scalp (62, 75.6%) were mostly caused by dermatophytes ($p < 0.05$). On the contrary, lesions of fingernails (566, 91.0%) and nails of both limbs (37, 60.7%) mostly were caused by yeasts ($p < 0.05$) (Table 8).

3.13. Distribution of cultivated fungal species by patient age groups

A statistically significant relationship was found between the age groups of the subjects and the fungal species. *Candida albicans* was most prevalent in the microbiological cultures of patients under the age of 12 (10, 12.8%), *Candida parapsilosis* in the group above the age of 65 (117, 17.8%), *Candida spp.* fungi in the age group of 13–20 years (195, 25.1%), *Trichophyton spp.* fungi in the age group of 21–49 years, *Aspergillus spp.* fungi – in the age group of 50–64 years, other fungi – in the age group up to 12 years ($p < 0.05$) (Table 9).

3.14. Distribution of cultivated fungal species by gender of patients

Statistically significant differences were observed between species distribution and gender. *C. albicans* (266, 14.8%), *C. parapsilosis* (304, 16.9%), unidentified *Candida spp.* fungi (477, 26.5%) were more common in the females and *T. rubrum* (694, 50.8%) in males (Table 10).

4. DISCUSSION

Fungal infections remain a public health concern worldwide [4]. Literature review shows that fungal infections of the skin and its derivatives account for between 2% and 14% of the world's population, but real numbers are likely to be significantly higher [8].

In this study, yeast species (55.04%) accounted for the largest proportion of all fungi, with a slightly lower proportion of dermatophytes (41.96%) and non-dermatophytes (3.00%). Similar results of distribution of fungal types in Lithuania are described by Paškevičius A. and Švedienė J. (2013) (Fig. 5).

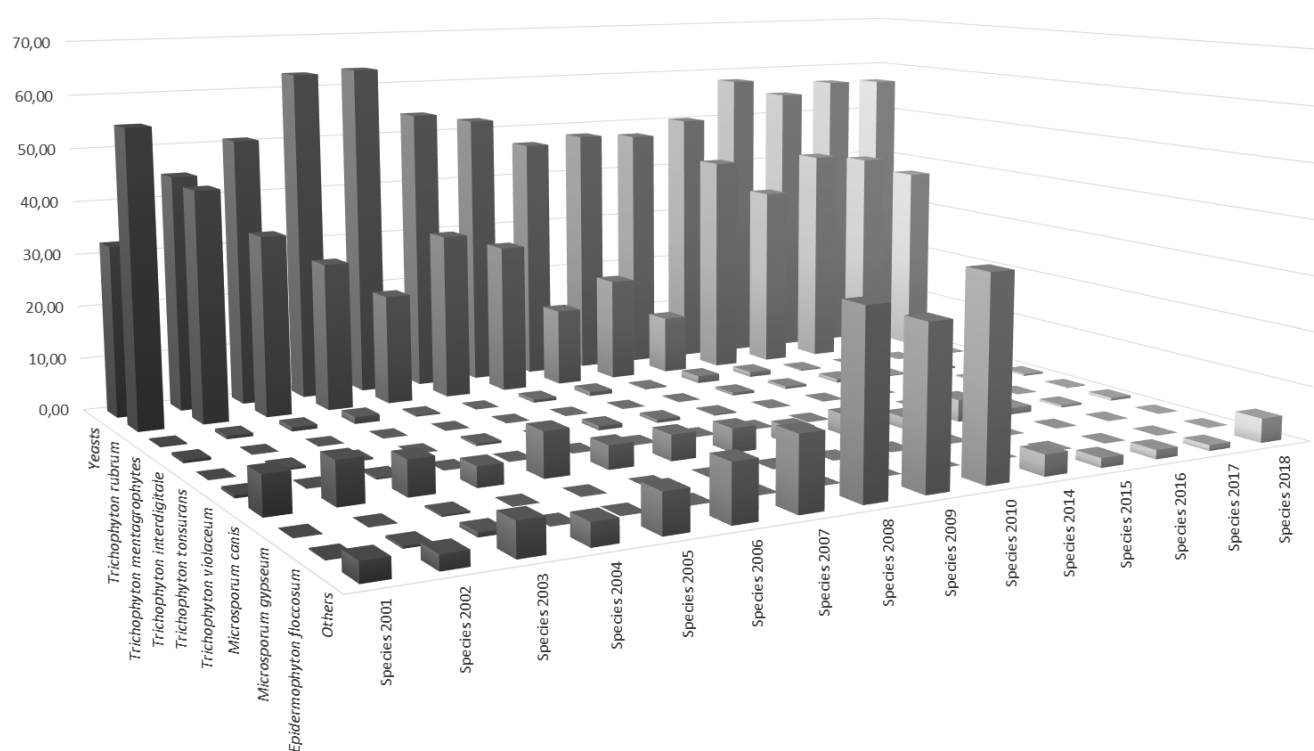


Fig. 5. Distribution of dermatomycosis causative agents in 2001–2018 in Lithuania (%) [9]

Table 5. Distribution of fungal species according to the localization of the lesion (abs.v. and %)

Fungal species	Lesion location					Total
	Toenails	Fingernails	Nails of both limbs	Skin	Scalp	
<i>Trichophyton spp.</i>	1135	43	21	39	28	1266
	49.80%	6.90%	34.40%	48.10%	34.10%	40.50%
<i>Candida spp.</i>	566	235	17	13	11	842
	24.80%	37.80%	27.90%	16.00%	13.40%	26.90%
<i>Candida parapsilosis</i>	335	124	10	4	2	475
	14.70%	19.90%	16.40%	4.90%	2.40%	15.20%
<i>Candida albicans</i>	104	197	7	13	6	327
	4.60%	31.70%	11.50%	16.00%	7.30%	10.50%
<i>Aspergillus spp.</i>	47	9	2	1	0	59
	2.10%	1.40%	3.30%	1.20%	0.00%	1.90%
Other species*	92	14	4	11	35	156
	4.00%	2.30%	6.60%	13.60%	42.70%	5.00%
Total	2279	622	61	81	82	3125
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

**Cladosporium spp.*, *Debaryomyces hansenii*, *Fusarium oxysporum*, *F. solani*, *Yarrowia lipolytica*, *Microsporum canis*, *Paecilomyces lilacinus*, *Penicillium spp.*, *Pichia kudriavzevii*, *Rhodotorula mucilaginosa*, *Scopulariopsis brevicaulis*, *Trichosporon mucoides*, *Torulaspora delbrueckii*, *Wickerhamomyces anomalus*.

Table 6. Distribution of lesion sites by gender of patients (abs.v. and %)

Gender	Lesion location					Total
	Toenails	Fingernails	Nails of both limbs	Skin	Scalp	
Male	1119	113	34	40	42	1348
	49.10%	18.20%	55.70%	49.40%	51.20%	43.10%
Female	1160	509	27	41	40	1777
	50.90%	81.80%	44.30%	5.60%	48.80%	56.90%
Total	2279	622	61	81	82	3125
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Candida spp. (95.47%) created the major part of the cultivated yeasts, while the minority belonged to different genera. The same situation is reflected in the literature [9].

Fungi of the genus *Candida* usually cause skin and nail infections. Also, these fungi are part of the temporary or commensal microbiota of certain areas of the human body. These are opportunistic pathogens that become pathogenic only to certain groups of patients with systemic or localized disease forms. *Candida* and other yeasts may also be saprophytes of the nail tissue, which directly damage the nail plate when the protective mechanisms of the host are impaired, for example in the case of immunosuppression [9]. Non-dermatophytic species are generally considered to be secondary pathogens that cause infections of already damaged nails, but these fungi may also be primary infectious agents that cause a small proportion of these infections. The worldwide prevalence of non-dermatophyte cases is 1.5–17.6% [9–11]. The number of non-dermatophyte species found in this study is in agreement with the literature and is 3.0%.

An analysis of cultivated fungal species showed that *T. rubrum* was the most common infectious agent (38.74%). This is confirmed by the analysed literature.

Trichophyton rubrum is a pathogen that is prevalent worldwide and causes various types of tinea. This fungus can damage the nails of the feet

Table 7. Distribution of lesion sites by patient age groups (abs.v. and %)

Lesion location	Age groups					Total
	Up to 12	13–20	21–49	50–64	Over 65	
Toenails	31	59	998	705	483	2276
	40.30%	69.40%	73.20%	74.50%	74.20%	72.90%
Scalp	26	7	30	8	11	82
	33.80%	8.20%	2.20%	0.80%	1.70%	2.60%
Fingernails	13	17	284	193	115	622
	16.90%	20.00%	20.80%	20.40%	17.70%	19.90%
Skin	6	2	31	22	20	81
	7.80%	2.40%	2.30%	2.30%	3.10%	2.60%
Nails of both limbs	1	0	20	18	22	61
	1.30%	0.00%	1.50%	1.90%	3.40%	2.00%
Total	77	85	1363	946	651	3122
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 8. Distribution of fungal types according to the location of lesion sites (abs.v. and %)

Types of fungi	Lesion location					Total
	Toenails	Fingernails	Nails of both limbs	Skin	Scalp	
Dermatophytes	1137	43	21	47	62	1310
	49.90%	6.90%	34.40%	58.00%	75.60%	41.90%
Non-dermatophytes	78	13	3	1	0	95
	3.40%	2.10%	4.90%	1.20%	0.00%	3.00%
Yeasts	1064	566	37	33	20	1720
	46.70%	91.00%	60.70%	40.70%	24.40%	55.00%
Total	2279	622	61	81	82	3125
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 9. Distribution of cultivated fungal species by patient age groups (abs.v. and %)

Fungal species	Age groups (years)					Total
	Up to 12	13–20	21–49	50–64	Over 65	
<i>Trichophyton spp.</i>	26	35	607	386	229	1283
	33.30%	40.70%	43.70%	40.60%	34.90%	40.60%
<i>Candida albicans</i>	10	8	150	93	71	332
	12.80%	9.30%	10.80%	9.80%	10.80%	10.50%
<i>Candida spp.</i>	8	27	337	277	202	851
	10.30%	31.40%	24.20%	29.10%	30.70%	26.90%
<i>Candida parapsilosis</i>	5	11	206	141	117	480
	6.40%	12.80%	14.80%	14.80%	17.80%	15.20%
<i>Aspergillus spp.</i>	1	0	25	23	10	59
	1.30%	0.00%	1.80%	2.40%	1.50%	1.90%
Other fungi*	28	5	65	31	28	157
	35.90%	5.80%	4.70%	3.30%	4.30%	5.00%
Total	78	86	1390	951	657	3162
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

**Cladosporium spp.*, *Debaromyces hansenii*, *Fusarium oxysporum*, *Fusarium solani*, *Yarrowia lipolytica*, *Microsporum canis*, *Paecilomyces lilacinus*, *Penicillium spp.*, *Pichia kudriavzevii*, *Rhodotorula mucilaginosa*, *Scopulariopsis brevicaulis*, *Trichosporon mucoides*, *Torulaspora delbrueckii*, *Wickerhamomyces anomalus*.

and hands, the skin of the toes, the feet or any other part of the body [10]. The obtained data correspond to the situation in Lithuania, and *T. rubrum* is mentioned in the literature as the most common cause of infections of the skin and its derivatives [9]. The analy-

sis of the results of the study showed that statistically significantly more microbiological cultures were performed on females, suggesting that fungal infections of the skin and its derivatives were more frequent in females. This situation is described in

quite different ways in the literature, and the prevalence of infection varies according to the gender of patients in different regions of the world, and the determinants are not yet fully understood [10]. It is believed that this could be due to the increased use of manicure salon services. Manicures and other procedures always are potential sources of infection if the tools used are not properly disinfected or sterilized. This problem is more acute in developing countries, where there is a lack of knowledge and understanding of proper hygiene. Also, various nail care procedures can be vulnerable and even minor nail damage can lead to the development of infection [1, 4, 10, 12–16].

Analysis of different patient age groups and infection-causing fungal types revealed that dermatophyte species were more common within the age group of up to 12 years ($p < 0.05$), yeast species within the age group over 65 years ($p < 0.05$), and non-dermatophyte species within age groups of 21–49 years and 50–64 years ($p < 0.05$) (Table 4). The findings are similar to the most common patient age groups reported in the literature. Fungal infection is most common in patients aged 10 to 20, 20 to 39 years or elderly (aged 60 and over) [17–18].

The most common localization of the lesion site was toenails (72.9%), the second most frequent was hand nails (19.9%), and the third was the nails of both limbs (1.9%). In patients of both genders, the lesions of toenails were similar in frequency. The lesions of hand nails were more common in females. The lesions of both limb nails were more common in men cases.

Differences in lesion localization across age groups were observed. Foot nails were most frequently affected in the 51 to 62 age group, hand nails and scalp in the 1 to 36 age group, both limbs and skin in the 63 to 91 age group.

Dermatophytes (49.9%) were the most common causative agents of foot, skin and scalp lesions, and yeasts (91.0% and 60.7%, respectively) of the hand nails and nails of both limbs. The findings are consistent with those reported in the literature, with same distribution of lesion sites, most affected age groups and fungal genus [4, 10, 12, 13, 19].

5. CONCLUSIONS

Number of positive dermatomycosis cases overall decreased in 2005–2018 year period in Lithuania. We analysed 3165 selected cases of dermatomycosis (nail, skin, hair and dandruff samples) positive in microbiological culture and

Table 10. Distribution of cultivated fungal species by gender of patients (abs.v. and %)

Fungal species	Gender		Total
	Male	Female	
<i>Trichophyton rubrum</i>	694 50.80%	532 29.60%	1226 38.70%
<i>Candida spp.</i>	233 17.00%	477 26.50%	710 22.40%
<i>Candida parapsilosis</i>	177 12.90%	304 16.90%	481 15.20%
<i>Candida albicans</i>	66 4.80%	266 14.80%	332 10.50%
<i>Candida tropicalis</i>	41 3.00%	48 2.70%	89 2.80%
<i>Trichophyton spp.</i>	29 2.10%	29 1.60%	58 1.80%
<i>Microsporum canis</i>	23 1.70%	21 1.20%	44 1.40%
<i>Scopulariopsis brevicaulis</i>	16 1.20%	4 0.20%	20 0.60%
<i>Rhodotorula mucilaginosa</i>	15 1.10%	23 1.30%	38 1.20%
<i>Aspergillus spp.</i>	14 1.00%	7 0.40%	21 0.70%
<i>Pichia kudriavzevii</i>	12 0.90%	17 0.90%	29 0.90%
<i>Aspergillus niger</i>	11 0.80%	12 0.70%	23 0.70%
<i>Candida glabrata</i>	10 0.70%	24 1.30%	34 1.10%
<i>Aspergillus fumigatus</i>	8 0.60%	7 0.40%	15 0.50%
<i>Candida guilliermondii</i>	7 0.50%	12 0.70%	19 0.60%
Other fungi*	11 0.80%	15 0.80%	26 0.80%
Total	1367 100.00%	1798 100.00%	3165 100.00%

**Cladosporium spp.*, *Debaromyces hansenii*, *Fusarium oxysporum*, *Fusarium solani*, *Yarrowia lipolytica*, *Paecilomyces lilacinus*, *Penicillium spp.*, *Trichosporon mucoides*, *Torulaspora delbrueckii*, *Wickerhamomyces anomalus*.

carried out in VUH SK. We found that fungal infections of the skin and its derivatives were more common in women. The most common infectious agents in women were yeasts and dermatophytes in men. The most common type of fungus were yeasts, while the most common species identified was *Trichophyton rubrum*, which is more likely to cause infections in men. Female fingernails were more frequently affected than men. In men lesions of both limbs were more common. Dermatophytes were the most common cause of lesions of the toenails, skin and scalp, while lesions of fingernails and nails of both limbs were more frequently caused by yeasts. The type of fungus depended on the age of the patients, dermato-

phytes were more common within the age group of up to 12 years old, yeasts – within females over 65 years and non-dermatophytes within the 21–49- and 50–64-year age groups. Toenail lesions were more common in the age group over 65 years, lesions of fingernails in the age group of 21–49 years, lesions of both limbs in the age group over 65 years, lesions of scalp and skin in the age group up to 12 years.

Conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest. ♦

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Santrauka

RETROSPETYVUSIS DERMATOMIKOZĖS SUKĖLĖJŲ TYRIMAS VILNIAUS UNIVERSITETO LIGONINĖJE SANTAROS KLINIKOSE

Jonas Žvirgždas, Silvija Kiverytė, Algimantas Paškevičius, Paulius Jacevičius

Įvadas. Lietuvos užkrečiamųjų ligų ir AIDS centro duomenimis, 2014–2018 metų laikotarpiu buvo diagnozuota 15 699 dermatofitozės atvejai.

Šio tyrimo tikslas – atlikti retrospektyviąją dermatomikozės atvejų analizę.

Tyrimo medžiaga ir metodai.

Vilniaus universiteto ligoninės Santaros klinikų Laboratorinės medicinos centre buvo atlikta retrospektyvioji penkerių metų laikotarpio analizė. Buvo ištirta 3 165 teigiami klinikiniai ėminiai. Grybų rūšys buvo identifikuotos MALDI-TOF metodu (tiesioginės ekstrakcijos skruzdžių rūgštimi bei etanolio ir skruzdžių rūgšties ekstrakcijos būdais) bei remiantis makromorfologinėmis ir mikromorfologinėmis savybėmis.

Rezultatai. Teigiamų dermatomikozės atvejų skaičius 2005–2018 m. laikotarpiu sumažėjo. Odos ir jos darinių grybinės infekcijos buvo dažnesnės moterims, jas daugiausia sukėlė mieliagrybiai. Dažniausiai nustatyta dermatofitų rūšis buvo *Trichophyton rubrum*, kuri dažniau sukėlė infekciją vyrams. Moterų nagai buvo paveikti dažniau. Vyrams abiejų galūnių pažeidimai buvo dažnesni. Dermatofitai buvo dažniausia nagų, kūno ir galvos odos pažeidimų priežastis, o abiejų galūnių nagų ir rankų nagų pažeidimus dažniau sukėlė mieliagrybiai. Grybo tipas priklausė nuo pacientų amžiaus: dermatofitai buvo dažnesni iki 12 metų amžiaus grupėje, mieliagrybiai – vyresnėms nei 65 metų moterims, o ne dermatofitai – 21–49 ir 50–64 metų amžiaus grupių tiriamiesiems.

Išvados. Dermatomikozė buvo dažnesnė moterims. Pacienčių moterų ėminiuose *Candida* genties mielės buvo dažnesnės, taip pat dažnesni buvo ir rankų nagų pažeidimai. Dažniausiai aptiktas sukėlėjas buvo *T. rubrum* ir jis buvo dažnesnis vyrams.

Reikšminiai žodžiai: epidemiologija, klinikinė mikologija, MALDI-TOF masių spektrometrija, *Trichophyton rubrum*, *Candida parapsilosis*.

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