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Distribution and Species Composition of Causative Agents of Dermatophytoses in Lithuania

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SUMMARY The aim of the investigation was to determine diversity of the causative agents of dermatophytoses and characterize the epidemiological situation in Lithuania in 2001-2010. During this period, dermatophytes showed a tendency to decline. The following dermatophytes were isolated: *Trichophyton (T.)* Malamsten, *Microsporum (M.)* Gruby and *Epidermophyton* E. Lang. The number of nondermatophytes increased. At the beginning of the investigation, nondermatophytes accounted for 3.4%, whereas at the end their number grew up to 35.9%. Among the agents of dermatomycosis, the incidence of yeasts was observed to have a growing tendency. Among dermatophytes, *T. rubrum* was the most common pathogen, which in 2001 amounted to 55.7% and in 2010 to only 11.0%. Among the *Microsporum* species, *M. canis* and *M. gypseum* were detected. A small number of *Epidermophyton* species were observed in 2001-2003, which accounted for 0.2%-0.8% of all isolates. Tinea unguium (75.5%) was the most common type of dermatophytosis, followed by tinea capitis (11.7%), tinea corporis (9.2%) and tinea pedis (1.2%). In 2001-2010, dermatophytes showed a decreasing tendency, whereas the incidence of *Candida* yeasts and other causative agents of dermatomycosis greatly increased.

KEY WORDS: dermatophytes, *Trichophyton, Microsporum, Epidermophyton*, distribution

INTRODUCTION

Dermatophytosis is a type of dermatomycosis and a worldwide common skin disease caused by microscopic fungi dermatophytes belonging to the three genera: *Trichophyton*, *Microsporum* and *Epidermophyton*. Dermatophytes are able to infect the hair, nails and skin and are divided according to the source of infection into anthropophilic, zoophilic and geophilic species. It is believed that the causative agents of dermatophytoses have affected 20%-25% of the world population and it seems that their incidence has a tendency to grow (1,2).

The endogenous and exogenous factors are very important for the prevalence of dermatophytes. Exogenous factors include geographic region, natural diseases and infection source, type of occupation, and biologic peculiarities of the fungus. The incidence of dermatophytes is also increased by endogenous factors, such as a weakened immune system of the body, impaired metabolism, chronic diseases, physiologic alterations, intensive antibiotic therapy, insufficient nutrition, and many other factors that emaciate the body (3-5).

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The main causative agent of dermatophytosis is the anthropophilic fungus *Trichophyton (T.) rubrum*. This dermatophyte, as well as *T. mentagrophytes* and *Epidermophyton floccosum,* are widely distributed in economically underdeveloped and developing countries (6-8). From the geographic viewpoint, other species of *Trichophyton* are less common and prevail in certain regions, e.g., *T. schoenleinii* in Eurasia and Africa continents, *T. soudanense* in Africa, *T. violaceum* in Africa, Asia and Europe, and *T. concentricum* on Pacific Islands, in the Far East and India (9-11).

Microsporum (M.) canis is a dominant dermatophyte in Central and South Europe, although it is also found on other continents (12). *M. audouinii* prevails in Africa, particularly in the northern and southern parts; furthermore, this fungus has been spreading into Europe and North America (13-15).

There are few data on the causative agents of dermatophytosis in Lithuania (16). Some agents of dermatophytosis are typical of certain geographic zones and are not recorded in our country. Nevertheless, it should be borne in mind that travelling of Lithuanian residents and growing international migration will lead to the emergence of new, alien to our country, causative agents of dermatophytosis.

The main aim of the investigation was to determine diversity of the causative agents of dermatophytosis and characterize the epidemiological situation in Lithuania in 2001-2010.

MATERIALS AND METHODS

The study included 9135 outpatients and inpatients with suspected fungal infections treated at the Centre of Dermatovenereology, Vilnius University Hospital Santariškių Clinics (VUH SC) from 2001 to 2010. The investigation was performed at the Laboratory of Microbiology, Centre of Laboratory Medicine, VUH SC. A total of 4580 causative agents of dermatomycosis were isolated during the study period.

Accuracy of the methods and the quality of work were ensured by the following factors: proper sampling, microscopic detection of fungus in tested material, isolation of pure culture and its identification, as well as precise implementation of requirements for reagents and preparation of media.

Primary samples were obtained from untreated lesions. Prior to sampling, the skin or nails were cleaned with 70% ethanol and pathologic material was examined immediately upon sampling. To cultivate the pathogenic fungi, standard media such as Sabouraud agar and Corn Meal Agar (Oxoid, England) supplemented with antibiotics were used. The pathologic material was plated on the agar with a microbiological needle at 2-4 points at a distance of 1-2 cm. The plates were cultivated in an incubator for 14-30 days at a temperature of 28±2 ºC.

Identification of dermatophytes was performed following the handbooks (17,18).

The data obtained were processed using Microsoft Excel XP (mean, standard deviation).

RESULTS

In this study, 9135 patients were investigated for dermatomycoses and 4580 cases were positive. The results showed that 35.6% to 67.8% of causative agents of dermatomycoses, isolated from patients, were able to grow on the media (Table 1). During ten years, the dermatophytes showed a tendency to decline. In 2001, dermatophytes accounted for 64.2% and in 2011 for only 16.7% of all isolates. On the contrary, the number of nondermatophytes increased from 3.4% at the beginning to 35.9% at the end of the investigation. Additionally, a growing tendency was also observed for the yeasts causing dermatomycoses. These fungi accounted for 32.4% of all isolates at the beginning and for 47.4% at the end of the investigation (Table 1).

During the study period, dermatophytes belonging to the *Trichophyton*, *Microsporum* and *Epidermophyton* were isolated. The results showed a decreasing tendency for all dermatophytes. *Trichophyton* species accounted for even 56.9% in 2001 and for only 13% in 2010; meanwhile, the fungi of *Microsporum* accounted for 7.0% in 2001 and for 3.7% in 2010. A small number of *Epidermophyton* species were observed in 2001-2003, which accounted for 0.2%-0.8% of all isolates. It should be noted that *Epidermophyton* species were not recorded in the 2004-2010 period.

Among dermatophytes, the most commonly isolated pathogen was *T. rubrum*, which accounted for 55.7% in 2001 and for only 11.0% in 2010 (Table 2). Despite the fact that this fungus is considered one of the main causative agents, a decrease in its incidence was evident during the investigation. The following *Trichophyton* species were isolated: *T. mentagrophytes, T. interdigitale, T. tonsurans* and *T. violaceum*. *T. mentagrophytes* was less frequently found, nevertheless, during the investigation, a growing tendency in its prevalence was observed: in 2001, the incidence of this fungus was 0.2%, whereas in 2010 it was 1.4% of all isolates.

Among *Microsporum* species, *M. canis* and *M. gypseum* were isolated, with the former accounting for 3.0%-8.2% of all isolates. During the investigation, *E. floccosum* was also found, accounting for 0.2%-0.8% during the 2001-2003 period.

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Table 1. Distribution of causative agents of dermatomycoses in Lithuania

Year	Number of patients	Isolated fungi	Culturability	Yeasts	Dermatophytes	Nondermatophytes
	n	n	%	%	%	%
2001	965	413	42.8	32.4	64.2	3.4
2002	1155	470	40.7	44.7	52.8	2.6
2003	819	374	45.7	50.8	43.3	5.9
2004	1052	375	35.6	62.9	33.1	4.0
2005	950	453	47.7	63.4	29.6	7.1
2006	936	489	52.2	54.0	35.8	10.2
2007	836	458	54.8	52.3	34.5	13.2
2008	724	491	67.8	46.8	20.6	32.6
2009	829	483	58.3	48.0	23.2	28.8
2010	869	574	66.1	47.4	16.7	35.9

The clinical forms of dermatophytosis are shown in Table 3. Tinea unguium (75.5%) was the most common type of dermatophytosis, followed by tinea capitis (11.7%), tinea corporis (9.2%) and tinea pedis (1.2%). *T. rubrum* was the most common species causing all types of tinea, while *T. violaceum* and *T. gypseum* caused tinea corporis, tinea capitis and tinea faciei. Tinea capitis was the most prevalent type of *M. canis* infection.

DISCUSSION

Fungal infections still constitute a major health problem all over the world (19). During the 2001-2010 period, mycologically positive isolations confirmed by cultures were found in 51.2% of all examined patients suspected of dermatomycoses. In our study, yeasts (50.3%) were the most common isolates, followed by dermatophytes (35.4%) and nondermatophytes (14.3%). *Candida* species typically infect the skin and nails, and are part of the transient or commensal flora in specific regions of the body. They are opportunistic pathogens that only become pathogenic to humans under particular systemic and local conditions. *Candida* and other yeasts can also be found as saprophytes in nail tissue, directly invading the nail plate only when host defenses are disturbed, such as in immune suppression (1,20). Nondermatophyte fungi have been considered secondary pathogens of the nails that are already diseased, although they may act as primary pathogens in a small number of cases. The prevalence of nondermatophyte fungi as nail invaders ranges between 1.5% and 17.6% (20,21). Petanović *et al*. (22) report that nondermatophytes accounted for 52.4% in 2002-2008. In Tehran, during the 2006-2009 period, the causative agents of dermatomycoses were dermatophytes (65.7%), yeasts (30.1%) and nondermatophytes (4.2%) (23).

The most frequent etiologic agents of dermatophytoses in Lithuania were *Trichophyton* species. These fungi can infect fingernails, toenails, spaces between fingers or toes, feet and skin in any area of the body. Similar to other countries, in Lithuania *T. rubrum* is the main causative agent of all types of tinea. This dermatophyte prevails in many countries of Europe (1,6,24,25). Our results show that dermatophytoses

Table 2. Spectrum of causative agents of dermatophytoses (%) in Lithuania 2001-2010

Species	Year									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Trichophyton rubrum	55.7	43.6	34.2	28.0	20.8	31.5	28.4	14.7	19.7	11.0
Trichophyton mentagrophytes	0.2	0.6	0.8	1.3	0.2	0	0.6	0.8	0.2	1.4
Trichophyton interdigitale	0.5	0	0	0	0	0	0	0	0	0.5
Trichophyton tonsurans	0	0.4	0.3	0	0.4	0	0.8	0.6	0.2	0
Trichophyton violaceum	0.5	0	0.3	0	0	0	0	0	0	0
Microsporum canis	7.0	7.8	6.4	3.7	8.2	4.3	4.7	4.4	3.0	3.8
Microsporum gypseum	0	0	0.3	0	0	0	0	0	0	0
Epidermophyton floccosum	0.2	0.4	0.8	0	0	0	0	0	0	0
Yeasts	32.4	44.7	50.8	62.9	63.4	54.0	52.3	46.8	48.0	47.4
Others	3.4	2.6	5.9	4.0	7.1	10.2	13.2	32.6	28.8	35.9

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Table 3. Dermatophytes isolated from 1502 patients with tinea infection (%)

Fungus	Clinical form							Percentage
	Tinea corporis	Tinea unguium	Tinea pedis	Tinea capitis	Tinea faciei	Tinea manuum	Tinea cruris	
Trichophyton rubrum	2.3	74.9	1.1	1.7	0.3	0.3	0.7	81.4
Trichophyton gypseum	0.4	-	-	0.1	0.2	-	-	0.8
Trichophyton interdigitale	-	0.2	0.06	-	-	-	-	0.3
Trichophyton tonsurans	0.1	0.1	-	0.4	0.06	-	-	0.7
Trichophyton violaceum	0.1	-	-	0.06	0.06	-	-	0.3
Trichophyton mentagrophytes	0.1	0.2	-	0.4	-	-	-	0.7
Trichophyton sp.	0.1	0.1	-	-	-	-	-	0.3
Microsporum canis	5.9	-	-	9.1	0.06	-	-	15.1
Microsporum gypseum	0.06	-	-	-	-	-	-	0.06
Epidermophyton floccosum	-	-	-	-	-	-	0.3	0.3
Total	9.2	75.5	1.2	11.7	0.8	0.3	1.0	100

caused by *T. rubrum* decreased from 55.7% in 2001 to 11% in 2010 of all isolates. In Lithuania, the decrease of dermatophytoses caused by *T. rubrum* has been observed since 1978 (26). *T. mentagrophytes* is also found in our country and able to infect hair and skin. This causative agent often causes purulent forms of dermatophytoses. Infections caused by *T. mentagrophytes* were on an increase: from 0.38% in 1993-1998 to 1.4% of all isolates in 2010 (27). *T. interdigitale* is an exceptionally anthropophilic species and was found rarely, only in 2001 and 2010 accounting for 0.5% of all isolates. In Europe, *T. rubrum* and *T. interdigitale* are the main causative agents of tinea pedis and onychomycosis (2,25,28). *T. violaceum* and *T. tonsurans* were also found, but their incidence was not high. These fungi are anthropophilic and can cause tinea capitis and tinea corporis. In Lithuania, they are usually sporadic and during the study, they accounted for 0-0.8% of all isolates. A similar tendency of *T. violaceum* and *T. tonsurans* spread was observed in 1979-1998 (26). Recently in Europe, infections caused by *T. violaceum* and *T. tonsurans* have been increasing. In 1991-1993 in the United Kingdom, in Birmingham, *T. tonsurans* accounted for 36%-72% of all tinea capitis cases. In Sweden and Belgium, tinea capitis caused by *T. violaceum* and *T. tonsurans* is on an increase (15,28). In some continents, other very aggressive diseases have been observed, such as favus caused by *T. schoenleinii.* Causative agents of this disease have not been found in Lithuania. *T. schoenleinii* has been mostly detected in Eurasia and Africa (2). In Europe, this dermatophyte prevails in the eastern part (29). Single cases of *T. soudanense* have been detected among immigrants in Spain (30). Until 2000 in Lithuania, only single cases of *T. verrucosum* and *T. flavum* were recorded, whereas in 2001-2010 they were not detected at all.

In the present work, *M. canis* was found to be the main causative agent of tinea capitis in Lithuania. *M. canis* affects mostly 6- to 14-year-old children and only rarely adults. In 2001, *M. canis* accounted for 7.0% and in 2010 for 3.8% of all isolates. Until 2000, *M. gypseum* was rarely found, whereas during the investigation period this fungus was detected in 2010. In many European countries, such as Austria, Spain and Greece, diseases caused by *M. canis* are known to be increasing (31,32). Poland also reports a high incidence of infections of tinea capitis and indicates that the main causes of the infection are abandoned cats (33).

Similar to the pattern of other causative agents of dermatophytoses in Lithuania, a decreasing tendency in the prevalence of *E. floccosum* was revealed. *E. floccosum* was detected in 2001-2003 and comprised 0.2%-0.8% of all isolates. This fungus is distributed all over the world (2,11,32).

The results showed that in Lithuania all dermatophytes are decreasing, whereas the incidence of non-dermatophytes and yeasts is on an increase. Today, when large-scale migration takes place, tourism is growing and economic conditions are changing, the epidemiologic situation of dermatophytes can also alter in the main.

CONCLUSION

In 2001-2010 in Lithuania, the causative agents of dermatophytoses, i.e. the *Trichophyton, Microsporum* and *Epidermophyton* fungi, showed a tendency to decrease, whereas the incidence of yeasts and other causative agents of dermatomycoses increased.

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