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DERMATOPHYTES IN REPUBLIC OF MACEDONIA

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A b s t r a c **t:** A total of 1742 clinically suspected samples was examined for the incidence and distribution of dermatophytes in the Republic of Macedonia from June 2007 to Jan. 2009. 600 dermatophytes were isolated and identified. In the studied period 9 different dermatophyte species were isolated, namely *Trichophyton rubrum* (48.83%), *Microsporum canis* (20%), *Trichophyton mentagrophytes var. interdigitale* (16.83%), *Epidermophyton floccosum* (4.17%), *Trichophyton verrucosum* (3.83%), *Trichophyton mentagrophytes var. mentagrophytes* (3%), *Trichophyton violaceum* (1.67%), *Microsporum ferrugineum* (1%) and *Microsporum gypseum* (0.67%). The anthropophilic dermatophytic species are predominant. Tinea unguium (onychomycosis) (37.50%) is the most frequently diagnosed dermatophytosis followed by tinea pedis (19.17%), tinea corporis (15.33) and tinea capitis (15.17%). Furthermore there is an increased number of *Microsporum canis* isolates in tinea capitis patients. *Microsporum canis* infection of the scalp remains a serious epidemiological problem in R. Macedonia.

Key words: dermatophytes, incidence, dermatophytoses, R. of Macedonia.

Introduction

The main etiologic agents causing cutaneous infections are dermatophytes [1], which are classified in three genera, according to the structure of their conidia: *Microsporum, Trichophyton* and *Epidermophyton* [2]. Even though more than 40 species have been identified, only a few can be pointed out as responsible for the majority of dermatophytoses [3]. In general, the clinical forms of disease are designated as tinea corporis, tinea cruris, tinea manus, tinea pedis, tinea unguium (onychomycosis), tinea capitis, tinea faciei and tinea barbae [4]. The natural habitat of dermatophytes is on the basis of their clas-

sification as anthropophilic, zoophilic and geophilic. So they are able to spread mainly by direct contact with other people, animals and soil respectively [5].

Dermatophytes that cause infections can vary from country to country and from region to region, creating a specific spectrum for that region [1, 6, 7]. Different factors have to be taken into consideration when the distribution and importance of dermatophytes are studied on each location. This includes life style, population, climate, presence of animals infected with zoophilic dermatophytes and the existence of conditions that allow epidemic expansion of antropophilic species. The migration of people, carriers of specific dermatophytes, makes the spread of the infection into new regions easy [8, 9, 10]. Anthropophilic dermatophytes are predominant in the Central and Northern European countries [8, 9, 10] and the zoophilic species in Southern Europe and Mediterranean [11]. The incidence and distribution of dermatophytes have been studied in various geographical areas of the world. With the exception of tinea capitis patients [12], in the R. Macedonia there is no controlled examination of usually isolated dermatophytes. The last study of that type was made 40 years ago [13]. A 2-year survey (2007–2009) on the incidence and distribution of dermatophytes was conducted on patients attending the Mycological Outpatients' Dept., Dermatology Department, Medical Faculty, Skopje for suspected dermatophytosis.

Materials and methods

Patients with suspected dermatophyte infections were studied from June 2007 to Jan. 2009. Their skin and nail scrapings were treated with 20% KOH preparation and examined under a light microscope. Not all findings of KOH treatment were recorded. All scrapings were cultured on Sabouraud's glucose agar with chloramphenicol, gentamycin and actidion. The culture plates were incubated at room temperature for 1–4 weeks. The dermatophytes were identified by standard methods [14].

Results

In the period studied, of a total of 1742 clinically suspected samples examined, 600 dermatophytes were isolated and identified. The incidences of dermatophytes isolated from the lesions are shown in Table 1. *Trichophyton rubrum* (48.83%) and *Microsporum canis* (20%) caused the majority of the infections. The incidences of the other isolated dermatophytes were *Trichophyton mentagrophytes var. interdigitale* (16.83%), *Epidermophyton floccosum* (4.17%), *Trichophyton verrucosum* (3.83%), *Trichophyton mentagrophytes var. mentagrophytes* (3%), *Trichophyton violaceum* (1.67%), *Microsporum ferrugineum* (1%) and *Microsporum gypseum* (0.67%). The anthropophilic dermatophyte species are predominant.

Table 1 – Табела 1

Distribution of dermatophytes in patients with dermatophytosis at the Dermatology Department in Skopje, 2007 to 2009
Дистрибуција на изолираните дерматофитии кај пациентите со дерматофитоза на Клиниката за дерматологија во Скопје од 2007 до 2009

Dermatophytes		Dermatophytosis							
		Tinea capitis	Tinea barbae	Tinea faciei	Tinea corporis	Tinea cruris	Tinea manuum	Tinea pedis	Onycho mycosis
Microsporum canis	N°	67	0	4	47	0	0	0	2
	%	73,63	0	30,77	51,09	0	0	0	0,89
Trichophyton verrucosum	N°	9	0	5	9	0	0	0	0
	%	9,9	0	38,46	9,78	0	0	0	0
Trichophyton mentag var. mentagrophytes	N°	3	2	1	5	0	1	6	0
	%	3,3	100	7,69	5,43	0	5,56	5,22	0
Trichophyton violaceum	N°	3	0	0	2	1	0	2	2
	%	3,3	0	0	2,17	2,27	0	1,74	0,89
Trichophyton rubrum	N°	0	0	3	20	29	10	74	157
	%	0	0	23,08	21,75	65,91	55,55	64,35	69,7
Microsporum gypseum	N°	1	0	0	3	0	0	0	0
	%	1,09	0	0	3,26	0	0	0	0
Trichophyton mentag var. interdigitale	N°	7	0	0	3	8	6	25	52
	%	7,69	0	0	3,26	18,18	33,33	21,73	23,11
Microsporum ferrugineum	N°	1	0	0	2	1	0	2	0
	%	1,09	0	0	2,17	2,27	0	1,74	0
Epidermophyton floccosum	N°	0	0	0	1	5	1	6	12
	%	0	0	0	1,09	11,37	5,56	5,22	5,33
Total		91	2	13	92	44	18	115	225

The distribution of dermatophytes in the regions of R. Macedonia is shown in Table 2. In the all the regions analysed, the most common isolaletd dermatophyte is the antropophilic *Trichophyton rubrum.* Of the zoophilic species, in all regions the most frequently isolated is *Microsporum canis*. In regions such as Skopje,

Polog, Northern Macedonia, Pelagonia and Southern Macedonia, the second most frequently isolated zoophilic dermatophyte is *Trichophyoton verrucosum*. However, in the other regions this is *Trichophyton mentagrophytes var.mentagrophytes*.

Table 2 – Табела 2

Distribution of dermatophytes by regions in R. Macedonia at the Dermatology Department in Skopje, 2007 to 2009
Дистрибуција на дерматофитите по региони во Р. Македонија на Клиниката за дерматологија во Скопје од 2007 до 2009

Regions in R. of Macedonia		Dermatophytes									
		Microsporum canis	*Trichophyton verrucosum*	*Trichophyton mentagrophytes var. mentagrophytes*	*Trichophyton violaceum*	*Trichophyton rubrum*	*Microsporum gypseum*	*Trichophyton mentagrophytes var. interdigitale*	*Microsporum ferrugineum*	*Epidermophyton floccosum*	Totally
Skopje	N°	80	10	7	9	202	2	65	2	20	397
	%	20,1	2,51	1,76	2,26	50,8	0,5	16,3	0,5	5,03	100
Vardar	N°	5	0	2	0	11	1	3	1	0	23
	%	21,7	0	8,69	0	47,8	4,34	13	4,34	0	100
Northeastern	N°	6	2	2	0	15	0	7	2	1	35
	%	17,1	5,71	5,71	0	42,8	0	20	5,71	2,85	100
Southwestern	N°	1	2	2	0	15	0	2	0	1	23
	%	4,34	8,69	8,69	0	65,2	0	8,69	0	4,34	100
Polog	N°	10	6	3	0	20	1	9	1	0	50
	%	20	12	6	0	40	2	18	2	0	100
Eastern	N°	7	0	0	0	8	0	14	0	2	31
	%	22,6	0	0	0	25,8	0	45,2	0	6,45	100
Pelagonia	N°	7	1	2	0	14	0	0	0	1	25
	%	28	4	8	0	56	0	0	0	4	100
Southeastern	N°	4	2	0	1	8	0	1	0	0	16
	%	25	12,5	0	6,25	50	0	6,25	0	0	100
Total		120	23	18	10	293	4	101	6	25	600

Tinea unguium (onychomycosis) (37.50%) was the most common type of dermatophytosis followed by tinea pedis (19.17%), tinea corporis (15.33%), tinea capitis (15.17%), tinea cruris (7.33%), tinea manuum (3%), tinea faciei (2.17%) and tinea barbae (0.33%) Figure 1.

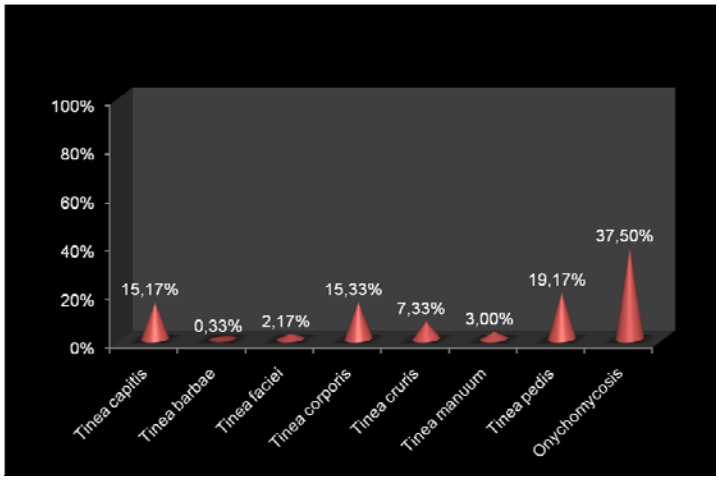

Figure 1 – Distribution of patients with dermatophytosis at the Dermatology Department in Skopje, 2007 to 2009
Слика 1 – Дистрибуција на пациентите со дерматофитоза на Клиниката за дерматологија во Скопје од 2007 до 2009

The relation between clinical forms and the etiologic agents, according to their natural habitat is summarised in Table 1. *Trichophyton rubrum* was the predominant organism and caused 69.7% of tinea unguium (onychomycosis), 65.91% of tinea cruris, 64.35% of tinea pedis, 55.55% of tinea manuum, 23.08 of tinea faciei and 21.75 of tinea corporis. *Microsporum canis* was the major cause of tinea capitis (73.63%) followed by *Trichophyton verrucosum* (9.9%).

Discussion

Although all dermatophytes are closely related, each species has certain characteristics in its geographical distribution. The changes in distribution of dermatophytes during the century all over the world are striking, and several explanations have been discussed. A true increase of a certain species and altered distribution would be a result of increased exposure, changes in human habits, change in the pattern of the animal household, a change in pathogenicity, intensive use of antimycotics, etc.

Each of the dermatophytes (anthropophilic, zoophilic, geophilic) has its own epidemiological importance, not only to people and the animals but also to the environment. Most important to people and animals are the antropophilic and zoophilic dermatophytes. The importance of each group is determined from the composition of the population and their hygienic habits.

As in the other geographical regions [8, 9, 10] in our country antropophilic dermatophytes predominate (72.5%). The most frequently isolated species is *Trichophyton rubrum* (48.83%) followed by *Trichophyton mentagrphytes var.interdigital* (16.83%), *Epidermophyton floccosum* (4.17%) and *Microsporum ferrugineum* (1%). The prevalence of the cosmopolitan anthropophilic species in each country is influenced by the constant change of the environment. *Trichophyton rubrum, Epidermophyton floccosum* and the anthropophilic *Trichophyton mentagrophytes (var. interdigitale)* show a common pattern of association with onychomycosis, tinea pedis, tinea cruris and tinea manuum [15, 16]. It is likely that exposure to these dermatophytes is a common occurrence. In all analyzed regions in R. Macedonia, *Trichophyton rubrum* is the most frequently isolated dermatophyte. The great majority of infections of nails (69.70%), feet (64.35%), groin (65.91%) and hand (55.55%) were caused by *Trichophyton rubrum.* Although the ecological and host factors involved in developing symptomatic infection are poorly known, known risk factors include foot dampness and abrasion combined with likely exposure to high fungal inoculum in communal aquatic facilities, such as swimming pools and showers [17, 18]. Exchange of clothing, towels and li.en, either directly or via substandard communal laundering, is another recognised risk that may lead to outbreaks [1]. *Trichophyton rubrum* is cosmopolitan but appears to have had a more restricted distribution in the past, having been transported widely as a result of human migration (the anthropophiles travel with their human hosts) [1]. The incidence of *Trichophyton rubrum* has increased significantly during the past 40 years in R. Macedonia. Mischenko [13] was unable to isolate *Trichophyton rubrum* in 1961 and now *Trichophyton rubrum* is the most frequently isolated dermatophytic species.

The once most common dermatophytes in R. Macedonia, *Trichophyton violaceum, Trichophyton schoenleinii* and *Microsporum ferrugineum* [13] have decreased to an insignificant value.

Furthermore, over the past period of 10 years we have isolated only one case of *Trichophyton schoenleinii* that caused tinea capitis. In the epidemiology of the anthropophilic infections economic, social and hygienic factors are of great importance. The superficial infections of the scalp that were caused by *Trichophyton violaceum* and *Trichophyton schoenleinii* were found in former Yugoslav regions such as Bosnia, Kosovo and Macedonia i.e. regions with low hygienic and socio-economic standards [19]. On the other hand, dermatophyto-

sis on the unexposed parts of the body caused by *Trichophyton rubrum, Trichophyton mentagrophytes var. interdigitale* and *Epidermophyton floccosum* are common in the regions with higher hygienic standards.

Zoophilic and geophilic dermatophytes in general tend to form lesions that are more inflammatory than those formed by anthropophilic dermatophytes but are also more likely to resolve spontaneously [1]. This pattern is seen in the tinea capitis caused by *Microsporum canis* [1, 20]. *Microsporum canis* is the second most commonly isolated dermatophyte species in our country and the most commonly isolated zoophilic dermatophyte. (20%). It is mainly found in cases of tinea capitis (73.63%) and tinea corporis (51.09%).

In the past 30 years *Microsporum canis* infection of the scalp has become a serious epidemiological problem in many regions in the world (1, 6). *Microsprum canis* is the predominant etiology for tinae capitis in many countries in the world with a temperate climate [21], i.e. the most common infection in Europe [22] and especially in the Mediterranean [23]. In R. Macedonia in the 70s *Microsporum canis* tinea capitis was rare in the cities and villages [19]. It is very hard to explain why this was so, was it because of ecological factors or because there were no pets infected with *Microsporum canis* at that time. Now there is a significantly increased number of *Microsporum canis* isolates in tinea capitis patients [12]. There are differences in the number of diagnosed cases with dermatophytosis from different regions. It is very important in understanding whether the differences represent the real epidemiological situation or the fact that many of the patients with *Microsporia* remain unregistered, i.e. without mycological confirmation.

Microsporum canis infection of the scalp remains a serious epidemiological problem in R. Macedonia. Consistent and integrated efforts by the medical and veterinary services associated with health education are required in future to eliminate a further spread of infection.

The other isolated zoophilic species *Trichophyton verrucosum* (3.83% of the dermatophytes) and *Trichophyton mentagrophytes var. mentagrophytes* (3%) are responsible for tinea capitis, 9.90% and 3.30% respectively.

Zoofilic dermatophytes were isolated in 86.83% of all cases with tinea capitis. In our country the ratio between zoophilic and antropohilic species is 4 : 1 as in the study of the European Confederation for Medical Mycology, carried out in Germany [24]. This is very important to establish because of the fact that prophylactic measures that should be applied are different for zoophilic and antropohilic tinea capitis.

Geophilic species are also found either to be cosmopolitan or confined to certain geographical areas. *Microsporum gypseum* have been more commonly isolated from human infections than any other geophilic dermatophytes [1]. We have isolated *Microsporum gypseum* in tinea capitis (one patient) and

tinea corporis (4 patients), i.e. in 0.67% of patients with dermatophytoses. From this we can conclude that *Microsporum gypseum* is insignificantly rare in R. Macedonia.

Conclusion

The anthropophilic dermatophytic species are predominant. *Trichophyton rubrum* is the most frequently isolated species. Onychomycosis is the most frequent type of dermatophytosis, followed by tinea pedis and tinea corporis. Furthermore there is an increased number of *Microsporum canis* isolates in tinea capitis patients. *Microsporum canis* infection of the scalp remains a serious epidemiological problem in R. Macedonia. A precise knowledge of the ecology and epidemiology of dermatophytes, and the major clinical aspects of dermatophytosis are essential for the identification of such infections and a better understanding of their transmission patterns.

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Резиме

ДЕРМАТОФИТИИ ВО РЕПУБЛИКА МАКЕДОНИЈА

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Во перидот јуни 2007 до јануари 2009 година на вкупно 1.742 клинички суспектни пациенти е испитана инциденцата и дистрибуцијата на дерматофитиите во Р. Македонија. Изолирани и идентифицирани се 600 дерматофитии. Во анализираниот период изолирани се 9 различни дерматофитски специиеси, и тоа: *Trichophyton rubrum* (48,83%), *Microsporum canis* (20%), *Trichophyton mentagrophytes var. interdigitale* (16,83%), *Epidermophyton floccosum* (4,17%), *Trichophyton verrucosum* (3,83%), *Trichophyton mentagrophytes var. mentagrophytes* (3%), *Trichophyton violaceum* (1,67%), *Microsporum ferrugineum* (1%) и *Microsporum gypseum* (0,67%). Предоминираат антропофилните дерматофитии. Tinea unguium (onychomycosis) (37,50%) е најчесто дијагностицираната дерматофитоза, пред tinea pedis (19,17%), tinea corporis (15,33%) и tinea capitis (15,17%). Понатаму, се констатира и зголемен број на *Microsporum canis* изолати (73,63%) кај пациентите со tinea capitis. *Microsporum canis* инфекција претставува сериозен епидемиолошки проблем во Република Македонија.

Клучни зборови: дерматофитии, инциденца, дерматофитози, Р. Македонија.

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