

Dermatophyte Infections in Primorsko-Goranska County, Croatia: a 21-year Survey

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SUMMARY This study examined the frequency of dermatophytoses in the Primorsko-Goranska County, a north-western part of Croatia, over a period of 21 years (1988-2008). All fungal samples were microscopically examined with 20% potassium hydroxide (KOH) solution. Fungal infections were confirmed in 26.9% cases. Out of these, dermatophytes were isolated in 38.3%, *Candida spp.* infection in 55.1% cases, while non-dermatophyte molds were identified in 6.6% isolates. The most frequently isolated dermatophyte was *Trichophyton (T.) mentagrophytes var. interdigitalis* (55.4%), followed by *Mycrosporium (M.) canis* (36.9%), *T. violaceum* (3.2%), *M. gypseum* (2.2%), and *T. verrucosum* (1.3%). *Epidermophyton (E.) floccosum* (0.9%) and *T. rubrum* (0.1%) were identified only sporadically. The most common dermatophytosis diagnosed in the 21-year period was tinea pedis (26.2%) followed by tinea capitis (21.8%) and tinea corporis (20.1%). Toenail onychomycosis (14.5%) was more common than fingernail onychomycosis (2.0%). *T. mentagrophytes var. interdigitalis* was the major pathogen causing tinea pedis (86.6%) as well as toenail onychomycosis (93.9%), while *M. canis* was most frequently isolated in tinea capitis (98.6%), tinea corporis (62.1%), and tinea faciei (40.2%). With regard to age and sex, *T. mentagrophytes var. interdigitalis* infections were predominant in middle-aged men. *M. canis* affected mostly children up to 9 years with a slight predominance in girls. Data from epidemiological trend analysis such as presented in our study are important for evidence-based public health measures for the prevention and control of dermatophytoses.

KEY WORDS: dermatophytes, epidemiology, tinea, Croatia, Primorsko-Goranska County

INTRODUCTION

Dermatophyte infections are very common worldwide. In different geographic areas, their distribution varies depending on lifestyle, population migration, and socioeconomic conditions (1-3). In recent decades, an important change in the epidemiological pattern of dermatophyte infections took place in most European countries, including Croatia (1-5). In

Central and Western Europe, tinea pedis and toenail onychomycosis caused by *Trichophyton (T.) rubrum* dominate in the dermatophyte spectrum (1-3,6,7). In contrast, *Microsporium (M.) canis* is the major cause of dermatophyte infections in Slovenia and Italy (8-10), and tinea corporis and tinea capitis caused by *M. canis* are the most common clinical forms of derma-

tophytoses in other Mediterranean countries (9-12). Because of these discrepancies, analyzing the epidemiological situation and pathogenic spectrum of dermatophyte infections in Croatia during the past decades is an interesting topic. In this study, we examined the frequency of dermatophytosis in the Primorsko-Goranska County (with Rijeka as the capital city), a north-western part of Croatia, over the period of 21 years (1988-2008).

METHODS

Skin scrapings as well as hair and nail samples were collected from patients with clinically suspected dermatomycosis in the 21-year period between January 1, 1988 and December 31, 2008. The specimens were analyzed in the mycological laboratory at the Department of Dermatovenerology, Clinical Hospital Centre Rijeka. A total of 52578 patients with suspected dermatomycosis were examined in this period. All fungal samples were prepared in 20% potassium hydroxide (KOH) solution and analyzed with direct microscopy. Part of the specimens were cultivated on Sabouraud maltose agar with added penicillin and streptomycin and further incubated at 27°C for 4 weeks. The isolated fungi were identified by their macroscopic and microscopic characteristics.

RESULTS

In the 21-year period, fungal infections were confirmed in 14787 (26.9%) cases (Table 1). Dermatophytes were isolated in 5668 (38.3%), *Candida spp.* infection in 8145 (55.1%) cases, while non-dermatophyte molds were identified in 974 (6.6%) isolates.

Anthropophilic *T. mentagrophytes var. interdigitalis* and zoophilic *M. canis* dominated in the spectrum of dermatophytes (Table 2). The most frequently isolated dermatophyte was *T. mentagrophytes var. interdigitalis* (55.4% of dermatophyte isolates), followed by *M. canis* (36.9%), *T. violaceum* (3.2%), *M. gypseum* (2.2%), and *T. verrucosum* (1.3%). Anthropophilic fungi *E. floccosum* (0.9%) and *T. rubrum* (0.1%) were identified only sporadically.

The most common dermatophytosis diagnosed in the study period was tinea pedis (26.2%) followed by tinea capitis (21.8%) and tinea corporis (20.1%); Table

Table 1. Distribution of isolated fungi in the Primorsko-Goranska County (1988-2008)

Species isolated	No (%)
Dermatophytes	5668 (38.3)
<i>Candida albicans</i>	8145 (55.1)
Non-dermatophyte molds	974 (6.6)
Total	14787 (100.0)

3). Toenail onychomycosis (14.5%) was more common than fingernail onychomycosis (2.0%). Tinea inguinallis (7.7%) and tinea manus (6.0%) were diagnosed with almost the same frequency, whereas tinea faciei was only seen in rare cases.

T. mentagrophytes var. interdigitalis, the most frequently isolated dermatophyte in this region, was the major pathogen causing tinea pedis (86.6%) as well as toenail onychomycosis (93.9%; Table 4). The same fungus was also very often identified in tinea inguinallis (77.8%), tinea manus (67.7%), tinea faciei (47.4%), and tinea corporis (30.9%). *M. canis* was most frequently isolated in tinea capitis (98.6%) and tinea corporis (62.1%) as well as in tinea faciei (40.2%). *M. gypseum* was found in some cases of tinea faciei (12.4%) and rarely in tinea corporis (3.2%) and tinea pedis (2.2%). *E. floccosum* was predominant in groins, while *T. violaceum* was isolated on trunk, hands, and inguinal region. *T. verrucosum* was an infrequent cause of tinea corporis and tinea pedis while *T. rubrum* was only rarely identified.

With regard to age and sex, *T. mentagrophytes var. interdigitalis* infections predominated in middle-aged men. *M. canis* affected mostly children up to 9 years with a slight predominance in girls. 67.3% of patients with *M. canis* infection were aged less than 9 years while 14.8% were from 10 to 19 years old. *T. violaceum* infections were predominant among adults (23.6%) ranging in age from 50 to 59 years. *M. gypseum* and *E. floccosum* were likewise most often identified among adult patients.

DISCUSSION

The distribution of dermatophytes in European countries has changed significantly within the last few decades (1-3). In our 21-year epidemiologic survey, fungal infections were confirmed in 26.9% cases, of which 38.3% had dermatophytoses while 55.1% had *Candida spp.* infection. This decrease in the frequency of dermatophyte isolates has already been noticed in the region of Rijeka in the post war

Table 2. Dermatophytes isolated in the Primorsko-Goranska County (1988-2008)

Species isolated	No. (%)
<i>T. mentagrophytes</i>	3144 (55.4)
<i>M. canis</i>	2087 (36.9)
<i>T. violaceum</i>	183 (3.2)
<i>M. gypseum</i>	128 (2.2)
<i>T. verrucosum</i>	71 (1.3)
<i>E. floccosum</i>	51 (0.9)
<i>T. rubrum</i>	4 (0.1)
Total	5668 (100.0)

Table 3. Frequency of dermatophytosis in the Primorsko-goranska County (1988-2008)

Dermatophytosis	No. (%)
Tinea pedis	1486 (26.2)
Tinea capitis	1237 (21.8)
Tinea corporis	1140 (20.1)
Toenail onychomycosis	821 (14.5)
Tinea inguinalis	436 (7.7)
Tinea manus	337 (6.0)
Fingernail onychomycosis	114 (2.0)
Tinea faciei	97 (1.7)
Total	5668 (100.0)

period (1995-1999) (4). The same epidemiological situation has been also observed in the Padua region, Italy, with higher incidence of *Candida spp.* infection compared to dermatophyte one (13). In Bosnia, our neighboring country, a decline in the rate of dermatophytoses has been noticed in the post war period as well (14,15). The same epidemiological situation has been observed in Greece and Poland, with a decline in dermatophyte incidence in the last twenty years (16,17). However, in other European countries dermatophytes are still dominant within the fungal spectrum (1-3).

The most frequently isolated dermatophyte in our survey was *T. mentagrophytes* var. *interdigitalis* with a frequency of over 50% of all dermatophyte isolates. The same epidemiological situation was observed in other parts of Croatia as well (5,18-22). In the region of Rijeka, *T. mentagrophytes* var. *interdigitalis* dominated in the pathogenic spectrum of dermatophytes since 1957 (23). The ratio of *T. mentagrophytes* var. *interdigitalis* isolates in this survey was much higher than in other European countries such as Germany (11.6%), Slovakia (9.4%), Czech Republic (4.7%), Slovenia (7.9%), Greece (14.4%) and Italy (10.6%) (3,6-12). However, in northern Poland, like in our region, *T. mentagrophytes* var. *interdigitalis* is still the most prevalent dermatophyte with the frequency of 41.6% (24). The same finding was reported in Cagliari, Italy,

where *T. mentagrophytes* var. *interdigitalis* was the predominant dermatophyte with the frequency of 49.6% (25). Higher incidence of this fungus has also been noted in Finland (24.2%) in the previous decades (26).

In our survey, the most common among all clinical forms of dermatophytoses was tinea pedis (26.2%), followed by tinea capitis (21.8%) and tinea corporis (20.1%). These findings are similar to those in some Mediterranean and central European countries (4-11). In contrast, in the Zagreb area, onychomycoses were the predominant clinical types of infection; a similar situation has been noted in the island of Crete, Greece as well (12,18). In central Europe, tinea pedis and toenail onychomycosis, mainly caused by *T. rubrum*, account for more than 50% of all dermatophytoses (2,3,6,7). In contrast, in Slovenia and northern Italy, tinea corporis is the most prevalent clinical form mainly due to high prevalence of *M. canis* infections in these parts of Europe (8-10). Interestingly, in Italy, tinea pedis constituted only 6.8% of all clinical forms of dermatomycosis (10). In our region, tinea pedis and toenail onychomycosis are dominated by *T. mentagrophytes* as the causal pathogen. In contrast to our findings, in Greece, most of Italy, and some central European countries, *T. rubrum* is the dominant agent causing tinea pedis (6-12). In Slovenia, *T. mentagrophytes* var. *interdigitalis* was isolated 2 to 4 times less frequently in tinea pedis than *T. rubrum* (8). However, *T. rubrum* is responsible for tinea pedis in most of Italy, in the region of Cagliari, *T. mentagrophytes* var. *interdigitalis* is the causative agent in almost 51.5% cases of tinea pedis (27).

The low isolation rates of *T. rubrum* in our survey have been already observed in the region of Rijeka, although in the past 20 to 30 years *T. rubrum* infections were more frequently noticed in this region (4,23). However, higher isolation rates of *T. rubrum* were found in other parts of Croatia: in Split (21.5%) and in the Zagreb area (10%) (5,18). In comparison with other European countries with high incidence

Table 4. Distribution of isolated dermatophytes by body location

Dermatophyte	Tinea capitis	Tinea faciei	Tinea corporis	Tinea inguinalis	Tinea manus	Tinea pedis	Onychomycosis - toenail	Onychomycosis - fingernail	Total
<i>T. mentagrophytes</i>	11	46	352	339	228	1287	771	110	3144
<i>M. canis</i>	1220	39	708	9	66	43	1	1	2087
<i>T. violaceum</i>	1	-	25	40	17	84	14	2	183
<i>M. gypseum</i>	5	12	43	3	17	32	15	1	128
<i>T. verrucosum</i>	-	-	5	8	7	33	18	-	71
<i>E. floccosum</i>	-	-	7	37	-	6	1	-	51
<i>T. rubrum</i>	-	-	-	-	2	1	1	-	4
Total	1237	97	1140	436	337	1486	821	114	5668

of *T. rubrum* isolates, Poland, particularly the northern part, was reported to have lower rates of *T. rubrum* isolates with a frequency of 15.5% (24).

M. canis was the second most common among all dermatophytes in our survey, with a frequency of 36.8%. 98.6% of the isolates were from the patients with tinea capitis, mostly children up to 9 years old. These findings are similar to those in other Croatian regions (5,18-22). In the Primorsko-Goranska area, *M. canis* was noted for the first time in 1974 with two isolated cases and a tendency of steadily increasing frequency over following decades (23). An increased frequency of *M. canis* was first noticed in Mediterranean and south European countries and it seems the infection spread to northern Europe from there (28). The high incidence of *M. canis* infection was also observed in Croatia's neighboring countries: Bosnia (90.4%), Slovenia (46.8%), and Italy (50%), where *M. canis* was reported to be the most prevalent dermatophyte (8-10,15). In contrast, a very low isolation rate of *M. canis* has been observed in southwest Poland (5.1%) and in the Kraków district (1.7%) (17,29).

The isolation rate of geophilic *M. gypseum* (2.2%) and antropophilic *Epidermophyton (E.) floccosum* (0.9%) has been low in this region and in other parts of Croatia as well (4,5,18-22). A similar epidemiological situation has been also observed in other European countries (2,3,6-12). In the 1930s *E. floccosum* was reported to be the most prevalent causative agent of fungal infections in Germany (2,3,30). Since then, the frequency of *E. floccosum* declined to below 1% in 1990 (2,3). However, in some European countries such as Poland, Greece, and Italy, *E. floccosum* still constitutes 10% of all isolates (9-12,24,31). It is interesting to note that in Iran and some other Islamic countries, *E. floccosum* is still the predominant cause of dermatophytoses with almost 31.4% isolates (32,33).

CONCLUSION

The distribution and frequency of dermatophytes in our survey differs in some points from the epidemiological pattern in other European countries. The most prevalent dermatophyte is still *T. mentagrophytes*; however, the ratio of *M. canis* is increasing, similarly to other Mediterranean countries. Data from epidemiological trend analysis such as presented in our study are important for evidence-based public health measures for the prevention and control of dermatophytoses.

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