Epidemiology of tinea capitis in Europe: current state and changing patterns

Gabriele Ginter-Hanselmayer,1 Wolfgang Weger,1 Marcit Ilkit2 and Josef Smolle3

1Department of Dermatology, Medical University of Graz, Graz, Austria, 2Department of Microbiology, Faculty of Medicine, University of Cukurova, Adana, Turkey and 3Institute for Medical Informatics, Statistics, and Documentation, Medical University of Graz, Graz, Austria

Summary

Tinea capitis (scalp ringworm) is the most common dermatophyte infection of the scalp affecting mainly children and rarely adults. The epidemiology of tinea capitis varies within different geographical areas throughout the world. It may occur sporadically or epidemically and an increase in its incidence has been noted over the last few decades. The aim of the study is to obtain a general overview of the current state and changing pattern of tinea capitis in Europe. According to the literature, there has been a significant increase in the incidence of tinea capitis and a change in the pattern of infectious agents in particular. Microsporum canis, a zoophilic dermatophyte, is still the most common reported causative agent of tinea capitis in Europe. The countries reporting the highest incidence of M. canis infections are mainly in the Mediterranean but also bordering countries like Austria, Hungary, Germany and Poland. Besides the increase in Microsporum-induced tinea capitis, there is a shift towards anthropophilic tinea capitis mainly in urban areas in Europe. The largest overall increase with anthropophilic dermatophytes has been noted with Trichophyton tonsurans mainly in the UK and with Trichophyton soudanense and Microsporum audouinii in France. The occurrence of anthropophilic infections seems to be geographically restricted and is possibly linked to the immigration from African countries. Children (aged 3–7 years with no predilection of gender) remain the most commonly affected, but recently an increase of tinea capitis has been observed in adults and in the elderly. The results of the study clearly demonstrate the importance of diagnosing and proper treatment of mycotic scalp infection in the Europe. If not diagnosed and treated properly, its prevalence might reach epidemic proportions in the near future. Therefore, an increased level of surveillance (screening in schools), and a highly effective interdisciplinary cooperation among general practitioners, mycologists, veterinarians and dermatologists are strongly recommended.

Key words: tinea capitis, Europe, epidemiology, zoophilic dermatophytes, anthropophilic dermatophytes, carrier-state, changing pattern.

Introduction

Tinea capitis, or scalp ringworm, is the classic type of dermatophyte infection and a common disease in childhood. In northern and western Europe, it is estimated to account for 1% of all superficial fungal infections. The epidemiology of tinea capitis is a complicated and complex subject, as the aetiological agents of this disorder have not been sought or identified in many parts of the world. Until recently, tinea capitis was thought to have a high prevalence mainly in the developing world because of poor hygiene, overcrowding and low socio-economic standards. During the last few decades, a substantial increase in the prevalence of mycotic scalp infection and a remarkable change in the pattern of the causative dermatophytes among different
European countries have been observed. Moreover, in most countries differences have been found between rural and urban areas. Immigration-movements, travel-activities, changes in the level of surveillance and possibly the sensitivity of *Microsporum audouinii* to griseofulvin treatment may at least partly account for these differences.

**Dermatophytes**

Although dermatophytes can be isolated worldwide, many species are only encountered in geographically restricted areas. Of the more than 40 species of dermatophytes previously identified, only about 12 are common causes of human infection. Worldwide tinea capitis is most commonly caused by the following dermatophytes: *Microsporum canis,* (M. *gypseum, M. fulvum, M. nanum,* Trichophyton mentagrophytes and *T. verrucosum,* whereas on the European continent *M. canis, T. tonsurans, T. violaceum, T. verrucosum* and *T. soudanense* are the most frequently encountered aetiological agents.

Dermatophytes with partial geographical restriction are *M. ferrugineum* (Africa, Asia), *M. distortum* (Australia, New Zealand), *T. tonsurans* (USA, Carribean, Mexio), *T. violaceum* (Africa, Asia; Europe), *T. schöneleinii* (Africa, Eurasia), *T. soudanense* (Africa) and *T. yaoundei* (Africa), the majority of them are of anthropophilic transmission. Not all dermatophytes are capable of invading the scalp hair (e.g. *Epidermophyton floccosum* and *T. rubrum*).

According to the major reservoirs and the mode of transmission, dermatophytes can be divided into anthropophilic, zoophilic and geophilic species. Most of the anthropophilic and some of the zoophilic species are geographically restricted, whereas in general, the geophilic species occur worldwide. The predominant organisms vary within a given geographical region during different periods – a fact, which is influenced by many aspects, such as population movements, socio-economic circumstances and the level of surveillance. Concerning this, a continuing change can be observed.

**Causative agents of tinea capitis in the past**

During the late 19th and early 20th centuries, *M. audouinii* and *M. canis* were the predominant causative agents of tinea capitis in Western and Mediterranean Europe, whereas *T. schöneleinii* predominated in Eastern Europe. In the late 1950s and early 1960s, a marked decline of the incidence of tinea capitis caused by *Microsporum* spp. could be achieved by both administration of griseofulvin for the treatment of tinea capitis and improvement in the level of surveillance. With the beginning of the 1990s, a sudden increase in the incidence of fungal scalp infections was reported in different European regions, with anthropophilic infections mainly in the cities and zoophilic infections in the southeastern European countries. At the same time, ringworm of the scalp was more frequently encountered in the USA with *T. tonsurans* being the most common cause, brought to North America by Hispanic immigrants via Central America and the Carribean.

**Causative agents of tinea capitis: current pattern in different European countries**

**Central Europe**

**Germany**

In 1998, a survey investigating the frequency, infectious spectrum and therapy of tinea capitis (under the assignment of the European Confederation of Medical Mycology) identified 394 cases in a German population. The most frequent causative agent for tinea capitis was *M. canis* (*n* = 216; 54.8%) followed by *T. mentagrophytes* (*n* = 58; 14.7%), *T. verrucosum* (*n* = 32; 8.1%), *T. violaceum* (*n* = 24; 6.1%) and *T. tonsurans* (*n* = 15; 3.8%). Zoophilic dermatophytes (*n* = 306; 81.2%) dominated the anthropophilic species (*n* = 71; 18.8%). Tinea capitis occurred at an average age of 17.3 years. Tinea capitis microsporica showed to be a more frequent infectious disease again.

**Austria**

Nearly the same pattern as in Germany has been reported in an Austrian population, with *M. canis* being the aetiological agent in up to 90% of cases. In a survey concerning tinea capitis at the Department of Dermatology/Medical University of Graz over the last two decades (1985–2004), a recent and significant rise in the incidence as well as a change in the pattern of infection, with the zoophilic *M. canis* being the commonest aetiological agent, could be established. A childhood-population (3–7 years of age; with no predilection of gender) was the most commonly affected.

The current situation with the epidemiology of tinea capitis in the area of Graz and its surroundings reflects a nearly similar pattern in countries like Germany, Poland, Hungary, Slovenia, Croatia and Italy. In addition to the increasing number of tinea capitis because of infection with *M. canis,* there is a shift towards
anthrophilic dermatophytes, mainly *T. soudanense* among African immigrants in southern Austria (Ginter-Hanselmayer unpublished data).

**Slovenia**
In a recently published paper by Dolenc-Voljc [7], the prevalence of tinea capitis among 33 974 patients examined at the University Medical Center in Ljubljana, Slovenia during the time period of 1995–2002 was found to be 3.9%. A total of 91.1% of tinea capitis cases were caused by *M. canis* with cats being the main source of infection. The author suggests that transmission of *M. canis* from stray cats to domestic cats leads to mycotic infection of young children playing with these kittens. As the vast majority of the patients came from urban areas and were living in good social and economic conditions, the relationship of *M. canis* infections to poor hygienic and social standards might be more questionable than previously thought.9,10 In a 12-year period (1987–1998) in Prague.8 Out of a total of 5605 isolated dermatophytes only 43 referred to infections of the scalp with *M. canis* (n = 19/44.2%) and *T. mentagrophytes var. granulosum* (n = 13/30.2%) being the most prevalent aetiological agents.

**Eastern Europe**

**Poland**
From Poland, only a few reports from the Gdansk area are available.9,10 In a 12-year period (1984–1995), mycotic scalp infection accounted for 11.9% out of a total of 1195 patients affected by epidermomyocotic infections. During a following 3-year period from 1999–2001, tinea capitis, mainly caused by *M. canis*, was second with 30% in frequency of dermatophytoses in children aged 4–7 years at the same Department of the Medical University of Gdansk. In 2004 tinea capitis favosa caused by *T. schönleinii* was diagnosed in a 48-year-old female living in an urban area in the Bialystok district.11 Cure could be achieved successfully with oral griseofulvin, but a small area of permanent alopecia persisted.

**Mediterranean countries**

**Italy**
There are several reports on fungal scalp infection covering nearly the main areas of Italy (Siena, Turin, Pavia, Florence, the district of Cagliari in Sardenia and Rome). The zoophilic *M. canis* was most frequently isolated by all investigators. Between 1986 and 1995, 336 (aged 1 month–13 years, 8.2%) out of 4104 children seen at the Clinic of Dermatology in Cagliari were affected by tinea capitis, with *M. canis* being the most frequent causative agent (82.7%).12 A similar epidemiological pattern was observed in Siena in the time period from 1980 to 1998. *Microsporum canis* was isolated in 162 cases (90.5%) out of 181 patients (12.2%) suffering from tinea capitis. The main source of infection were the cats, which were often healthy carriers.13

At the Department of Dermatology of the University of Florence, 203 patients with tinea capitis were observed over a 9-year period (1985–1993). As in the other Italian areas, *M. canis* was the main causative agent, but interestingly, there were 12 cases of tinea capitis because of *T. violaceum* among African immigrants – a dermatophyte that was believed to have disappeared from Italy. One case was due to *E. floccosum*.14 Romano et al. [15] described from 1985 to 1997 in Tuscany 25 cases of tinea capitis because of *T. violaceum* (22 of them were children, all of African origin, ranging in age from 1 to 12 years). The Africans contracted the infection in their country of origin, therefore, the increase in cases of infection by *T. violaceum* in Italy is certainly linked to immigration. A survey on dermatophytoses observed in Rome between 1985 and 1993 again revealed *M. canis* as the most important dermatophyte.16

**Croatia**
As in Italy, an outbreak of *M. canis* infections was observed within the last decades in the Croatian population, although some differences exist between coastal parts (*M. canis*) and northern parts (Rijeka area) (*T. mentagrophytes*). In the southern parts of Dalmatia and in Split, tinea capitis accounted for 29% (383/1318) of all dermatophytoses found over a 7-year period (1996–2002) with *M. canis* (74%) being the most common cause of mycotic scalp infection.17 In the Rijeka area, 44% (320/724 cases) of dermatophytoses caused by *M. canis* between 1990 and 2001 were related to tinea capitis, with males being more commonly affected.18 In the majority of the cases, more than one child in a family was infected.

In contrast to this, recent investigation *M. canis* represented only 0.10% and 5.53% of isolated dermatophytes, respectively in the two previous periods of observation in Rijeka area (1957–1966 and 1974–1984). In the time period from 1990 until 2002, *M. canis* was the second most frequently isolated dermatophyte, with *T. mentagrophytes* being the most
common one. Currently, *M. canis* infections are increasing steadily, especially in the urban areas and their surroundings. Similar incidences were observed in other Croatian areas, such as Zagreb, Zadar and Med- jimruje.18

**Spain**

The epidemiological situation with tinea capitis in Spain is increasingly influenced by immigrants, mainly from the African continent. As with all European countries, data regarding the epidemiological pattern of causative agents are only sporadic; this means restricted to a certain geographical area. In a review of dermatophytooses in Galicia from 1951 to 1987, Pereiro-Miguens *et al.* [19] have reported a decline in tinea capitis since 1951 with *M. canis* having always been the most common agent and *T. scho¨nleinii* being only found between 1951 and 1959, but not afterwards.19 Among 190 cases with tinea capitis (age group most commonly infected 1–10 years) observed in Zaragoza between 1977 and 1997, the most frequent aetiological agents were *M. canis* (119/190) and *T. mentagrophytes* (57/190).20

In a prospective school survey in 10 000 unselected school children in Madrid from October 1994 to December 1996, dermatophytes could be detected in 52 (0.52%) children (including 13 immigrants from Africa), in whom 33 (0.33%) (including 10 immigrants from Africa) suffered from tinea capitis and 19 were scalp carriers. Almost half of the symptomatic cases were caused by *T. tonsurans* (12/33) and *M. canis* (16/33). *Trichophyton tonsurans* was the predominant species in the scalp carriers (13/19). There was a significantly higher occurrence of tinea capitis and of asymptomatic scalp carriers in the immigrant population from Africa.21 In contrast, a cross-sectional study of 1305 children (aged 3–15 years) conducted in an area with the highest immigrant population in Barcelona could only detect 3 (0.23%) children with tinea capitis, thus indicating a lower prevalence than expected in this population.22

**Greece**

Reports regarding the causative agents of tinea capitis in Greece reveal nearly the same pattern as in Italy. In a 15 year of investigation (1981–1995) in northern Greece, in a total of 559 children suffering from tinea capitis, 88% (494 strains) were caused by *M. canis*, followed by *T. violaceum* (*n* = 32; 6%) and *T. mentagrophytes* (*n* = 11; 2%). The majority of scalp infections was detected in boys (62%), with the age of the children affected ranging from 2 months to 14 years. Whereas the number of patients steadily increased over the years, the causative agents did not alter markedly in this time period.23

The same pattern of distribution with infectious agents in tinea capitis is seen in the greater Athens, where a total of 577 patients were diagnosed at the A. Sygros’ Hospital of Skin and Venereal Diseases between 1996 and 2001. Among these patients, 100 were immigrants from Balkans, the Near East and African countries. Zoophilic dermatophytes accounted for 86.5% (with *M. canis* isolated most often in 84.5%), followed by anthropophilic (12.4%; with *T. violaceum* 8.4%) and geophilic (1.2%; *M. gypseum*) dermatophytes. With respect to the anthropophilic dermatophytes, there is a substantial increase in the isolation rate of *T. violaceum*, attributed mainly to the influx of economic immigrants from countries where the infection is endemic.24 In Crete, Greece, 33/111 isolated *M. canis* infections showed involvement of the scalp over a 5-year period from 1994 to 1998.25 In contrast to other Mediterranean countries, the prevalence of *M. canis* infections has gradually decreased in recent years, possibly because of successful epidemiological measures (e.g. elimination of the reservoir of the infection, mainly straying cats).

**Turkey**

Data on the prevalence and the aetiological agents of tinea capitis from Turkey are scarce and incomplete, and mainly restricted to short periods of observation and distinct geographical areas. The majority of the investigations have been conducted in the southern and eastern parts (Anatolia) of Turkey. Tinea capitis favosa, which is caused by *T. scho¨nleinii*, has decreased in the second half of the 20th century but can still sporadically be found. Between February and April 2000, 34 cases out of 4760 school children living in Anatolia were clinically diagnosed with tinea capitis. Causative agents comprised *T. verrucosum* (five cases), *T. rubrum* (three cases), *T. mentagrophytes* (three cases), *M. canis* (three cases) and *T. tonsurans* (two cases).26 In two recent studies from Diyarbakir (*n* = 149 cases) and the Ceyhan district, Adana (*n* = 8 cases), the anthropophilic *T. violaceum* was isolated most frequently, followed by *M. canis*, *T. mentagrophytes*, and *T. verrucosum*. *T. tonsurans* and *M. gypseum* were only infrequently detected.27,28

**Western Europe**

**France**

The majority of reports on tinea capitis is based on surveys in the Paris suburbs.29–31 In general, there is a
rise in the number of anthropophilic tinea capitis, with *T. tonsurans* reaching epidemiological proportions (March 2001), *T. soudanense* (45% of 336 cases over an 11-year period from 1985 to 1995 in Creteil), and *M. audouinii* var. *langeronii*. The specific dermatophytes isolated are probably related to the increasing immigrant population of different ethnic origin. Despite the rise in anthropophilic scalp infections the extent of that development is not often recorded.

In Lorraine, tinea capitis is the most frequent dermatophyte infection in children in the 0- to 10-year age group. The vast majority of tinea capitis is because of zoophilic dermatophytes with *M. canis* remaining the most common agent isolated, less than one-third is caused by anthropophilic agents, such as *M. langeronii*, *T. violaceum*, *T. gourvilii* and *T. soudanense*. This epidemiological situation is quite different compared with studies conducted in other parts of France, where anthropophilic species (Paris area) are far more common.

**Belgium and the Netherlands**

In the Netherlands, 435 cases of tinea capitis were investigated for aetiological agents by Korstanje et al. [33] over a period of 30 years (1963–1993). There was a change in organisms from *T. schoenleinii* to *T. violaceum*, which may be partly due to increased immigration from the Mediterranean countries. In general, the authors reported an increase in tinea capitis caused by zoophilic dermatophytes, such as *M. canis*. As a consequence the zoophilic dermatophytes have supplanted the anthropophilic species.

In the Rotterdam area, the epidemiological situation seemed to be similar: in 64 children diagnosed with tinea capitis at the outpatient clinic of the University Hospital Sophia/Dijkzigt during the years 1977–1988, the pathogen most frequently isolated was *T. violaceum*, with *M. canis* ranking second. Sixty-one per cent of the patient population studied were children of immigrants of Moroccan descent. In 43% of the children, the clinical features were mild flaking without hair loss.34

Similar to the neighboring Netherlands, in 2001/2002 in a retrospective study of 122 children affected by tinea capitis in Brussels, the responsible pathogen was found to reflect immigration flows originating mostly in African countries Anthropophilic tinea capitis was found in 89.34% of the cases with the implicated anthropophilic dermatophytes being *M. langeronii* (39.34%), *T. soudanense* (28.69%), *T. violaceum* (18.03%) and *T. tonsurans* (3.28%).15

**United Kingdom**

As early as 1977, reports showed an increase in incidence of scalp ringworm in London schoolchildren.36 In addition, they noted the isolation of a greater variety of dermatophyte-spp. so far not indigenous in Britain, such as *T. soudanense*. Since 1993, several reports on a new pattern of infection with tinea capitis in the UK mainly from cities like London, Birmingham and Bristol were published. *Trichophyton tonsurans* was found to have become the predominant cause of tinea capitis in Birmingham, accounting for 72% of infections investigated.37 The majority of patients were of Afro-Caribbean descent (average age of 6.3 years).

In the following years, outbreaks of *T. tonsurans* infections were reported in south-east London.38–40 In a survey in 14 nursery, infant and junior schools in Lambeth carried out between March and June 1995, a total of 1057 school children were screened and a total of 26 children were found to be infected, and 56 to be asymptomatic carriers. In 71 different classes examined, the scalp infection rate ranged from 0 to 12% (mean 2.5%), and further 4.9% of children were scalp carriers of dermatophytes (range: 0–47%).38 According to the authors, the mechanism of spread to the UK remains speculative and the reasons for the emergence of *T. tonsurans* tinea capitis are as yet still unclear.

**Northern Europe**

**Sweden**

Regarding the epidemiological situation in Sweden, there is only one report from Stockholm, where the increasing prevalence as well as the changing pattern of causative organisms reflects immigration.41 In this study, all children up to 15 years of age diagnosed with tinea capitis during two 3-year periods, 1989–1991 and 1999–2001 seen at the Department of Dermatology/Karolinska Hospital Stockholm were enrolled. Whereas in the first period (1989–1991), only five children were diagnosed with tinea capitis (aetiological agents: *T. violaceum*: three cases, *M. canis*: one case; culture negative in one case), 92 children with mycotic scalp disorder were identified in the second period (1999–2001). The vast majority of the latter was of foreign descent (86%), most frequently from Africa (83%), especially Somalia (41%) and Eritrea (25%); only 5% were of Swedish parentage. The frequency of dermatophyte species among these children was predominated by anthropophilic species, with *T. violaceum* (68/92), *T. soudanense* (14/92) and *T. tonsurans* (92/92).
(3/92), followed by zoophilic species like T.verrucosum (9/92), M. canis (5/92) and T. mentagrophytes (1/92). Data from both 3-year-periods showed that the origin of the anthropophilic dermatophyte infection was in 62% linked to relatives of the child with the majority of siblings having been infected.

Discussion

In Europe, a change in the epidemiology and in the pattern of causative agents in mycotic scalp infection can currently be observed. Reflecting the data, there is an increase in anthropophilic infections mainly in urban areas, whereas M. canis still remains the most common actiological agent. These developments raise some questions concerning the causes and consequences.

M. canis emerging

Not only in the Mediterranean, but also in Western Europe the incidence of M. canis infection is rising steeply. The main reservoirs of this organism are not only cats and dogs, but also numerous different mammalian species may serve as endemic reservoir. Microsporum canis causes lifelong infections in these animals and appears to be in active evolution. Strains associated with particular animal species and colonial variants, especially in particular geographical areas, have been observed over the years. Without its animal reservoirs, M. canis cannot spread widely in the human population. It appears to lose virulence after about four human-to-human transmissions, and infection needs to be re-established by a new contact with an animal carrier.

The zoophilic species M. canis can be found worldwide, but its incidence seems to vary considerably. In most countries, where anthropophilic species have disappeared, infections caused by M. canis are on the rise. In the USA, M. canis, once the major agent of tinea capitis, has been superseded by T. tonsurans. In a 1997 European survey, conducted among 92 medical mycology laboratories across 19 European countries, M. canis was reported to be the most common organism with the highest incidence in the Mediterranean countries. The high contagiousity of M. canis and its different modes of transmission by humans, animals (infectious as well as carriers) and by fomites remain major problems. It has been presumed that domestic animals in large cities, especially stray cats are the most important carriers and transmitters of this zoophilic dermatophyte.
interdisciplinary cooperation between general practitioners, mycologists, veterinarians and dermatologists are strongly recommended.

References


