Tinea capitis in Iraq: laboratory results

H.I. Fathi[1] and A.M. Al-Samarai[2]

سعفة الرأس في العراق: نتائج استقصاء مخبري

هدى إبراهيم فتحي وعبد الغني محمد السمرائي

خلاصة: أجري استقصاء مدرسي على 4461 تلميذاً بالمدارس الابتدائية، أسفر عن تشخيص سعفة الرأس بالفحص السريري في 204 حالة من بينهم. وقد تم استزراع عينات من جميع الحالات، كما تم فحصها مجهرياً من أجل المقارنة بين صلاحية كل من الطريقتين. فاكتُشفت بالفحص المجهري 92 حالة إيجابية (45.1%) بينما كشفت المزارع عن 105 من الحالات (51.4%). ثم إننا استفردنا (عزلنا) العوامل المُمرضة المسبِّبة لسعفة الرأس في هذه العينة، وتعرّفنا على أنواعها. وتبيّن أنها تشمل الشعروية من نوع الثؤلولية (في 38 حالة) ومن نوع الحمراء (في 22 حالة) ومن نوع الدُقانية (في 12 حالة) ومن نوع الجازّة (في 11 حالة). ولقد كانت نتائجنا مماثلة لنتائج الدراسات المماثلة الأخرى.

ABSTRACT A school survey of 4461 primary-school children was carried out in which 204 cases of tinea capitis were clinically diagnosed. All cases were cultured and examined microscopically in order to compare the validity of the two methods. Microscopy detected 92 positive cases (45.1%), whereas culture detected 105 cases (51.4%). We also isolated and identified the species causing tinea capitis in our sample. These included *Trichophyton verrucosum (38 cases), T. rubrum (22 cases), T. mentagrophytes var. mentagrophytes (12 cases)* and *T. tonsurans* (11 cases). Our results are compared with other studies.

La teigne du cuir chevelu en Iraq: résultats d'examens de laboratoire

RESUME Une enquête scolaire a été menée auprès de 4461 écoliers du primaire, au cours de laquelle 204 cas de teigne du cuir chevelu ont été diagnostiqués cliniquement. Des cultures et un examen microscopique ont été effectués pour tous les cas afin de comparer la validité de ces deux méthodes: 92 cas positifs (45,1%) ont été détectés à l'examen microscopique et 105 cas (51,4%) à la mise en culture. Nous avons aussi isolé et identifié les espèces responsables de la teigne du cuir chevelu dans notre échantillon. Celles-ci étaient notamment *Trichophyton verrucosum* (38 cas), *T. rubrum* (22 cas), *T. mentagrophytes var. mentagrophytes* (12 cas) et *T. tonsurans* (11 cas). Nos résultats sont comparés à ceux d'autres études.

[1]*Department of Community Medicine;* [2]*Department of Medicine, Tikrit University College of Medicine, Tikrit, Iraq.*

Received: 30/12/97; accepted: 25/08/99

Introduction

Tinea capitis can be caused by any one of several of the dermatophytes belonging to the genera *Trichophyton* and *Microsporum*; the genus *Epidermophyton* is not known to invade the hair [*1*]. The fungi most frequently causing tinea capitis are *T. tonsurans, M. audouinii* and *M. canis*. The first two are spread from human to human, whereas *M. canis* is caught from animals such as cats and dogs [*2*]. *M. ferrugineum* and *M. gypseum* may occasionally cause ringworm of the scalp but the endothrix type such as *T. tonsurans* (blackdot ringworm) and *T. violaceum* are the most frequent invaders of the scalp [*1–3*]. Pipkin was among the first to recognize that *T. tonsurans* was beginning to replace *M. audouinii* in tinea capitis epidemics in the 1950s. Several other authors also found that *T. tonsurans* was becoming more common in scalp ringworm [*3*]. Arnold et al. reported that while *T. tonsurans* regularly affected adults (chiefly women), dermatophytes were almost always confined to children [*2*]. The ectothrix fungi found most frequently on the scalp and the main cause of kerion are *T. verrucosum* and *T. mentagrophytes*. Infection with *T. schoenleinii*, a relatively common dermatophyte in the Middle East, also occurs in South Africa and Greenland [*1,3–6*]. The classical presentation of tinea capitis due to this organism is known as favus. Although the initial infection is probably nearly always contracted in childhood, it shows little, if any, tendency to clear up spontaneously at puberty and families with several generations affected are often found [*2,3,7*].

The limited community-based epidemiological studies that have been conducted in Iraq have shown that dermatophytosis is the third most common infection encountered by dermatological practices after pyogenic and eczematous dermatoses. Akrawi and Rassam (1962) observed that the majority of cases of scalp infections were caused by *Trichophyton*, especially *T. violaceum* and *T. schoenleinii* and that *Microsporum* infections were uncommon [*8*]. Rahim (1966) observed that ringworm of the scalp continued to be a public health problem in Iraq; the main species isolated in his study were *T. schoenleinii, T. violaceum* and *T. mentagrophytes* [*7*]. In later studies, Junaid and Rassam (1974) and Gumer and Guirges (1978) found that *T. schoenleinii* was the main cause of infection and that *Microsporum* species were rarely encountered [*9,10*]. Yehia (1980) reported that tinea capitis was the second most common clinical type of dermatophytosis, followed by tinea corporis, with *T. shoenleinii, M. ferrugineum* and *T. verrucosum* being the main species causing tinea capitis [*5*]. In Basra, the main cause of tinea capitis has been reported to be *M. canis*, (83.3% of cases), followed by *T. violaceum* and *T. verrucosum* [*11*]. Al-Mosawi et al. found that 5% of apparently healthy children were carriers of dermatophytes in their scalp and the main species isolated was *T. mentagrophytes* [*12*].

As there have been no extensive studies on the epidemiology of tinea capitis among primary-school children in Iraq, we assessed the validity of microscopical examination tests in relation to the culture method of examination and isolated and identified the species causing tinea capitis in a community field-based study.

Subjects and methods

Study population

Two groups of schools were chosen; the first group from urban areas and the second from differing rural areas in the vicini-

ty of Tikrit. Three boys' schools, three girls' schools and two large mixed schools were randomly selected from five urban areas of Tikrit (Al-Meddar, Al-Asry, Al-Gameya, Al-Askary and Al-Kadiseya). Six schools from four rural villages were chosen; one boys' school and one girls' school from Al-Door (chosen because the area had overcrowding), a boys' school and girls' school from Mekishifa and mixed schools from both Owenate and Albo-Ageel (all three areas chosen because of their poor water supply). Data were collected between September 1994 and April 1995.

The children studied were schoolchildren aged between 6 years and 16 years. All the students in each school were examined. The entire scalp of each child was thoroughly examined for evidence of scaling, crusting, follicular inflammation, hair loss or erythema. Other parts of the body (nails, hands, chest and legs) were examined for any evidence of scaling or erythema. In each clinically diagnosed case of tinea capitis, a detailed history was recorded. Information noted was: disease duration, home address, socioeconomic status and the level of crowding at home. Students were questioned about their use of soap and the existence of potentially contagious contacts (including contact with animals and the history of certain practices such as sharing towels, combs and hats). Family history was recorded and personal hygiene taken into consideration.

Sample collection

In all suspected cases, hair and scales were collected for mycological examination by a conventional technique. Scale scrapings were collected from at least two areas with a number 15 sterile surgical blade and approximately twelve hair stumps (roots) were pulled out with sterile epilator forceps. Both hairs and scales were placed in a clean, labelled envelope and sent to the laboratory for investigation.

Laboratory procedures

Three or four hairs were mounted on a clean slide in a drop of 25% potassium hydroxide solution with Parker ink, then covered with a 22 × 22 mm cover slip. The slide was heated gently for a few seconds to digest the keratin and clear the fungal elements. The slide was examined under low and high lens magnification for the presence of spores and/or hyphae and their distribution pattern (ectothrix, endothrix or favic type). The size and distribution of spores on the hair can provide information about the species of dermatophyte.

All samples from suspected cases were cultured irrespective of the negative or positive examination result. Each sample was cultured on two plates of Sabouraud agar, one with penicillin and streptomycin or chloramphenicol and cycloheximide, and the other with penicillin, streptomycin or chloramphenicol.

The agar was inoculated by transferring some of the hair stubs and scales to the surface of the medium using a sterile straight loop and forceps. The inoculated plates were then incubated for 4–6 weeks at 28–30 °C, except in cases of suspected infection by *T. verrucosum* when it is best accomplished at 37 °C. The cultures were examined periodically for evidence of growth. Negative or contaminated plates were repeatedly reinoculated until a positive finding was established. After the growth of the dermatophytes was established, a subculture was made on Sabouraud dextrose agar for further identification.

Identification

Species were identified using a conventional method which emphasized colony morphology, microscopy and other

miscellaneous tests. Cultures were examined macroscopically for morphology, texture and colour from the top and reverse side of the plate. Then using a sterile straight loop the colony was examined by placing a sample on a drop of lactophenol solution on a clean glass slide. The matted mycelial mass was teased or separated with dissecting needles to facilitate microscopical observation. The preparation was then covered by a cover slip (22 × 22 mm) and examined under the microscope for the presence of microconidia, macroconidia and other structures. Every positive growth obtained was subcultured on two Sabouraud plates, one with added yeast and the other with added sodium chloride. The inoculated plates were incubated for 2 weeks at 28 °C to further stimulate the chlamydospores. After identification was completed the plates were kept refrigerated at 4 °C for a maximum period of 1 month.

In vitro hair perforation by certain dermatophytes was used for further species identification. This test was used to differentiate certain species of *T. mentagrophytes* which can penetrate hair *in vitro* from *T. rubrum* which cannot. This simple procedure involved the use of baby hair in Petri dishes to which 25 mL of sterile distilled water and 2–3 drops of 10% sterilized yeast extract were added. Several colony fragments served as inoculum and the inoculated dishes were incubated in the dark at 25 °C. After 3 weeks of incubation, hair segments overgrown with mycelium were removed from the dishes with sterile forceps, placed in a drop of lactophenol cotton blue mounting fluid and examined under the microscope. Penetrated hair segments were identified by wedge-shaped perforations.

Corn meal agar tests and potato dextrose agar tests were used to differentiate *T. rubrum* and *T. mentagrophytes;* the first showing deep pigmentation and the second no pigmentation.

Results

Of a total of 4461 students, 2333 were from urban areas and 2128 from rural areas; 2364 were male and 2097 were female. Of these, 204 children (126 males and 78 females) were provisionally diagnosed with tinea capitis. Mycologically proved infection was found in 120 cases, 82 male and 38 female. The overall prevalence rate was 2.7%; the urban prevalence rate 2.4% and the rural rate 3.0%. The rate for males was 3.5% and for females 1.8%.

Of the 120 proven cases, 15 (12.5%) were found to be positive by direct microscopic examination only, 28 (23.3%) by culture only and 77 (64.2%) positive by both techniques (Table 1). Culture methods detected 105 cases (51.4%) among the 204 provisionally diagnosed children, while the microscopic method revealed only 92 positive cases (45.1%). The sensitivity and specificity of direct microscopical examination to culture examination was 73.3% and 84.8% respectively. The positive predictive value was 83.6% and the negative predictive value 75.0% ($P < 0.05$).

Among the isolated dermatophytes, *T. verrucosum* was the predominant species, found in 38 cases (36.2%), followed by 22 cases of *T. rubrum* (20.9%), 12 of *T. mentagrophytes variant metagrophytes* (11.4%), 11 of *T. tonsarans* (10.5%), 8 of *M. audouinii* (7.6%), 5 of *T. mentagrophytes variant interdigitale* (4.8%), 3 of *T. violaceum* (2.9%) and 6 cases (5.7%) which were unidentified. Of all the identified dermatophytes, 50 (47.6%) were zoophilic and 49 (46.7%) were anthropophilic (Table 2).

Table 1 **Results of direct examination of the cultures of 120 cases of tinea capitis**

Culture	Direct examination		Total
	Positive	Negative	
Positive	77	28	105
Negative	15	84	99
Total	92	112	204

We observed that *T. verrucosum* was the slowest growing dermatophyte and *T. rubrum* the fastest. The assocation between the cultures isolated and the clinical variants of tinea capitis are shown in Table 3. Most of the species isolated were of the seborrhoid type, including all cases of infection with *T. rubrum*. The condition known as grey patch was the result of infection with *T. verrucosum* and *M. audouinii* and kerion was caused by *T. verrucosum* and *T. mentagrophytes*. All cases of black dot were caused by *T. tonsurans* and favus mainly caused by *T. violaceum* infection. The distribution of species by urban and rural residence and according to sex is shown in Table 4. Zoophilic species (*T. verrucosum* and *T. mentagrophytes var. mentagrophytes)* were mainly isolated in rural areas. In contrast, anthropophilic species, (*T. rubrum, M. audouinii, T. mentagrophytes var. interdigitale* and *T. violaceum*) were predominantly isolated in urban areas. *T. tonsurans* was the only anthropophilic species encountered in rural areas.

Discussion

The initial diagnosis of tinea capitis may depend on clinical features. However, clinical judgement alone is unsatisfactory since frequent mistakes in clinical diagnoses result from cases of dermatoses that mimic tinea capitis clinically. In our study, 120 positive cases were detected by mycological methods, only 58.8% of the total suspected cases. Out of these 120 cases, 15 (12.5%) were incompletely identified because of a negative culture growth. The possible reason for negative culture growth from microscopically positive samples may be that highly contaminated samples were grown over by fast growing saprophytic species which prevented the growth of dermatophytes even on a medium with cycloheximide [*13*]. On the other hand, our finding of 28 (13.7%) positive cases with negative results from direct examination and positive culture results has also been observed by others [*3,5*]. Munro suggested that the hair shaft may be obscured by melanin granules in black-haired patients leading to negative microscopical findings, (FM Munro personal communication, 1995). Eighty-four

Table 2 **Isolation frequency (%) of organisms causing tinea capitis**

Species	No.	%
Zoophilic		
Trichophyton verrucosum	38	36.2
T. mentagrophytes var. mentagrophytes	12	11.4
Anthropophilic		
T. rubrum	22	20.9
T. tonsurans	11	10.5
Microsporum audouinii	8	7.6
T. mentagrophytes var. interdigitale	5	4.8
T. violaceum	3	2.9
Unidentified	6	5.7
Total	105	100

Table 3 **Clinicoetiologic correlation in cases of tinea capitis**

Type of infection	Clinical type					Total
	Seborrhoid	Grey patch	Kerion	Black dot	Favus	
Trichophyton verrucosum	29	6	3	0	0	38
T. rubrum	22	0	0	0	0	22
T. mentagrophytes	14	0	3	0	0	17
T. tonsurans	6	0	0	5	0	11
Microsporum audouinii	4	4	0	0	0	8
T. violaceum	1	0	0	0	2	3
Unidentified	3	2	0	0	1	6
Total no. (%)	79 (75.2)	12 (11.4)	6 (5.7)	5 (4.8)	3 (2.9)	105 (100)

Table 4 **Distribution of positive culture according to sex and residence**

Type of infection	Urban area		Rural area		Total
	Male	Female	Male	Female	
Trichophyton verrucosum	9	4	16	9	38
T. rubrum	10	3	7	2	22
T. mentagrophytes	9	0	7	1	17
T. tonsurans	0	1	6	4	11
Microsporum audouinii	3	2	3	0	8
T. violaceum	1	1	0	1	3
Unidentified	0	1	2	3	6
Total	32	12	41	20	105

suspected cases (41.2%) gave negative culture and microscopy results. These negative results could be due to the absence of dermatophytes or to the inadequacies of the isolation technique. In such cases the presence of antifungal agents in the sample will give a negative result [*3,5*].

It was interesting to observe the accuracy of clinical evaluations compared with the cultural and microscopical examination results. The results should be interpreted with caution, especially as some of the children with a negative mycological result were still clinically judged to be infected. It could be concluded that culture growth is the best assessment method as the yield of fungal isolation was higher than that revealed by direct examination.

The tests used for verification identified six species from the anthropophilic and zoophilic groups. Species of the genus *Trichophyton* were responsible for the majority of cases of tinea capitis, a finding which concurs with other studies [*3–5*]. *T. verrucosum* causes an inflammatory mycosis seen chiefly in rural communities and although children are particularly vulnerable, several members of a family may be affected. It is believed that the most common of the *Trichophyton* species causes kerion, an inflammatory skin infection in hairy areas.

T. verrucosum

The most common species we found was *T. verrucosum* (36.2%). It was isolated from 29 seborrhoid cases, 6 cases of grey patch and 3 cases of kerion. The cases of kerion were detected in three Egyptian sisters in an urban school. On careful examination multiple inflammatory lesions over the occipital area were observed. They reported a history of continuous contact with rabbits and that the infection had been present for more than 6 months. Although human infection due to *T. verrucosum* is usually confined entirely to rural populations, infection in laboratory employees working with rabbits and white mice has been recorded. It would seem that the higher rate of infection among the rural population found in this study was due to cattle and other domestic animals being housed beside or within the same building as the children. Continuous close contact between humans and animals facilitates the contagion and the 13 urban cases reflect the fact that people have more contact with animals in their homes than before.

Finding *T. verrucosum* to be the main eitiological cause of tinea capitis concurs with other studies. Kolemen found it to be the main cause of tinea capitis (36.1%) in Ankara and that all sources were isolated from rural areas [*4*]. Chadegani et al. estimated that tinea capitis was the most common form of dermatophytoses (72.1%) and that *T. verrucosum* was the most frequent dermatophyte (43.8%) isolated from patients with tinea capitis in Isfahan [*6*]. In a later study in the Islamic Republic of Iran between 1986 and 1991, Khosravi et al. isolated 472 cases of *T. verrucosum* infection from 2790 cases of tinea capitis [*14*]. *T. verrucosum* was the second most common organism found in the United Arab Emirates and Puerto Rico [*15,16*]. In Pakistan it was the third most common source of tinea capitis with lower isolation rates than those reported for the United Arab Emirates, areas in Saudi Arabia and Florence [*15,17–19*]. In previous studies in Iraq, Yehia [*5*] estimated that it was isolated in 14.3% of tinea capitis cases in Mosul, and Al-Mosawi et al. [*12*] isolated 4 cases of *T. verrucosum* from 20 cases of dermatophyte carriers in primary-school children in Basra. Junaid and Rassam found the prevalence of *T. verrucosum* in Baghdad to be 3.2% and Al-Hashimi's findings in Basra were of 3.1%; both considerably lower than our findings [*9,11*].

Up to the mid-1970s, *T. verrucosum* was the most important dermatozoonoses causing 60%–70% of tinea capitis cases. Farmers raising cattle were frequently infected but the mechanization of farming has significantly reduced *T. verrucosum* as a cause of tinea capitis [*20*]. Our study population, however, present a different picture as contact with cattle continues, even in urban areas.

T. rubrum

Trichophytosis due to *T. rubrum* is a many faceted disease characterized by a low-grade inflammatory reaction and includes

what is commonly known as chronic dermatophytoses; curing it is characteristically difficult. *T. rubrum* is considered the most common anthropophilic species worldwide found in crural pedal disease and often in tinea corporis [*1,4,21*].

In our study *T. rubrum* was the second most common etiological agent causing tinea capitis (20.9%). Males were three times more likely to be infected with *T. rubrum* than females and the species was predominantly encountered in urban schools. The cases isolated included three Kuwaiti brothers and two Egyptian sisters. *T. rubrum* has also been reported as the second most common cause of tinea capitis in the United Arab Emirates (19%) and in Pakistan (21.7%) [*15,17*]. However, *T. rubrum* in tinea capitis is relatively rare worldwide, although there are reports from Germany, India, the Islamic Republic of Iran and Portugal, which document significant isolation rates [*1,3,14,20*].

Lower levels than ours have been reported by Woodgyer in New Zealand (2.5%), Mercantini and Moretto in Italy (1.7%) and Khosravi et al. in the Islamic Republic of Iran (0.5%) [*14,22,23*]. One survey of more than 16 000 patients revealed only 139 tinea capitis cases caused by *T. rubrum*, and tinea capitis caused by *T. rubrum* does not seem to be increasing worldwide with frequencies of between 1%–10% [*24*].

Previous studies in Iraq have indicated an absence of *T. rubrum*, except for one study by Junaid and Rassam who reported that it constituted 1.9% of all their isolates [*9*].

T. mentagrophytes

T. mentagrophytes is a major type of superficial fungal infection. Like *T. verrucosum*, this fungus is associated with highly inflammed lesions and kerion-type scalp infections. It is frequently encountered in the skin of healthy laboratory animals and Torres-Rodriguez et al. reported that *T. mentagrophytes* was responsible for 77% of dermatophytic lesions among staff working with infected farm rabbits in Spain [*1,25*].

T. mentagrophytes was the third most common species we encountered (16.2%). It was isolated from 14 seborrhoeic cases and three cases of kerion. There were 16 males and 1 female infected in urban schools, including 6 Kuwaiti children. It should be noted that familial infection with *T. mentagrophytes* may occur. Comparable results were reported by Gumer and Guirges (17.2%) and *T. mentagrophytes* was the predominant species isolated from the healthy scalps of children in two primary schools in Basra [*10,12*]. Our finding that *T. mentagrophytes* was the third most frequently isolated species in patients with tinea capitis has also been reported by Rahim in Baghdad (2.7%) [*7*].

According to Ajello, *T. mentagrophytes* is one of the most polymorphic dermatophytes. It exists in two principal forms, a zoophilic powdery variety (*T. mentagrophytes var. mentagrophytes*) that is transmitted from animals to humans, and a downy variety (*T. mentagrophytes var. interdigitale*) which has human to human transmission (L. Ajello, personal communication, 1995). Since some isolates of *T. mentagrophytes var. mentagrophytes* produce a red pigment and thus may be misidentified as *T. rubrum*, perforation of hair *in vitro* is used to differentiate between them. Of the 17 isolates of *T. mentagrophytes*, 12 were diagnosed as *T. mentagrophytes var. mentagrophytes* and all the children infected with this variety had a history of contact with animals. The remainder were diagnosed as *T. mentagrophytes var. interdigitale*.

T. tonsurans

Tinea capitis due to the anthropophilic species *T. tonsurans* has become a significant health problem worldwide. It was responsible for the secondary epidemic of tinea capitis which began in the 1970s and it continues to spread [*1,17,26*].

In our study *T. tonsurans* was the fourth most commonly isolated dermatophyte, accounting for 10.5% of the total isolates. It was detected in six seborrhoeic cases and five cases of black dot. *T. tonsurans* can be found in all members of a family [*26*]. For example, we found eight related children from the mixed school in Owenate with chronic infection. If untreated, non-inflammatory *T. tonsurans* may persist for long periods of time, unlike inflammatory tinea capitis which tends to be acute but self-limiting [*1*].

Preliminary studies in Iraq found *T. tonsurans* to constitute 6.5% of cases (reported by Gunaid and Rassam) and 3.5% of cases (reported by Gumer and Guirges) [*9,10*]. The percentage found in surrounding countries has also been low; 2.8% in Turkey and 3.7% in the Islamic Republic of Iran [*4,14*]. By comparison, in the United States of America in the early 1980s, *T. tonsurans* was responsible for 90% of tinea capitis in Brooklyn, Charleston and Philadelphia, and for 98% of tinea capitis in Chicago [*1*]. Many American researchers consider that this type of dermatophyte may have spread from Hispanic immigrants to the African–American population in cities in the United States [*1*]. In common with other reports, we found no significant difference between males and females [*1,22*].

M. audouinii

M. audouinii was the only *Microsporum* species isolated in this study. *M. audouinii* was the main cause of tinea capitis epidemics in the 1940s and 1950s, typically in Caucasian boys [*1*]. Unlike infection with *T. tonsurans*, a spontaneous cure at puberty is more likely to occur with *M. audouinii*. In our study, it represented 7.6% of total isolates, although it has not previously been reported in Iraq. It was found to be the main cause of tinea capitis among schoolchildren in Ile-Ile and *M. audouinii* and *T. soudanense* were reportedly isolated from 374 primary-school children in North and South Togo [*1,3*].

The fungus was identified from four typical cases of grey patch and four seborrhoeic cases. The male to female ratio in our study was 3:1 and the fungus was found to be more prevalent among immigrants from Egypt and Kuwait. Similarly, *M. audouinii* reportedly constituted 23.3% of isolated cases found among African immigrants from western, tropical Africa [*3*].

T. violaceum

T. violaceum is widely distributed throughout the world and is a common cause of scalp infection [*3,13,17*]. This fungus has been responsible for epidemics of tinea capitis in Africa and in some areas as many as 41% of schoolchildren without symptoms are carriers and 30% of mothers show positive cultures [*1*]. *T. violaceum* was our least commonly encountered dermatophyte (2.9%); it was detected in two favic cases and one seborrhoeic case. It can cause favus and may appear as heavy dandruff [*2*]. *T. violaceum* has been reported in all previous studies on tinea capitis in Iraq, but was usually more prevalent. For example, the following prevalence rates have been reported: Rahim (21.3%), Junaid and Rassam (17.1%), Yehia (10.5%), and Al-Hashimi et al. (12.3%) [*5,7,9,11*]. Al-Mosawi et al. isolated eight cases in dermatophyte carriers in two primary schools in Basra [*12*]. Our findings were more in

agreement with Mercantini and Moretto who found that *T. violaceum* was the cause of 2.1% of all cases of tinea capitis in Rome [*23*]. The explanation for the low prevalence of this fungus may be attributed to its physiological characteristics. It has been found that it is difficult to obtain a characteristic colony during the winter months [*3*]. Certain species of dermatophytes experience spontaneous mutation, causing them to lose the ability to form conidia. This is known as a pleomorphism and occasionally these organisms may be isolated in such a condition as to make them almost impossible to identify, with only white, fluffy mycelium visible [*27*]. This phenomenon is not reversible [*3*].

Unidentified

Finally, in our study six isolates were unidentified. They were obtained from three seborrhoeic cases, two cases of grey patch and one favic case. Of these cases, one resembled *M. ferrugineum* and another resembled *M. canis*. However, despite repeated subculturing, we were unable to confirm these findings. Unidentified fungi have also been reported by other researchers [*7,15*].

References

1. Fitzpatrick TB et al. eds. *Dermatology in general medicine*, 4th ed. New York, McGraw–Hill, 1993.
2. Arnold HL, Odom RB, James WD. *Andrew's diseases of the skin*, 8th ed. Philadelphia, WB Saunders Company, 1990.
3. Rook A, Savin JA, Wilkinson DS, eds. *Textbook of dermatology*. Oxford, Blackwell Scientific Publications, 1986.
4. Kolemen F. Dermatophytic flora of Ankara (Turkey). *Dermatologia*, 1981, 162(4):260–4.
5. Yehia MM. *Studies on dermatophytes in Mosul and vicinity* [Thesis]. Mosul, University of Mosul, College of Medicine, 1980:48–106.
6. Chadegani M et al. A study of dermatophytoses in Esfahan (Iran). *Mycopathologia*, 1987, 98(2):101–4.
7. Rahim GF. A survey of fungi causing tinea capitis in Iraq. *British journal of dermatology*, 1966, 78(4):213–8.
8. Akrawi F, Rassam KH. Species of fungi which cause ringworm of the scalp in Iraq with a study of the action of griseofulvin on them *in vitro*. *Journal of the Faculty of Medicine, Baghdad*, 1962, 4(1):23–5.
9. Junaid AJ, Rassam KH. Species of fungi causing dermatomycosis in Iraq. *Iraqi medical journal*, 1974, 22:38–40.
10. Shaikh Gumar AW, Guirges SY. Survey of etiological agents of fungal infections of the skin. *Journal of the Faculty of Medicine, Baghdad*, 1978, 20:19–29.
11. Al-Hashimi JM, Hussain I, Nair BK. Tinea capitis in Basrah, an exploratory study. *Medical journal of Basra University*, 1980, 2:107–19.
12. Al-Mosawi T, Al-Affas NH, Al-Ramahyi AK. The incidence of scalp fungal infestation among primary pupils in Basra city. *Journal of community medicine*, 1993, 6(1):31–6.

13. Al-Fouzan A, Nanda A, Kubec K. Dermatophytoses of children in Kuwait: a prospective study. *International journal of dermatology*, 1993, 32(11):798–801.

14. Khosravi AR, Aghamirian MR, Mahmoudi M. Dermatophytosis in Iran. *Mycosis*, 1994, 37(1–2):43–8.

15. Lestringant GG, Qayed K, Blayney B. Tinea capitis in the United Arab Emirates. *International journal of dermatology*, 1991, 30(2):127–9.

16. Ross S et al. Epidemiological study of tinea capitis in Puerto Rico. *Puerto Rico health sciences journal*, 1993, 12(4):287–9.

17. Hussain I et al. Tinea capitis in Lahore, Pakistan. *International journal of dermatology*, 1994, 33(4):255–7.

18. Venugopal PV, Venugopal TV. Tinea capitis in Saudi Arabia. *International journal dermatology*, 1993, 32(1):39–40.

19. Flammia M, Vannini P, Difonzo EM. Tinea capitis in Florence between 1985 and 1993. *Mycoses*, 1995, 38(7–8):325–8.

20. Korstanje MJ, Staats CG. Tinea capitis in northwestern Europe 1963–1993. Etiologic agents and their changing prevalence. *International journal of dermatology*, 1994, 33(8):548–9.

21. Manzano-Gayosso P et al. Dermatophytoses in Mexico city. *Mycoses*, 1994, 37(1–2):49–52.

22. Woodgyer A. *Trichophyton tonsurans* infections in New Zealand. *Mycoses*, 1993, 3:1–15.

23. Mercantini R, Moretto D. Epidemiology of tinea capitis in Rome. *Mycologia dermatologia*, 1994, 8:83–8.

24. Anstey A, Lucke TW, Philpot C. Tinea capitis caused by *Trichophyton rubrum*. *British journal of dermatology*, 1996, 135(1):113–5.

25. Torres-Rodriguez JM et al. Incidence of dermatophytoses in rabbit farms in Catalonia, Spain, and its repercussion on human health. *European journal of epidemiology*, 1992, 8(3):326–9.

26. Vargo K, Cohen BA. Prevalence of undetected tinea capitis in household members of children with disease. *Pediatrics*, 1993, 92(1):155–7.

27. Al-Doory Y. *Laboratory medical mycology*. Philadelphia, Lea and Febiger, 1980.