

# Ringworm of the scalp in primary-school children in Alexandria: infection and carriage

A.A. Omar<sup>1</sup>

سفعة الرأس بين تلاميذ المدارس الابتدائية في الإسكندرية: حالات العدوى والحالات الحاملة

عبير علي عمر

**خلاصة:** تم فحص 510 تلميذاً بمدرسة ابتدائية في الإسكندرية بحثاً عن سفعة الرأس، وأخذت عينات من فروات رؤوسهم. وتم فحص العينات بالفحص المجهرى المباشر كما تمت زراعتها. واعتمد التشخيص على نتائج الفحص السريري والفطري. ولقد وجدت بيئات سريرية على وجود قمل الرأس في 54.1% من الأطفال مع زيادة الانتشار بين الإناث. وقد تم عزل الفطريات الجلدية من 7.4% من عينات القروة (2.9% حالات مؤكدة و4.5% حالات حاملة). وكانت هناك نسبة أخرى من الحالات (2%) محل الاشتباه نظراً لأنها كانت سلبية بالفحص الفطري. لقد كان معظم الأطفال دون العاشرة من العمر، ولم يكن أحد منهم يدري أنه مصاب بالعدوى. ولقد شُخصت المُستفردات جميعها بأنها فطريات شعروية بنفسجية. وأسفرت طريقة إرساء العينات في هدر كسيد البوتاسيوم عن معدل انتشار أعلى من نتائج المزرعة بدرجة إحصائية يتعد بها. ومن جهة أخرى أعطت الطريقتان على السواء معدلات انتشار أعلى في الحالات المؤكدة عنها بين الحالات الحاملة.

**ABSTRACT** A total of 510 children from a primary school in Alexandria were examined for tinea capitis, and samples were taken from their scalps. Specimens were examined by direct microscopy and were cultured. Diagnosis was by clinical and mycological findings. Clinical evidence of pediculosis capitis was found in 54.1% of children, more commonly in girls. Dermatophytes were isolated from 7.4% of scalp samples (2.9% confirmed cases, 4.5% carriers). A further 2% were suspected cases as they were negative by mycology. Most of the children were under 10 years and none was aware of having the infection. All isolates were identified as *Trichophyton violaceum*.

## La teigne tondante chez des écoliers du primaire à Alexandrie: infection et portage

**RESUME** Au total, 510 enfants d'une école primaire à Alexandrie ont été examinés à la recherche de la teigne tondante microscopique et des échantillons ont été prélevés sur leur cuir chevelu. Les échantillons ont été examinés par microscopie directe et mis en culture. Le diagnostic a été effectué à l'aide des résultats cliniques et mycologiques. Des arguments cliniques de pédiculose de la tête ont été trouvés chez 54,1% des enfants, plus couramment chez les filles. Des dermatophytes ont été isolés dans 7,4% des échantillons de cuir chevelu (2,9% de cas confirmés, 4,5% de porteurs). Deux autres pour cent (2%) étaient des cas suspects étant donné qu'ils étaient négatifs à la mycologie. La plupart des enfants étaient âgés de moins de 10 ans et aucun n'était conscient d'être infecté. Tous les isolats ont été identifiés comme *Trichophyton violaceum*.

<sup>1</sup>Department of Microbiology, High Institute of Public Health, University of Alexandria, Alexandria, Egypt.  
Received: 26/10/99; accepted: 21/05/00

## Introduction

*Tinea capitis* is a common superficial fungal infection found throughout the world [1]. It occurs primarily in prepubertal children over the age of 6 months [2]. It is highly contagious and represents a significant public health problem, particularly among schoolchildren [2].

Most infections are caused by the spread of anthropophilic dermatophyte species leading to endemic or epidemic disease. Zoophilic species may be spread by infected animals, causing sporadic infection. Some individuals have symptomatic infection while others are asymptomatic carriers of the disease [2]. The lack of symptoms means that carriers remain an untreated reservoir in close association with the uninfected population [3]. The clinical manifestations of *tinea capitis* range from non-specific, self-limiting scaling lesions to widespread scarring alopecia [4].

Outbreaks appear to be caused by indirect spread via external agents (combs or hairdressers' equipment) or by person-to-person transmission in overcrowded conditions, for example in schools or refugee camps [5].

The disease is one of the most prevalent dermatomycoses in Egypt and represents a major public health problem in children of school age. The aim of the present study therefore was a mycological assessment of primary-school children to estimate the prevalence of ringworm scalp infection and carriage.

## Participants and methods

All pupils enrolled in a junior school in Kom El-Shokafa, Alexandria were included in the study. The school is located in a poor and crowded area of Alexandria. The total number of children investigated was 510.

A questionnaire recording the name, age, sex, school class, address and self-awareness of scalp infection was given to each child. Data on symptoms (itching and hair loss) and signs (scaling, alopecia, loss of hair lustre, grey patches, pustules and evidence of pediculosis capitis) were noted. A presumptive clinical diagnosis of *tinea capitis* was made on the basis of the presence of at least two clinical signs suggestive of the disease.

The scalp of each child was sampled by scraping its four quadrants with a sterile scalpel blade. Specimens were collected into small sterile Petri dishes [6]. Specimens were examined by direct microscopy using 10% potassium hydroxide (KOH) and cultured on Sabouraud dextrose agar with and without cyclohexamide [7]. Cultures were incubated at 27 °C and examined twice weekly for up to 6 weeks before being discarded as negative. The isolated dermatophytes were identified by their gross and microscopic morphology [6,7].

After mycological investigation, children were classified according to the combined clinical and mycological findings as either confirmed cases, suspected cases, carriers or healthy subjects. Confirmed cases were children who were positive by both clinical and mycological diagnosis (positive microscopy and/or culture). Suspected cases were children with a positive clinical diagnosis but with negative mycological confirmation. Carriers were children with no clinical evidence of infection but with positive mycological confirmation [5].

## Results

The total number of children enrolled in the present study was 510. Their ages ranged from 6.5 years to 11 years; 250 (49.02%)

were male, 260 (50.98%) female, giving a male to female ratio of 1:1.04.

Clinical evidence of pediculosis capitis was present in 276 (54.1%) of the children examined, with more infestation in females than males [191 (69.2%) and 85 (30.8%) respectively].

According to the combined clinical and mycological classification 15 (2.9%) were confirmed cases, 23 (4.5%) were carriers, 10 (2.0%) were suspected cases, and 462 (90.6%) were healthy.

None of the diagnosed children was aware they had the disease. The school health authority had not diagnosed any cases of tinea capitis among the children investigated.

According to clinical diagnosis alone, 25 cases (4.9%) were considered to be tinea capitis; 15 of these were mycologically proven and confirmed as cases (Figures 1-3), while 10 were mycologically negative and classified as suspected cases. The positive predictive value of the clinical diagnosis was therefore 60%. In contrast, of 485 children with no clinical evidence of tinea capitis, 23 were identified as carriers by

mycology, while 462 were mycologically negative and classified as healthy. The absence of clinical evidence of tinea capitis therefore had a negative predictive value of 95.3%.

All the confirmed cases were positive by KOH examination, while culturing gave



Figure 1 Clinical picture of tinea capitis

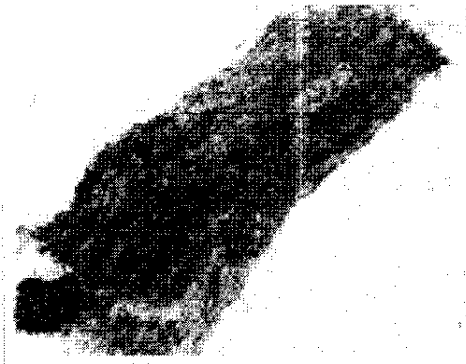


Figure 2 Potassium hydroxide examination of hair showing endothrix pattern of hair invasion

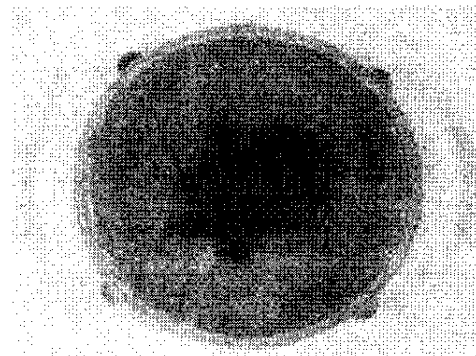


Figure 3 Culture of *Trichophyton violaceum* on Sabouraud dextrose agar

a lower prevalence (9 cases, 60.0%). Of the 23 carriers, 19 (82.6%) were KOH-positive and only 5 (21.7%) were positive by culture. Both KOH and culture gave a higher prevalence in confirmed cases than in carriers, although significance was achieved only in the culture results (Tables 1 and 2). Overall, KOH gave significantly higher positive results than did culture in the 38 mycologically proven cases (confirmed and carriers) (Table 3). All the dermatophytes isolated were *Trichophyton violaceum*.

Of the confirmed cases, 10 (66.7%) were male and only 5 (33.3%) were female. Of the carriers, 15 (65.2%) were male and 8 (34.8%) were female. In contrast, 7 of the suspected cases (70%) were female. The sex difference was not statisti-

cally significant (Table 4). Most of the confirmed and suspected cases and carriers (38, 79.2%) were less than 10 years old. Scaling was the most frequent clinical lesion recorded, present in 100% of confirmed cases, in 8 (80%) of suspected cases and in 8 (34.8%) classified as carriers.

## Discussion

Ringworm of the scalp is a common dermatophyte infection that constitutes an important public health problem among children worldwide, including Egypt [8,9]. The disease remains endemic in Egypt, largely because of lack of information on its prevalence and carrier rate and the absence of control measures.

**Table 1 Distribution of confirmed cases and carriers according to the results of potassium hydroxide (KOH) examination**

Test	Confirmed cases		Carriers	
	No.	%	No.	%
KOH +ve	15	100	19	82.6
KOH -ve	0	0	4	17.4
Total	15	100	23	100

Fisher exact probability test, one-tailed = 0.120 (non-significant).

**Table 2 Distribution of confirmed cases and carriers according to culture results**

Test	Confirmed cases		Carriers	
	No.	%	No.	%
Culture +ve	9	60.0	5	21.7
Culture -ve	6	40.0	18	78.3
Total	15	100	23	100

$\chi^2_1 = 5.71$ ,  $P = 0.017$  (significant).

**Table 3 Distribution of mycologically proven cases according to results of mycological tests**

Culture	Potassium hydroxide				Total	
	+ve		-ve		No.	%
	No.	%	No.	%		
+ve	10	71.4	4	28.6	14	36.8
-ve	24	100	0	0	24	63.2
Total	34	89.5	4	10.5	38	100

McNemar test = 12.89,  $P = 0.00033$  (significant).

**Table 4 Distribution of confirmed and suspected cases and carriers according to sex**

Sex	Confirmed		Suspected		Carriers	
	No.	%	No.	%	No.	%
Male	10	66.6	3	30	15	65.2
Female	5	33.3	7	70	8	34.8
Total	15	100	10	100	23	100

$\chi^2_2 = 4.18$ ,  $P = 0.124$  (non-significant).

In the present study, an attempt was made to confirm dermatophyte infection and carriage on the scalp by mycology. Of 510 children studied, the prevalence of pediculosis capitis was high (276 cases, 54.1%), particularly among females. This high level indicates poor health habits and personal hygiene, both of which are factors that perpetuate scalp ringworm infection or carriage.

In our study, the prevalence of scalp dermatophytosis was 7.4% (2.9% confirmed cases and 4.5% carriers). Furthermore, 2% were suspected (mycologically negative) cases. Culturing gave a similar carrier rate of 4% (but for *T. tonsurans*) in the report by Sharma et al. [3] of their random survey of 200 healthy children's scalps in Kansas city.

By contrast, a lower prevalence of scalp dermatophytosis of 0.64% (0.44% tinea capitis and 0.2% carriers) was reported from Spain by Cuetara et al. [10]. In Palestine, Ali Shtayeh et al. [11] reported 1% mycologically proven cases of tinea capitis during a school survey. However, a higher prevalence rate (7.8%) of tinea capitis was reported in rural Kenya [12]. Louw et al. [13] reported a prevalence of scalp dermatophytosis of 13% (10.9% confirmed cases and 2% carriers), with a further 29.7% suspected cases. In Ethiopia, a much higher prevalence of 33% has been reported (16% confirmed cases and 17% carriers), with 13% suspected cases [5].

The frequency of confirmed cases and carriers of tinea capitis in boys in our study is in agreement with several investigators in different countries [9,11,14-18]. This preponderance among males may be attributed to the easier implantation of spores and the easier detection of even a small lesion, both factors a result of boys' short hair. However, the majority of suspected (mycologically negative) cases were female (Table 3).

This may be attributed to the difficulty of sampling long hair or hair dressed with Vaseline or oils.

The majority of cases of scalp dermatophytosis (79.2%) were under 10 years of age. Many other investigators have reported that tinea capitis mainly occurs in children under 10 years of age [5,9,11,15-17]. This can be explained by poorer hygiene at this age, and also by the absence of saturated fatty acids that provide a natural protective mechanism [7,9].

The results of our mycological tests showed that examination by KOH gave more accurate results than culturing (Tables 1-3). Specimens containing few organisms tend to be negative by culture. However, culture should be attempted for every specimen to verify the diagnosis and for epidemiological purposes. In contrast to our findings, Amer et al. [8] and Abdel-Hafez et al. [9] reported more accurate results from culture during their studies on tinea capitis in Zagazig and Sohag respectively.

The lower prevalence of carriers than confirmed cases, indicated by both KOH mounts and culture (Tables 1 and 2), can be attributed to the presence of fewer organisms in carriers, which inevitably will lower the detection rate of the tests performed.

The organisms responsible for tinea capitis have a variable geographic distribution. *T. violaceum* predominates in North Africa and Asia [19]. In our study, it was the only dermatophyte isolated. Authorities have isolated *T. violaceum* as the primary etiological agent of tinea capitis in Assuit, Ismailia and Cairo (Egypt) [9], Palestine [11], Pakistan [18], the Netherlands [20], Zimbabwe [21] and Ethiopia [5]. However, studies from Assuit and New Valley governorate (Egypt) [9], Qatar [15], United Arab Emirates [22], Kuwait [14] and Saudi Ara-

bia [16] recorded *Microsporum canis* as the primary etiological agent, with *T. violaceum* second.

In conclusion, our survey throws some light on scalp dermatophytosis among the population at risk. We considered not only undetected cases of tinea capitis, but also identified carriers. Neither the children diagnosed nor their school health authority were aware of the presence of scalp disease, hence the size of the problem is underestimated. Moreover, the diagnosed

children represent a persistent and hidden source of infection, both to other sites on their own bodies and to their school and household contacts. From this preliminary survey, we recommend routine regular examination of the entire population of schoolchildren for a more precise estimate of the disease prevalence in this risk group and for early monitoring of changes in the disease pattern, so that preventive and control measures can be established and modified as necessary.

### References

- Williams JV et al. Semiquantitative study of tinea capitis and the asymptomatic carrier state in inner city school children. *Pediatrics*, 1995, 96:265-7.
- Elwiski BE, Hay RJ. International summit on cutaneous antifungal therapy, focus on tinea capitis. Boston, Massachusetts, November 11-13, 1994. *Pediatric dermatology*, 1996, 13:69-77.
- Sharma V et al. Scalp colonization by *Trichophyton tonsurans* in an urban pediatric clinic. ?Asymptomatic carrier state. *Archives of dermatology*, 1988, 124:1511-3.
- Korstanje MJ, Staats CG. Tinea capitis in north-western Europe 1963-1993: etiologic agents and their changing prevalence. *International journal of dermatology*, 1994, 33:548-9.
- Figueroa JI et al. Tinea capitis in south-western Ethiopia: a study of risk factors for infection and carriage. *International journal of dermatology*, 1997, 36:661-6.
- Kern ME. *Medical mycology*. Philadelphia, FA Davis Company, 1985:44-62, 116-34.
- Fisher F, Cook NB. *Fundamentals of diagnostic mycology*. Philadelphia, WB Saunders Company, 1998:118-56.
- Amer M et al. The frequency of causative dermatophytes in Egypt. *International journal of dermatology*, 1981, 20:431-4.
- Abdel-Hatez K et al. Clinical and mycological study of tinea capitis in Sohag governorate. *Journal of the Pan-Arab League of Dermatologists*, 1997, 8:95-101.
- Cuetara MS et al. Prevalence of undetected tinea capitis in a school survey in Spain. *Mycoses*, 1997, 40:131-7.
- Ali-Shtayeh MS et al. Epidemiological study of tinea capitis in schoolchildren in the Nablus area (West Bank). *Mycoses*, 1998, 41:243-8.
- Schmeller W, Baumgartner S, Dzikus A. Dermatophytes in children in rural Kenya: the impact of primary health care. *Mycoses*, 1997, 40:55-63.
- Louw CM, Schulz EJ, Koornhof HJ. Scalp ringworm in black children in rural areas in the northern and eastern Transvaal. *Southern African journal of epidemiology and infection*, 1996, 11:116-9.

14. Al-Fouzan A, Nanda A, Kubec K. Dermatophytosis of children in Kuwait: a prospective survey. *International journal of dermatology*, 1993, 32:798-801.
15. El-Benhawi MO et al. Mycologic study of tinea capitis in Qatar. *International journal of dermatology*, 1991, 30:204-5.
16. Venugopal PV, Venugopal TV. Tinea capitis in Saudi Arabia. *International journal of dermatology*, 1993, 32:39-40.
17. Sehgal VN, Saxena AK, Kumari S. Tinea capitis. A clinicomycologic correlation. *International journal of dermatology*, 1985, 24:116-9.
18. Hussain I et al. Tinea capitis in Lahore, Pakistan. *International journal of dermatology*, 1994, 33:255-7.
19. MacDonald E, Smith EB. The geography of the dermatophytes. *Dermatologic clinics*, 1995, 2:85-9.
20. Van der Willigen AH et al. Tinea capitis in the Netherlands. (Rotterdam area). *Mycoses*, 1990, 33:46-50.
21. Robertson VJ, Wright S. A survey of tinea capitis in primary-school children in Harare, Zimbabwe. *Journal of tropical medicine and hygiene*, 1990, 93:419-22.
22. Lestringant GG, Qayed K, Blayney B. Tinea capitis in the United Arab Emirates. *International journal of dermatology*. 1991. 30:127-9.

#### Note from the Editor

We wish to draw our readers' attention to the subject and author indexes for Volume 5 (1999), which are distributed as an insert in the present issue.