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Spectrum and burden of dermatophytes in children

Leila Ferguson ^{a,*}, L. Claire Fuller ^a

^a Department of Dermatology, Chelsea and Westminster Hospital, Fulham Road, London, SW10 9NH, UK

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Tinea imbricate;
Tinea corporis;
Tinea faciei

Summary Tinea capitis is the most important superficial fungal condition in children. It is often unrecognised but the presence of alopecia, scale and lymphadenopathy, especially in inner-city children should prompt investigation. An understanding of changing epidemiology and prevalence of causative organisms is important in deciding appropriate therapy. The use of diagnostic aids including dermoscopy is increasing and is reported to be helpful in identifying subtle signs. *Trichophyton tonsurans* accounts for the majority of cases in the UK and terbinafine is increasingly advocated as a safe and effective therapy. Exclusion from school is unnecessary provided the child is receiving appropriate systemic and topical therapy, but family members should be screened and carriers should receive treatment. Steroids and surgical treatments should be avoided. Treatment failure is common and may be multifactorial. Mycological cure after completing treatment should be sought and therefore follow up is necessary for Tinea capitis cases. Development of molecular diagnostic methods may improve our ability to diagnose Tinea capitis accurately and quickly in the future. Emerging new dermatophytoses affecting other anatomical sites are discussed which, although not common in the UK, may be seen due to increasing travel worldwide.

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Introduction

Superficial fungal infections are a result of fungal invasion restricted to skin, hair, nails and mucous membranes and include a specialised group of fungi called dermatophytes.¹ According to a recent study examining the global burden of disease, superficial mycosis is the fourth most common cause of illness worldwide.² Although common, dermatophytoses often masquerade as alternative dermatological conditions, such as seborrheic dermatitis, alopecia and psoriasis, delaying their recognition and treatment and thus allowing

a high carriage rate. Dermatophytes, known in lay terms as ringworm and clinically as Tinea, depend on their host/environment for survival. Their host may be animal, human or they may live in soil, referred to as zoophilic, anthropophilic or geophilic dermatophytes respectively.

Classification of dermatophytes

An understanding of the classification and epidemiology of dermatophytes is relevant to clinicians as it enables prediction of likely causative organisms and appropriate

* Corresponding author. Department of Dermatology, Chelsea and Westminster Hospital, Fulham Road, London, SW10 9NH, UK.
Tel.: +44 20 3315 8000.

E-mail addresses: leilaferguson@gmail.com (L. Ferguson), claire.fuller@nhs.net (L.C. Fuller).

Table 1 Classification of dermatophytes.^{1,8}

	Organism	Anatomical site	Geographical distribution	Type of hair invasion
Anthropophilic	<i>T. rubrum</i>	Foot, nail, body	Europe	Endothrix
	<i>T. interdigitale</i>	Foot, groin, nail	Worldwide	
	<i>T. tonsurans</i>	Scalp, body	UK, USA	Endothrix
	<i>M. audouinii</i>	Scalp	Africa	Ectothrix
	<i>T. violaceum</i>	Scalp, body, nail	Africa, Asia	Endothrix
	<i>M. ferrugineum</i>	Scalp	Far East, Africa	Ectothrix
	<i>T. schoenleinii</i>	Scalp (favus)	Africa, Brazil	Endothrix
	<i>T. megninii</i>	Scalp, beard	Europe, Africa	
	<i>T. soudanense</i>	Scalp	Africa	Endothrix
	<i>T. yaoundei</i>		Central Africa	
	<i>T. concentricum</i>	Body	Pacific, SE Asia, Amazonia	
Zoophilic	<i>M. canis</i> (cats and dogs)	Scalp, body	Europe	Ectothrix
	<i>T. equinum</i> (horses)	Scalp	Worldwide	Ectothrix
	<i>T. erinacei</i> (hedgehogs)	Exposed areas	NZ, Europe	Ectothrix
	<i>T. verrucosum</i> (cattle)	Scalp, beard, body	Worldwide	Ectothrix
	<i>M. nanum</i> (pigs)	Scalp, body	Worldwide	Both
	<i>M. distortum</i>	Scalp	NZ, Australia, USA	Ectothrix
		(<i>M. canis</i> variant)		
Geophilic	<i>M. gypseum</i>	Scalp, body	Worldwide	Ectothrix
	<i>M. fulvum</i>	Scalp, body	Worldwide	Ectothrix

T; *Trichophyton*, M; *Microsporum*

tailoring of treatment to the patient. For example, anthropophilic dermatophytes are so well adapted to living on human skin that they provoke minimal inflammatory reaction. By contrast, zoophilic and geophilic dermatophytes often provoke a more vigorous inflammatory reaction when they attempt to invade human skin. Additionally, the site of infection and host immune response will affect the clinical appearance of *Tinea capitis*.

In 1934 Emmons³ reported that dermatophytes can be recognised by the nature of their macroconidia (asexual spores) and divided accordingly into three genera: *Trichophyton*, *Microsporum* and *Epidermophyton*. There are now recognised to be about 40 species, though not all elicit infections in humans, some of which are shown in Table 1.

Clinically, dermatophyte infections are classified by body site as *Tinea corporis* (body, in particular trunk and limbs), *Tinea capitis* (scalp) and *Tinea unguium* (nail, also known as onychomycosis). *Tinea manuum* (hands), *Tinea faciei* (face), *Tinea cruris* (groin) and *Tinea pedis* ("athlete's foot") are subtypes.

Tinea capitis

Tinea capitis is the most important clinical superficial fungal issue in children, and will therefore be the focus of this review. Dermatophytes infect the scalp hair follicles and surrounding skin resulting in typical features including hair loss, scale and erythema.

Epidemiology

Tinea capitis is a problem worldwide and the prevalence of the causative dermatophyte varies internationally. It is

most common in inner-city cosmopolitan communities and developing countries, but as accurate community prevalence studies are scanty we are reliant on laboratory mycology data to inform us of the extent of the problem. Historically, the British conquest and control of *Tinea capitis* began at the start of the century with the introduction by Sabouraud and Noire of epilation with X-rays⁴ and the segregation of infected children. However, soon after the demographic disruption of the second world war *Tinea capitis* recurred in many parts of the United Kingdom and to an even greater extent in the United States.

A British survey from the late 1940s identified *M. audouinii* (anthropophilic) as the major cause of *Tinea capitis* nationwide.⁵ There were only a minority of isolates of *T. tonsurans* recorded by that time as *T. sulfureum*. The dominant dermatophyte shifted in the 1960s to the zoophilic organism *Microsporum canis* and *Tinea capitis* continued to be a relatively common childhood infection in the UK. With the arrival of griseofulvin introduced in 1958 at Kings Hospital London for the treatment of *Tinea capitis* by Williams and colleagues⁶ and the implementation of surveillance with Wood's light, the frequency of infection was at last reduced to insignificant levels. Although the problem was never fully eliminated *Tinea capitis* remained a sporadic problem, which generated a relative inexperience in diagnosing it amongst general physicians.

In Britain, there has been a developing epidemic of anthropophilic species, especially *T. tonsurans*, which is now reported to account for 50–90% of scalp isolates in the UK⁷. This trend, which is thought to be due to immigration and travel patterns, is reflected in recent UK treatment guidelines.⁸ By contrast, in Europe *M. canis* remains most common and is characteristically acquired from puppies and

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