

## Combs and Hair-trimming Tools as Reservoirs for Dermatophytes in Juvenile Tinea Capitis

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Accepted May 6, 2009.

Sir,

Dermatophytes are a group of closely-related fungi that are able to invade keratinized tissue (skin, hair and nails) of humans and animals to produce an infection, dermatophytosis, commonly referred to as ringworm or tinea. Important factors leading to the different clinical forms are the infecting fungus, the site infected, the keratinization at that site, and the immune status of the host (1).

Tinea capitis refers to dermatophytosis of the scalp and is caused by invasion of the stratum corneum through close contact with an infected person, often in the same household, or with an animal such as a cat (2). Fungal conidia are shed in the air, and may, in theory, remain viable for long periods on combs, brushes, blankets and telephones (3).

In Sweden tinea capitis occurs to a limited extent, but is over-represented in children belonging to families emigrated from Africa ("exotic tinea") (4). A study in 2004 showed an increase in Stockholm during the past decade, most commonly caused by *Trichophyton violaceum*, corresponding with the increased immigration from East Africa (5).

Most Swedish children with exotic tinea capitis have never been outside Sweden, so they must have attracted their dermatophytes from domestic contacts. The aim of the study was to investigate further whether hair-trimming tools or combs act as a reservoir for dermatophytes in the home environment of young patients with tinea capitis.

### MATERIALS AND METHODS

The study was based on home visits to families with children previously diagnosed with tinea capitis at the Department of Dermatology, Karolinska University Hospital Solna, Sweden. Ten of 16 families approached accepted a home visit. The inclusion criteria were: age below 16 years; positive dermatophyte culture from the scalp within the previous 6 months; treatment initiated; willingness to attend the study; ability to speak or understand basic Swedish or English; and living in northern Stockholm. The patients' parents took part in a structured interview during the home visit, regarding living conditions, symptoms, epidemiology and routines for cleaning combs and hair-trimming tools.

Where applicable, the combs and hair-trimming equipment used frequently by the patient were chosen. These were dipped several times in Sabouraud broth with antibiotics (50 ml Erlenmeyer bottle) and rubbed with a sterile cotton tip to release possible dermatophyte conidia. The samples were transported in Falcon tubes to the mycology laboratory at the Karolinska University Hospital in Solna. They were cultured on Dermatophyte Test Medium (DTM) and Mycoceil agar plates and incubated at 28°C for 3 weeks.

### RESULTS

The patients' ages on diagnosis ranged from 2 to 11 years. All the families sampled had at least 4 family members. All but 2 families had their origins in East Africa. Half of the patients with positive equipment cultures were born in Sweden (families 1 and 7); compared with 4 of the 6 with negative equipment cultures. Concerning the origin of the dermatophytosis, 2 families (families 4 and 5) believed that their children were infected abroad and one (family 7) by relatives visiting from abroad. Symptom duration ranged from 6 months to 5 years. The median percentage of affected siblings beyond the index patients was 46.7% (range 0–100%). No parents were affected. When interviewed, 9 of the 10 families stated that they were aware that tinea capitis is contagious. All 4 families with positive equipment cultures stated in the structured interview that they had no specific routines for cleaning combs and hair-trimming equipment. As against this, 5 of the 6 families with negative dermatophyte cultures from the equipment reported that they followed cleaning routines, including regular dismissal of old combs and trimming aids, frequent washing with soap, and dipping equipment in household bleach according to the manufacturers' recommendations.

Dermatophytes were found in combs and hair-trimming equipment from 4 of the 10 families visited (Table I). All these 4 families with positive cultures had the same type of dermatophyte as the index. Three had growth in combs or brushes, one also in trimming equipment and one solely in trimming equipment. All patients with tinea capitis were diagnosed with both positive direct

Table I. Dermatophyte culture of hair-care tools at homes of index patients

Sex/age, years	Origin	Dermatophyte culture from			Trimming tools
		Scalp	Comb 1	Comb 2	
M/2	Congo	<i>T. soudanense</i>	–	–	+
M/3	Eritrea	<i>T. tonsurans</i>	+	–	–
M/4	Gambia	<i>T. soudanense</i>	–	–	–
F/7	Ethiopia	<i>T. violaceum</i>	–	+	+
M/7	Somalia	<i>M. audouinii</i>	–	–	–
M/7	Turkey	<i>T. violaceum</i>	–	–	–
M/7	Somalia	<i>T. violaceum</i>	+	+	+
M/8	Somalia	<i>T. violaceum</i>	–	–	ND
F/10	Eritrea	<i>T. violaceum</i>	–	–	ND
M/11	Somalia	<i>T. tonsurans</i>	–	–	ND

ND: not done, unavailable; T: Trichophyton; M: Microsporon.

microscopy and positive culture, and all had received oral terbinafine treatment for 4 weeks. In addition, when this treatment started, the patients were urged to take care of combs, brushes and hair-trimming tools.

## DISCUSSION

Three of the 4 “equipment-positive” families had other family members with subjective clinical symptoms of tinea capitis, compared with 4/6 of the equipment-negative families. According to a study in London where 209 households of patients with *T. tonsurans* were examined for tinea capitis, only 7.2% had clinically evident disease, yet 44.5% had silent fungal carriage on the scalp (6). Other studies imply that sharing of combs may also spread infection with tinea capitis (7, 8). This raises the question of where recurrence or infection within a family originates: in a reservoir, through silent carriage by other household members or a combination of both.

A study from the USA regarding asymptomatic dermatophyte carriers in the households of children with tinea capitis showed that initial prevalence of asymptomatic carriage of dermatophytes among household contacts of a child with tinea capitis was 16%, with 41% of carriers persisting up to 2 months. Thirty-two percent of families included at least one carrier. Seven percent of the carriers developed an active infection. The study concluded that treatment of carriers with sporicidal shampoo should be considered, since carriers may act as reservoirs for infection – or may develop active disease. The high prevalence of sharing beds and combs may be an important factor in the spread of the disease (9). Other studies have determined that carrier rate may increase to as high as 44% for the siblings of index cases (10). Accordingly; it seems beneficial to treat dermatophyte-positive family members considering the rate of silent carriers and the number of families where other members also have symptoms. It may also be important to eliminate another source of spread, i.e. dermatophytes on combs and hair-trimming tools.

All the 4 families with positive dermatophyte cultures lacked specific routines for cleaning combs and hair-trimming equipment, while 5 of the 6 families with negative cultures did have such routines. Therefore, management of the disease should also emphasize specific information regarding how infection is transmitted and how to avoid re-infection. Translators should be used if necessary, and written information in the patient’s first language should be given regarding cleaning routines for hair-care tools. Cleaning should be carried out mechanically and by disinfection with, for example, household bleach (11, 12).

A biasing factor could be that the families studied may have cleaned the equipment prior to sampling, which

might explain why none of the positive-culture families had routines for cleaning hair equipment while 83% of the negative-culture families did.

Of the 10 families studied, 4 (40%) showed growth of dermatophytes in cultures from combs and hair-trimming tools taken at the home visit. Five families had routines for cleaning hair-care tools, and all their cultures were negative. None of the 4 positive-culture families had clear routines for such cleaning; this can pave the way for recurrence and explain the high prevalence and frequent recurrence within a geographic group, despite moves to a different environment with a lower incidence of tinea capitis. In addition to sampling and, where applicable, treating the patient’s family members, it is important to inform the families regarding routines for cleaning hair-care tools.

## ACKNOWLEDGEMENTS

This study was supported by grants from Karolinska Institutet.

*The authors declare no conflicts of interest.*

## REFERENCES

1. Degreef H. Clinical forms of dermatophytosis (ringworm infection). *Mycopathologia* 2008; 166: 257–665.
2. Rabinowitz PM, Gordon Z, Odofin L. Pet-related infections. *Am Fam Physician* 2007; 76: 1314–1322.
3. Habif T, Campbell J Jr, Chapman M, Dinulos J, Zug K. *Skin diseases: diagnosis and treatment*. 2nd edn. Philadelphia: Mosby; 2005.
4. Wahlgren CF, Kaaman T, Wikström U. Exotisk tinea. Ökad förekomst hos barn i Stockholmstrakten. [Exotic tinea. Increased occurrence among children in the district of Stockholm]. *Läkartidningen* 1993; 90: 1761–1763 (in Swedish).
5. Hallgren J, Petrini B, Wahlgren CF. Increasing tinea capitis prevalence in Stockholm reflects immigration. *Med Mycol* 2004; 42: 505–509.
6. White JM, Higgins EM, Fuller LC. Screening for asymptomatic carriage of *Trichophyton tonsurans* in household contacts of patients with tinea capitis: results of 209 patients from South London. *J Eur Acad Dermatol Venereol* 2007; 21: 1061–1064.
7. Basnet SB, Basnet NB, Hiruma M. Tinea capitis infection in school children of Nepal. *J Epidemiol* 2001; 11: 126–130.
8. Grimalt R. A practical guide to scalp disorders. *J Investig Dermatol Symp Proc* 2007; 12: 10–14.
9. Pomeranz AJ, Sabnis SS, McGrath GJ, Esterly NB. Asymptomatic dermatophyte carriers in the households of children with tinea capitis. *Arch Pediatr Adolesc Med* 1999; 153: 483–486.
10. Chen BK, Friedlander SF. Tinea capitis update; a continuing conflict with an old adversary. *Curr Opin Pediatr* 2001; 13: 331–335.
11. Moriello KA. Management of dermatophyte infections in catteries and multiple-cat households. *Vet Clin North Am Small Anim Pract* 1990; 20: 1457–1474.
12. Rutala WA, Weber DJ. Uses of inorganic hypochlorite (bleach) in health-care facilities. *Clin Microbiol Rev* 1997; 10: 597–610.