



Retrospective Analysis of Tinea Capitis in Xinjiang, China

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Abstract Tinea capitis is a cutaneous infection of dermatophytes and predominant in children. It is one of common infectious diseases of children in Xinjiang, particularly in the southern Xinjiang. The aim of this study is to analyze the clinical and mycological characteristics of patients with tinea capitis in Xinjiang China. Medical records from 2010 to 2021, Mycology Laboratory Department of Dermatology in the First Affiliated Hospital of Xinjiang Medical University, retrospectively investigated the clinical and mycological characteristics of 198 patients with tinea capitis. Hairs have been obtained for fungal examination, and analysis with 20% KOH and Fungus Fluorescence Staining Solution has been conducted. Identification of fungi was using of morphological and molecular biological methods. Among total number of 198 patients, 189 (96%) were children with tinea capitis, of which 119 (63%) were male and 70 (37%) were female; 9 (4%) were adult patients with tinea capitis, of which 7 were female and 2 were male. Preschool children between the ages of 3 and 5 years had the highest distribution (54%), followed by those between the ages of 6 and 12 years (33%), the ages

under 2 years (11%) and the ages of 13–15 years (2%) respectively. Among all patients, 135 (68.18%) were Uygur, 53 (26.77%) were Han, 5 (2.53%) were Kazak, 3 (1.52%) were Hui, 1 (0.5%) was Mongolian and nationality information of 1 patient (0.5%) is unknown. The identification results of the isolates showed that 195 (98%) patients had single-species infections and 3 (2%) patients had double mixed infections. Among single-species infection patients, *Microsporum canis* (n = 82, 42.05%), *Microsporum ferrugineum* (n = 56, 28.72%) and *Trichophyton mentagrophytes* (n = 22, 11.28%) were the most prevalent species. Other dermatophytes included *Trichophyton tonsurans* (n = 12, 6.15%), *Trichophyton violaceum* (n = 10, 5.13%), *Trichophyton schoenleinii* (n = 9, 4.62%) and *Trichophyton verrucosum* (n = 4, 2.05%). Among 3 cases of mixed infections, 1 was *M. canis* + *T. tonsurans* (n = 1), and the other 2 were *M. canis* + *T. mentagrophytes* (n = 2). In conclusion, the majority of tinea capitis patients in Xinjiang, China are Uygur male children aged 3–5 years. *M. canis* was the most prevalent species causing tinea capitis in Xinjiang. These results provide useful information for the treatment and prevention of tinea capitis.

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1. Introduction

Tinea capitis is a mycosis caused by dermatophytes that is found primarily in children and more commonly in males [1–4]. Adults are infrequently affected. The diversity of clinical manifestations of tinea capitis in Xinjiang, may be caused by the causative agents, the type of hair invasion, and the host inflammatory response (Fig. 1). The epidemiological and mycological characteristics of tinea capitis change over time and are influenced by environmental health, socio-

economic status, living habits, climatic factors and individual immunity [5–7]. The prevalence of tinea capitis and the predominance of its etiological agents differ on the geographical distribution. A study from Xinjiang showed that the prevalence of tinea capitis in southern Xinjiang is about 4.13%, but relatively rare in northern part [8]. In another study from Xinjiang, *T. violaceum* (1517/3276, 47.95%) was the most common dermatophyte which was responsible for tinea capitis the 1970s–1990s [9], but *M. canis* has

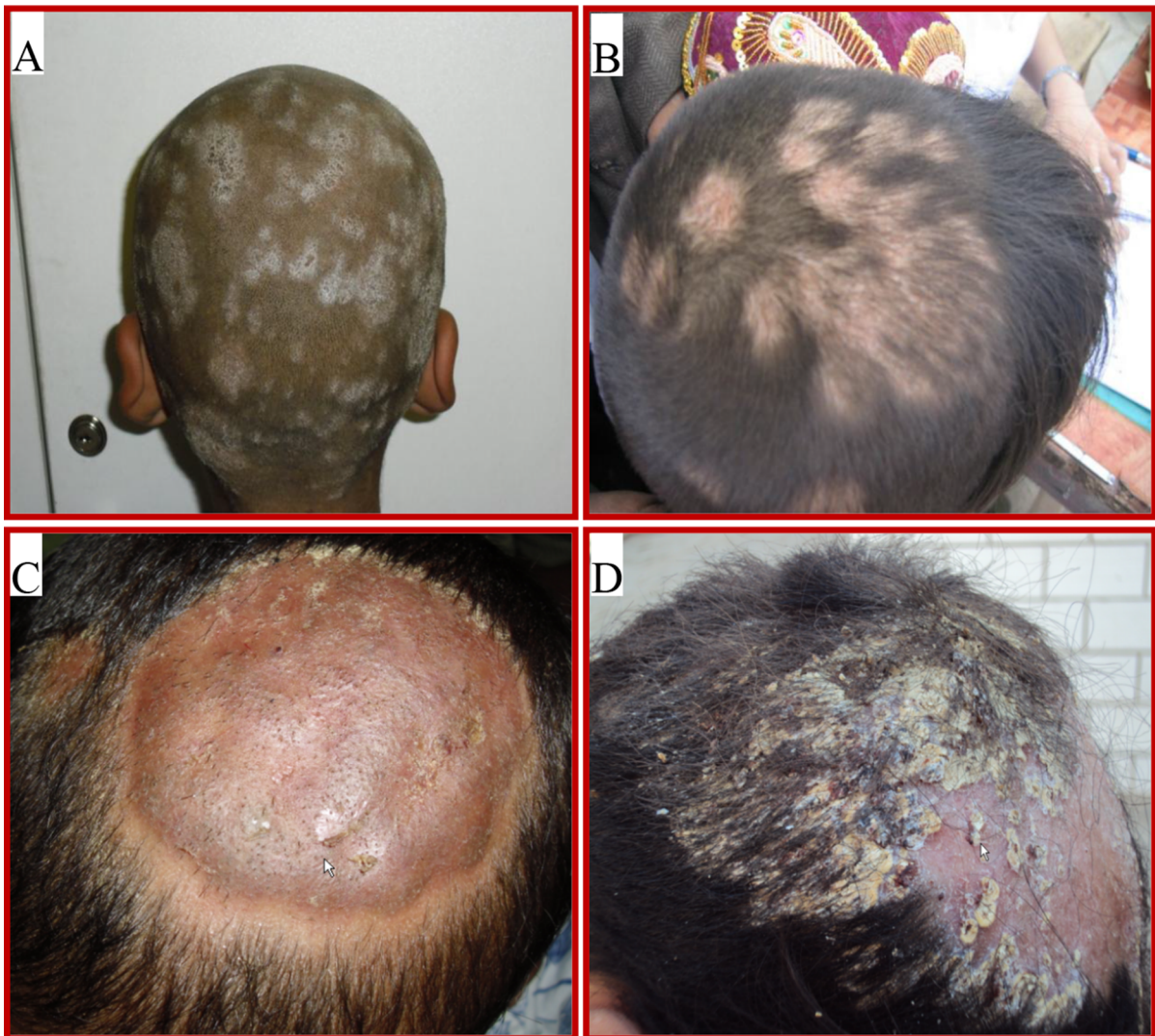


Fig. 1 Tinea capitis presentation in Xinjiang. **A** Tinea capitis. “White tinea”, localized patch, multiple scaly lesions (“gray-patch”), stubs of broken hair, caused by *Trichophyton tonsurans*. **B** Tinea capitis. “Black dot” ringworm caused by *Trichophyton tonsurans*, presents as multiple areas of alopecia

studded with black dots. **C** Kerion celsii. Inflammatory reaction of tinea capitis caused by *Microsporium canis*. Kerion may be followed by scarring and permanent alopecia in the areas of inflammation and suppuration. **D** Favus. Favus of scalp, showing scutulae, caused by *Trichophyton schoenleinii*

increasingly been identified as the cause of tinea capitis in Xinjiang in recent years. Children tinea capitis is in particular remaining endemic in southern in Xinjiang. However, information about the prevalence of tinea capitis in Xinjiang has been limited in recent 10 years. We thus investigated changes in the clinical and mycological characteristics of tinea capitis patients presented to our hospital and patients from all over Xinjiang.

Materials and Methods

Patients

Using medical records from Mycology Laboratory Department of Dermatology in the First Affiliated Hospital of Xinjiang Medical University from 2010 to 2021, the retrospective investigation of the clinical and mycological characteristics of 198 patients with tinea capitis after species identification has been completed. Ethical approval has been obtained from Ethics Committee in the First Affiliated Hospital of Xinjiang Medical University.

Mycological Examination

After routine disinfection of scales and hairs, the KOH examination (20% potassium hydroxide) and Fungus Fluorescence Staining Solution (Nanjing Hanrui Biotech Company, Nanjing, China) were performed to check for the presence of fungi.

Isolation and Strain Identification

The dermatophytes responsible for the infection were isolated from fungal cultures using potato-dextrose agar (PDA) plates. The cultures were incubated at 27 °C and examined after 7–14 days. The fungal identification was done by morphological and molecular biological methods. The morphological identifications indeterminate specimens and culture-negative specimens for further molecular biological identification. Dermatophytes were cultured from 198 patients, and microscopic examination was conducted after staining with lactophenol cotton blue to identify fungal hyphae with conidia.

A total of 90 morphological identifications indeterminate isolates were collected used for ITS

sequencing. Fungal DNA was extracted by using the Fungal DNA Isolation Kit (Sangon Biotech, Shanghai, China) according to the manufacturer's protocol. The ITS1–ITS4 region of the fungal ITS region was amplified by PCR amplifier by using ITS primers (ITS1forward, 5'-TCCGTAGGTGAACCTGCGG-3'; ITS4reverse, 5'-TCCTCCGCTTATTGATATGC-3'). The sequences were compared to the NCBI nucleotide database (BLAST: <https://blast.ncbi.nlm.nih.gov/Blast.cgi>).

A total of 51 hair specimens of culture-negative were collected used for extracted DNA, seven set of specific primers and oligonucleotied probes were designed to amplify different species of the tinea capitis pathogens and using quantitative Real-time PCR assay.

Statistical Analysis

Descriptive statistics were used to analyze the clinical data.

Results

Patients

The total of 198 tinea capitis patients visiting in our hospital presented with infection of the scalp hair or non-inflammatory scaly lesions. The majority of patients had contact with animals or contact with tinea capitis patients. We used microscopic examination, fungal culture, and ITS sequencing to identify the fungal species isolated from tinea capitis patients. Diagnosed patients were treated with terbinafine or griseofulvin at least 6–8 weeks. The clinical symptoms, such as hair loss and inflammatory were significantly relieved until disappeared after treatment. Meanwhile, the hair was tested negative upon direct microscopic examination and fungal culture.

Among 198 patients (Table 1), 123 (62%) were male and 75 (38%) were female, mean age was 6.69 years (range 11 months–54 years), of which 135 (68.18%) were Uygur, 53 (26.77%) were Han, 5 (2.53%) were Kazak, 3 (1.52%) were Hui, 1 (0.5%) was Mongolian and nationality information of one patient (0.5%) was unknown. 189 (96%) were childhood tinea, of which 119 (63%) were male and 70 (37%) were female. The minimum age of the patient is

Table 1 Clinical characteristic of the tinea capitis (n = 198)

Clinical characteristic	Frequency	Percentage (%)
Gender		
Male	123	62
Female	75	38
Nation		
Uygur	135	68.18
Han	53	26.77
Kazak	5	2.53
Hui	3	1.52
Mongolian	1	0.5
Unknown	1	0.5
Children tinea capitis	189	96
Gender		
Male	119	63
Female	70	37
Age range(years)		
< 2	21	11
3–5	103	54
6–12	62	33
13–15	3	2
Adult tinea capitis	9	4
Gender		
Male	2	2
Female	7	78

11 months, the maximum age is 13 years, and the average age is 5.33 years. Among of childhood tinea capitis, 21 (11%) were early childhood (< 2 years), 103 (54%) were preschool children (3–5 years), 62 (33%) were school-age children (6–12 years) and 3 (2%) were 13 years old. All children with tinea capitis were the initial visit and mostly from rural areas of southern Xinjiang. 9 (4%) were adult patients with tinea capitis, 7 (78%) were female and 2 (2%) were male, and the mean age was 35.23 years(range 23–54 years).

Species Identification

The identification results of the species showed that 195 (98%) patients had single-species infections and 3 (2%) patients with double mixed infections (Table 2). Among single-species infection patients, 7 detected species were *M. canis* (n = 82, 42.05%), *M.*

Table 2 Frequency of isolated dermatophytes from 198 tinea capitis patients

Dermatophyte isolated	Frequency	Percentage (%)
Single-species	195	98
<i>M. canis</i>	82	42.05
<i>M. ferrugineum</i>	56	28.72
<i>T. mentagrophytes</i>	22	11.28
<i>T. tonsurans</i>	12	6.15
<i>T. violaceum</i>	10	5.13
<i>T. schoenleinii</i>	9	4.62
<i>T. verrucosum</i>	4	2.05
Mixed-species	3	2
<i>M. canis</i> + <i>T. tonsurans</i>	1	33.33
<i>M. canis</i> + <i>T. mentagrophytes</i>	2	66.67

ferrugineum (n = 56, 28.72%), *T. mentagrophytes* (n = 22, 11.28%), *T. tonsurans* (n = 12, 6.15%), *T. violaceum* (n = 10, 5.13%), *T. schoenleinii* (n = 9, 4.62%) and *T. verrucosum* (n = 4, 2.05%). Among 3 cases of mixed infections, 1 was *M. canis* + *T. tonsurans* (n = 1), and the other 2 were *M. canis* + *T. mentagrophytes* (n = 2).

3.3 Distribution of Strains in Different Ethnic Groups

A total of 195 patients presented with a single-species infection. Therefore, we analyzed the distribution of isolates in different ethnic groups (Table 3).

4. Discussion

In this study, the number of tinea capitis patients in Xinjiang Uygur and Han nationalities were the biggest. We found a high prevalence of the infection among Uygur children aged 3–5 years, with a male predominance. This is mainly because of a majority of the population of Uygur and Han in Xinjiang. Tinea capitis patients mainly come from southern Xinjiang. *M. canis* was the most prevalent species causing tinea capitis in Xinjiang.

We found that tinea capitis is more prevalent in children between the ages of 3 years and 5 years (103 patients), followed by the ages of 6 years and 12 years (62 patients). Only 3 patients of tinea capitis with

Table 3 Distribution of strains in different ethnic groups

Distribution	Frequency	Percentage (%)
<i>M. canis</i>	82	
Uyгур	47	57.32
Han	31	37.8
Hui	3	3.66
Kazak	1	1.22
<i>M.ferrugineum</i>	56	
Uyгур	43	76.79
Han	10	17.86
Kazak	2	3.57
Unknown	1	1.78
<i>T.mentagrophytes</i>	22	
Uyгур	18	81.82
Han	4	18.18
<i>T.tonsurans</i>	12	
Uyгур	8	66.7
Han	4	33.3
<i>T.violaceum</i>	10	
Uyгур	8	80
Han	1	10
Kazak	1	10
<i>T.schoenleinii</i>	9	
Uyгур	7	77.8
Han	2	22.2
<i>T.verrucosum</i>	4	
Uyгур	3	75
Mongolian	1	25
<i>Mix-species</i>	3	
Uyгур	3	100

children were over 13 years. This is similar to the findings in other studies [10, 11], such as the study by Thakur R, which reported that most of the infected children were below the age of 10 years [12]. These results support the suggestions that tinea capitis is predominantly a pre-pubertal disease [5]. Another factor that may support the higher prevalence of tinea capitis among younger children is the likelihood of poor hygiene in pre-pubertal stages, compared to older children who usually become more conscious of their hygiene practices when they reach their teenage years [3, 5]. Regarding gender distribution of children with tinea capitis, the infection was found to be more prevalent among male pupils [63%, (119/189)],

compared to female pupils [37%, (70/189)]. Some previous studies have considered this could be that female pupils and their parents are more conscious of their appearance and hygiene practices than the males [12–14].

Previous studies have suggested that at least 20 years ago in Xinjiang, the *T. violaceum* and *M. ferrugineum* were prevalent causative agent of tinea capitis, not *M. canis* [15–19]. In our previous study, *M. canis* (n = 45), *M. ferrugineum* (n = 23), *T. violaceum* (n = 12), *T. schoenleinii* (n = 8), *T. tonsurans* (n = 5) and *T. verrucosum* (n = 2) were found to be the causal agents for tinea capitis from 2003 to 2010 in Xinjiang. In the present study, *M. canis* (n = 82, 42%) was the most common dermatophyte isolated from tinea capitis from 2010 to 2021, follow by *M. ferrugineum* (n = 56, 29%), both of which were also the two most common dermatophytes for the entire study period. *M. canis* is a zoophilic fungi and a common pathogen that causes tinea capitis and is present worldwide [18–20]. Liu et al. [21] reported that *M. canis* was the most predominant causative agent of tinea capitis with children, from 2000 to 2010, in most parts of China. Our findings are consistent with these studies. However, *M. canis* was rare in Xinjiang before 2004, the incidence of *M. canis* infection has been increasing and transformed into common causative agent of tinea capitis for nearly 10 years in Xinjiang, which may be caused by the increasing popularity of pet raising. In addition, *M. ferrugineum* and *T. schoenleinii* have become uncommon elsewhere in China in recent years, but it retains a stable prevalence in Xinjiang.

Tinea capitis caused by more than one dermatophyte species is extremely rare. In the present study, the identification results of the species showed that 195 patients had single-species infections and 3 patients had double mixed infections. Hair coinfecting with two dermatophyte species is uncommon. A study from Xinjiang showed that 20 cases of mixed infection of tinea capitis were found in 3276 cases of tinea capitis [9]. In this study, 3 patients had double mixed infections caused by *M. canis*, *T. tonsurans* and *T. mentagrophytes*. Mixed infection of tinea capitis, the clinical manifestations can also vary among different species.

As systematic epidemiological survey has not been investigated, so this study only a preliminarily unraveled the clinical and mycological characteristics of tinea capitis patients presented to our hospital. Tinea

capitis patients attending our hospital come from all over Xinjiang, so the sample is representative. There are several shortcomings in the present study, such as our failing to obtain clinical types of tinea capitis, patient residence and seasonal distribution data for all patients. Further refinement of the information is needed in the future.

5. Conclusion

In Xinjiang, tinea capitis was the most prevalent in Uyghur male children aged 3–5 years old, but cases were also found in adults. *M. canis* was the most common causative agent of tinea capitis with children. These results provide valuable information about the treatment and prevention of tinea capitis.

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Author Contributions All authors listed have made substantial, direct and intellectual contribution to the work and approved it for publication.

Declarations

Conflict of interest The authors declare no conflict of interest.

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