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Tinea capitis in adults: A 18-year retrospective, single-centre study in Korea

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Summary

Background: Tinea capitis (TC) is a dermatophyte infection involving hair and scalp and occurs primarily in prepubertal children. However, data on adults are limited.

Objectives: The aim of this study was to evaluate epidemiological, clinical and mycological characteristics of TC in adults in Korea.

Patients/Methods: We retrospectively evaluated 82 adults (44.3%) among 185 TC patients at a tertiary hospital during June 2000-2017.

Results: Mean patient age was 66.9 ± 15.8 (20-90) years with female predominance; mean disease duration until mycological diagnosis, 22.5 (1-144) weeks; and misdiagnosis rate, 65.9%. Most common presumptive initial diagnoses were seborrhoeic dermatitis (24.4%) and bacterial folliculitis (18.3%). Chronic systemic illness and accompanying alopecia were found in 61 (74.4%) and 46 (56.1%) patients, respectively. Pustular type was found in 26.8% patients, followed by seborrhoeic dermatitis–like 25.6%, grey patch 23.2%, kerion celsi 22.0% and black dot 2.4%. Forty-eight patients (58.5%) had tinea infection at other skin areas. *Microsporum canis* (56.5%) and *Trichophyton rubrum* (21.7%) were the most common causative organisms; 92.7% patients achieved complete resolution, and seven patients (9.2%) had a recurrence.

Conclusions: We report the largest, most recent series of case studies of adult TC. Adult TC is not an uncommon problem, especially in elderly women, and has distinctive epidemiological and clinicomycological characteristics compared to those in prepubertal children. Recognising adult TC profile will help clinicians avoid misdiagnosis and provide appropriate treatment.

KEYWORDS

adult, dermatomycoses, scalp, tinea capitis

1 | INTRODUCTION

Tinea capitis (TC) is a superficial fungal infection of the hair and scalp that is caused by dermatophytes, mainly *Trichophyton (T.)* and *Microsporum (M.)* species.[1] TC typically presents with single or multiple scaly patches of hair loss (grey patch), or in some cases with a bald patch with numerous short broken hair (black dots pattern), diffuse scaling without apparent hair loss, follicular pustules or inflamed boggy mass (kerion).[1] Even though the percentage of TC among dermatophyte infections is small, it is considered as an important public health problem in many countries including Korea. The incidence of TC varies and is dependent upon region, age, ethnicity, socio-economic conditions, climate, urbanisation, hygiene and population density. In general, it predominantly involves people who

either belong to large families, or live in densely populated areas, or in places with poor hygiene.[2]

Tinea capitis primarily occurs in prepubertal children between 3 and 14 years of age. TC in adults is rare, but is occasionally found among the elderly.[3-20] The rarity of TC in adults is not well understood, but can be explained by fungistatic properties of the long-chain fatty acids in postpubertal sebum, maturation of hair follicles and immune system after adulthood that may protect against fungal invasion.[8,9,14] The prevalence of TC has changed over the past decades, and the occurrence of TC in adults is gradually increasing due to multiple factors including systemic illness and long-term use of corticosteroid or immunosuppressants.[1] However, despite the increase in cases of adult TC, there is limited literature on TC in adults. Therefore, this study aims to comprehensively determine the current epidemiological, clinical and mycological characteristics of adult TC in Korea and also provide a review of available literature.

2 | PATIENTS AND METHODS

We conducted a retrospective study at the Department of Dermatology, Chonbuk National University Hospital, which is located in the south-western area of Korea from June 2000 to June 2017.

This study included TC patients older than 20 years, who had a clinical presentation of TC and confirmed by at least one of the mycological test (KOH examination, histopathology or fungal culture) from scalp hair specimen. Patients who had positive result of mycological test from only skin specimens (interfollicular scales) were excluded in this study. Clinical diagnosis was made by physical examination, trichogram, wood's light examination and dermoscopy. Dermoscopic examination was performed with a hand-held dermoscope equipped with a digital camera (Dermlite Foto II Pro [3Gen] and Canon EOS 50D [Canon Tokyo]). Confirmation of the diagnosis was made by mycological examination such as direct KOH examination, histopathology (haematoxylin-eosin and periodic acid-Schiff stain), fungal culture on Sabouraud dextrose agar (SDA) or polymerase chain reaction (PCR). Specimens for microbial diagnosis included plucked hairs, skin scraping, swabs and excised skin tissue. Swabs were directly inoculated on SDA agar, while hair and skin scraping were examined by direct microscopy and then cultured on SDA agar. Causative fungal species were identified based on the macro- and microscopic morphological characteristics of colonies on SDA and, in selected cases, by PCR using primers targeting the internal transcribed spacer (ITS) regions, ITS1 and ITS4, as has been previously described.[21,22]

For each patient, we collected relevant clinical information including age, sex, duration of illness until confirmation of diagnosis, presumptive initial diagnosis, associated underlying systemic diseases or medication, history of animal contact, clinical patterns, accompanying hair loss, involvement of other site in dermatomycoses, treatment response and incidence of recurrence by reviewing patients' electronic or written chart. Clinical pattern was classified as seborrhoeic dermatitis–like diffuse scaling, pustular, grey patch, kerion celsi or black dot type. Mycological information including aetiological organisms was also collected. This study was approved by the institutional review board (or Ethics Committee) of Chonbuk National University Hospital (CUH 2017-10-019) and was conducted in compliance with the Helsinki Declaration. Informed consent was obtained from all participants.

TABLE 1 Age and sex of tinea capitis patients in this study

	Sex		
Age (years)	Male	Female	Total (%)
0~9	45	44	89 (48.1)
10~19	5	9	14 (7.6)
20~29	3	0	3 (1.6)
30~39	2	2	4 (2.2)
40~49	2	1	3 (1.6)
50~59	3	5	8 (4.3)
60~69	3	20	23 (12.4)
70~79	4	20	24 (13.0)
80~89	3	12	15 (8.1)
90~	0	2	2 (1.1)
Total	70	115	185 (100.0)

3 | RESULTS

Among the 185 patients (10.3 cases/year) who were diagnosed of TC from 2000 to 2017 at our institute, 82 (44.3%) patients were adult and 103 (55.7%) of them were child patients. The incidence of TC was 2.2% of 8225 tinea infections of the skin. During the analysed period of 18 years, a total number of patients who visited the outpatient clinic were 409 624: 332 694 (81.2%) were adults and 76 930 (18.8%) were children. Detailed demographic profile and the clinical and mycological characteristics of adult TC patients included in this study are summarised in Tables 1-3. The mean age of the adult patients was 66.9 ± 15.8 (20-90) years, and the most prevalent age group was 70s. TC in adult population showed a female predominance with the male:female patient ratio of 1:3.1. Among the female patients, 58 patients (93.5%) were postmenopausal.

The mean duration of disease until confirmation of diagnosis was 22.5 (1-144) weeks. At the first clinical examination without any mycological test at a local clinic or our institute, only 22 patients (26.8%) were correctly diagnosed as TC, while 54 cases (65.9%) were misdiagnosed. The most common presumptive initial diagnosis was tinea capitis (n = 22, 26.8%), followed by seborrhoeic dermatitis (n = 20, 24.4%), bacterial folliculitis (n = 15, 18.3%), allergic contact dermatitis (n = 5, 6.1%), psoriasis (n = 4, 4.9%), dissecting cellulitis (n = 3, 3.7%) and unclassified eczema (n = 3, 3.7%). Underlying chronic systemic disease was noted in 61 patients (74.4%). Among these patients, 17 patients (27.9%) were actively being treated with systemic corticosteroid or immunosuppressants. Close contact with animals was reported in 14 cases (17.1%).

TABLE 2 Clinical characteristics of adult tinea capitis patients in this study

Clinical characteristics	Number	Percentage (%)
The duration of disease onset until the confirmation of diagnosis		
<1 mo	12	14.6
1 - 3 mo	30	36.6
3-12 mo	33	40.3
More than a year	7	8.5
Initial clinical diagnosis		
Tinea capitis	22	26.8
Seborrhoeic dermatitis	20	24.4
Folliculitis	15	18.3
Allergic contact dermatitis	5	6.1
Psoriasis	4	4.9
Dissecting cellulitis	3	3.7
Eczema, unclassified	3	3.7
Telogen effluvium	2	2.4
Lupus erythematosus	1	1.2
Acne	1	1.2
Not available	6	7.3
Underlying systemic diseases (n = 61, plural disease possible)		
Hypertension	18	22.0
Diabetes	12	14.6
Malignancy	10	12.2
Liver/gastrointestinal disease	7	8.5
Heart disease	6	7.3
Kidney disease	5	6.1
Thyroid disease	4	4.9
Pulmonary disease	3	3.7
Close contact with animals		
Dog	7	8.5
Cow	4	4.9
Cat	2	2.4
Chicken	1	1.2
Types of clinical pattern		
Pustular type	22	26.8
Seborrhoeic dermatitis–like type	21	25.6
Grey patch type	19	23.2
Kerion celsi	18	22.0
Black dot type	2	2.4
Accompanying alopecia (n = 46)		
Bald patch	31	37.8
Diffuse hair loss	15	18.3
No alopecia	36	43.9
Other site of dermatomycoses (n = 48, plural site possible)		
Tinea faciale	32	39.0
Tinea corporis	8	9.8
Tinea pedis	5	6.1
Onychomycosis	3	3.7
None	34	41.5
Main treatment		
Oral terbinafine	54	65.9
Oral itraconazole	5	6.1
Oral terbinafine and oral itraconazole	4	4.9
Topical terbinafine only	13	15.9
Not available	6	7.3
Treatment response		
<4 wk	7	8.5
5-8 wk	37	45.1
9-12 wk	6	7.3
More than a year	18	22.0
Follow-up loss	14	17.1

Regarding clinical features, the most common clinical subtype was pustular type (n = 22, 26.8%), followed by seborrhoeic dermatitis–like scaling (n = 21, 25.6%), grey patch (n = 19, 23.2%), kerion celsi (n = 18, 22.0%) and black dot type (n = 2, 2.4%) (Figure 1A-E). Hair loss was observed in 46 patients (56.1%): single bald patch in 11 cases, multiple bald patches in 20 cases and diffuse alopecia without apparent margination in 15 cases.

The most two common dermoscopic findings were broken hairs and scales (92.0%), followed by black dots (80.0%), perifollicular erythema (76.0%), comma hairs (68.0%), empty follicles (64.0%), pustules (60.0%), arborising vessels (56.0%), corkscrew hairs (52.0%), Morse code-like hairs (bar code-like hairs) (48.0%), follicular hyperkeratosis (44.0%), crusts (32.0%), and dotted and glomerular vessels (12.0%).

KOH examination was positive in 76 (92.7%) of all 82 patients. In the 6 cases (7.3%) when KOH examination was negative for hair samples, histopathology or fungal culture was positive. Histopathology revealed fungal elements within hair follicles in 72.2%. Among the 38 patients for whom either fungal culture or PCR was conducted, causative organism was identified in 23 cases (60.5%). *Microsporum canis* (n = 13, 56.5%) was the most common causative organism, followed by *Trichophyton rubrum* (n = 5, 21.7%), *T mentagrophytes (T interdigitale/Arthroderma vanbreuseghemii)* (n = 4, 17.4%) and *T verrucosum* (n = 1, 4.4%).

Post-treatment follow-up of these patients showed clinical improvement and mycological cure in 76 patients (92.7%) after treatment with systemic or topical antifungal agents in combination with antifungal shampoo. In addition to antifungal therapy, systemic corticosteroid (n = 16, 19.5%) or topical corticosteroid (n = 9, 11.0%) was used in severe and inflamed cases. During the entire treatment period, no patient showed any serious systemic side effects. The duration of the treatment ranged from 1 to 27 weeks. Seven patients

TABLE 3 Results of diagnostic test of adult tinea capitis patients in this study

Diagnostic test	Total number of tested patients	Findings	Number (%) of cases
Dermoscopy	25	Broken hairs	23 (92.0)
		Scales	23 (92.0)
		Black dots	29 (80.0)
		Perifollicular erythema	19 (76.0)
		Comma hairs	17 (68.0)
		Empty follicles	16 (64.0)
		Pustules	15 (60.0)
		Arborising vessels	14 (56.0)
		Corkscrew hairs	13 (52.0)
		Morse code-like hairs	12 (48.0)
		Follicular hyperkeratosis	11 (44.0)
		Crusts	8 (32.0)
		Dotted and glomerular vessels	3 (12.0)
Wood's light	35	Positive (green fluorescence)	23 (65.70%)
		Negative (no fluorescence)	12 (34.30%)
Direct microscopy (KOH)	82	Positive	76 (92.7%)
		Negative	6 (7.3%)
Histopathology	18	Fungal elements (spore or hyphae) within hair follicles	13 (72.2%)
		Folliculitis	11 (61.1%)
		Perifolliculitis	7 (38.9%)
Fungal culture	38	*Microsporum canis*	13 (56.5%)
		Trichophyton rubrum	5 (21.7%)
		Trichophyton mentagrophytes (Trichophyton interdigitale/ Arthroderma vanbreuseghemii)	4 (17.4%)
		Trichophyton verrucosum	1 (4.4%)
		Contamination	2 (8.8%)
		No growth	13 (34.2%)

(8.5%) discontinued treatment due to concerns about possible side effect of the systemic drugs. Three patients (3.7%) healed but with permanent alopecia and 7 patients (9.2%) had a recurrence.

4 | DISCUSSION

The prevalence of adult TC varies in different countries (Table 4). The incidence of adult TC was previously reported to be <1%[3]; however, a higher rate of incidence has been reported by studies from different regions and countries: 4.9%-11.4% in USA,[23] 2.6%-11.4% in Europe (2.6% in Italy,[9] 5.8% in Greece,[6] 11.0% in France,[15] 11.4% in Spain[24]), 4.2%-5.3% in Africa (4.2% in Egypt,[8] 5.3% in Tunisians[7]) and 6%-13.6% in China.[25,26] Extraordinarily high incidence rate of 63% was observed in Taiwan.[4] In Korea, the prevalence of adult TC has changed over the past decades and the occurrence of TC in adult has gradually increased. The percentage of adult TC patients among all TC patients was 0%-2%[3] in 1970-1980s, 11.2% and 23.1%[27,28] in 1990s, and 34.3%[29] in 2000s. In this study, the prevalence of adult patients was 44.3% among all TC patients, which is significantly higher than that reported earlier in Korea. The reason for the increasing rate of incidence of adult TC may be related to an increase in the elderly population and alteration in immune system due to systemic diseases such as diabetes, malignancy, or use of immunosuppressants. In this study, 74.4% of adult TC patients had underlying chronic disease, and 27.9% of them were actively on steroids or immunosuppressants. In addition to these, social factors such as expansion of nursing facilities for the elderly, and frequent contact with prepubertal children or pets may also be responsible for increase in the incidence rate of adult TC. In particular, most of adult patients were postmenopausal elderly woman, which is consistent with previous studies.[3-9,15,18,24,27-29] The older female predominance can be explained by decreased secretion of fungistatic sebum due to decreased blood oestrogen level after menopause.[15]

While typical clinical presentation of TC in children is a well-circumscribed alopecic patch with apparent scaling, adult TC has

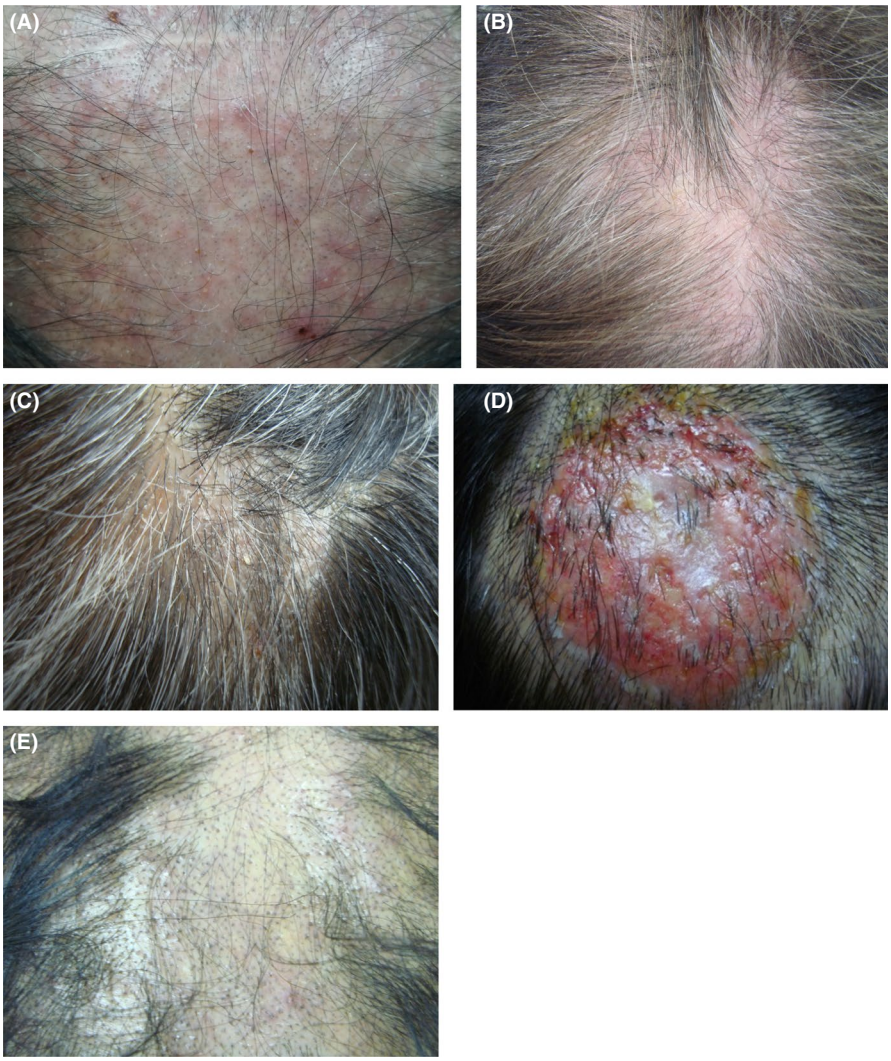

FIGURE 1 Clinical presentation of adult tinea capitis (A) pustular type with diffuse hair loss, (B) seborrhoeic dermatitis–like diffuse scaling type with no apparent hair loss, (C) grey patch type showing well-circumscribed bald patch, (D) kerion celsi, (E) black dot type

atypical and variable presentation. Previously, seborrhoeic dermatitis–like diffuse scaling was a common clinical presentation of adult TC (37.9% and 30.3%).[8,29] In this study, common clinical presentations were pustular type (26.8%) and seborrhoeic dermatitis–like scaling type (25.5%), which closely resembles and is confused with folliculitis or seborrhoeic dermatitis. In addition, 62.2% of adult patients had no noticeable alopecia. The rate of misdiagnosis upon clinical examination was 65.9% at the first visit in this study. The mean duration until confirmation of diagnosis was 8-10 months by Aste et al,[5].1 months by El-Khalawany et al[8] and 7-8 months in this study, which is longer than the duration in cases of TC among all ages (<1 month) in previous studies.[27-29] Incorrect or delayed diagnosis may be due to the rarity of this disease in adults as well as its atypical presentation. Therefore, when elderly patients show inflammatory skin changes on the scalp even in the absence of alopecic patch, higher index of suspicion and routine mycological examination may be necessary to confirm TC. Dermoscopy is a non-invasive tool that can help clinicians on the differential diagnosis of TC based on its characteristic patterns. In this study, the most sensitive findings in TC were scales and the specific findings were comma hairs, corkscrew hairs and Morse code-like hairs, which was similar with the result of earlier studies primarily done in prepubertal TC.[30-32]

The causative organism of TC varies across geographical areas and time periods. At present, *T tonsurans* is the primary causative fungal species for TC in USA, Canada, Mexico and Central America,[23,33] while *T violaceum* is the most prevalent causative organism for TC in Africa, India and Thailand.[7,8] In some European and Asian countries, including Korea, *M canis* is the main pathogen for TC.[5,21,27,34] In this study, the most common fungal pathogen was *M canis*, which is the same as in prepubertal TC. However, *T rubrum* was reported as the causative organism in considerably higher proportion of TC patients, which is consistent with previous case studies of adult TC in Korea.[18,35] *Trichophyton rubrum*, an anthropophilic fungus, is the most common cause of dermatophytosis other than TC, including tinea pedis and tinea unguium; however, TC caused by *T rubrum* is extremely rare in children. Therefore, the pathogenesis of TC in adult may be direct transmission from proceeding dermatophytosis from other skin sites. Actually, more than half of patients had concurrent tinea infection on the other skin site in this study. A thorough skin examination from head to toe may facilitate accurate diagnosis and identification of the causative organism and the route of transmission.

TABLE 4 Previous and present studies of adult tinea capitis

Author (year)	Region	Cases (adult proportion)	Age range (Mean)	Sex (M:F)	Disease duration	Other site involvement (%)	Infection from animals (%)	Chronic underlying disease (%)	Isolated species	Treatment
Oh et al[2] (1978-88)	Daegu, Korea	41 (2.0%)	21-85 (58.5)	1:19.5	N/A	14.6	31.7	N/A	*M canis* > *T ferrugineum*, *T mentagrophyte*, *T rubrum*, *T verrucosum*	Griseofulvin (500 mg/d) (1-30 wk)
Aste et al[4] (1973-94)	Cagliari, Italy	17 (N/A)	17-76 (N/A)	All female	8-10 mo	N/A	N/A	29.4	*M canis* > *T violaceum*, *T mentagrophyte* > *T verrucosum*	Griseofulvin (25 mg/kg/d) or terbinafine (250 mg/d), topical antifungal agent (40-50 d)
Devliotou-Panagliotidou et al[5] (1981-95)	Northern Greece	35 (5.8%)	19-89 (N/A)	1:16.5	1 mo-30 y	28.6	N/A	20.0	*T violaceum* > *M canis* > *T rubrum*, *T verrucosum* > *T schoenleinii*, *T mentagrophyte* > *T tonsurans*	N/A
El-Khalawany et al[7] (2002-12)	Cairo, Egypt	58 (4.2%)	42.9 ± 8.54	1:5.4	7.1 ± 2.41 mo	29.3	17.2	34.4	*T violaceum* > *M audouinii* > *M canis* > *T schoenleini*	Griseofulvin (500 mg/d), itraconazole (200 mg/d), terbinafine (250 mg/d)
Cervetti et al[8] (1997-2012)	Turin, Italy	13 (2.6%)	29-80 (56.5)	1:2.2	N/A	38.5	46.2	23.1	*M canis* > *T mentagrophyte* > *T rubrum* > *T violaceum*	Griseofulvin (500 mg/d), terbinafine (250 mg/d)
Present data (2000-2017)	Jeonju, Korea	82 (44.3%)	20-90 (66.9 ± (15.8)	1:3.1	22.5 wk	46.2	12.8	74.4	*M canis* > *T rubrum* > *T mentagrophyte*, *T verrucosum*	Terbinafine (250 mg/d), itraconazole (200 mg/d), topical antifungal agent

Treatment of adult TC patients is similar with those of children. However, special consideration related to the choice of drugs is necessary for elderly TC patients due to their underlying systemic conditions and medications. In this study, most patients were successfully treated with systemic antifungal agents. Only 7 patients (8.5%) had to discontinue treatment due to concerns about potential hepatic toxicity of oral antifungal agents. Although topical antifungals are known to be not effective due to inadequate penetration in hair follicles, 15.9% of patients who were contraindicated for oral antifungals were treated with topical antifungal cream and shampoo and this was effective, especially for the seborrhoeic form of TC.

This retrospective study was performed in a single, tertiary hospital, which bears several limitations. The selection bias and missing data can restrain the clinical, microbiological and epidemiological characterisation. One main drawback is that the pathogens were confirmed for less than half of the patients, which makes the analysis of results less informative. In addition, our data do not allow for the calculation of prevalence of adult TC and the findings may not be generalised to our region. Multicentre, prospective study with larger patient population is required for better understanding of TC in adults.

In conclusion, we report the largest case study of TC in adults, and one of the longest, most recent survey of TC in Korea. TC is overlooked skin problem of adults. Adult TC shows distinctive epidemiological, clinical and mycological characteristics compared to prepubertal TC, which lead to incorrect or delayed diagnosis. Better recognition of TC profile in adult population is needed.

CONFLICTS OF INTEREST

None.

AUTHOR CONTRIBUTIONS

J.P. conceived the ideas; SW.P. and SK.P. collected the data; SK.P., SK. Y., HU. K. and J.P. analysed the data; and SK.P. and J.P. led the writing.

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