

Clinicoepidemiological Trends and Features of *Epidermophyton floccosum* Infections in Korea: Between Year 1998~2007 and 2008~2019

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Background: The knowledge of the clinical features and changing epidemiology of dermatophytes helps in better managing them.

Objective: This study investigated the recent epidemiologic characters of *Epidermophyton floccosum* from January 2008 to December 2019 and attempted to compare these with previous studies.

Methods: The current study included 57 patients who visited our clinic and were diagnosed with *E. floccosum* infection through fungal culture between January 2008 and December 2019. Data on the date of visit, gender, age at onset, and site of infection were collected through a review of medical charts and were compared with previously reported studies.

Results: The frequency of isolation of *E. floccosum* decreased gradually, and the infections caused by *E. floccosum* were 33 cases of tinea cruris, 20 of tinea pedis, and 2 each of tinea corporis and tinea unguium. The male to female ratio was 10.4:1, and most infections occurred in the 10~29 year age group.

Conclusion: *E. floccosum* infections in Korea have been decreasing rapidly since 1987. However, the clinical features of *E. floccosum* infections remained unchanged even at a low incidence.

Key Words: Epidemiology, *Epidermophyton floccosum*, Korea

INTRODUCTION

Dermatophytoses are fungal infections caused by filamentous fungi that possess the ability to invade and proliferate within keratinized tissue (i.e., skin, nail, and hair). The fungal

biota of superficial infections does not only vary geographically but also historically. For example, *Epidermophyton floccosum*, *Microsporum audouinii*, and *Trichophyton schoenleinii* were the major pathogens of superficial fungal diseases 100 years ago, but their frequency decreased dramatically since the

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middle of the twentieth century and they are limited to some less developed countries today¹. Knowledge of the clinical features and changing epidemiology of dermatophytes helps in better managing them. *E. floccosum* causes a variety of clinical manifestations such as tinea cruris, tinea corporis, tinea pedis, and tinea unguium². *E. floccosum* is more common in tropical and subtropical areas^{3,4}. Moreover, *E. floccosum* can invade and cause deep fungal infections in immunocompromised patients^{5,6}. Previously, our study group (Bang and Kim) reported the epidemiologic aspects of *E. floccosum* isolated from 71 patients between January 1998 and December 2007 in Korea⁷. In this study, the recent epidemiologic traits of *E. floccosum* between January 2008 and December 2019 were investigated and compared with previous studies.

MATERIALS AND METHODS

The current study included 57 patients who visited our clinic and were diagnosed with *E. floccosum* infection via fungal culture between January 2008 and December 2019. Data on the date of visit, gender, age at onset, and site of infection were collected through a review of medical charts, and the findings were compared with that of previously reported studies⁷. KOH test was performed by collecting the scale and nail of the lesion and dissolving them in a 20% KOH solution. The mixture was then observed under a microscope. The culture was identified by inoculating the specimen into a Sabouraud dextrose agar medium and incubating it at 25°C for 3~4 weeks. Colonies were identified based on the features, growth rate, color, and microscopic findings, and tests on pigment production, urease, and hair perforation were also conducted if necessary.

This study was conducted with the approval of the Institutional Review Board of Kyungpook National University Hospital (IRB No. 2020-08-001). Informed patient consent was waived

by the board.

RESULTS

1. Isolation frequency of *E. floccosum* in dermatophytosis cases

Fifty-seven patients were diagnosed with *E. floccosum* infections among dermatophytes between 2008 and 2019, and only one case each was identified in 2018 and 2019. Therefore, the frequency of isolation of *E. floccosum* decreased gradually (0.076% and 0.013% in 2008 and 2019, respectively) (Table 1).

2. Distribution of *E. floccosum* according to year and gender

The annual new cases of *E. floccosum* ranged from 1 to 10 between 2008 and 2019. The number of new cases was lowest in 2018 and 2019 and highest in 2010. The mean annual new cases of *E. floccosum* was 4.75. The distribution, divided by 2 years, showed a steadily decreasing tendency (Table 2). Patients most commonly visited the hospital in summer (19 cases) and fall (14 cases).

3. Distribution of *E. floccosum* according to infection site and gender

Fifty-two men (91.2%) and five women (8.8%) were diagnosed with *E. floccosum* infections with a male to female ratio of 10.4:1 (Table 3). The inguinal area (33 cases) and the feet (tinea pedis, 19 cases) were the most common infection sites. Two cases each of tinea corporis and tinea unguium were identified.

Table 1. The frequency of isolation of *E. floccosum* in dermatophytosis cases from 1998 to 2019 by two years duration intervals

Year	1998~ 1999	2000~ 2001	2002~ 2003	2004~ 2005	2006~ 2007	2008~ 2009	2010~ 2011	2012~ 2013	2014~ 2015	2016~ 2017	2018~ 2019
Dermatophytosis cases	19,061	19,756	23,841	22,122	22,246	19,740	17,368	16,697	16,513	17,203	15,545
<i>E. floccosum</i> cases	15	5	13	18	20	15	17	10	6	7	2
Frequency (%)	0.08	0.025	0.054	0.081	0.089	0.076	0.098	0.060	0.036	0.041	0.013

*Data from 1998 to 2007 were cited in a previous paper from our group⁷

Table 2. Seasonal distribution of *E. floccosum* infections

	2008~2009	2010~2011	2012~2013	2014~2015	2016~2017	2018~2019	Total (%)
Spring	2	6	3	2	0	0	13 (22.8%)
Summer	6	3	6	2	2	0	19 (33.3%)
Fall	3	5	1	0	3	2	14 (24.6%)
Winter	4	3	0	2	2	0	11 (19.3%)
Total	15 (26.3)	17 (29.8)	10 (17.5)	6 (10.5)	7 (12.3)	2 (3.5)	57 (100.0%)

Table 3. Distribution of *E. floccosum* infections according to infection site and gender

	T. cruris	T. pedis	T. corporis	T. manus	T. unguium	T. faciale	T. capitis	Total (%)
Men	30	19	1	0	2	0	0	52 (91.2%)
Women	3	1	1	0	0	0	0	5 (8.8%)
Total	33	20	2	0	2	0	0	57 (100.0%)

Table 4. Distribution of *E. floccosum* infections according to infection site and age groups

	T. cruris	T. pedis	T. corporis	T. manus	T. unguium	T. faciale	T. capitis	Total (%)
0~9	0	0	0	0	0	0	0	0 (0.0%)
10~19	12	1	0	0	0	0	0	13 (22.8%)
20~29	16	4	0	0	0	0	0	20 (35.1%)
30~39	1	3	0	0	0	0	0	4 (7.0%)
40~49	1	4	0	0	1	0	0	6 (10.5%)
50~59	1	4	0	0	1	0	0	6 (10.5%)
60~69	2	2	2	0	0	0	0	6 (10.5%)
≥70	0	2	0	0	0	0	0	2 (3.5%)
Total	33	20	2	0	2	0	0	57 (100.0%)

4. Distribution of *E. floccosum* according to infection site and age groups

Most of the patients with tinea cruris were in their teens and 20s (28 out of 33, 84.8%), while those with tinea pedis were evenly identified in all age groups (Table 4). *E. floccosum* infections occurred in patients in their teens (22.8%) and 20s (35.1%). Two cases of tinea unguium occurred on the toenail while two cases of tinea corporis occurred on the chest and hip. In this study, tinea manus, tinea faciale, and tinea capitis were not identified.

DISCUSSION

It is difficult to identify the occurrence and distribution patterns of dermatomycosis, and many limitations are present in selecting and targeting the general study population. Consequently, many epidemiological studies have been conducted with patients visiting large hospitals in regional areas⁸. *E. floccosum* was previously the leading causative organism of tinea cruris infection worldwide⁹, and, in Korea, it has been known to be the fourth most common causative agent among dermatophytes after *Trichophyton rubrum*, *Trichophyton mentagrophytes*, and *Microsporum canis*^{10,11}.

Furthermore, epidemiological investigations of this species were reported in 1999 and 2008 in Korea^{7,12}. In this study, the authors investigated the epidemiology of patients who had been diagnosed with *E. floccosum* infection during the recent 12 years (2008 to 2019) and sought to compare these with previous studies.

The frequency of isolation of *E. floccosum* in dermatophytoses was found to be extremely low in this study. In combination with previous studies^{7,10,12}, it can be concluded that *E. floccosum* infections in Korea have been decreasing rapidly since 1987. In Korea, the isolated proportion of *E. floccosum* was 3.87% from 1976 to 1980 but decreased sharply to 0.34% from 1986 to 1990¹². Zhan et al. reported that *E. floccosum* infections were disappearing in many areas other than Iran and Nigeria¹. In this article¹, *E. floccosum* accounted for 1% of isolated species in Denmark (2003) and 30~40% in Iran (2013~2014) and Nigeria (2011).

E. floccosum is generally known to cause superficial dermatomycosis, among which tinea cruris, tinea pedis, and tinea corporis are common². In this study, the inguinal and feet area were the most commonly involved sites, indicating that the infection site remained unchanged even at a low incidence. Our previous study showed similar results among the 71 patients diagnosed with *E. floccosum* infection (62.0% for tinea cruris and 28.1% for tinea pedis)⁷. Likewise, a recent study in Iran showed similar results¹³. In Italy, similar results were published¹⁴ with a reported incidence of 4.5%. The infections caused by *E. floccosum* were classified as 83 cases of tinea cruris, 7 of tinea corporis, 3 of tinea pedis, and 1 each of tinea capitis and tinea unguium. Males were by far the most affected, and the majority are in the 21~30 year age group¹⁴.

A high male to female ratio was evident in patients with dermatophytosis, which tended to be similar to the reports from Korea and other countries^{8,12,13}. In particular, some Korean and Italian studies reported the presence of extremely more male patients with *E. floccosum* infection. The male to female ratio was 6.6:1 and 4.28:1 according to Korean¹² and Italian reports¹⁴. Similarly, the male to female ratio was 6.9:1 in our previous study⁷. However, the proportion of male patients increased further in this study.

Overall, dermatophytosis occurs most frequently in post-pubertal hosts. The most commonly infected age group in this study was the 10~29 year age group, showing similar results with our previous study⁷. Caretta et al.¹⁵ reported that 19.3% in their teens and 23.5% in their 20s were infected with *E. floccosum*, and Ahn et al.¹² showed that 71.1% in their teens and 20s were affected by *E. floccosum* infection. This indicates that *E. floccosum* infections had a higher

tendency to occur at younger ages than other causative fungi. Thus, more studies are needed to elucidate this.

In conclusion, the frequency of isolation of *E. floccosum* was found to decrease progressively, and the infections caused by *E. floccosum* were 33 cases of tinea cruris, 20 of tinea pedis, and 2 each of tinea corporis and tinea unguium. The male to female ratio was 10.4:1, and the majority was in the 10~29 year age group.

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CONFLICT OF INTEREST

In relation to this article, we declare that there is no conflict of interest.

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