

Review article

Prevalence, clinical features, and diagnostic methods of dermatophyte skin infection in Korea

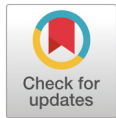
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Abstract

Cutaneous dermatophyte infections, dermatophytosis, are common worldwide, affecting various age groups and body parts. Despite advancements in antifungal therapies, the prevalence of dermatophytosis continues to increase, posing significant challenges for diagnosis and treatment. This review provides an overview of the prevalence, clinical features, and diagnostic methods for dermatophytosis in Korea. A comprehensive review of domestic reports and research on dermatophytosis in Korea was conducted using data from KoreaMed. This study covers the various clinical presentations, age distributions, seasonal trends, and types of dermatophytes identified in different body areas. Dermatophytosis in Korea have shown changing patterns in terms of prevalence and causative species. *Trichophyton rubrum* remains the most common causative organism, with varying presentations depending on the site of infection, such as tinea pedis, tinea corporis, tinea capitis, tinea faciei, and onychomycosis. Diagnostic practices largely depend on the potassium hydroxide smear test, which has limited sensitivity, particularly for onychomycosis. Recent trends indicate an increase in the incidence of dermatophytosis among older adults, which may be linked to underlying health conditions and lifestyle changes. Dermatophytosis in Korea exhibit diverse clinical manifestations influenced by factors such as patient age, body site, and seasonal variation. Improved diagnostic methods are needed to enhance the accuracy and guide appropriate treatment, especially with the emergence of antifungal-resistant strains. This review aims to provide a better understanding of the current state of dermatophytosis in Korea and contribute to more effective management and prevention strategies.

Keywords: Dermatophytes, Dermatophytoses, Tinea, Korea



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Introduction

Background

Fungal skin infections are generally classified as those caused by dermatophytes or non-dermatophyte fungi. Most cases are due to dermatophytes, and dermatophytoses that thrive during hot and humid seasons [1]. These infections affect a wide range of age groups, from infants to older adults, and can occur in various body parts, including the face, scalp, nails, trunk, and extremities [2]. Without proper management, these infections have a high recurrence rate and are highly contagious, leading many individuals to seek dermatological treatment [2].

Dermatophytoses have various clinical manifestations. Although dermatologists can often visually diagnose these infections based on their characteristic clinical features, diagnosis can be more challenging when patients receive other treatments, when atypical clinical features are present, or when visual diagnosis alone is difficult [3]. In such cases, laboratory tests are often required for diagnosis. Methods such as direct potassium hydroxide (KOH) examination in the clinic, biopsy, or fungal culture can be used to confirm the disease.

Objectives

This review summarizes domestic reports on dermatophytoses in Korea gathered through searches in KoreaMed. This study provides valuable insights into dermatophytoses in Korea, considering its unique geographical and climatic characteristics. This review aimed to provide a detailed examination of the prevalence, types, and identified fungal species of dermatophytoses in Korea.

Epidemiology of dermatophytosis

Global incidence of dermatophytosis

Dermatophytosis is a common disease worldwide, affecting an estimated 20%–25% of the global population [4]. Hot and humid climates significantly influence the prevalence of dermatophytoses. However, recently, various factors such as increased international travel and a rise in the immunocompromised and aging populations have contributed to changes in its prevalence [5,6].

Dermatophytosis occurs primarily in patients with poor hygiene or inadequate nutrition. Notably, despite improvements in living standards, hygiene, and nutritional status, the incidence of dermatophytosis has shown an upward trend [7]. This is associated with an increase in conditions that lead to diabetes or immunosuppression, the use of steroids, and a growing number of pets.

Recent epidemiological studies indicate that dermatophytosis is one of the most prevalent superficial fungal infections worldwide. In particular, drug-resistant dermatophytic strains have emerged that pose a significant challenge for effective management and treatment. This increase in resistance is partly attributable to the widespread use of over-the-counter antifungal medications and incomplete treatment courses. Furthermore, lifestyle changes such as the increased use of communal spaces (e.g., gyms and swimming pools), a growing preference for tight clothing, and the use of synthetic footwear have contributed to the persistence and spread of dermatophytoses. Consequently, dermatophytosis continues to be a public health concern, necessitating further research for improved prevention and treatment strategies.

Epidemiology of dermatophytosis in Korea

The causative fungi of cutaneous dermatophytosis in Korea have changed over time [8-12]. Several factors such as socioeconomic status, lifestyle, and the development of new antifungal drugs have contributed to changes in the main causative dermatophytes of superficial mycoses. With advancements in antifungal agents, an increasing number of patients have sought treatment at dermatological clinics for dermatophytosis,

which is more commonly observed in men than in women.

According to a study conducted by a Korean research team, the number of patients with dermatophytosis is increasing annually [8]. Analysis of the causative strains in 1,314,400 patients revealed that the most common causative organism was *Trichophyton rubrum* (88.4%), followed by *T. mentagrophytes*, *Microsporium canis*, and *Epidermophyton floccosum*. Although infections caused by *T. rubrum* are increasing each year, the identification rates of *T. mentagrophytes*, *M. canis*, and *E. floccosum* have been decreasing [8]. In a study by Lee et al. [9] that analyzed patients suspected of having superficial mycoses at Asan Medical Center in Seoul from 1998 to 2002, the age distribution of dermatophytosis showed a normal distribution, peaking in the 40s and 50s for both men and women. The toenails, feet, fingernails, trunk, groin, scalp, and face were most commonly affected, in that order. The positivity rate for the KOH smear test was 49% and that for fungal cultures was 51%. The identified fungi included dermatophytes (78.5%), yeasts (20.5%), and non-dermatophytic molds (1.0%) [9]. Among the dermatophytes, *T. rubrum* was the most prevalent, followed by *Candida* and *Trichosporon* species. Non-dermatophytic molds are primarily *Aspergillus* species [9]. Except for the scalp and face, *T. rubrum* was the dominant species across all body parts. On the scalp, *M. canis* was the most frequently found, whereas *T. mentagrophytes* was the most common on the face. *Candida* species were mainly detected on the fingernails, toenails, hands, and feet, with *Candida parapsilosis* being the most prevalent. *Trichosporon* species were found in about 8%–10% of cases, primarily on the feet, toenails, and hands. Non-dermatophytic molds are mostly detected on the fingernails and hands, accounting for 1.0% of the total identified fungi [9]. Another study by Lee et al. [10] analyzed 7,487 patients who visited the Dermatology Department of Chonnam National University Hospital and were clinically suspected of having superficial mycoses. The study concluded that patients with superficial mycoses accounted for 12.5% of all new patients. By age, 24.2% were in their 60s or older, and 17.7% were in their 50s; however, the disease was relatively evenly distributed across all age groups above 20 years. The male-to-female ratio was 1.2:1, indicating a higher prevalence among males. Seasonal distribution showed a peak in the summer months (June–August, 33.4%) [10]. The most common clinical type of tinea was tinea pedis (24.1%), followed by onychomycosis (18.1%), tinea corporis (14.5%), tinea cruris (9.3%), tinea faciale (7.7%), tinea manuum (7.5%), candidiasis (7.0%), pityriasis versicolor (6.3%), and tinea capitis (5.2%). Coinfections were observed in 693 patients (9.2%), with the most common being the co-occurrence of tinea pedis and onychomycosis. The positive rate of the KOH test was 49.7%, and the culture rate was 36.5% [10]. The frequency of isolated fungi in cases of superficial mycoses was as follows: *T. rubrum* (34.1%), *C. albicans* (9.6%), *M. canis* (5.4%), *T. mentagrophytes* (3.9%), *M. gypseum* (0.4%), *E. floccosum* (0.3%), *T. verrucosum* (0.3%), *T. tonsurans* (0.1%), and *T. violaceum* (0.1%) [10]. According to Lee et al. [11], who analyzed the medical records of Kyungpook National University from 2013 to 2016, fungal infections most commonly occurred in patients in their 50s and peaked in August. The most common clinical type of superficial fungal infection is tinea pedis, and the most prevalent causative fungus is *Trichophyton rubrum*.

According to a study conducted by a research team at Kyungpook University in Korea, the number of patients with dermatophytosis is increasing every year [8]. Analysis of the causative strains in 1,314,400 patients revealed that the most common causative organism was *Trichophyton rubrum* (88.4%), followed by *T. mentagrophyte*, *Microsporium canis*, and *Epidermophyton floccosum*. Although infections caused by

T. rubrum are increasing annually, the identification rates of *T. mentagrophyte*, *M. canis*, and *E. floccosum* have been reported to be decreasing [8]. Moreover, these studies highlighted certain demographic trends, indicating that dermatophytosis is more prevalent in the elderly population, possibly because of the increased vulnerability associated with aging, immunosenescence, and chronic conditions such as diabetes. Geographic analysis within Korea has shown a higher incidence in urban areas, which is potentially linked to lifestyle factors such as the use of communal facilities and tight, non-breathable clothing [8].

The increase in *T. rubrum* infections is thought to be associated with its high adaptability to the keratinized environment of the human skin and its resistance to common antifungal treatments. Conversely, the decreases in *T. mentagrophyte*, *M. canis*, and *E. floccosum* may be owing to improved hygiene practices, reduced animal exposure, and changes in public health measures. These evolving patterns underscore the need for ongoing surveillance and tailored strategies for managing dermatophytosis in South Korea (Table 1).

Table 1. Comparative overview of dermatophytosis epidemiological studies in Korea

Studies	Research period	Institution	Sample size	Key findings	Key demographics
[8]	1979-2013	Catholic Skin Clinic, Daegu	415,526 cases (131,440 confirmed)	<i>T. rubrum</i> increasing; decline in <i>E. floccosum</i>	Higher incidence in urban areas; more common in males
[9]	1998-2002	Asan Medical Center	8,955 patients	<i>T. rubrum</i> most prevalent; KOH positivity 49.2%	Age peak: 40-50s; Male-to-female ratio: 1.09:1
[10]	2001-2010	Chonnam National University	7,785 patients	<i>T. rubrum</i> (51.1%), <i>Candida</i> spp. (33.2%) common	Common in older adults (60s); male-to-female ratio: 1.2:1
[11]	2013-2016	Kyungpook National University	20,413 patients (8,106 culture positive)	Most common: Tinea pedis; causative agent: <i>T. rubrum</i>	Predominantly males; peak in 50s; seasonal peak in August

Various dermatophytoses according to the body sites (Table 2)

Tinea pedis

Tinea pedis (athlete's foot) is an extremely common condition, with global statistics indicating a prevalence of 20%–25% in the population. Despite the development of various antifungal agents, the prevalence has continued to rise over the years [4,13]. The prevalence of tinea pedis can change owing to factors such as migration to different regions, travel, host immunity, advancements in medical technology, and socioeconomic status. The increase in prevalence is believed to be due to factors such as an aging population, an increase in immunocompromised individuals resulting from the use of antibiotics and immunosuppressants, and the increased use of sports facilities such as swimming pools and gyms [6].

Recently, Cho et al. [14] analyzed the results of a public awareness and behavior survey on athlete's foot conducted by the Korean Dermatological Association in 2022 in commemoration of the 20th Skin Health Day. Although tinea pedis is a well-known and common condition, this study reported that the public awareness of tinea pedis is insufficient. More than 25% of the individuals relied on self-diagnosis and the use of over-the-counter medications or home remedies. Some of these remedies include "soaking feet in vinegar or glacial acetic acid," "soaking feet in soju or alcohol," and "bursting blisters before applying medication [14].

This highlights the urgent need to raise awareness regarding the accurate diagnosis and appropriate treatment of tinea pedis.

Tinea pedis can be clinically classified into interdigital, vesicular, hyperkeratotic, and mixed types [15]. The interdigital type is the most common form of tinea pedis, characterized by maceration, fissures, or scaling of the skin in the interdigital spaces, most frequently affecting the fourth toe web, followed by the third toe web. This type has a high fungal positivity rate and can spread to the soles in warm and moist environments, potentially leading to secondary bacterial infections through the damaged skin. The hyperkeratotic type is the most common form of chronic fungal infection and presents with thickened keratin scaling across the entire sole. Patients typically present with minimal subjective symptoms. The vesicular type refers to vesicles scattered on the soles or sides of the feet. Upon infection, it triggers inflammation and blister formation, with heat and moisture playing important roles. The vesicles are often itchy during formation. These three types are often difficult to distinguish clearly, and multiple types frequently occur in a mixed form [15].

Tinea pedis thrives in hot and humid climates, and in Korea, it has a high military infection rate [16]. Soldiers live in close quarters in barracks and wear enclosed military boots even during hot and humid summers, which may have contributed to the high prevalence of tinea pedis. In the U.S. military, the prevalence rate is reported to be as high as 75% in summer [17], whereas in tropical regions such as Colombia, the prevalence among soldiers ranges from 64% to 84% [18]. According to a study by Seo et al. [16], the prevalence of tinea pedis in a Korean battalion was 51.5%, with the highest rate of 74% in August and the lowest rate of 36.7% in February. Among Korean soldiers, the interdigital type was the most common, observed in 60% of cases. The fungal strains identified were *T. rubrum* (67.7%) and *T. mentagrophytes* (25.8%) [16].

In another study by Park et al., the prevalence of tinea pedis in Korea was found to be the highest in patients aged 60 years and above (25.6%), followed by those in their 50s (23%), 40s (17.6%), 20s (10.8%), and teens (4.1%) [19]. The clinical manifestations observed were interdigital (50%), interdigital-hyperkeratotic (43.6%), and interdigital-vesicular (4%). Mycologically, *T. rubrum* was identified in 96% of cases, whereas *T. mentagrophytes* was observed in 4% of cases [19].

Tinea pedis frequently recurs and can spread to other parts of the body, thus serving as an important source of infection for tinea in others. It often spreads through keratin particles containing fungi shed from patient lesions, thereby increasing the likelihood of infection within the family.

Table 2. Summary of dermatophytic skin infections in Korea: key features, causative agents, and epidemiological insights

Dermatophytoses	Clinical characteristics	Most common fungi	Prevalence in Korea
Tinea pedis	Common globally (20%-25%). Interdigital type most common. High prevalence in military personnel. Causes include aging, immunosuppression, and humid environments.	<i>T. rubrum</i> , <i>T. mentagrophytes</i>	51.5% in Korean soldiers; 75% in U.S. military during summer.
Tinea corporis	Occurs on non-hairy skin. Most common annular type in Korea (87.6%). Coinfections common, mainly with tinea pedis and onychomycosis.	<i>T. rubrum</i> , <i>T. mentagrophytes</i> , <i>M. canis</i>	Annular type most common (87.6%). Coinfections in 57.1% of cases.
Tinea capitis	Occurs on scalp and hair follicles. More common in children. Increased incidence in adults due to immunosuppression. <i>M. canis</i> most common in children, <i>T. rubrum</i> in adults.	<i>M. canis</i> (children), <i>T. rubrum</i> (adults)	Primarily children (85.5% <i>M. canis</i>). Increasing cases in adults, especially postmenopausal women.
Onychomycosis	Fungal infection of nails. Common in elderly. <i>T. rubrum</i> most frequent in toenails; <i>Candida</i> spp. in fingernails. Rising in children due to lifestyle changes.	<i>T. rubrum</i> , <i>Candida albicans</i>	Higher in elderly; rising in children. <i>T. rubrum</i> causes 76% of toenail infections in Korea.
Tinea faciei	Occurs on hairless facial areas. Often misdiagnosed as dermatitis or rosacea. Common in agricultural workers. <i>T. rubrum</i> most prevalent.	<i>T. rubrum</i> , <i>T. mentagrophytes</i> , <i>T. tonsurans</i>	More frequent in men and agricultural workers. Cheeks most commonly affected (64.3%).
Tinea cruris	Groin infection. Common in males. Often associated with tinea pedis. <i>T. rubrum</i> most frequent causative agent (93.5%).	<i>T. rubrum</i> , <i>T. mentagrophytes</i> , <i>E. floccosum</i>	Male-to-female ratio as high as 23.9:1. Peaks in summer.
Tinea manuum	Affects hands, commonly linked to tinea pedis. 'Two feet-one hand' syndrome common. <i>T. rubrum</i> most frequent cause.	<i>T. rubrum</i> , <i>T. mentagrophytes</i> , <i>M. gypseum</i>	Higher in men (Male:Female = 2:1). Frequently coexists with other tinea infection

Tinea corporis

Tinea corporis is an inflammatory or non-inflammatory dermatophytic infection that occurs on the skin, excluding the scalp, face, hands, feet, and groins. A typical lesion presents with a well-defined border surrounded by papules or vesicles, whereas the center heals to show either a hyperpigmented patch covered with scales or a normal skin color. Although *tinea corporis* can occur regardless of the region or age, it is more prevalent in individuals with poor hygiene or nutritional status, and hot and humid environments play a significant role in its development. Clinical manifestations were classified into annular, eczematous, annular, plaque, herpetiform, kerion, and crusted types.

According to Jang et al. [20], 87.6% of *tinea corporis* cases in Korea present with the annular type, 9.5% with the eczematous annular type, and 2.9% with the plaque type. Most patients had a disease duration of less than one month (64.8%) [20]. The size of the lesions varied, with 14.3% of lesions smaller than 2 cm, 53.4% between 2 and 5 cm, 19.0% between 5 and 10 cm, and 13.3% larger than 10 cm. The lesions were more commonly located in the non-exposed areas (55.7%) than in the exposed areas (44.3%). Co-infections with other types of tinea were observed in 57.1% of the cases, with *tinea pedis* being the most common (42.5%), followed by onychomycosis (28.7%), *tinea cruris* (19.1%), *tinea faciei* (8.5%), *tinea manuum* (4.3%), and *tinea capitis* (1.1%) [20]. The causative fungi varied depending on the clinical presentation; *T. mentagrophytes* infections were commonly associated with the eczematous annular type, whereas *T. rubrum*

infections frequently presented with lesions sized between 2 and 10 cm. Infections caused by *M. canis* typically result in smaller clinical lesions than those caused by other species [20].

Tinea capitis

Tinea capitis is a dermatophyte infection of the hair follicles and scalp. *Tinea capitis* can present in both noninflammatory and inflammatory forms with a variety of clinical manifestations, making it necessary to differentiate it from conditions such as seborrheic dermatitis, folliculitis, alopecia areata, trichotillomania, psoriasis, and syphilis. The non-inflammatory types of *tinea capitis* include diffuse scaling, grey patches, and black dots, whereas the inflammatory types include diffuse pustular forms and kerion [21]. The typical clinical presentation of *tinea capitis* is a well-defined patch of hair loss accompanied by scaling especially in children. However, in adults, *tinea capitis* tends to be smaller, show less severe hair loss, and present with atypical and diverse clinical features, making them prone to misdiagnosis. *Tinea capitis* primarily occurs in children aged 3–14 years, its incidence decreases after puberty, and is relatively rare in adults. This is explained by several factors, including the antifungal activity of fatty acids in postpubertal sebum, maturity of hair follicles, and changes in the immune system in adults, which help prevent fungal infections [22]. However, the prevalence of *tinea capitis* has changed recently, and its occurrence in adults is increasing owing to various factors, such as systemic diseases and the prolonged use of steroids or immunosuppressants [23,24]. In particular, postmenopausal women are more susceptible to *tinea capitis* than other adults because of hormonal changes that further reduce the secretion of sebum, which has antimicrobial properties [25].

The causative fungi in children are mostly zoophilic species such as *Microsporum canis*. However, in Korean adults, recent studies have reported an increasing prevalence of anthropophilic species such as *Trichophyton rubrum*, in addition to *M. canis* [26,27]. Nonetheless, with the growing number of households keeping pets as a hobby, the incidence of zoophilic species is also increasing [28].

Recently, Seong et al. [29] analyzed the mycological characteristics of 60 adults and 58 children diagnosed with *tinea capitis* over a past 24 years. *Microsporum canis* was the most common causative organism in adults (48.8%) and children (85.5%). However, in adults, an increasing number of infections caused by dermatophytes other than *Microsporum* was identified [29]. This trend is consistent with the findings of studies by Lee et al. and Jung et al., who reported a recent increase in *Trichophyton rubrum* infections in adult *tinea capitis* [27,30]. In domestic studies, adult *tinea capitis* was more prevalent in women, particularly postmenopausal women [29,30]. Treatment of *tinea capitis* includes oral medications such as itraconazole and terbinafine, as well as topical agents containing sertaconazole.

Onychomycosis

Onychomycosis is a very common fungal infection of the nails caused by dermatophytes, yeasts, and non-dermatophytic molds. Onychomycosis poses cosmetic issues and can cause functional impairment, making treatment necessary to reduce the risk of transmission. It is considered an age-related infectious disease because of its increasing incidence among the elderly population. This is believed to be due to the

underlying conditions and circulatory disorders common in older adults, which lead to nail deformities and delayed nail growth, thereby increasing susceptibility to fungal infections [31]. Onychomycosis is relatively rare in children compared to that in adults because of their different environmental and physical conditions. However, with lifestyle changes, such as increased use of antibiotics and immunosuppressants, exposure to swimming pools and gyms, and wearing tight shoes, the prevalence of onychomycosis in children is gradually increasing [32].

The main causative agents of onychomycosis are dermatophytes, which include *Trichophyton rubrum*, *T. mentagrophytes*, and *Epidermophyton floccosum*. Yeast species include *Candida albicans*, *C. parapsilosis*, and *C. tropicalis*, while non-dermatophytic molds include *Scopulariopsis brevicaulis*, *Aspergillus* sp., *Fusarium* sp., and *Acremonium* sp. [33,34].

Onychomycosis is clinically classified using the Zaias and Baran classification into distal and lateral subungual onychomycosis, white superficial onychomycosis, proximal subungual onychomycosis, and total dystrophic onychomycosis [35,36].

Lim et al. [37] have identified the clinical features and causative organisms of onychomycosis in South Korea. For toenail onychomycosis, *T. rubrum* was the most common pathogen, followed by *T. mentagrophytes*. Among the yeasts, *C. albicans* was the most frequently observed, followed by *C. parapsilosis* and *C. tropicalis*. In contrast, in fingernail onychomycosis, yeast infections account for 48.2%, dermatophyte infections for 44.4%, and non-dermatophytic molds for 7.4%.

The prevalence of pediatric onychomycosis has increased in Korea. According to Kim et al. [38], the number of pediatric onychomycosis patients has gradually increased, and factors such as trauma, family history, and underlying diseases are associated with the condition. Fingernail onychomycosis occurs at a younger age than toenail onychomycosis, with *C. albicans* identified in more than 50% of cases. In toenail onychomycosis, *T. rubrum* was the most common fungus, observed in 76% of cases [38].

Tinea faciei

Tinea faciei is a relatively uncommon dermatophytic infection that occurs in hairless areas of the face, specifically from the forehead (where hair does not grow) to the jawline [39]. Historically, *tinea faciei* was generally classified as *tinea corporis*, and some mycologists still include it in this category. In Korea, it was also reported as *tinea corpora* until the 1970s. However, following a report by Yim et al. [40] in 1982, it was classified as a separate condition owing to the unique anatomical and physiological characteristics of the facial area, which influence the features of the lesion and the conditions that need to be differentiated.

Similar to *tinea* infections in other areas, *tinea faciei* often presents as a central area of healed scaly patches surrounded by a ring of erythema. However, owing to the high exposure of the face to sunlight and the use of cosmetics, it can manifest in atypical forms such as patches, plaques, or blisters [41]. This atypical presentation can often be mistaken for other facial skin conditions, such as lupus erythematosus, rosacea, atopic dermatitis, or granuloma annulare, leading to misdiagnosis. In Korea, there have been reports of *tinea faciei* presenting with atypical clinical manifestations [42,43], including cases resembling eczema herpeticum [44], contact dermatitis [45], and rosacea [46].

A common issue is the frequent use of steroid preparations without definitive mycological diagnostic tests such as KOH smears, under the assumption that the condition is common dermatitis. This leads to further confusion in diagnosis. Tinea faciei can exhibit clinical patterns similar to those of other dermatoses, and its prevalence, distribution of fungal species, and clinical presentation may vary depending on the environmental and regional characteristics.

Kim et al. [47] analyzed 56 patients diagnosed with tinea faciei who visited Daegu Catholic University between 2013 and 2014. The highest incidence was observed in patients in their 50s and the occurrence rate was higher in men than in women. The most common occupations among the patients were agriculture and livestock (46.6%), with a higher frequency than other occupational groups [47]. The most frequently affected area was the cheek (64.3%), followed by the forehead, temples, and nose. The average lesion size was relatively large with a mean diameter of 9.6 cm [47]. The cultured strains included *T. rubrum* (79.2%), *T. mentagrophytes* (8.3%), *T. tonsurans* (8.3%), and *T. verrucosum* (4.2%) [47].

Tinea cruris

Tinea cruris is a superficial dermatophytic infection that occurs in the groin and is more common in adult males. It frequently affects individuals living in hot and humid regions, and obesity and mechanical friction from tight-fitting underwear are important contributing factors. The higher prevalence of tinea cruris in men is thought to be due to men wearing more enclosed clothing, the groin area being more enclosed due to the presence of the scrotum, and increased physical activity, which raises the humidity and temperature in the groin area due to sweating.

Shin et al. [48] analyzed 598 cases of tinea cruris in patients over 13 years of age who visited Yeungnam University. The results showed that the highest number of cases occurred during the summer, particularly in July and August, with a male-to-female ratio of 23.9:1, indicating a significantly higher prevalence in males. Regarding the identified strains, *T. rubrum* accounted for 93.5% of the identified strains, followed by *T. mentagrophytes*, *E. floccosum*, and *M. canis* [48]. Tinea cruris is most commonly associated with tinea pedis (22.4%), followed by onychomycosis (6.7% of cases) [48]. In a study by Lim et al. [49], which analyzed 89 patients with tinea cruris between 2000 and 2005, the male-to-female ratio was 10.8:1, with most cases occurring in individuals in their 20s to 40s. Among these patients, 8.7% had concurrent *T. pedis*, suggesting that many patients initially present with *T. pedis* symptoms. In this study, *T. rubrum* was identified in 89.2% of cases, *T. mentagrophytes* in 7.2%, and *E. floccosum* in 3.6% [49].

Tinea manuum

Tinea manuum is a dermatophytic infection that occurs on the hands and accounts for approximately 5% of all tinea infections [12]. The main causative fungi of tinea manuum in Korea are *Trichophyton rubrum*, *T. mentagrophytes*, and *Microsporum canis*, with *T. rubrum* responsible for 76% of the cases. Many of these cases are associated with concurrent tinea pedis [12]. The primary source of infection for tinea manuum is self-inoculation, which is usually caused by scratching the lesions of the tinea pedis with the hands [50].

Tinea manuum often occurs alongside tinea pedis, and when it involves one hand and both feet or toenails, it is referred to as the "two feet-one hand" syndrome [50]. However, there are other reported routes of infection, such as direct contact with pets such as hedgehogs, leading to tinea development exclusively on the hands that came into contact with the infected animal. This phenomenon has been documented both domestically and international literature [51-53]. In cases of tinea manuum caused by zoophilic subtypes such as *T. mentagrophytes*, atypically severe inflammatory lesions such as pustular patches may appear localized in areas exposed to the animal [51-54].

According to a study on tinea manus in Korea published by Ko et al. [55], the incidence of tinea manus was higher in men than in women (Male:Female = 2:1), and the presence of other tinea lesions was also more common in men. Clinically, the most frequent site is the palm, followed by cases involving both the palm and dorsum of the hand [55]. The most common clinical presentation was the hyperkeratotic type, appearing as scaly patches on the palm, followed by the vesicular and interdigital types [55]. Coexisting tinea infections were observed in 78% of patients, with tinea pedis and onychomycosis being the most common, although tinea corporis was also noted. Among the cultured strains, *T. rubrum* was the most frequently isolated, followed by *T. mentagrophytes* and *M. gypseum* [55].

Diagnosis of dermatophytic infections in dermatologic clinics

A KOH smear is commonly used as the primary diagnostic test because it is simple and provides rapid results. However, its accuracy depends on the examiner's skill and experience and is less sensitive than other diagnostic methods. In particular, the positivity rate of KOH in onychomycosis was lower than that of KOH results from other sites. According to a study by Lee et al. [56], the sensitivity of the KOH smear ranges from 16.7% to 70.0%, depending on the number of months of training of dermatology residents.

When onychomycosis is suspected but both fungal culture and KOH smear results are negative, a pathological staining examination of the nail plate can be considered to improve diagnostic accuracy. This involves aseptically cutting the nail plate of a suspected patient, followed by staining with Grocott-Gomori methenamine silver or periodic acid-Schiff to confirm the presence of fungi. Meta-analyses have shown that this test has a sensitivity of 84% and a specificity of 89%, offering the highest accuracy as a single diagnostic test [57,58].

Conclusion

Dermatophytoses vary depending on the site of occurrence, patient age, and medication history. For an accurate diagnosis, it is important to identify the fungus from the lesion site easily and quickly. Despite many advancements in identifying fungi, most clinical diagnoses still rely on the KOH method, which is simple to perform but has low sensitivity. However, owing to improper diagnosis and medication misuse, the prevalence of dermatophytosis has not decreased, and many patients require treatment each year.

Recently, the emergence of strains resistant to major treatment drugs such as terbinafine, itraconazole, and fluconazole has become a concern abroad, raising alarms for the treatment of dermatophytic infections. For dermatologists, it is necessary to develop new diagnostic methods to ensure more accurate patient treatment, which may also help prevent the misuse of medications.

Ethics statement

This was not a human population study; therefore, approval by the institutional review board and informed consent were not required.

Conflicts of interest

No potential conflicts of interest relevant to this article were reported.

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Data availability

None.

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