

An overview of dermatophytosis and treatment in specific patient population

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Abstract

Dermatophytosis is the most common fungal infection that occupies the epidermal layer and causes infection in various regions of our body. Causative agents that are responsible for causing superficial fungal infections are *Microsporum*, *trichophyton*, and *Epidermophyton*. Based on their natural habitat, they are classified into three species. Anthropophilic dermatophytes usually infect humans, and *T. rubrum* is the most common human-infecting dermatophyte. Zoophilic dermatophytes commonly affect animals. Geophilic dermatophytes live in soil and rarely infect humans and animals. Based on the site of infection, they are classified as *Tinea pedis*, *Tinea unguium*, *Tinea corporis*, *Tinea faciei*, *Tinea manuum*, etc. Symptoms may vary depending on the site and type of infection. Inflammation with an erythematous sign is the most common feature of dermatophytosis. Treatment for elderly patients, children, and pregnant women varies based on the patient's comorbidities, drug characteristics, and immune response. Fluconazole, itraconazole, and terbinafine are the drugs that should be avoided during pregnancy.

Keywords: Dermatophytosis; Anthropophilic dermatophyte; *T. rubrum*; Fluconazole; Itching; *Tinea corporis*.

1. Introduction

The most common fungal infection worldwide is cutaneous mycoses, which are caused by dermatophyte fungi [1]. Dermatophytes occupy the epidermal layer and live on the keratin of skin, hair, and nails [2]. These infections occur in various regions of our body, such as our feet, hands, groin, face, trunks and extremities, palms, hair, and nails [2].

Ringworms, or *Tinea*, are a specific group of fungi consisting of the genera *Microsporum* (skin and hair), *Trichophyton* (infects skin, hair, and nails), and *Epidermophyton* (skin and nails), which cause dermatophytoses, also called dermatomycoses. These are the causative agents responsible for superficial fungal infections [1] and [5].

They can be classified into zoophilic, geophilic, and anthropophilic species based on their natural habitat [6]. In the world population, a total of 20–25% of people were affected by a superficial fungal infection [1]. It can be transmitted either directly or indirectly from infected humans, animals, or by contact with contaminated fomites [1]. High temperatures and humid weather, the use of antibiotics and immunosuppressive drugs, and a change in lifestyle are the reasons for the high prevalence of fungal infections. Poor personal hygiene, overcrowding, sharing clothes, close contact with infected people, and farming occupations (direct contact with soil) increase the risk for the development of dermatophytosis [7]. It takes few months to years to cure [2]. Depending upon the site of infection and the immunological response, the clinical manifestation varies [3]. These infections are not critical, but their morbidity rate will be high in immunocompromised and diabetic patients [2].

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Based on their clinical presentation and laboratory confirmation, these infections can be diagnosed [6]. Clinical samples of dermatophytosis are required for the proper identification of the causative agent, which is essential to giving appropriate antifungal therapy and preventing its spread [4]. Monotherapy, combination therapy, or sequential therapy are the treatment options available to treat fungal infections [5]. This review article mainly focuses on causal agents, types of dermatophytosis, its symptoms, and treatment in a specific patient population.

1.1. Causative agents

Dermatophytosis is a communicable disease caused by dermatophytes. Based on their primary habitat, they are classified into three species: anthropophilic, zoophilic, and geophilic. Anthropophilic dermatophytes usually infect humans and rarely cause infection in animals. Zoophilic dermatophytes commonly affect animals but less often affect humans [8]. Geophilic dermatophytes are soil-occupying fungi that less often infect humans and animals [9]. All three classifications have over 40 species that have the ability to infect humans [10]. *T. rubrum*, *T. mentagrophytes*, and *T. tonsurans* are the major pathogenic dermatophytes that cause infection in humans. *M. gypseum*, *T. verrucosum*, and *T. soudanense* are the less common pathogenic dermatophytes that cause infection in humans [21].

1.2. Anthropophilic dermatophytes

Theoretically, anthropophilic dermatophytes are developed from geophilic dermatophytes. They usually cause infections in humans. This group contains approximately 10 dermatophyte species. The main genera are *Trichophyton* and *Epidermophyton* [10]. *Trichophyton rubrum*, *Trichophyton interdigitale*, and *Epidermophyton floccosum* are the species that cause dermatophytosis in humans [11] [12]. Anthropophilic species infect particular body parts because they have been adapted to humans. In the world, the most common human-infecting dermatophyte is *T. rubrum* [10]. *T. rubrum* and *T. tonsurans* are the human-infecting anthropophilic species [13]. *T. rubrum* and *T. interdigitale* are the species responsible for causing tinea pedis [10]. *Tinea captitis* is an infection caused by *M. audouinii* and *T. tonsurans* and occurs mostly in children [14]. Around the world, the primary agent responsible for *Tinea captitis* is *T. tonsurans*. *Trichophyton schoenleinii* causes *Tinea captitis favosa*, which is a rare form of *Tinea captitis* [10]. Zoophilic dermatophytes, *T. mentagrophytes* and *T. verrucosum*, and anthropophilic dermatophytes, *T. rubrum*, cause *Tinea barbae* infection [10].

Trichophyton rubrum, *T. tonsurans*, and *Microsporum canis* are the common causative agents responsible for causing tinea corporis in humans [17] [10]. *T. corporis* can also be transmitted from close contact with dogs or cats and is often caused by fungi called *M. canis*. *T. schoenleinii*, *Nannizzia gypsea*, *N. nana*, *M. gallinae*, *M. fulvum*, *T. erinaceid*, *T. equinum*, and *T. simii* are the organisms that cause *T. corporis* very rarely [17] [10]. *T. rubrum*, *T. mentagrophytes*, *T. tonsurans*, or *M. canis* are the agents responsible for *Tinea faciei* infection, which is a special form of *Tinea corporis*. *T. cruris* (jock itch) is the infection caused by *T. rubrum* and *E. floccosum*. *T. rubrum* or *M. canis* causes a tinea manuum infection; they are usually associated with tinea pedis [10]. A newly found dermatophyte species is *Trichophyton Indotineae*, where some of the isolates are resistant to terbinafine treatment [18]. *Trichophyton Indotineae* causes various types of dermatophytosis; they are *Tinea pedis*, *Tinea unguium*, *T. cruris*, *T. corporis*, and *T. fascii* [10]. Antifungal medications such as itraconazole are the current treatment given for this dermatophytosis, but they show reduced sensitivity to this treatment, so healthcare workers should be aware of this dermatophyte [10].

1.3. Zoophilic dermatophytes

Zoophilic dermatophyte species are tailored to dwelling on animal hosts. Zoophilic dermatophyte species are *Microsporum canis* (infects cats and dogs), *M. equinum* (horse), *M. persicolor* (voles), *M. nanum* (pig), *Trichophyton equinum* (horse), *T. verrucosum* (cattle), and *Trichophyton mentagrophytes* (rodents, rabbits, and hedgehogs). *M. canis* and *M. equinum* are zoophilic species; they are phylogenetically closely related to *M. ferrugineum* and *M. audouinii* (anthropophilic species) [19]. [13]. *Rubrum* and Zoophile *Trichophyton mantagrophytes* are the common fungi that cause *Tinea unguium* [10]. *Microsporum canis*, *Nannizzia persicolor*, *Nannizzia nana*, *Trichophyton equinum*, *Trichophyton mentagrophytes*, and *Trichophyton verrucosum* are the species that cause infection in animals. *M. canis*, *T. mentagrophytes*, and *Verrucosum* cause infections in humans. Mammals are more often infected with dermatophytosis than reptiles and birds. Symptoms include circular alopecic lesions with erythematous margins. Pruritus is a rare clinical sign. Dermatophytosis can be transmitted from infected animals to other animals or humans by close contact. The distinction between zoophiles and geophiles is difficult to find because zoophiles can also breed in the soil [10].

1.4. Geophilic dermatophytes

Geophilic dermatophytes live in the soil. These are the fungi that cause infection very rarely in humans and animals [10]. Geophilic dermatophyte species are nonpathogenic, and they cause the decomposition of keratin in hair, feathers, and horns present in the soil. *M. gypseum* is the most common species that can sporadically infect animals and humans

as they come into contact with contaminated soil [19]. As they are responsible for returning nutrients to the soil, they are an ecologically important fungus. Infection from these geophilic dermatophytes generally occurs in the environment and is not transmitted between hosts [10]. *Nannizzia gypsea* is the most common species that causes infections in humans and animals. Its former name is *Microsporum gypseum* [19] [20]. A geophilic species is *M. gypseum*, found in soil [13]. Anthropophilic and zoophilic dermatophytes are the most common causative agents that cause infection in humans, whereas geophilic species cause it occasionally [20]. Frequent contact with soil and certain professions, such as farming, are at higher risk for this infection. Its symptoms are usually severe, and the infection duration is shorter. Diagnosis by clinical presentation is difficult for dermatophytosis, so culture or sequence analysis should be performed [10].

1.5. Types of dermatophytosis

1.5.1. *Tinea capitis*

The most typical form of childhood dermatophytosis, tinea capitis, is an infection of the scalp and hair follicles. Transmission can happen through contaminated headwear, brushes, pillowcases, and other inanimate objects and is encouraged by poor hygiene and crowding. Affected hairs can sustain living organisms after being shed for more than a year [35].

1.5.2. *Tinea pedis or athlete's foot*

Tinea pedis, often known as “one hand, two feet syndrome,” is a dermatophyte infection that affects both feet and one hand and is more common in people with weakened immune systems, such as diabetics [36].

1.5.3. *Tinea cruris*

Other names of tinea cruris are crotch itch, crotch rot, eczema marginatum, gym itch, jock itch, jock rot, and ringworm of the groin [37]. It occurs frequently in men, with the exception of auxiliary infections, which are identified in women as a similar small pattern. It affects the proximal medial thighs and buttocks [38].

1.5.4. *Tinea unguium*

The other name of tinea unguium is onychomycosis. It is caused by dermatophytes, and it affects nails [39]. Exterior white onychomycosis (pits on the nail's surface) and subungual dermatophytosis are two symptoms of onychomycosis [38].

1.5.5. *Tinea barbae*

The names “Barber's itch,” “ringworm of the beard,” and “tinea sycosis” are all used to describe tinea barbae. Men's beards and moustaches are affected, and it is a surface hair illness. Beginning on the neck and face, tinea barbae Shaved skin and steroid misuse are the main contributors [38].

1.5.6. *Tinea faciei*

Tinea faciei typically affects the part of the face without beards [40]. It affects females more than males [41]. Symptoms are red hives on the face containing small patches, lifted bumps, the upper lips, and the chin [42].

1.5.7. *Tinea manuum*

One or occasionally both hands can get infected with *Tinea manuum*, a fungal infection. It frequently happens to those who have tinea pedis [43].

1.6. Symptoms and clinical features

Depending on the site and type of infection, symptoms may vary. Itching is the main symptom of dermatophytosis. In the location of infection, a little severe itching was revealed in *Tinea corporis*, and in the case of *Tinea cruris*, it showed very severe itching, and that can be painful. Various levels of itching were revealed in other types of dermatophytosis. The appearance of the nail changed from normal and shiny to dull, opaque, opaque and yellow; this can be noted in onychomycosis. Thickening, brittleness, and crumbling of nails are also noted in onychomycosis [22]. Inflammation with an erythematous sign is the most important feature of dermatophytosis. Inflammatory lesions were produced more by the zoophilic and geophilic dermatophytes. *Tinea capitis* infects hair and scalps that are characterised by a spreading, scaly, irregular, or well-demarcated area of erythema and alopecia. The characteristics of *Tinea Pedis* are dryness, scales, and fissures, or a moist macerated lesion with vesicles between the fingers of the foot [22]. Erythematous, round,

scaly plaques or patches with a raised, red border were seen in the case of *Tinea corporis* [23]. With an annular aspect, *Tinea corporis* can be differentiated from other dermatoses [24]. Erythematous, pruritic patches in the groin area are the characteristics of *Tinea cruris*. *Tinea manuum* infects the palmar, dorsal, or interdigital surfaces of the hand and fingernails, and it may appear to resemble *Tinea corporis*. Characteristics of *Tinea Faciei* or *Tinea incognito* were itchy, red skin without a distinct border or may resemble *tinea corporis* with a red, raised border [23]. *Tinea imbricata* is a fungal infection caused by anthropophilic fungi that causes skin lesions characterised by concentric and lamellar plaques of scale, resembling erythema gyratum repens. Diffuse erythema with follicular papules and pustules is the clinical form of *Tinea Incognito* [24].

1.7. Treatment in specific patient population

1.7.1. Elder patients

Depending on the patient's needs, physical condition, the site of lesions, any associated pathology, the type of onychomycosis, and the vascular impairment, treatment must be individualised in elderly patients [25]. Healthy patients can receive the same care as young adults. Patients who have been taking several medications were advised to stop the additional systemic treatment [25]. Systemic therapy is recommended in the following circumstances:

- tinea involving two or more areas at once, such as *tinea corporis* and *tinea cruris*
- *tinea corporis* with extensive involvement, making topical therapy impractical.
- *tinea pedis* and
- persistent failure of treatments with various topical agents [31][32][33]. The patient could be given a single dose of fluconazole (300mg) or terbinafine (250 mg/day for one week each month) if they are persistent and distressed by their illness, respectively [25].

1.7.2. Pregnant women

Fluconazole should not be prescribed to pregnant women because it can cause congenital anomalies and is excreted with milk. The outcome of pregnancy does not seem to be impacted by oral terbinafine; however, there is little clinical data to support this. Because it is secreted in breast milk, it is not advisable for a nursing mother to take this medication. Itraconazole has a limited track record of use during pregnancy; however, it can cross the blood-placental barrier and is eliminated in milk. Because of this, these drugs should be avoided by pregnant women [25]. Topical azoles can be prescribed at any stage of pregnancy because they are not absorbed systemically [34].

1.7.3. Children

When compared to *tinea capitis*, cutaneous tinea is substantially less common in children [26]. The use of topical antifungals is typically the only option for treating cutaneous tinea in children. In comparison to adult patients, children show a superior clinical response to topical therapy alone because of their rapid turnover of skin [27]. Itraconazole systemic therapy was proven to be effective and safe when used for 1 week in cases of *tinea corporis* and *cruris* and 2 weeks in cases of *tinea pedis* and *manuum* [28]. Itraconazole was shown in a review to be safe and effective, with few major side effects, making it the second-line systemic therapy in the paediatric age group for infants with superficial dermatophytosis (5 mg/kg/day) and systemic mycoses (10 mg/kg/day) [29]. Fluconazole is available in India as an oral suspension in the dosage of 50 mg/ml, and itraconazole comes in an oral solution formulation in the dosage of 10 mg/ml [30].

2. Conclusion

Based on the primary habitat, the dermatophytes are classified into three species: anthropophilic, zoophilic, and geophilic. *T. rubrum* is the most common agent responsible for causing dermatophytes. Dermatophytes can be transmitted from one animal to another by close contact. The most common symptom of dermatophytosis is itching, which may vary depending on the site and type of infection. Special care should be taken while prescribing drugs to pregnant women because some drugs may cause congenital anomalies, e.g., terbinafine, fluconazole, and itraconazole. Few more pieces of information have been published on the treatment of dermatophytosis in pregnant, elderly, and paediatric patients and about its types and symptoms.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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