

# Dermatophytosis and its clinical types

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## Abstract

Dermatophytes is a group of pathogenic fungi which thrives on the keratin part of the human body like skin, hair and nails. They mostly cause a cutaneous infection. The primary habitat for dermatophytes are animals, humans and soil. Dermatophytoses are mainly classified in three anamorphic genera- *Trichophyton*, *Epidermophyton* and *Microsporum*. Dermatophytic infection generally can be diagnosed with KOH microscopic examination and with the help cultural examination and sometimes wood's lamp test is also performed. Dermatophytes can be manage with the help of antifungal drugs and by maintenance of hygiene.

**Keywords:** Dermatophytes, *Trichophyton*, *Epidermophyton*, *Microsporum*

## INTRODUCTION

Dermatophytosis, also named as 'ringworm infection', is a fungal infection involving hair, skin or nails caused by group of related filamentous fungi known as Dermatophytes [1]. The dermatophytes causing cutaneous mycosis (fungal infection restricted to the nonliving cornified layers) includes: *Epidermatophyton*, *Trichophyton* and *Microsporum* [2]. Infection caused by dermatohytes is generally limited to nonliving cornified layer as it cannot penetrate deeper in immunocompetent host. But in case of chronic condition, fungi may invade in deeper tissue.. Dermatophytes only effect the keratin part of the body such as startum corneum layer of skin, hair and nails by liberating keratinase enzyme. Hence, also called keratinophilic fungi. It may occur in both healthy as well as immunocompromised person.

## Epidemiology

Dermatophytosis is developed worldwide and estimated prevalence is about 20-25% of world's total population[3-5]. The factors influencing the epidemiology of dermatophytic infection includes- tourism, migration, drug therapy conditions, changes in socioeconomic conditions and immunocompromised patient [3, 6]. The aetiological agent of dermatophytosis varies across geographic reagions. The best temperature for the growth of dermatophytes is 25–28°C and for this reason, the humid and warm climate of tropical countries and subtropical regions show more incidence of cutaneous mycosis [4, 7]. Species such as *Trichophyton rubrum*, *Trichophyton mentagrophytes* var. *interdigitale*, *Epidermophyton floccosum* and *Microsporum canis* are distributed globally, while others have partial geographic restriction such as *Trichophyton schoenleinii* (Eurasia, Africa), *Trichophyton soudanense* (Africa), *Trichophyton violaceum* (Africa, Asia, and Europe) [6]. A study conducted by Foster et al. found that the most prevalent fungal pathogen in the United States was *T. rubrum* as from 1999 and 2002, increase in incidence reported to be 32% to 47% [8]. An epidemiological study conducted

by Drakensjö & Chryssanthou in Sweden revealed onchomycosis to be the most common dermatophytic infection and the predominant causative agent isolated from 93% of positive fingernail and toe cases was *T. rubrum*. While about 7.4% cases isolated *T. mentagrophytes* [9]. A report given by Bassiri-Jahromi & Khaksari in Tehran, Iran showed more prevalence of anthropophilic dermatophytes (about 92%) was there, of which *Epidermophyton* being most prevalent followed by *Trichophyton rubrum* and *Trichophyton mentagrophytes* [10]. An old study conducted in South India also revealed more prevalence of *Trichophyton rubrum* (about 58.9%), followed by *Trichophyton mentagrophytes* (24.6%) while predominant dermatophyte in positive cases of tinea capitis being *Trichophyton tonsurans* [11]. The report given by National survey for the years 1986, 1996 and 2006 conducted in China revealed variation in dermatophytic infection. According to the report *Trichophyton rubrum* being most prevalent (47%) in 1986 as compared to *Trichophyton mentagrophytes* (20%), while *Microsporum lanosum* (5%) and *Epidermophyton* (3%) reported least. But a change in trend was reported in 1996, which showed drop in prevalence of *Trichophyton rubrum* from 47% to 40% and *Trichophyton* from 20% to 12%. The same year number of *Candida* positive cases also increased to 23%, being the second highest. For year 2006, *Candida albicans* positive cases were reported to be more prevalent (31%), followed by *Trichophyton rubrum* (30%), *Trichophyton mentagrophytes* (7%) and *Candida glabrata* (7%) [12]. The incidence of tinea capitis is getting declined in developed countries however, tinea pedis and onchomycosis incidence are becoming more common [5, 7, 13]

### Ecology of Dermatophytes

Dermatophytes are among those fungi that cause communicable disease, as infection can be transferred through birds or animals or soil. Depending upon the primary habitat of dermatophytes, they are categorized into three groups- anthropophilic, geophilic and zoophilic species. Anthropophilic dermatophytes are associated primarily with humans. It is transmitted from person to person by using the contaminated belongings of an infected person such as comb, towel, clothes, brushes etc. It rarely infect other animals. Zoophilic dermatophytes most commonly infect animals but rarely humans by direct contact with infected animals or indirectly through fomites [14]. Geophilic dermatophytes mostly found as a saprophyte in soil. It causes infection to humans due to its ability to penetrate skin and get colonized by degrading the keratin. It is most common in people who work in soil or barefooted person [15]. These dermatophytes have high number of spores which is transmitted to man and animal either by direct or indirect exposure to soil.

### Classification of dermatophytes

Dermatophytes are mainly classified in three anamorphic genera- *Epidermophyton*, *Microsporum*, and *Trichophyton* [2, 16]. The classification scheme is based on the formation of conidia and its morphology [2, 17]. ***Epidermophyton*** is a type of dermatophytes causing a superficial infection in the skin. It mainly includes two species - *Epidermophyton floccosum*, the only pathogenic species and the other is *Epidermophyton stockdaleae*. *Epidermophyton* gives rise to a special type of ringworm infection, attacking the moist opposing

surfaces, especially the inguinal region. It forms clavate, smooth, thin to thick walled macroconidia either single or in clusters, having one to nine septa. Microconidia are absent.

**Microsporum** is usually present in the soil which affects humans as well as animals. Most of the *Microsporum* spp. infect hair and skin, except for *Microsporum persicolor*. *Microsporum* has 16 species, out of which three are the main who are responsible for the dermatophytes infection which includes *Microsporum audouinii*, *Microsporum canis* and *Microsporum gypseum*. They form spindle shaped, fusiform, obovate or cylindrofusiform, thin to thick walled macroconidia. Microconidia are sessile or stalked, clavate and usually arranged singly along the hyphae or rarely raceme [18].

**Trichophyton** is a dermatophytes majorly responsible for tinea pedis, jock itch, nail infections and scalp infection. Microconidia, usually numerous, may be pyriform, globose or clavate, stalked or sessile and are either borne singly along hyphae or grape like cluster arrangement. Macroconidia, if present, are clavate, pencil shaped, fusiform or cylindrical, usually smooth having one or 12 septa borne singly or in clusters.

### Clinical findings of dermatophytes

**Tinea pedis**, also known as Athlete's foot infection, is a dermatophyte fungal infection involving webspace between toes and it may spread along the sole. This infection results in crack formation due to which skin becomes red and the infection further spreads across the sole of foot. Skin turns into white and becomes more itchy. It is mostly seen in immunocompromised or immune suppressed person.

**Tinea cruris** is a dermatophytic fungal infection involving the groin area of the patient. Males are usually more prone to this infection than females. Fungus colonizes the scrotum but does not infect scrotal skin. It may be caused due to the direct transmission as well as indirect transmission. Mostly a person gets this infection by using the infected clothes or towels.

**Tinea corporis** is a type of infection which occurs in all the parts of the body except scalp, groin area and in beard area of the body or in other words infection of non hairy part of the body. It may be acute or chronic, mostly it is acute but if it is not treated at a time it may get converted into a chronic infection leading to the severe inflammatory reaction on the skin. In body it appears as "O" shaped with raised scaly borders that expand peripherally.

**Tinea faciei** is an infection involving non-bearded part of face, appearing as a red rash on the face. It is a contagious infection which can spread easily. Either it is present just below the eye or present on the cheeks.

**Tinea capitis** also known as black dot ringworm infection affecting the scalp of the human and causes hairfall and it may lead to alopecia [19]. It also involves hair shaft and is known as ectothrix, when the fungal spores are residing outside the hair shaft and endothrix, when present inside.

**Tinea manuum** is an infection which affects the hand. It causes red itchy rashes on both the hands.

**Tinea Ungium** is a fungal infection of the nails, commonly known as onychomycosis which is mostly found on the toes. Nails become thickened and there is cottony wool like structure present on the nail bed. As the infection goes deeper it may lead to the discolouration of nail and may lead to increased nail thickness. It can

affect several nails at the same time but generally not all of the nails together.

### Pathogenesis of dermatophytosis

Severity of the fungal infection depends upon two things – fungal strain/species or the host sensitivity. In order to cause the infection, a dermatophyte need to bypass the innate defense mechanism of host which includes constant exposure to ultraviolet light, structure of skin (physical and chemical), temperature and normal microflora of host. One biggest hurdle for the establishment of dermatophyte is the constant shedding of the epithelial cell and stratum corneum renewal, keratinization. So, the very first step of adherence with the host plays a crucial role in the establishment of the disease [20]. Once the spore comes in contact with host cell, there occur a deposition of a elongated fibrillary structure between the spore and host cell that possibly play a major role in adhesion of the spores to the skin surface. It may also help in making connection with adjacent spores forming a spore complex that results in biofilm formation and intercellular communication[15, 21]. Once dermatophyte get established, secretion of various enzyme such as lipases, proteases, elastases, phosphatases, collagenases, and esterases occurs resulting in the degradation of structural component of host epidermal tissue and increasing the virulence of pathogen[22]. Keratin, a fibrous protein present in host is degraded by keratinase secreted by dermatophytes into simpler forms that is further assimilated by fungus. Beacause of this reason dermatophytes are also known as keratinophilic fungi. Once in the host tissue, these pathogenic fungi induces inflammatory response. The inflammatory response so produced cause the pathogen to move elsewhere from the site of entry or infection to a new site resulting in the formation of characteristics ringed lesions[19, 23].

**Conclusion:** Fungal skin infections are the most frequently encountered disease observed every day. Conditions such as immunosuppressive drugs, immunocompromised patient, and temperature etc. play a crucial role in the onset of such infections. Dermatophytes are capable to invade the host tissue and get adapted to the host environment. The enzymatic machinery possessed by the fungus is the key virulence factor of dermatophytosis. Three genera – Trichophyton, Epidermophyton and Microsporum are frequently resonpsible for such cutaneous infections. In a country like India, where there is a paucity of original studies of dermatophytosis and its treatment, it is becoming amply clear that experience-based treatment of dermatophytosis is ruling the roost and is proving to be more effective.

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