

## Clinical Manifestations of Dermatophytoses a Review



### Microbiology

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### ABSTRACT

*Dermatophytic infections have been considered to be a major public health problem in several parts of the world. They are generated by the dermatophytic fungi which produce extracellular enzymes known as keratinases. Keratinase enzyme is capable for hydrolyzing to keratin substrate. Environmental factors play main role in the growth and sporulation of dermatophytic fungi. Dermatophytoses poses a serious alarm to the sociologically backward and economically poor population of India. Jaipur has got a dry climate but in the summer, the temperature exceeds even 46°C with high humidity during the monsoon season. These extreme climatic conditions favor the occurrence of fungal infections. The infections are caused by 40 species of fungi which are grouped into three anamorphic genera; Trichophyton, Microsporium and Epidermophyton which are distributed around the world. Infections caused by these fungi are also known by the names "Tinea" and "Ringworm." The major etiologic agents may be worldwide, such as T. rubrum, while the distribution of others may vary geographically. Dermatophytoses consist of tinea barae, tinea faciei, tinea incognito, tinea capitis, tinea favosa, tinea corporis, tinea cruris, tinea manuum, tinea pedis, and tinea unguium.*

### INTRODUCTION

Fungi pathogenic to man can be conveniently separated into two basic groups, molds and yeasts. Molds consist of those fungi that grow in a filamentous form, whereas yeast is characterized by unicellular morphology that reproduces by budding. They can grow as a mould at room temperature (25-30°C) and as yeast at 37°C or in tissue.

Skin infections by mould-like fungi known as dermatophytes. Dermatophytosis or ringworm is a clinical condition caused by fungal infection of the human skin, pets such as cats, and domesticated animals such as sheep and cattle. The term "ringworm" is a misnomer, since the circumstances is caused by fungi of several different species and not by parasitic worms. The fungi that cause parasitic infection (dermatophytes) feed on keratin, the material start in the superficial layer of skin, hair, and nails. These fungi increase on skin that is warm and moist, but can as well survive directly on the outsides of hair shafts or in their interiors. In pets, the fungus conscientious for the disease survives in skin and on the outer surface of hairs. Dermatophytes can survive on moist areas of the skin, on ecological surfaces, and on household items such as clothing, towels, and bedding. Dermatophytes, or more correctly, Keratinophilic fungi, produce extracellular enzymes (keratinase) which are capable of hydrolyzing keratin. Dermatophytes usually do not invade living tissues, but colonize the surface layer of the skin.

Dermatophytes are a group of morphologically and physiologically related molds some of which cause well defined infections: dermatophytoses (tinea or ringworm). They possess two important properties: they are Keratinophilic and keratinolytic. This means they have the ability to digest keratin *in vitro* in their saprophytic state and utilize it as a substrate and some may invade tissues *in vivo* and provoke tinea. However, their morphology in the parasitic growth phase is different from the morphology exhibited in culture or *in vitro*.

Dermatophytoses are the most common type of cutaneous fungal infections seen in man and animals affecting skin, hair, nail. These are caused by group of closely related Keratinophilic fungi, which are capable to invade keratinized tissues of skin and its appendages and are collectively known as dermatophytes. The other frequently used terms like tinea and ringworm infections are symptoms of dermatophytoses.

Dermatophytes are the most common agents of fungal infections worldwide. Dermatophytic infections have been considered to be a major public health problem in many parts of the world. The infections are widespread in the developing countries, and are of particular concern in the tropics, especially in infants (Guest and Sam, 1998). Dermatophytoses are superficial infections of keratinised tissue caused by organism of three genera of fungi known as dermatophyton (Bhaduria et al., 2001). The infections are caused by 40 species of fungi which are grouped into three anamorphic genera; *Trichophyton*, *Microsporium* and *Epidermophyton* which are distributed around the world (Behzadi et al., 2014; David et al., 1997; Emmons 1977; Luilma 2005; Fisher 1998).

Dermatophytes are Keratinophilic fungi that can be pathogenic by infecting the *stratum corneum*, nails, hair. The first infection step consists of adherence of arthroconidia to the *stratum corneum* (Baldo 2012). The dermatophytes are "among the commonest infectious agents of man". A dermatophytosis is a mycotic infection of the hair, skin or nails (Fisher 1998). Dermatophytoses poses a serious concern to the sociologically backward and economically poor population of India. Fungal etiological infections in human are frequently observed during those seasons of the year when the environmental temperature and relative humidity are high (Karmakar et al., 1995). Dermatophytic infections are probably the most common cause of skin disease in developing countries of tropical regions. Jaipur has got a dry climate and in summer, the temperature exceeds even 46°C with high humidity during monsoon season. These climatic conditions favour the incidence of the fungi and consequently the disease (Sharma 2012).

The lifestyle in societies, contact with animals and prolonged use of antibiotics, corticosteroids, and antineoplastic drugs are some of the factors that contribute to the increase in risk of infection by fungi, especially by dermatophytes (Rippon 1985; Aghamirian 2008). Dermatophytes are significant due to their zoonotic potential and the concern of owner of pets with some time severe inflammatory diseases. In the present day living conditions, human and animal (domesticated) live their lives in close proximity to one another and are housed under the same roof or sleep on a common floor. In such a situation, skin and other infections are contracted easily and are perpetually multiplied. Dermatophytes are spread by direct contact from other people, animals and soil, as well as indirectly from fomites (Hainer 2003). Dermatophytes typically do not affect the mucus

membranes but rather affect the keratinized tissues and spread by direct contact from infected human beings (anthropophilic organisms), animals (zoophilic organisms), and soil (geophilic organisms) and by indirect way from fomites. Although the clinical signs of dermatophytosis may vary depending on the affected region of the body, pruritis is the generally frequent symptom in humans (Nweze 2010).

Infections caused by these fungi are also known by the names "Tinea" and "Ringworm." tinea is a Latin word for worm or grub because the infections were originally thought to be caused by worm-like parasites (Brooks *et al.*, 2007). It is important to emphasize that "ringworm" is not caused by a worm, but rather by a type of fungus called "Dermatophyte". The species of dermatophytes are differentiated by Microconidia & Macroconidia. Clinically, ringworm can be classified depending on the site involved. These include Tinea capitis (scalp), Tinea corporis (non-hairy skin of the body), Tinea cruris (groin), Tinea pedis (foot) or athlete's foot and Tinea barbae or barber's itch (bearded areas of the face and neck). Favus is a chronic type of ringworm involving the hair follicles (Ananthanarayan 2009).

Different fungi, depending on their site on the body, cause ringworm. It is caused by a fungal infection not an real worm. Fungi on the skin, hair, and nail bed are called dermatophytes. Infection on the scalp, arms, legs, face, and trunk is characterize by ring-shaped, red, scaly patches with clearance centers. Tinea infections of the feet, nails, and genital areas are not commonly referred to like ringworm, as they may not take on the usual ring shape. There is an increased risk of contracting ringworm and other tinea infections if a person:

- Is malnourished
- Has poor hygiene
- Lives in a warm climate
- Make contact with with other people or pets that have ringworm
- Immunocompromised by disease or medication
- Shepherd
- Labour working on dockyard
- Labour working in poultry farms
- Plays contact sports, such as wrestling
- Uses communal baths or locker rooms

#### CLINICAL MANIFESTATIONS OF TINEA

Traditionally, infections caused by dermatophytes (ringworm) have been named according to the anatomic locations involved by appending the Latin term designating the body site after the word tinea, e.g., tinea capitis intended for ringworm of the scalp. The clinical manifestations are as follows:

- Tinea capitis (scalp, eyebrows, and eyelashes)
- Tinea barbae (ringworm of the beard and mustache)
- Tinea faciei (Face)
- Tinea corporis (glabrous skin- chest, back & abdomen)
- Tinea cruris (groin)
- Tinea manuum (hand)
- Tinea unguium (nails)
- Tinea pedis (feet)

Several anatomic sites may be infected by a single dermatophyte species, and different species may produce clinically identical lesions. The major etiologic agents may be global, such as *T. rubrum*, while the division of others may vary geographically. According to historical evidences, the Persian scientists knew regarding skin disease of dermatophytosis in ancient Persia (Moriarty 2012; Behzadi 2003; Behzadi 2012; Behzadi 2012; Achterman 2012; Mahmoudabadi 2005). Females constituted 54% of the study group and males constituted 46%. Tinea capitis was common in the younger males (18-30 years), with tinea pedis

in (31-42 years) and tinea cruris in the older age group of (43-55 years), tinea unguium was the commonest across most age groups of females (Humera *et al.*, 2014).

The majority of fungal skin infections are caused by dermatophytes and the main clinical manifestations are detailed below.

#### TINEA CAPITIS

Tinea capitis is a fungal infection of the scalp, hair follicles and hair shafts, mainly common in the pediatric population and under tropical conditions (Elewski 2000). Tinea capitis presents in numerous ways: the most important lesions may be papules, pustules, plaques, or nodules on the scalp. Inflammation and secondary infection lead to secondary processes, such as scaling, alopecia, erythema, exudate, and edema. The initial presentation may be subtle and asymptomatic, and as the inflammatory response increases inflammatory alopecia, breakage of hairs (black dot alopecia) and scaling may appear. Tinea capitis, which is one of the most common dermatophytosis in children below 12 years of age, is an infection of the scalp and hair shafts (Abdel-Rahman 1997; Bhadauria 2001). It can be caused by any dermatophyte pathogen with the exception of *Epidermophyton floccosum* and *Trichophyton concentricum*. *Trichophyton rubrum*, the most commonly isolated dermatophyte worldwide is only responsible for tinea capitis in exceptional cases. The causative agent varies between continents and from one country to another. For instance, *Microsporum canis* is the predominant pathogen worldwide, while *Trichophyton tonsurans* is the main causative agents (Fitzpatrick 2003; Elewski 1999).

The presence of symptoms like hyperkeratosis of scalp, seborrhea-like symptoms, excoriation secondary to pruritus, alopecia, broken hair or "black dot" appearance, cervical lymphadenopathy, pustules, or indurated or boggy plaques in a child should alert the dermatologist toward the possibility of tinea capitis (Chen 2001; Trovato 2006). Tinea capitis has 3 clinical forms: tinea capitis superficial (non inflammatory), tinea capitis profunda (inflammatory), and tinea capitis favosa (favus). Inflammatory tinea capitis presents with painful, inflammatory, indurated, and pustular masses that can be accompanied by regional lymphadenopathy (Aktas 2009).

Infection develops on the scalp and hair and tends to affect young children worldwide (Bindu 2002). It can be non-inflammatory, inflammatory or black dot type. The non-inflammatory is caused by *Microsporum audouinii* or *Microsporum ferrugineum* and usually develops as a small papule surrounding a single hair shaft, which spreads centrifugally to other hairs. Scaling occurs and the hair turns grey. The inflammatory type is usually associated with zoophilic or geophilic germs such as *Microsporum canis* and *Microsporum gypseum* respectively. Most common agents are *Trichophyton tonsurans*, *Microsporum audouinii*, and *Microsporum canis*. Other fungi are *Microsporum ferrugineum*, *Microsporum gypseum*, *Microsporum nanum*, *Microsporum versicolor*, *Trichophyton megninii*, *Trichophyton mentagrophytes*, *Trichophyton schoenleinii*, *Trichophyton sudanense*, *Trichophyton verrucosum* and *Trichophyton violaceum* (Kanwar 2001).

#### TINEA BARBAE

Tinea barbae is a type of superficial infection involves the skin and the hairs (shafts and follicles) of mustache, beard and a part of neck area, and is usually seen in men. The clinical demonstrations of *Tinea barbae* include kerion, scaling, folliculitis, itching, burning, and inflammatory reactions (Behzadi *et al.*, 2003; Hainier 2003; Pakshir 2006; Rezaei-Matehkolaei 2013). Tinea barbae can be caused by zoophilic or Anthropophilic dermatophytes. Farm workers are often affected. Most common agents are *Trichophyton verrucosum* while, other agents are *Microsporum canis*, *Trichophyton megninii*, *Trichophyton mentagrophytes*,

*Trichophyton rubrum* and *Trichophyton violaceum*. Tinea barbae, an infection of the bearded area, may be mild and superficial or a severe inflammatory pustular folliculitis, the latter form more commonly caused by the zoophilic dermatophytes *Trichophyton verrucosum*, *T. mentagrophytes* var. *mentagrophytes*, and *T. mentagrophytes* var. *erinacei* (Kwon-Chung *et al.*, 1992).

#### TINEA FACIEI

Tinea faciei is seen in the same anatomic locations as well as in men, but this infection belongs to women and children. Tinea faciei is dermatophytosis limited to the non bearded regions of the face, characterized by a mildly pruritic single or multiple erythematous scaly patches with or without active border. It occurs worldwide, but more prevalent is in tropical humid climates (Lin 2004). The causative agent of Tinea faciei varies according to the geographic region and the potential reservoirs located in the environment (Alteras 1988; Kemna 1996). Tinea faciei is uncommon and often misdiagnosed at first. It is often confused with other dermatoses, as fungal infections occur more frequently on other parts of the body. Most cases of Tinea faciei are superficial and curable with topical antifungal (Lin 2004).

However Tinea faciei may occur in those aged 20 – 40 years. This may be due to the heightened physical activity common in this age group (Adams 2002; Allen 1973). Females are most frequently affected than males (Ghilardi *et al.*, 2005). Most common agents of T. faciei are *T. tonsurans*, *T. Verrucosum*, *T. Mentagrophytes*, *M. Canis*, *T. Rubrum* (Szepietowski *et al.*, 2012; Starova *et al.*, 2010). Sometimes, Tinea faciei occurs completely mild and its clinical appearance is not distinguishable. The most important risk factors of these groups of ring worms are low personal hygiene, moisture, and get in touch with soil, get in touch with with pets and contact with infected people (Behzadi *et al.*,

2003; Rezaei-Matehkolaei 2013; Moriarty 2012).

#### TINEA CORPORIS

Tinea corporis affects the trunk, often in exposed areas like the abdomen or limbs, causing red patches. It is generally in children than in adults and occurs most frequently in hot climates (Venkatesan 2007). Dermatophytes of the genera *Trichophyton* and *Microsporum* and *Epidermophyton* are the most common causative agents. *Trichophyton rubrum* can occur as a result of misdiagnosis or mistreatment (Nenoff 2007). Most common fungi are *Trichophyton rubrum*, *Trichophyton canis*, *Trichophyton tonsurans*, and *Trichophyton verrucosum*. Other agents are *Epidermophyton floccosum*, *Microsporum audouinii*, *Microsporum gypseum*, *Microsporum nanum*, *Microsporum versicolor*, *Trichophyton equinum*, *Trichophyton mentagrophytes*, *Trichophyton raubitschekii*, *Trichophyton schoenleinii* and *Trichophyton violaceum* (Singh 2003).

*Tinea corporis* occurred in wrestlers is known as *Tinea gladiatorum* which infection spreads via skin to skin and wrestling mats to skin. *T. tonsurans*, *T. rubrum*, *E. floccosum*, and *T. mentagrophytes* are the most common causative agents (Bassiri Jahromi 2010).

#### TINEA CRURIS

Tinea cruris or “jock itch” is a common dermatophytosis of groin. It affects adults and occurs three times more in men than women. Tinea cruris was the predominant clinical condition in the 18-30 years and 43-55 years age-groups (Ansari *et al.*, 2014). The most important causative dermatophyte agents of tinea cruris are *Trubrum*, *E. floccosum*, *T. interdigitale*, *T. mentagrophytes*, and *T. verrucosum* in Iran and other countries (Moriarty 2012; Behzadi 2003; Hainer 2003; Pakshir 2006; Rezaei-Matehkolaei 2013; Danesh 2000; Falahati 2003; Nadalo 2006; Singh 2003; Dismukes 2003; Hashemi 2004). Moisture, low hygiene, high temperatures, tight-fitting clothes are the most common predisposing factors which may lead to tinea cruris appearance (Behzadi 2003; Hain-

er 2003; Dismukes 2003). Tinea cruris, or “jock itch,” forms an erythematous, pruritic patch in the groin area that usually spares the scrotum and penis. The leading edge may include follicular papules and pustules. The lesion may be secondarily infected with bacteria or yeast. Moisture, low hygiene, high temperatures, tight-fitting clothes are the most common predisposing factors which may lead to Tinea cruris appearance. In chronic cases, no inflammation is seen, while the acute infections are correlated with inflammation and severe itching. Lesions progression and erythema appear centrifugally and are seen symmetrically or asymmetrically. Erythematous rashes with vesicles at the lesions edges are common clinical demonstrations for Tinea cruris (Hainer 2003; Moriarty 2012; Dismukes 2003).

#### TINEA MANUUM

Tinea manuum is superficial infection of dermatophytosis which involves hands, palms and interdigital parts unilaterally or bilaterally. Tinea manuum is a dermatophytes infection of one or, occasionally, both hands. In this type, the palms become diffusely dry, scaly and erythematous. Tinea manuum are evenly distributed in the 43-55 years age-group (Ansari *et al.*, 2014). It is most often caused by anthropophilic dermatophytes (cases may be an extension of Athlete’s foot) but is occasionally caused by zoophilic organisms. Tinea manuum appears mostly with tinea pedis. *Trubrum*, *T. mentagrophytes*, *T. interdigitale*, and *E. floccosum* are the most etiological agents of tinea manuum worldwide (Behzadi 2003; Hainer 2003; Rezaei -Matehkolaei 2013; Moriarty 2012). Humidity and moisture, pre-infection of Tinea pedis are the most important risk factors for tinea manuum. Clinical demonstrations of tinea manuum include dryness and scaly hand which is similar to eczema. Sometimes, finger nails may be infected in the following of tinea manuum (Behzadi *et al.*, 2003; Dismukes 2003).

#### TINEA UNGUIUM

Typical clinical demonstrations of tinea unguium comprise deformity and discoloration of the nails. Trauma, tight wearing shoes, humidity, pre-tinea manuum, pre-tinea pedis are the most frequent risk factors for dermatophyte onychomycosis (Behzadi 2003; Rezvani 2010; Dismukes 2003; Dawson 2012). Tinea unguium was most common in the 31-42 years age-group (Ansari *et al.*, 2014). The most common causative dermatophytes of tinea unguium are *Trubrum*, *T. mentagrophytes*, *T. interdigitale*, and *E. floccosum* which are reported from Iran and other countries around the world (Behzadi 2003; Rezaei-Matehkolaei 2013; Dismukes 2003; Ameen 2010; Khosravi 2001; Zomorodian 2002). The causative include *Candida* species and nondermatophytes moulds. Dermatophytes are most commonly responsible for Onychomycosis in temperate western countries, whereas *Candida* and non-dermatophytes moulds are more frequently recorded from countries with a hot and humid climate (Chi 2005).

#### TINEA PEDIS

Tinea pedis is the most common dermatophytosis, affecting up to 70% of adults worldwide (Zuber 2001). The incidence of tinea pedis in adults is significantly more than children and it occurs more in men than women (Moriarty 2012; Behzadi 2003; Behzadi 2012; Hainer 2003; Dismukes 2003; Dawson 2012). Mostly, tinea pedis is produced by *Trubrum*, *T. mentagrophytes*, *T. interdigitale*, and *E. floccosum* in Iran and other countries (Behzadi 2003; Rezvani 2010; Dismukes 2003). Tinea pedis is also known as “One hand two feet syndrome” which means to the dermatophyte illness of both feet and one hand and be found in patients of lower immunity competence, such as diabetics (Havlickova *et al.*, 2008). Naturally its influences observe on the feet accepting infection or spreading to additional areas of the body (Daniel 2010). Tinea pedis (athlete’s foot) is one of the most common superficial fungal infections of the skin in all regions of the world. It is more common in close communities such as army barracks, boarding schools and among those frequenting swimming pools,

when the feet are occluded with nonporous shoes. The incidence of this infection is higher in warm humid climates which are known to promote the growth of fungi, but has been found to occur less frequently in areas of the world where shoes are not commonly worn (Masri-fridling 1996).

Clinical signs of tinea pedis are appeared in different forms including inflammation and ulcer (with putules and vesicles on sole), moccasin (with scaly and thick keratinized sole and heel), and interdigital spaces (with itching and burning). Clinical manifestations may be seen unilateral, bilateral, symmetrical, asymmetrical, acute or chronic. Humidity, high temperature, low hygiene, and, wearing footwear for long period are known as important risk factors for dermatophytosis of *tinea pedis* (Behzadi 2003; Hainer 2003; Moriarty 2012; Dismukes 2003; Behzadi 2012; Dawson 2012).

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