## **Original Research Article**

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# Tinea pedis: a clinico mycological study

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### **ABSTRACT**

**Background:** To study the varied clinical presentations, the predominant etiological agent and incidence of tinea pedis in relation to sex, age group, occupation and aggravating factors among the patients. Also an attempt was made to know if any significant association is there with blood group and the occurrence of tinea pedis.

**Methods:** A study was conducted among 75 patients who attended Mycology clinic in tertiary care hospital. Detailed history was taken along with complete physical examination and local examination. All cases of tinea pedis were first confirmed by KOH examination. Isolation of the agent was done in Modified SDA medium with cycloheximide. Differentiation of the species was done by culturing on corn meal agar.

**Results:** Prevalence of tinea pedis infection was more common among males with male: female ratio of 2.26:1. The 21-30 years age group was commonly affected by tinea pedis. The distribution of blood groups reflected the general distribution pattern of the population. Culture positivity was recorded in 81.3%.

**Conclusions:** More incidences of bilateral involvement and recurrent episodes were noted among the shoe wearing population than in the non-shoe wearing population. Any patients diagnosed with tinea pedis should be screened for diabetes as implied by the outcome of the study. Infected toe nails may be the site of primary infection and fungal disease can spread to other body areas from these primary sites. *Trichophyton rubrum* happened to be the chief isolate.

Keywords: Tinea pedis, Ringworm, Trichophyton, KOH, SDA medium, Ide eruption

## INTRODUCTION

Dermatophytosis is the superficial fungal infection of keratinized tissues caused by dermatophytes. They are a group of taxonomically related fungi that utilize keratin as a source of nutrients. Tinea pedis is a common superficial dermatophyte infection of the feet. It may present in several clinical varieties such as intertriginous, hyperkeratotic, vesiculobullous, ulcerative or a combination of these. It is often referred to as "Athlete's Foot".

Tinea pedis may be accompanied by dermatophyte infection of other parts of the body including groin, hands or nails. It is estimated to affect about 15% of the population at large, being more common in closed communities such as army barracks and boarding schools, in warm weather, among those frequently using swimming pools, and when the feet are occluded with nonporous tight fitting shoes.

In the west, tinea pedis is estimated to be present in about 40% of all patients who attend clinics for any medical concern. Those patients with more severe symptoms

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seek medical help and often have concomitant fungal infection of the toenails.  $^{2,3}$ 

There are many undiagnosed cases, many of which may be asymptomatic and unsuspecting of having tinea pedis and be a possible source of infection for others. Chronic infection is common in patients with concomitant diabetes, atopy, and immunosuppression. In an increasingly ageing population and with the increasing numbers of immune compromised patients, tinea pedis is emerging as an important and a significantly prevalent infection.

#### **METHODS**

Seventy five randomly selected patients with tinea pedis, during the period August 1<sup>st</sup> 2007 to September 30<sup>th</sup> 2009, were enrolled to the study. The study was conducted in Mycology department of Department of Dermatology, Madras Medical College. A clinical diagnosis of tinea pedis was made by the presence of scales, fissuring and morphology of the lesions and all cases of tinea pedis were first confirmed by KOH examination.

Age, sex and duration of the disease were recorded. A detailed history was obtained in all the patients with regard to socioeconomic status, occupation, about the habit of shoe wearing, any similar episodes in the past with exacerbation during summer months or associated with hyperhidrosis. Any contact with pet animals and living in institutions with habit of sharing of shoes or socks, similar illness among the residents or the family members were especially enquired into. History of any systemic illness and treatment were also recorded.

The dermatological examinations included the clinical type of infection with areas of involvement. Particular importance was given to the presence of any anatomical deformities of the foot, spacing between the toes and the nature of sweating. Any other associated dermatological condition of the foot was also noted. Screening for dermatophyte infection over other areas of skin and nails especially the palms for ide eruptions were done. Systemic examination and screening for other dermatological disorders were done in all the patients.

In all the 75 patients, mycological examination of the skin scrapings from the affected site or blister top specimens from the vesiculobullous lesions were carried out in wet mount in 10% potassium hydroxide (KOH). Isolation of the agent was done through inoculating the specimen (scales or crusts) in Modified Sabouraud's Dextrose Agar medium with cycloheximide. The isolates were studied with regard to macroscopic, microscopic colony morphology and pigment production. Differentiation of the species was done by culturing on corn meal agar and looking for the persistence of pigmentation.

#### Inclusion criteria

All cases of tinea pedis who are comfirmed by KOH positivity

#### Exclusion criteria

KOH Negative tinea pedis patients and patients with pompholyx lesions

#### **RESULTS**

#### Sex distribution

Out of the 75 patients enrolled into the study 52 (69.3%) were males and 23 (30.7%) were females.

Table 1: Sex distribution among patients.

Sex	Number (n=75)	Percentage (%)
Male	52	69.3
Female	23	30.6

M:f=2.26:1

#### Age distribution

The youngest patient in the study was a 5 year old male child and the oldest a 60 year old man. Majority of patients were in the age group 21 - 30 years.

**Table 2: Age distribution patients.** 

Age	Male	Female	Percentage (%)
0-10	1	1	2.6
11-20	7	3	13.3
21-30	24	8	42.6
31-40	13	5	24.0
41-50	6	4	13.0
51->	1	2	4.0

**Table 3: Association with shoe wearing** 

Total cases	N=75	Percentage (%)
Shoe wearing	23	69.3
Non shoe wearing	52	30.6

**Table 4: Occupation wise distribution.** 

S. no	Occupation	Number
1	Student	8
2	Policemen	4
3	Business	2
4	Security	2
5	Driver	2
6	Cook	1

#### Association with shoe wearing

Among the patients studied shoe wearing habit has been noted in only 23 cases. Most of these patients are students and others were policemen, drivers and businessmen who must wear shoes as routine as their occupation demands.

#### Episode of tinea pedis

In the study 67 cases presented to us with tinea pedis for the first time and 8 patients had recurrent episode. 7 patients with recurrent episode were having regular shoe wearing habit. Bilateral affection of foot by tinea pedis was seen in 7 patients (9.3%).

Table 5: Number of episodes.

Episode	Number	Percentage (%)
First	67	89.3
Recurrent	8	10.6

#### Systemic associations

Among the 75 patients studied 12 patients were diabetics (16%). Hyperhidrosis as associated in 11 patients (14.6%). 7 patients gave history of atopy and 2 patients were known HIV positives.

Table 6: Systemic associations with tinea pedis.

Syatemic association	No. of people
Diabetes	12
Hyperhidrosis	11
Atopy	7
HIV	2
Renal transplant	1
Ichthyosis vulgaris	1
Urticaria	1

## Blood group distribution

The blood group distribution in dermatophytosis patients demonstrated that 37.3% of the patients belonged to group O+, 32% to group B+ and 21.3% to group A+. Other blood groups found were AB +ve 4 cases, AB- ve 2 cases and 1 patient O –ve.

**Table 7: Blood group distribution.** 

Blood group	No. of people	Percentage (%)
O +	28	37.3
B+	24	32
<b>A</b> +	16	21.3
Ab+	4	5.3
Ab-	2	2.6
0-	1	1.3

#### Association with other types of dermatophytosis

Tinea pedis was an isolated entity in 46 patients (61.3%). Among the remaining, 29 patients (38.7%) had other types of dermatophytosis and 11 patients studied had associated tinea unguium infections. Ide eruption was seen among 2 patients with vesiculobullous tinea pedis.

Table 8: Association with other types of dermatophytosis.

Types of dermatophytosis associated with tinea pedis	No. of patients
Tinea unguium	11
Tinea cruris	6
Tinea corporis	5
Tinea manuum	2
Extensive dermatophytosis	4
Tinea capitis	1

### Association of other foot dermatoses

The foot was examined for the presence of other dermatosis and the other dermatoses associated are given in the following table. Traumatic fissure was the most common finding seen among 15 patients. Crowding of toes was noted in 8 patients.

Table 9: Association with other foot dermatoses.

Other foot dermatoses	No. of patients
Traumatic fissure	15
Wart	6
Keratolysis punctata	5
Corn foot	4
Chromoblastomycosis	1

## The various types of tinea pedis observed

Of the 75 patients, 65 patients (86.7%) had a single clinical type fitting into the 4 major forms. Other 10 cases (13.3%) presented with combination of two types of the clinical varieties. The type of tinea pedis and the organism isolated with each are recorded in the table given below.

Table 10: Types of tinea pedis.

Type of t. pedis	Total number	Percentage (%)
Interdigital	36	48
Hyperkeratotic	20	26.6
Vesiculobullous	7	9.3
Ulcerative	2	2.6
Interdigital+hyperkeratotic	7	9.3
Vesiculobullous+interdigital	3	4

## Web space affected

Total number of interdigital type of tinea pedis= 36. The predominant web space involved was the 3<sup>rd</sup> space with a total of 15 patients. Next commonly involved was both the 3<sup>rd</sup> and 4<sup>th</sup> web spaces together with 10 cases.

## Culture positivity

Positive isolates were obtained in culture among 61 patients from the total 75 patients, giving the culture positivity rate of 81.3%.

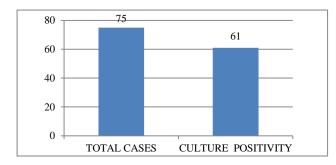


Figure 1: Culture positivity.

Table 11: Web space affected.

Webspace	No. of cases	Percentage (%)
1 <sup>st</sup>	2	5.5
2 <sup>nd</sup>	4	11.1
3 <sup>rd</sup>	15	41.6
4 <sup>th</sup>	5	13.8
3 <sup>rd</sup> & 4 <sup>th</sup>	10	27.7

Table 12: Organisms isolated.

S. No	Туре	No. of cases (n=61)	Percentage (%)
1	Trichophyton rubrum	47	77.04
2	Trichophyton mentagrophytes	14	22.95

#### Type of tinea pedis and the organism isolated

Table 13 below gives the various organisms isolated and the morphological type with which they were associated.

Table 13: Tinea pedis and the organism isolated.

Type of tinea pedis	Total number	Organisms isolated	
		T. rubrum	T. mentagrophytes
Interdigital	36	22	4
Hyperkeratotic	20	18	1
Vesiculobullous	7	1	5
Ulcerative	2		1
Interdigital+hyperkeratotic	7	6	
Vesiculobullous+interdigital	3		3

The macroscopic morphology of the colony of *Trichophyton rubrum* was downy with the diffusible red pigment on the reverse. On lactophenol cotton blue staining, microscopically the hyphae were thin with few to plenty of microconidia both in enthyrse and engreppe distribution. Pencil shaped macroconidia were also seen. Subcultures in corn meal agar produced diffusible red pigment characteristic of *Trichophyton rubrum*.

The macroscopic colony of *Trichophyton mentagrophytes* appeared as white powdery colony on the surface which in some cases developed a cream centre. The reverse appeared tan to golden in colour with no pigment production. On microscopic examination, spherical microconidia arranged in bunches and linear distribution around the hyphae were seen. Spiral hyphae and macroconidia were present in some isolates. Subcultures in corn meal agar did not produce any diffusible red pigment into the medium.

## DISCUSSION

Out of the 75 cases taken in our study 52 were males and 23 were females. This gave a male: female ratio of 2.26:

1. This is in accordance with the previous study by Bindu et al and other studies on tinea pedis by Singh et al which all showed male predominance.<sup>5,6</sup> Lack of shoe wearing and indoor dwelling among females explains to some extent the male predominance in incidence observed in all these studies.

All the studies conducted previously by Banerjee et al, Maheshwari et al and Singh et al showed that maximum number of patients belonged to the age group 21–30 years. In our study also the maximum patients were seen in the 21-30 year age group (32 patients, 42.6%), in agreement with the previous studies. But the study by Bindu et al, have reported higher incidence of tinea pedis in the second decade. This higher incidence may be attributed to more participation in active field work, high incidence of hyperhidrosis and shoe wearing encountered in this age group. The youngest patient is a 2 years old male child and the oldest a 60 year old man. Average age group in the study was 28.78 years. Majority of patients belonged to the middle and lower income groups.

Shoe wearing habit has been noted in 23 patients (30.6%). Among the 23 patients who have the habit of

shoe wearing in our study the maximum were students (34.7%) followed by policemen, businessmen and car drivers whose occupation compels them into the habit of shoe wearing. Tight fitting occlusive footwear, and usage of non-absorbable socks were the most important

predisposing factors which caused fungal infection in these patients. In the West it has been called penalty of civilization as tinea pedis has been the predominant type of dermatophyte infection among the most active younger age group people.



Figure 2: (A) Intertriginous type of tinea pedis, (B) Vesiculobullous type of tinea pedis—blister top, (C) Hyperkeratotic type of tinea pedis: Moccasin type, (D) Ulcerative type of tinea pedis, (E) Hyperkeratotic type of tinea pedis with tinea manuum, (F) Associated with tinea unguium, (G) Associated with traumatic fissure, (H) Associated with keratolysis punctate, (I) Vesiculobullous type of tinea pedis with ide eruption.

Hyperhidrosis was associated with tinea pedia is 11 cases (14.6%). Bilateral affection of foot by tinea pedis was seen in 7 patients (9.3%). Such bilateral involvement was observed in the regular shoe wearing population especially school and college students. Among the patients 8 of them had recurrent episode of tinea pedis at presentation and others in the study presented with their first episode. Like the bilateral involvement of the foot, recurrent episodes were also found in the majority of regular shoe wearing population.

Among the 75 patients 12 patients are diabetics (16%). Among the 12 cases 5 were newly diagnosed as diabetics on investigation and 7 were already known diabetics. The prevalence rate of diabetes among the patients in our study is less when compared to study by Abbas Ali et al which recorded 24.8%. In our study 6.6% of patients turned out to be diabetics on screening. Diabetes is one of the most important predisposing factor for foot diseases including tinea pedis among the elderly age group patients. The compounding factors of immune

suppression, local trauma and vascular problems that are associated with diabetes make the person more susceptible to fungal foot diseases. Any patient

diagnosed with tinea pedis should be screened for diabetes as routine.

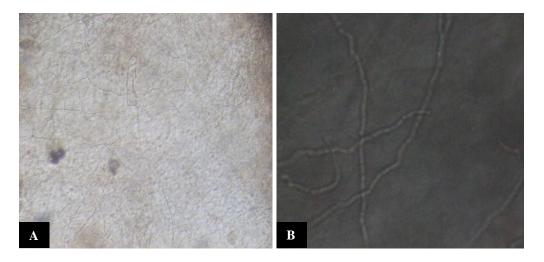


Figure 3: Potassium hydroxide mount. (A) Low power view/ (B) high power view-branched septate hyphae.

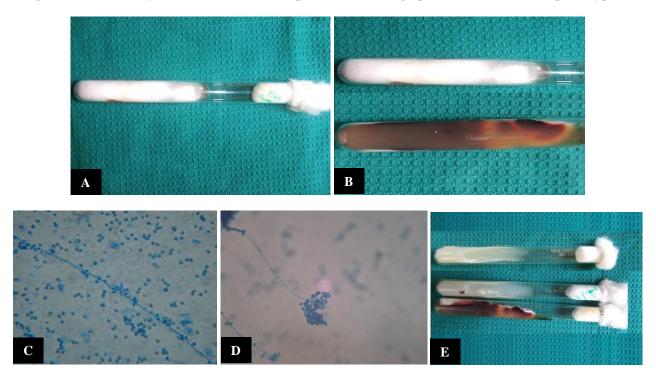


Figure 4: (A) Sabouraud's dextrose agar—*Trichophyton rubrum*, (B) Sabouraud's dextrose agar—*Trichophyton rubrum*- reverse pigmentation, (C, D) Lactophenol cotton blue mount *Trichophyton rubrum*- enthyrse/engreppe arrangement of microconidia, (E) *Trichophyton rubrum*- persistence of pigmentation.

Atopic diathesis history was obtained in 7 cases (9.3%). Among the patients 2 were known HIV positive patients (2.6%). One patient had extensive dermatophytosis. Usually dermatophytosis is not associated with an increased in prevalence in a HIV positive patient. Patients with HIV though do not show increased incidence of infection, can have atypical and extensive forms of presentation. Thus in HIV patients where the cell

mediated immunity is affected drastically, it is interesting that only the severity of dermatophytosis is increased and not the prevalence.

Gamborg-Nielsen while evaluating patients with hereditary palmoplantar keratoderma and dermatophytosis found higher frequency of individuals from group A infected by *Trichophyton* 

mentagrophytes.<sup>11</sup> Similarly, Balajee et al suggested that individual from group A are more susceptible to dermatophyte fungi infections, once they found an increased percentage of patients belonging to this blood group when compared to the control group.<sup>12</sup> But the study results of Neering et al and from the study done in our hospital by Selvi et al, no significant association with specific blood group and increased incidence of fungal

infection has been proved. 13,14 The blood group distribution in our study showed 37.3% of patients belonging to blood group O +ve, 32% patients belonging to B+ve group, 21.3% patients belonging to A +ve and rest 9.4% to other groups. This distribution reflects the blood group prevalence that is noted in the general population.

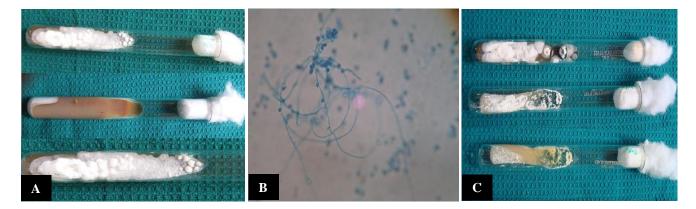


Figure 5: (A) Sabouraud's dextrose agar *Trichophyton mentagrophytes* var interdigitale, (B) Lactophenol cotton blue mount *Trichophyton mentagrophytes*- spiral hyphae, (C) Corn meal agar *Trichophyton mentagrophytes* – no pigmentation.

Intertriginous scaling type with slight extension to the adjacent plantar and dorsal surface was the commonest presentation observed in these series (36 cases, 48%) followed by scaling hyperkeratotic type in 20 cases (26.6%). The vesiculobullous type of tinea pedis came next with 7 cases and the least common was the ulcerative type with 2 cases. Mixed types were observed in 10 patients. 7 patients with interdigital and hyperkeratotic variety and 3 patients with interdigital and vesiculobullous variety.

As per the literature and the study by Abbas ali et al, 4<sup>th</sup> web space and 3<sup>rd</sup> web space were the most commonly involved sites. In our study, among 36 patients with the interdigital type of tinea pedis, the web space most commonly involved was the third with 15 patients presenting with such involvement which is in coherence with above study. Both 3<sup>rd</sup> and 4<sup>th</sup> web spaces were involved in 10 patients.<sup>9</sup> Fourth web space was involved in 5 patients, second web space in 4 patients and first web space in 2 patients.

On examination of foot anatomical problems like crowding of toes was found in 8 of the patients studied. 5 patients had associated keratolysis punctata. Most were women who had history of frequent immersion in water for long periods during the house hold works. The maceration and trauma associated with such predisposition are the major factor responsible for the occurrence of tinea pedis among the house wives who does not have the habit of shoe wearing or other factors

that usually predispose men for fungal infection. Other foot problems noted were traumatic fissure in 15 patients, plantar wart among 6 patients and corn foot in 4 patients.

As per study by Jacek et al one third of patients with toe nail onychomycosis had tinea pedis. Infected toe nails may be the site of primary infection and fungal disease can spread to other body areas from them. <sup>10</sup> In a study by Zais et al one third of patients with toe nail onychomycosis had tinea pedis. <sup>15</sup> Other dermatophyte infections noted among the patients with tinea pedis, in our study, tinea unguium was the most commonly associated problem among 11 patients (14.6%). The toe nail involvement was seen in 9 cases.

Tinea cruris was the next common dermatophyte infection among the tinea pedis patients with 6 patients, followed by tinea corporis 5 cases and tinea manuum 2 cases. A 13 year old school student who presented with vesiculobullous type of tinea pedis had associated tinea capitis. Two cases of acute vesiculobullous type of tinea pedis had associated allergic vesicular ide eruption of hands. 4 patients were diagnosed with extensive dermatophytosis. Among them one patient was diagnosed with chromoblastomycosis left foot who also had extensive dermatophytosis.

The previous studies by Singh et al and Selvi et al recorded *Trichophyton rubrum* to be the most common isolate. Our study results were in accordance with the above studies. Some workers Allen et al, Sharma et al,

Attye et al have recorded *Trichophyton mentagrophytes* as the chief isolate from tinea pedis cases. <sup>16-18</sup> But most other reports by Ramanan et al, Banerjee et al are in keeping with the trend observed in the present series in which *Trichophyton rubrum* is the most common isolate. <sup>7,19-21</sup> In our study culture positivity was recorded in 81.3% (61 cases) of cases studied. This positivity rate is higher in our study when compared to similar study by Singh et al which recorded a positivity of 72.55%. Among the culture positive isolates *Trichophyton rubrum* was isolated in maximum patients. Sharing 47 (77.04%) of 61 isolates, *Trichophyton rubrum* happened to be the chief isolate among all. 85.1% (40 isolates) of it belonged to either dry hyperkeratotic or interdigital scaling type of tinea pedis.

Rest of the 14 isolates was *Trichophyton mentagrophytes* which contributed to 22.95% of isolates. *Epidermophyton floccosum* was not isolated from any of the culture specimens. In study by Singh et al *Epidermophyton floccosum* formed the 3<sup>rd</sup> common isolate accounting for 8.11% of cases.<sup>6</sup>

Some studies by Ali et al and Ramanan et al have correlated the dry squamous or hyperkeratotic lesions of tinea pedis with *Trichophyton rubrum* on one hand and wet vesicular lesions with *Trichophyton mentagrophytes* on the other. <sup>9,19</sup> We have recorded the isolates almost in complete agreement with it. But in one case of bullous tinea pedis *Trichophyton rubrum* was the organism isolated. Similar observation was noted in a study by Maroon and Miller who have isolated *Trichophyton rubrum* from a 2 year old girl who presented with vesiculobullous tinea pedis. <sup>22</sup>

#### **CONCLUSION**

Intertriginous type of tinea pedis was the most common type observed in this study and 3<sup>rd</sup> web space was the most commonly affected. Trichophyton rubrum was the chief isolate among the patients of Tinea pedis in our study which affected young males more commonly. Epidermophyton floccosum was not isolated from any of the culture specimens. Most common associated factor and the cause of recurrence is the presence of tinea unguium lesions in toes. No common blood group associations as suggested by other studies were not noted in our study. Any patients diagnosed with tinea pedis should be screened for diabetes as implied by the outcome of the study. Among the 12 patients who were associated with diabetes 5 were newly diagnosed patients after our investigation. In all patients diagnosed with chronic recurrent dermatophytosis screening for foot lesions and treating the tinea pedis lesions completely helps in preventing the relapses and recurrences.

## Points:

 Prevalence of tinea pedis infection was more common among males with male: female ratio of 2.26:1.

- The 21- 30 years age group was commonly affected by tinea pedis. The mean age was 28.8 years.
- Shoe wearing habit has been encountered among 30.6% of patients. Most of them were school or college students and policemen who have to wear shoes compulsorily.
- More incidence of bilateral involvement and recurrent episodes were noted among the shoe wearing population than in the non shoe wearing population
- Bilateral involvement was seen in 9.3% and hyperhidrosis was associated among 14.6% patients.
- Any patients diagnosed with tinea pedis should be screened for diabetes as implied by the outcome of the study. Among the 12 patients who were associated with diabetes 5 were newly diagnosed patients after our investigation.
- The blood group distribution in our study showed 37.3% of patients belonging to blood group O +ve. The distribution of blood groups reflected the general distribution pattern of the population.
- Intertriginous type of tinea pedis was the most common type observed in this study in 36 patients. 3<sup>rd</sup> web space was the most commonly affected with involvement seen in 15 patients.
- 4 patients had extensive dermatophytosis and ide eruption was noted in 2 patients.
- Among other dermatophyte infections noted in the
  patients with tinea pedis, tinea unguium was the most
  commonly associated problem in our study with 11
  patients (14.6%). Infected toe nails may be the site of
  primary infection and fungal disease can spread to
  other body areas from these primary sites.
- Other foot abnormalities noted were crowding of toes, traumatic fissures, keratolysis punctata, corn foot and plantar wart.
- Culture positivity was recorded in 81.3% (61 cases) of cases studied.
- *Trichophyton rubrum* happened to be the chief isolate. Among the 61 culture positive specimens *Trichophyton rubrum* was isolated in 47 cases.
- *Trichophyton mentagrophytes* was isolated from the rest of the tinea pedis patients.
- Trichophyton rubrum was isolated more commonly from the dry squamous or hyperkeratotic lesions of tinea pedis and Trichophyton mentagrophytes was isolated from wet vesicular lesions.

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Ethical approval: The study was approved by the

institutional ethics committee

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