A mycological study of tinea corporis: A changing epidemiological trend from *Trichophyton rubrum* to *Trichophyton mentagrophytes* in India

Dermatophytosis constitutes an important public health problem throughout the world. It is more prevalent in tropical and subtropical countries like India, where the heat and humidity are high for most part of the year.[1] The etiologic agents of dermatophytosis are categorized into one of the three genera: Epidermophyton, Microsporum and Trichophyton. The response to infection ranges from mild to severe, based on the host's immunity to the fungal metabolic products, the virulence of the strain, the anatomic location of the infection and environmental factors.[2] Tinea corporis represents a major public health issue in India, especially in the past few years with an alarmingly increasing trend noticed especially with regard to recurrent and chronic dermatophytosis infection. *Trichophyton rubrum* was the most common cause of dermatophytosis worldwide, but changing trends have been observed.[3]

The present study was conducted in the Yenepoya Medical College and Hospital, Mangalore, a coastal region of the South Karnataka. Patients with a clinical diagnosis of tinea corporis, whose skin scrapings were received in the microbiology laboratory, were included in the study. Ethical clearance from the institutional ethics committee was obtained prior to the study. Demographic and clinical data were retrieved. Specimens were divided into two parts: first for direct microscopic examination and the second for mycological culture. Direct microscopic examination of fungal elements was done using 10% KOH. Positive cases were those which showed spores (conidia) and branching septate hyphae.

Aerobic culture was done on Sabouraud's dextrose agar, with chloramphenicol and cycloheximide, and incubated at 25°C in BOD incubator for 4 weeks. The cultures were examined thrice weekly for the appearance of growth. Fungal species were identified by colony morphology [Figure 1], pigment production, urease test, microscopic examination

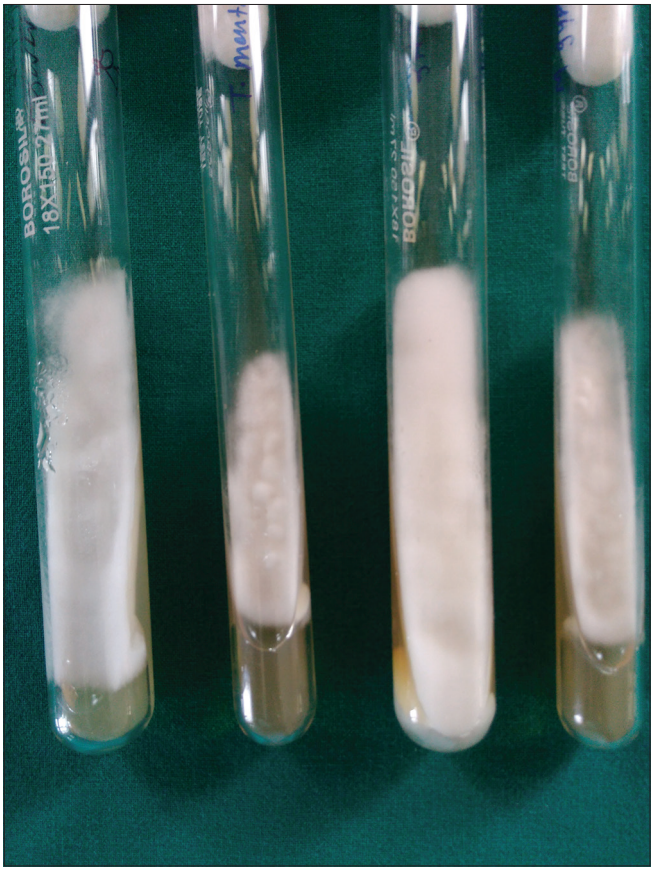

Figure 1a: Macroscopic examination (obverse): from left to right – *Trichophyton rubrum*, *Trichophyton mentagrophytes*, *Microsporum gypseum*, and *Microsporum canis*

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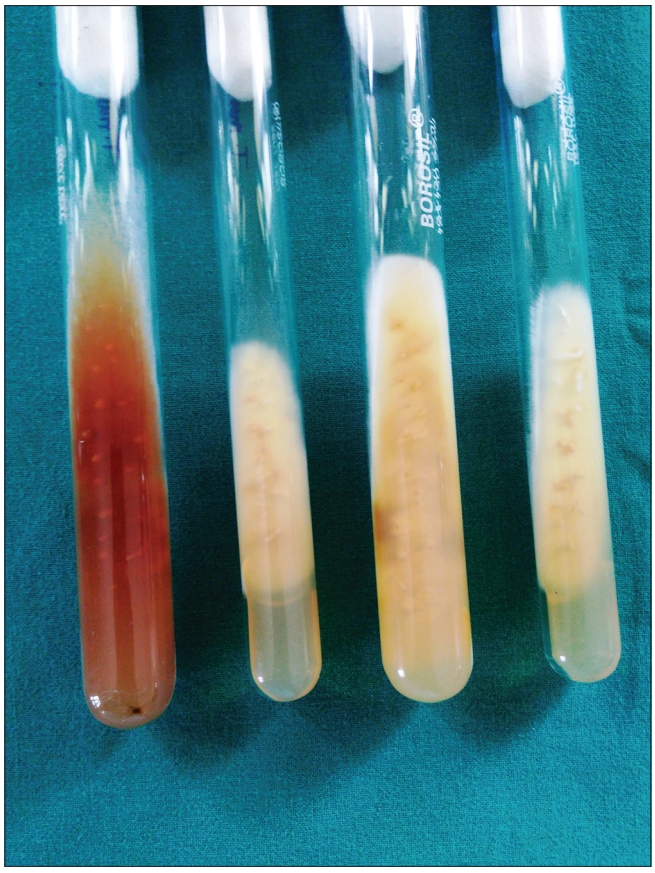

Figure 1b: Macroscopic examination (reverse): from left to right – *Trichophyton rubrum* (red pigmentation), *Trichophyton mentagrophytes*, *Microsporum gypseum*, and *Microsporum canis*

by tease mount with lacto phenol cotton blue stain and slide culture [Figure 2].

A total of 154 skin scrape samples of tinea corporis were included in the study period from May 2017 to July 2017. Of them, 101 (66%) samples were from male patients and 53 (34%) samples were from female patients. The most

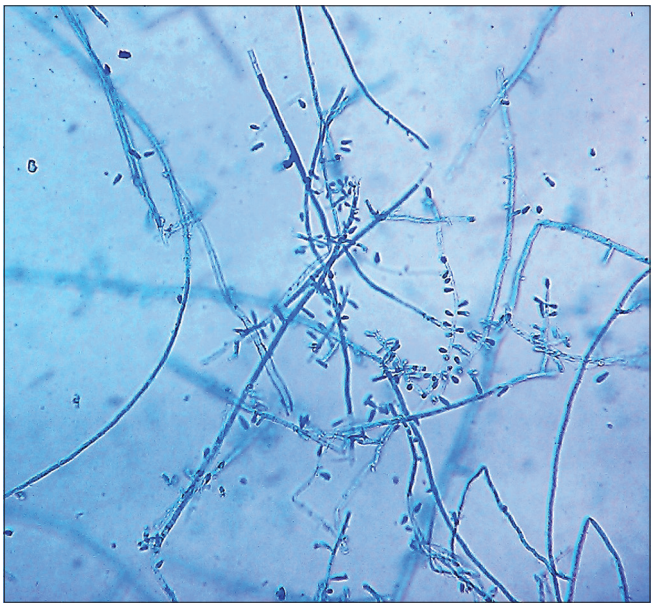

Figure 2a: Microscopic examination: *Trichophyton rubrum* (more microconidia, tear drop-shaped and few macroconidia; LPCB, ×400)

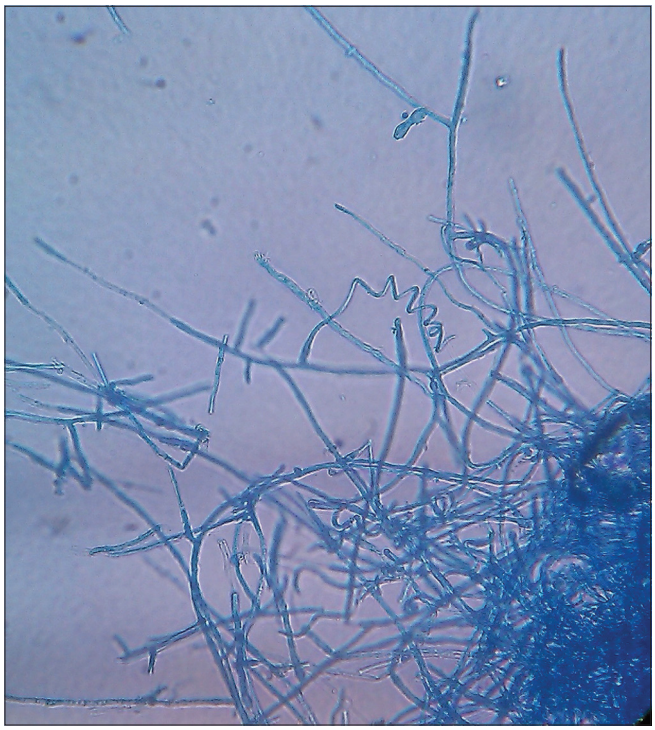

Figure 2b: Microscopic examination: *Trichophyton mentagrophytes* (spiral hyphae with microconidia and few macroconidia; LPCB, ×400)

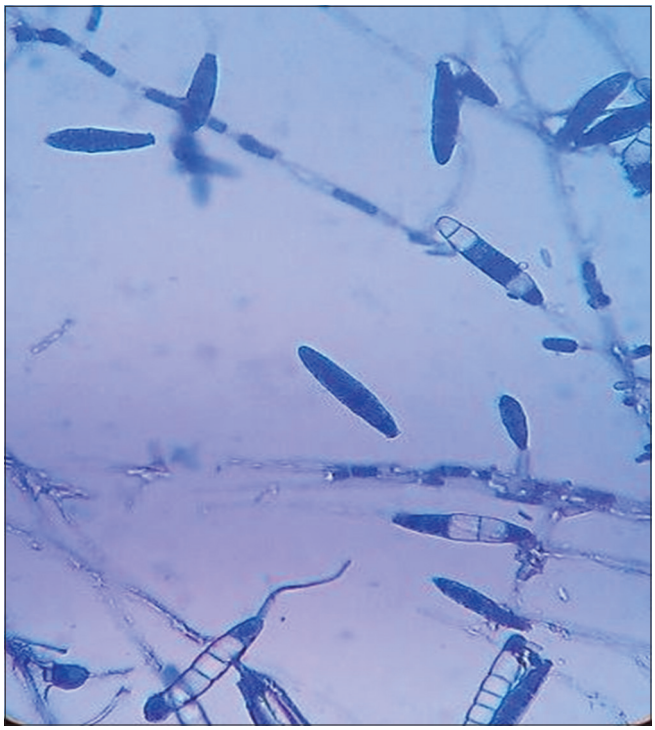

Figure 2c: Microscopic examination: *Microsporum gypseum* (single-walled macroconidia with blunt ends with 3–5 cells and few microconidia; LPCB, ×400)

common age group was 20–30 years (63/154; 41%). All 154 (100%) samples were positive for direct microscopy; whereas 96 (62.3%) were culture-positive. *Trichophyton mentagrophytes* was the most common isolate [55 (57.3%)], followed by unidentified *Trichophyton species* [17 (17.7%)], *Microsporum gypseum* [15 (15.6%)], *Trichophyton rubrum* [6 (6.3%)], *Microsporum canis* [2 (2.1%)], and *Epidermophyton floccosum* [1 (1%)] as shown in Figure 3.

Recent studies have shown a rising trend in the prevalence of dermatophytosis with a change in the spectrum of infection and a change in pattern of isolates. A study on dermatophytosis in 2005–2006 from coastal Karnataka reported that *T. rubrum* was the most common organism isolated from ringworm infection followed by *T. mentagrophytes*.[4]

However, our results are not in concordance with the results published earlier; as in the present study, *T. mentagrophytes* (55/96; 57.3%) was the predominant isolate, followed by the unidentified species of the genus *Trichophyton, M. gypseum* and then *T. rubrum,* which accounted for only 6.3% of the isolates.

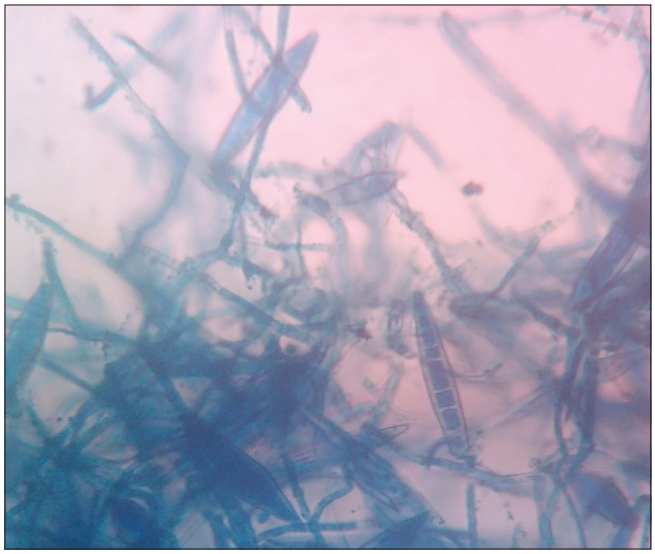

Figure 2d: Microscopic examination: *Microsporum canis* (double-walled macroconidia with pointed ends with 3–6 cells and few microconidia; LPCB, ×400)

In keeping with the present study, a study on dermatophytosis from Banaras Hindu University in 2014 reported that 79.5% were *T. mentagrophytes* followed by *T. rubrum* being 21.9%.[3] Recently, Rudramurthy *et al*. reported that *T. interdigitale* (a variety of *T. mentagrophytes*) was the most common isolate in their study, rather than *T. rubrum*.[5] It appears that the epidemiology of dermatophytic infections is changing with time. *T. mentagrophytes* is now emerging as the major pathogen as shown in Table 1.[6-8]

The reasons for this transformation are not clearly understood. The onslaught of recalcitrant and chronic dermatophytosis encountered in the recent past may partly be due to this changing epidemiology, which is clearly depicted in our study. Other reasons for the increased incidence could be antifungal resistance for drugs commonly used in tinea infections. According to Mahajan *et al*., there is an increased resistance to griseofulvin and terbinafine, but less so with itraconazole in case of *T. mentagrophytes*; which is also observed in clinical practice.[3] Historically, the ubiquitous *T. rubrum* is anthropophilic, whereas *T. mentagrophytes* can be anthropophilic or zoophilic and is capable of inducing more inflammation and highly contagious glabrous skin infections.[9]

It may be concluded from the present study that the epidemiological pattern of occurrence is changing with

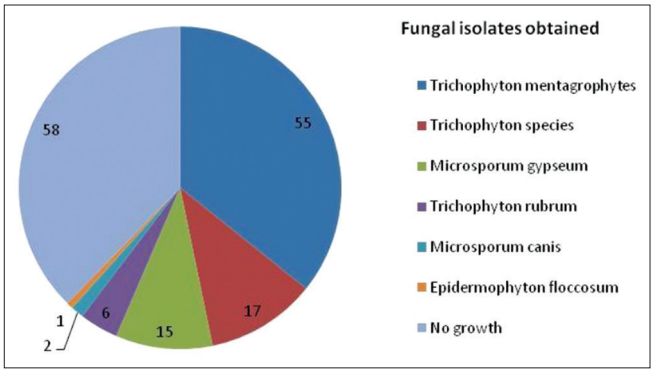

Figure 3: Fungal isolates obtained from samples with tinea corporis

Table 1: Distribution of *Trichophyton mentagrophytes* as the dominant pathogen of tinea corporis among other dermatophytes

Author	Place/year	Culture-positive (%)	Frequency of isolates (%)
Sahai and Mishra[6]	Central India/2011	137 of 165 (83)	*T. mentagrophytes* (25), *T. tonsurans* (20), *T. verrucosum* (10.5), *M. ferrugineum* (9.5), *T. schoenleinii* (7), *M. audouinii* (5), *T. rubrum* (5), and *E. floccosum* (3)
Agarwal *et al*.[7]	Jaipur/2012	240 of 300 (80)	*T. mentagrophytes* (37.9), *T. rubrum* (34.2), *T. violaceum* (11.3), *T. tonsurans* (8.3), *M. audouinii* (6.2), *M. canis* (1.7), and *T. verrucosum* (0.4)
Bhatia and Sharma[8]	Himachal Pradesh/2014	74 of 202 (36.6)	*T. mentagrophytes* (64.9) and *T. rubrum* (35.1)
Mahajan *et al*.[3]	Varanasi/2014	139 of 265 (52.4)	*T. mentagrophytes* (75.9), *T. rubrum* (21.9), and *T. tonsurans* (0.7)
The present study	Mangalore/2017	96 of 154 (62.3)	*T. mentagrophytes* (57.3), *T. species* (17.7), *M. gypseum* (15.6), *T. rubrum* (6.3), *M. canis* (2.1), and *E. floccosum* (1)

T. mentagrophytes: *Trichophyton mentagrophytes*, *T. tonsurans*: *Trichophyton tonsurans*, *T. verrucosum*: *Trichophyton verrucosum*, *M. ferrugineum*: *Microsporum ferrugineum*, *T. schoenleinii*: *Trichophyton schoenleinii*, *M. audouinii*: *Microsporum audouinii*, *T. rubrum*: *Trichophyton rubrum*, *E. floccosum*: *Epidermophyton floccosum*, *T. violaceum*: *Trichophyton violaceum*, *M. canis*: *Microsporum canis*, *M. gypseum*: *Microsporum gypseum*

T. mentagrophytes as an emerging pathogen over *T. rubrum*. The reasons for this are not clearly understood. However, human-adapted *T. mentagrophytes var. interdigitale* frequently isolated from tinea pedis differs clinically from animal-associated infection; and more information is hence required regarding the pathogen isolated in different parts of the country. Hence, this study signifies the importance of mycological examination and possibly accurate identification of the pathogen by molecular diagnostic methods as species identification of these fungi is important for therapeutic and epidemiological aspects.

As unidentified *Trichophyton* species are also significantly important in recalcitrant and chronic dermatophytoses; therefore, it is important to speciate the causative dermatophyte by molecular techniques such as polymerase chain reaction (PCR). In the present study, the speciation of unidentified *Trichophyton* species was not possible either by culture because of the overlapping of the microscopic and macroscopic features, or by PCR because of the limitation of sources, which could be considered as the limitation of the study.

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Conflicts of interest
There are no conflicts of interest.

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