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# CLINICO-MYCOLOGICAL PROFILE AND ANTIFUNGAL SUSCEPTIBILITY OF SUPERFICIAL MYCOSES AMONG PATIENTS ATTENDING A TERTIARY CARE DERMATOLOGY OUTPATIENT DEPARTMENT IN NORTHERN INDIA

Clinical Microbiology

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## ABSTRACT

**Background:** Superficial mycoses affect approximately 20–25% of the global population, with India currently experiencing a "dermatophytosis epidemic" characterized by rising antifungal resistance, a etiological shift toward Trichophyton mentagrophytes, and increasing chronicity. Continuous regional mycological surveillance is essential for rational therapeutic guidance. **Objectives:** To determine the clinico-mycological profile and etiological spectrum of superficial mycoses in symptomatic patients attending a tertiary care Dermatology OPD, to evaluate the antifungal susceptibility pattern of isolates, and to identify associated sociodemographic risk factors. **Methods:** A hospital-based, cross-sectional, descriptive study was conducted on 88 symptomatic patients at Dr. KNS Memorial Institute of Medical Sciences, Barabanki, Uttar Pradesh, over 18 months (2023–2026). Specimens underwent 10% KOH direct microscopy and culture on Sabouraud's Dextrose Agar (SDA). Antifungal susceptibility testing (AFST) was performed per CLSI M38-A2 guidelines using E-test strips. **Results:** The 48–57-year age group was most affected (21.6%); male-to-female ratio was 1.38:1. Lower socioeconomic status (63.63%; $p < 0.001$) and agricultural occupation (29.55%; $p = 0.012$) were significantly associated with infection. Tinea corporis predominated (53.41%). KOH positivity was 77.27%; culture yield was 59.09%, with dermatophytes comprising 76.92% of isolates. T. mentagrophytes was the leading species (49.32%), followed by T. rubrum (46.58%). Fluconazole demonstrated high MICs for T. mentagrophytes (64 µg/mL), while itraconazole retained potent activity (≤0.12 µg/mL). **Conclusion:** Trichophyton mentagrophytes has displaced T. rubrum as the primary etiological agent in this region. Fluconazole and terbinafine resistance is an emerging clinical reality, while itraconazole remains effective. Institutional protocols emphasizing species-level diagnosis, rational antifungal use, and curbing topical steroid misuse are urgently warranted.

## KEYWORDS

Superficial Mycoses; Dermatophytosis; Trichophyton Mentagrophytes; Antifungal Susceptibility; Tinea Corporis; KOH Microscopy

## INTRODUCTION

Superficial mycoses are among the most prevalent infectious conditions in dermatological practice worldwide, affecting the keratinized layers of the skin, hair, and nails. Caused principally by dermatophytes, Candida species, and non-dermatophyte molds (NDMs), these infections affect an estimated 20–25% of the global population, with a substantially higher burden in tropical nations such as India.[1]

Over the past decade, India has witnessed a dramatic epidemiological transition in dermatophytosis, now characterized as a national "epidemic." Historically, Trichophyton rubrum was the predominant etiological agent, typically causing well-demarcated, treatment-responsive infections. Contemporary evidence documents a shift toward the Trichophyton mentagrophytes/interdigitale complex, particularly the newly recognized species Trichophyton indotineae, which is strongly associated with high-level antifungal resistance and recalcitrant disease.[2,3] This shift has been accompanied by a surge in chronic, multifocal, and treatment-refractory presentations at dermatology outpatient departments (OPDs) across India.

Several interrelated factors underpin this transition. High ambient temperature and humidity in India's tropical climate facilitate fungal sporulation and transmission. Socioeconomic conditions—overcrowding, shared fomites, and limited access to healthcare—sustain community reservoirs of infection. The irrational and unsupervised application of potent topical corticosteroid– antifungal combination products—widely available over the counter—has created pharmacological selection pressure, particularly for steroid-modified tinea with altered clinical presentations.[4] Furthermore, emerging high-level terbinafine resistance mediated by point mutations in the squalene epoxidase (SQLE) gene (notably Phe397Leu and Leu393Phe) has compromised the historically reliable first-line allylamine therapy.[5]

Despite the escalating burden, longitudinal mycological data from semi-urban and rural tertiary care centres in northern Uttar Pradesh remain scarce. Regional clinico-mycological surveillance is essential for constructing evidence-based treatment protocols and curbing the propagation of antifungal resistance. This study was therefore undertaken to characterize the etiological spectrum, clinical distribution, and antifungal susceptibility patterns of superficial mycoses among patients attending the Dermatology OPD of a teaching hospital in Barabanki, Uttar Pradesh.

## MATERIALS AND METHODS

### Study Design and Setting

This hospital-based, cross-sectional, descriptive study was conducted in the Department of Microbiology in collaboration with the Dermatology OPD of Dr. KNS Memorial Institute of Medical Sciences (Dr. KNS MIMS), Barabanki, Uttar Pradesh, over 18 months (January 2023 to June 2026). The study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies and received approval from the Institutional Ethics Committee (IEC) of Dr. KNS MIMS. Written informed consent was obtained from all participants in their preferred language.

### Sample Size and Participant Selection

The sample size was calculated using the standard cross-sectional formula: $n = Z^2p(1-p)/d^2$, where $Z = 1.96$ (95% confidence interval), $p = 0.35$ (estimated prevalence from comparable Indian studies), and $d = 0.10$ (allowable margin of error), yielding a minimum of 83 participants. Adjusting for an anticipated 5–10% rate of non-viable cultures, the final sample size was set at 88 patients.

Patients aged 18 years or older of either sex presenting with clinical features suggestive of superficial mycoses—including annular erythematous plaques with peripheral scaling, central clearing, scalp lesions, or nail changes consistent with onychomycosis—were eligible for inclusion. Patients who had received topical antifungals within the preceding 7 days or systemic antifungal agents within 14 days, those with severe secondary bacterial superinfections, and those with non-fungal dermatological mimics (psoriasis, nummular eczema, seborrheic dermatitis) without evidence of fungal co-infection were excluded, as were pregnant women and patients with severe systemic comorbidities likely to confound the clinical presentation.

### Specimen Collection and Laboratory Processing

Skin lesions were cleaned with 70% isopropanol. Using the blunt edge of a sterile No. 15 scalpel blade, scrapings were obtained from the active advancing margin of lesions. Hair stubs were plucked with sterile forceps for suspected tinea capitis cases. Specimens were placed on black chart paper, folded into sterile labelled envelopes, and

transported immediately to the mycology laboratory.

Direct microscopy was performed by mounting specimens in 10% KOH (20% KOH for hair), warming gently, and examining under 10× and 40× objectives for branching septate hyphae or arthroconidia. Culture was performed on Sabouraud's Dextrose Agar (SDA) supplemented with chloramphenicol (0.05 mg/mL) and cycloheximide (0.5 mg/mL), incubated at 20–28°C for up to four weeks with twice-weekly observation. Dermatophyte Test Medium (DTM) was used as a supplementary tool. Colony morphology (obverse and reverse pigmentation, texture) and microscopic morphology on Lactophenol Cotton Blue (LPCB) mounts—evaluating macroconidia and microconidia characteristics—were used for species identification.

Antifungal Susceptibility Testing (AFST) was performed on all pure isolates following CLSI M38-A2 guidelines. E-test strips for fluconazole (concentration gradient 0.016–256 µg/mL), itraconazole, terbinafine, ketoconazole, and voriconazole (0.002–32 µg/mL) were used. The inoculum was standardized to $10^3$–$10^4$ CFU/mL. Internal quality controls employed standard ATCC fungal strains.

### Statistical Analysis

Data were analyzed using SPSS v28.0. Categorical variables were expressed as frequencies and percentages; continuous variables as mean ± standard deviation (SD). Associations between categorical variables were assessed by the Chi-square ($\chi^2$) test. Pearson correlation coefficient was computed for symptom duration versus number of lesions. A p-value of <0.05 was considered statistically significant.

## RESULTS

### Demographic and Socioeconomic Profile

Among the 88 enrolled patients, the 48–57-year age group was most frequently affected (n = 19; 21.6%), followed by the 58–67-year cohort (n = 18; 20.5%), with the youngest group (18–27 years) comprising only 12.5% of cases (Table 1). Males constituted 57.95% (n = 51) and females 42.05% (n = 37), yielding a male-to-female ratio of 1.38:1, with no statistically significant difference between genders (p = 0.136). Socioeconomic analysis revealed that 63.63% of patients belonged to the upper-lower and lower economic strata, a distribution that was highly statistically significant (p < 0.001). Farmers and agricultural laborers formed the largest occupational group (29.55%), followed by housewives (25.00%) and students (20.45%), with significant occupational variation (p = 0.012). Diabetes mellitus was identified in 18.18% (n = 16) of patients, with a highly significant association with fungal infection (p < 0.001).

**Table 1. Age-wise Distribution of Study Patients (N = 88)**

| Age Group (years) | Number (n) | Percentage (%) |
|---|---|---|
| 18–27 | 11 | 12.5 |
| 28–37 | 12 | 13.6 |
| 38–47 | 15 | 17.0 |
| 48–57 | 19 | 21.6 |
| 58–67 | 18 | 20.5 |
| >67 | 13 | 14.8 |
| Total | 88 | 100.0 |

### Clinical Spectrum

Tinea corporis was the predominant clinical diagnosis, accounting for 53.41% (n = 47) of cases. Mixed infections involving multiple anatomical sites comprised 10.23% (n = 9), while Tinea capitis was noted in 7.95% (n = 7). Less frequent presentations included Tinea cruris (5.68%), Tinea faciei (4.55%), onychomycosis (4.55%), Tinea pedis (4.55%), candidal intertrigo (3.41%), Tinea manuum (2.27%), candidal vulvovaginitis (2.27%), and a single case of cutaneous aspergillosis (1.14%) (Table 2).

Symptom duration analysis demonstrated that 47.73% of patients presented within four weeks of symptom onset, while 25.00% reported symptoms persisting for more than three months. A significant positive correlation was observed between symptom duration and total number of lesions at presentation (Pearson r = 0.46; p < 0.001), consistent with progressive anatomical spread through autoinoculation in chronic cases.

**Table 2. Clinical Types of Superficial Mycoses Among Study Participants (N = 88)**

| Clinical Diagnosis | n | % |
|---|---|---|
| Tinea corporis | 47 | 53.41 |
| Mixed infections | 9 | 10.23 |
| Tinea capitis | 7 | 7.95 |
| Tinea cruris | 5 | 5.68 |
| Tinea faciei | 4 | 4.55 |
| Onychomycosis | 4 | 4.55 |
| Tinea pedis | 4 | 4.55 |
| Candidal intertrigo | 3 | 3.41 |
| Tinea manuum | 2 | 2.27 |
| Candidal vulvovaginitis | 2 | 2.27 |
| Cutaneous aspergillosis | 1 | 1.14 |
| Total | 88 | 100.0 |

### Mycological Findings

Direct KOH microscopy was positive in 77.27% (68/88) of specimens. Fungal culture on SDA yielded growth in 59.09% (52/88) of cases. Among the 52 culture-positive isolates, dermatophytes were predominant (76.92%; n = 40), followed by yeasts (15.39%; n = 8) and NDMs (7.69%; n = 4). The association between KOH positivity and culture yield was statistically significant ($\chi^2$ = 8.38; p = 0.0038). Sixteen cases (18.18%) were KOH-positive but culture-negative, likely reflecting non-viable fungal elements or the effect of partial antifungal exposure.

Within the dermatophyte group (Table 3), T. mentagrophytes was the predominant isolate (49.32%; n = 36), followed closely by T. rubrum (46.58%; n = 34). Microsporum canis accounted for 4.11% (n = 3) of der atophyte isolates.

**Table 3. Dermatophyte Species Distribution (N = 73 Dermatophyte Isolates)**

| Species | n | % |
|---|---|---|
| Trichophyton mentagrophytes | 36 | 49.32 |
| Trichophyton rubrum | 34 | 46.58 |
| Microsporum canis | 3 | 4.11 |
| Total | 73 | 100.0 |

### Antifungal Susceptibility Testing

AFST results across all major isolates are summarized in Table 4. Fluconazole demonstrated high MIC values for T. mentagrophytes (MIC 64 µg/mL) and Candida glabrata (MIC 64 µg/mL), indicating clinically significant resistance. Terbinafine showed variable activity: it retained efficacy against T. rubrum (MIC 1 µg/mL) but demonstrated an upward MIC shift for T. mentagrophytes (MIC 4 µg/mL), signaling emerging allylamine resistance. Itraconazole was the most consistently potent agent, with MIC values ≤0.12 µg/mL across all dermatophyte isolates. Voriconazole showed the lowest MIC range overall (0.03–0.50 µg/mL). Ketoconazole maintained moderate activity with MICs of 0.25 µg/mL for most dermatophytes.

**Table 4. Antifungal Susceptibility Profile of Major Isolates (Representative MIC Values, µg/mL)**

| Organism | n | Fluconazole | Itraconazole | Terbinafine | Ketoconazole | Voriconazole |
|---|---|---|---|---|---|---|
| T. mentagrophytes | 36 | 64 | 0.12 | 4 | 0.25 | 0.12 |
| T. rubrum | 34 | 16 | 0.06 | 1 | 0.25 | 0.12 |
| Candida albicans | 8 | 8 | 0.12 | 2 | 0.25 | 0.06 |
| Candida tropicalis | 4 | 32 | 0.25 | 4 | 0.50 | 0.12 |
| Candida glabrata | 2 | 64 | 0.50 | 8 | 1.00 | 0.25 |
| NDM (Aspergillus spp.) | 1 | 64 | 1.00 | 16 | 2.00 | 0.50 |

MIC = Minimum Inhibitory Concentration; NDM = Non-Dermatophyte Mold. Values represent representative MIC (µg/mL) per E-test.

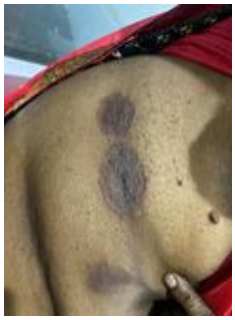

Fig. 1

Fig. 2

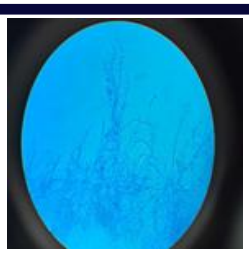

Fig. 3

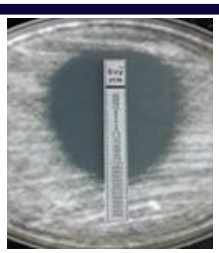

Fig. 4

## DISCUSSION

The present study offers a clinico-mycological characterization of superficial mycoses from a semi-urban tertiary care setting in northern Uttar Pradesh, a region where dedicated mycological surveillance data are sparse. Our findings corroborate and extend the evidence of a fundamental etiological transition underway in Indian dermatophytosis.

Trichophyton mentagrophytes emerged as the predominant species (49.32%), displacing the historically dominant T. rubrum (46.58%). This finding is consistent with the nationwide trend documented by Das et al., whose systematic review of Indian data from 2015 to 2021 confirmed a rising trajectory for T. mentagrophytes with a concomitant decline in T. rubrum.[9] Hazarika et al. similarly identified the T. mentagrophytes complex as the dominant species (75%) in a northeastern Indian cohort.[15] The predominance of T. mentagrophytes is epidemiologically significant, as strains within this complex—particularly T. indotineae—harbour SQLE gene mutations that confer high-level allylamine resistance and are associated with clinically refractory disease.[5]

The predominance of the 48–57-year age group (21.6%) in our cohort contrasts with the younger peak (21–40 years) reported in earlier national series,[6,7] possibly reflecting age-related decline in skin barrier function and the higher prevalence of metabolic comorbidities, particularly diabetes mellitus, in this population. The significant association of diabetes with superficial mycoses ($p < 0.001$) reinforces the role of glycaemic dysregulation in impairing cutaneous defence mechanisms, consistent with data from Baranwal et al.[13] The moderate male predominance (1.38:1) is broadly consistent with Indian literature, driven largely by occupational exposure, and corroborates findings from Vasudha et al. and Sudhaharan et al.[14]

The highly significant association between lower socioeconomic status and infection burden ($p < 0.001$), with 63.63% of patients from the upper-lower and lower economic strata, underscores the role of overcrowding, shared fomites, and limited access to healthcare in sustaining community transmission, as noted in the systematic analysis by Das et al.[9] The high proportion of farmers (29.55%) reflects the agrarian landscape of Barabanki district and the consequent exposure to geophilic and zoophilic fungal species.

Tinea corporis predominated clinically (53.41%), consistent with national data showing glabrous skin infections as the defining feature of the current Indian epidemic.[11] The notable proportion of mixed infections (10.23%) likely reflects progressive autoinoculation facilitated by delayed presentation and suppressive, non-curative use of topical steroid–antifungal combinations. The significant positive correlation between symptom duration and number of lesions (Pearson $r = 0.46$; $p < 0.001$) corroborates findings from earlier reports[12] and highlights the consequences of delayed or inadequate treatment.

The KOH positivity rate of 77.27% affirms the continued utility of direct microscopy as the most accessible and sensitive frontline diagnostic tool. The culture yield of 59.09% in our study exceeds rates reported by Baranwal et al. (29%) and Sudhaharan et al. (35.4%),[13,14] likely attributable to strict specimen collection protocols and the use of cycloheximide-supplemented SDA. The statistically significant concordance between microscopy and culture ($\chi^2 = 8.38$; $p = 0.0038$) supports employing both modalities in tandem: KOH for rapid bedside confirmation and SDA culture for definitive species identification and susceptibility profiling.

The AFST data present a critical therapeutic challenge. Fluconazole, despite widespread prescription at the primary care level, demonstrated alarmingly high MICs for T. mentagrophytes and C. glabrata (64 µg/mL each), corroborating the resistance profile reported by Lohariwala et al.[10] Terbinafine, long regarded as first-line therapy, showed an upward MIC shift for T. mentagrophytes (MIC 4 µg/mL), consistent with emerging SQLE-mutant strain dissemination beyond specialized referral centres.[5] Itraconazole retained reliable in-vitro potency across all dermatophyte isolates (MIC ≤0.12 µg/mL), supporting its current recommendation as the preferred systemic agent for recalcitrant tinea by the IADVL/ITART consensus.[16]

## CONCLUSION

Trichophyton mentagrophytes has emerged as the primary etiological agent of superficial mycoses in this semi-urban northern Indian setting, reflecting a nationwide epidemiological shift. Lower socioeconomic status, agricultural occupation, and diabetes mellitus are significant predisposing factors. Fluconazole and terbinafine resistance is demonstrable, while itraconazole remains the most potent systemic agent. Species-level identification through culture and routine AFST should be incorporated into the diagnostic workflow for all chronic or treatment-refractory cases. Institutional protocols prioritizing rational antifungal prescribing, elimination of unsupervised topical steroid use, and structured patient education are urgently required. Future investigations should employ ITS rDNA sequencing to definitively characterize T. indotineae prevalence and associated resistance gene mutations in this region.

**Limitations:** Single-centre design and moderate sample size (n = 88) may limit generalizability. Absence of molecular species identification (ITS sequencing) precludes definitive differentiation within the T. mentagrophytes/indotineae complex.

**Ethical Approval:** Approved by the IEC of Dr. KNS MIMS, Barabanki. All participants provided written informed consent.

**Conflict of Interest:** None declared.

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