Prevalence and Pattern of Superficial Fungal Infections Among Patients Attending a Tertiary Care Hospital in Midwestern Nepal: A Potassium Hydroxide Wet-Mount Based Study

Shah R[1], Jha RK[2], Pokhrel S[3], Karn SL[3], Rai M[4]

ABSTRACT

Introduction: Superficial fungal infections are among the most common cutaneous infections globally, with limited data from mid-western Nepal. These infections primarily involve keratinized tissues such as the skin, hair, and nails and are mainly caused by dermatophytes, *Candida* species, and *Malassezia* species. **Aims:** To determine the prevalence and clinical patterns of superficial fungal infections among patients attending a tertiary care hospital in midwestern Nepal using potassium hydroxide wet-mount microscopy. **Methods:** A hospital-based cross-sectional study was conducted between August 2024 to July 2025. A total of 714 clinically suspected cases were enrolled using consecutive sampling. Skin scrapings, nail clippings, and hair samples were examined using 10% potassium hydroxide wet-mount microscopy. Data were analyzed using descriptive statistics and Chi-square test ($p < 0.05$ significant). **Results:** Out of 714 suspected cases, 421 (58.96%; 95% CI: 55.3–62.6%) were potassium hydroxide microscopy positive. Positivity was similar in males (58.9%) and females (59.0%) ($p = 0.974$). The most affected age group was 16–30 years (47.0%). *Tinea cruris* was the most common clinical presentation (32.8%), followed by *Tinea corporis*/*manuum* (21.4%). Dermatophytes were the predominant organisms (87.1%), followed by *Candida* spp. (10.0%) and *Malassezia* spp. (2.9%). **Conclusion:** Superficial fungal infections are highly prevalent in midwestern Nepal, affecting nearly 60% of suspected cases, with dermatophytes and *Tinea cruris* being most common. Young adults are predominantly affected, with no significant sex difference. Strengthening diagnostic facilities, including fungal culture and antifungal susceptibility testing, is essential to address emerging antifungal resistance.

Keywords: Dermatophytes; Potassium hydroxide wet-mount; Prevalence; Superficial fungal infections; *Tinea cruris*

Authors:

1. Mr. Rajesh Shah
2. Dr. Rakesh Kumar Jha
3. Mr. Sandeep Pokhrel
4. Dr. Subhash Lal Karn
5. Dr. Maya Rai

[1]Department of Microbiology, B & C Medical College Teaching Hospital and Research Center, Birtamode, Jhapa, Nepal

[2] Department of Physiology, Nepalgunj Medical College and Teaching Hospital, Banke, Nepal

[3]Department of Microbiology, Nepalgunj Medical College and Teaching Hospital, Kohalpur, Banke

[4] Department of Microbiology, Rapti Academy of health Sciences, Dang, Nepal

Address for Correspondence:

Mr. Rajesh Shah
Department of Microbiology
B & C Medical College Teaching Hospital and Research Center
Birtamode, Jhapa, Nepal
Email: hirajeshshah@gmail.com
ORCID: https://orcid.org/0009-0000-0235-7132

INTRODUCTION

Superficial fungal infections (SFIs) are among the most common infectious diseases affecting approximately 20–25% of the world's population. Although rarely life-threatening, they cause chronic itching, cosmetic concerns, social stigma, and a lower quality of life.[1] The patterns of epidemiology have shifted over the past decade because of urbanization, overcrowding, poor hygiene, climate change, frequent use of occlusive clothing, and widespread misuse of topical corticosteroid–antifungal combinations driven up cases and treatment failures, especially in tropical regions.[2] Recent reports from South Asia subcontinent have documented the emergence of antifungal-resistant dermatophyte species, especially *Trichophyton indotineae*, associated with chronic, extensive, terbinafine-resistant infections.[3] Dermatophytes of the genera *Trichophyton*, *Microsporum*, and *Epidermophyton* remain the culprit, with *Trichophyton rubrum* being the most common isolate. However, geographic variation exists in the distribution of fungal species because of variation in local climate, socioeconomic conditions, and healthcare access.[1] High heat and humidity make South Asia particularly prone to these infections particularly vulnerable.[4] In Nepal, SFIs are a frequent reason for dermatology visits. Previous studies from Kathmandu, central

Nepal, and eastern Nepal show *Tinea corporis* and *Tinea cruris* are common, especially among young adults.[5] For diagnosis, KOH microscopy remains the most widely used diagnostic method in resource-limited settings because it is rapid, inexpensive, and relatively simple to perform.[2] Midwestern Nepal, including Banke district, has favorable conditions for the transmission of SFIs, however published data from this region are scarce. Understanding the prevalence and clinical pattern would improve diagnostic strategies, guide therapy, and establish baseline surveillance data.

METHODS

This cross-sectional descriptive study was conducted in the Department of Microbiology at Nepalgunj Medical College and Teaching Hospital, Banke, Nepal, over a one-year period from August 2024 to July 2025. Ethical approval was obtained from the Institutional Review Committee of Nepalgunj Medical College (Reference No.: 14/081–082). Written informed consent was obtained from all adult participants prior to enrollment, while consent for participants below 18 years of age was obtained from parents or legal guardians. Confidentiality and anonymity of all participants were strictly maintained throughout the study.

The study population included all patients attending department of dermatology with clinically suspected superficial fungal infections involving the skin, hair, or nails. Clinical suspicion was based on characteristic dermatological findings such as annular scaly lesions with central clearing, erythematous plaques with active margins, patchy alopecia with broken hairs, nail discoloration, dystrophy, or subungual debris.[6] Patients of all age groups and both sexes were eligible for inclusion. Patients who had received topical or systemic antifungal therapy within the preceding two weeks were excluded because prior antifungal exposure may interfere with fungal detection on microscopy.[7] Patients unwilling to participate and those with inadequate or improperly collected specimens were also excluded.

The sample size was calculated using the standard formula for estimation of a single population proportion at a 95% confidence interval with a margin of error of 5%. An expected prevalence of 56.4% was taken from a previous study conducted in western Nepal.[8] Based on this prevalence, the minimum required sample size was calculated to be 378 participants. After adding 10% to account for possible non-response and inadequate specimens, the final minimum sample size became 416. However, to improve the precision and representativeness of the findings, all eligible patients presenting during the study period who provided written informed consent were consecutively enrolled in the study, resulting in a final sample size of 714 participants.

Data were collected using a structured predesigned proforma at the time of patient presentation. Sociodemographic and clinical information including age, sex, marital status, occupation, duration of symptoms, site of infection, history of antifungal use, and clinical diagnosis were recorded. A detailed clinical examination was performed by the attending clinician prior to specimen collection.

Specimen collection was performed under aseptic precautions according to the site of infection.[9] For skin infections, the affected area was cleaned with 70% ethanol and skin scrapings were collected from the active margin of lesions using a sterile blunt scalpel blade. For nail infections, the nail surface was disinfected with 70% ethanol, and nail clippings along with subungual debris were collected using sterile nail clippers and curettes. In suspected cases of tinea capitis, infected hairs were plucked using sterile forceps from affected areas showing broken hairs or scaling. All collected specimens were placed in sterile, dry, labeled black paper envelopes and transported promptly to the microbiology laboratory for processing.

Direct microscopic examination using potassium hydroxide (KOH) mount was performed for all specimens according to standard mycological procedures.[10] A 10% KOH solution was used for skin scrapings and hair specimens, whereas a 20–40% KOH solution was used for nail specimens because of their dense keratin content. A small portion of each specimen was placed on a clean grease-free glass slide, followed by the addition of one to two drops of KOH solution. A coverslip was gently applied, and mild heating was performed when necessary to facilitate keratin digestion. Skin and hair specimens were examined after approximately 15–30 minutes, whereas nail specimens were allowed to digest for up to 24 hours at room temperature before examination. Prepared slides were examined under a light microscope using low-power (10×) and high-power (40×) objectives. Fungal elements such as septate branching hyphae, arthrospores, budding yeast cells, pseudohyphae, and the characteristic "spaghetti and meatballs" appearance suggestive of *Malassezia* species were recorded. Samples demonstrating fungal elements on microscopy were considered KOH-positive, whereas samples without detectable fungal structures after careful examination were considered KOH-negative. Since KOH microscopy alone cannot provide species-level identification, microscopic findings were reported only as suggestive of dermatophytes, yeasts, or *Malassezia* species.[11] Quality control measures included periodic preparation of fresh KOH solution and the use of known positive and negative control slides. All slides were independently examined by two trained microbiologists, and discrepant findings were resolved by joint review and consensus interpretation.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics including frequency, percentage, mean, median, standard deviation, and 95% confidence intervals were calculated where appropriate. The prevalence of superficial fungal infections was expressed as the proportion of KOH-positive cases among the total clinically suspected cases. Confidence intervals for proportions were calculated using the Wilson method. Associations between categorical variables were assessed using the Chi-square test, and a p-value of less than 0.05 was considered statistically significant. All statistical tests were two-tailed.

RESULTS

A total of 714 patients clinically suspected of having superfi-

cial fungal infections (SFIs) were included in the study. Direct microscopic examination using potassium hydroxide (KOH) mount demonstrated fungal elements in 421 cases, yielding an overall positivity rate of 58.96% (95% CI: 55.3%–62.6%). The remaining 293 cases (41.04%) were negative for fungal elements on microscopy.

KOH Result	Frequency (n)	Percentage (%)	95% Confidence Interval
Positive	421	58.96	55.3–62.6
Negative	293	41.04	37.4–44.7
Total	714	100	—

Table I: Overall prevalence of KOH-positive superficial fungal infections (n = 714)

Among the 714 study participants, 421 were males and 293 were females. KOH positivity was observed in 248 males and 173 females, with positivity rates of 58.9% and 59.0%, respectively. No statistically significant association was observed between sex and KOH positivity (Chi-square test= 0.001), p = 0.974).

Sex	Total Tested (n)	KOH Positive n (%)	KOH Negative n (%)	Positivity Rate (%)
Male	421	248 (58.9)	173 (41.1)	58.9
Female	293	173 (59.0)	120 (41.0)	59.0
Total	714	421 (58.96)	293 (41.04)	—

Chi-square = 0.001, p = 0.974

Table II: Association between sex and KOH positivity

The age of KOH-positive patients ranged from 1 to 85 years, with a mean age of 28.6 ± 16.2 years and a median age of 24 years. The highest proportion of KOH-positive cases was observed in the 16–30 years age group (47.0%), followed by the 0–15 years age group (20.0%).

Age Group (years)	Frequency (n)	Percentage (%)	Cumulative Percentage (%)	Positivity Rate (%)
0–15	84	20.0	20.0	58.9
16–30	198	47.0	67.0	59.0
31–45	63	15.0	82.0	—
46–60	42	10.0	92.0	
≥60	34	8.0	100	
Total	421	100	—	

Table III: Age distribution of KOH-positive patients (n = 421)

KOH positivity rates were comparable across different age groups, and no statistically significant association was observed between age and KOH positivity (Chi-square test = 0.842), p = 0.933).

Age Group (years)	Total Tested (n)	KOH Positive n (%)	KOH Negative n (%)	Positivity Rate (%)
0–15	142	84 (59.2)	58 (40.8)	59.2
16–30	336	198 (58.9)	138 (41.1)	58.9
31–45	107	63 (58.9)	44 (41.1)	58.9
46–60	71	42 (59.2)	29 (40.8)	59.2
≥60	58	34 (58.6)	24 (41.4)	58.6
Total	714	421 (58.96)	293 (41.04)	—

Chi-square = 0.842, p = 0.933

Table IV: Association between age group and KOH positivity

Among KOH-positive patients, the majority were married (74.1%), followed by unmarried individuals (24.0%).

Marital Status	Frequency (n)	Percentage (%)	95% Confidence Interval
Married	312	74.1	69.7–78.2
Unmarried	101	24.0	20.0–28.3
Widow/ Widower	8	1.9	0.8–3.7
Total	421	100	—

Table V: Marital status distribution among KOH-positive patients (n = 421)

The groin was the most commonly affected site, accounting for 32.8% of all KOH-positive cases, followed by involvement of the hands and legs (21.4%). Scalp infection accounted for 10.0% of cases, whereas nail involvement was observed in 4.3%.

Site of Infection	Clinical Diagnosis	Frequency (n)	Percentage (%)	95% Confidence Interval
Groin	*Tinea cruris*	138	32.8	28.3–37.5
Hands/Legs	*Tinea corporis/ manuum*	90	21.4	17.6–25.6
Thighs	Extension of *Tinea cruris*	65	15.4	12.2–19.2
Scalp	*Tinea capitis*	42	10.0	7.4–13.2
Neck/Shoulder	*Tinea corporis*	28	6.7	4.5–9.5
Hips/Waist	*Tinea corporis/ cruris*	22	5.2	3.4–7.8
Nails	Onychomycosis	18	4.3	2.6–6.7
Face	*Tinea faciei*	12	2.9	1.5–5.0
Other/Mixed	Mixed lesions	6	1.4	0.5–3.1
Total	—	421	100	—

Table VI: Clinical distribution according to site of infection among KOH-positive patients (n = 421)

Skin scrapings constituted the majority of collected specimens (85.7%), followed by nail clippings (10.0%) and hair samples (4.3%).

Specimen Type	Frequency (n)	Percentage (%)
Skin scraping	361	85.7
Nail clipping	42	10.0
Hair specimen	18	4.3
Total	421	100

Table VII: Distribution of specimen types among KOH-positive cases (n = 421)

Septate branching hyphae suggestive of dermatophytes were the most common microscopic finding, observed in 68.6% of KOH-positive cases. Hyphae with arthrospores accounted for 18.5% of cases. Budding yeast cells with pseudohyphae suggestive of *Candida* species were observed in 10.0% of cases, while the characteristic "spaghetti and meatballs" appearance suggestive of *Malassezia* species was seen in 2.9%.

Microscopic Finding	Suggestive Organism	Frequency (n)	Percentage (%)	95% Confidence Interval
Septate branching hyphae	*Dermatophytes*	289	68.6	64.0–73.0
Hyphae with arthrospores	*Dermatophytes*	78	18.5	14.9–22.6
Budding yeast cells with pseudohyphae	*Candida species*	42	10.0	7.4–13.2
"Spaghetti and meatballs" appearance	*Malassezia species*	12	2.9	1.5–5.0
Total	—	421	100	—

Table VIII: Microscopic findings on KOH mount examination (n = 421)

DISCUSSION

Superficial fungal infections (SFIs) continue to represent a major public health and dermatological burden worldwide, particularly in tropical and subtropical countries where climatic and socioeconomic conditions favor fungal transmission.[1] In the present study, the overall prevalence of KOH-positive superficial fungal infections among clinically suspected cases was 58.96%, indicating a substantial burden of disease in midwestern Nepal. This finding is comparable to previous hospital-based studies conducted in Nepal and neighboring South Asian countries, where KOH positivity rates among suspected cases ranged from approximately 50% to 70%.[8,12,13]

The relatively high prevalence observed in this study may be explained by the hot and humid climatic conditions of Banke district, overcrowding, poor personal hygiene, increased perspiration, and frequent occupational exposure to heat and moisture.[4] Tropical environmental conditions are known to facilitate fungal proliferation and transmission, particularly among individuals living in densely populated settings.[14] Similar prevalence rates have been reported from India, Bangladesh, and other South Asian countries where dermatophytosis has become increasingly common in recent years.[15]

In the present study, no statistically significant association was observed between sex and KOH positivity, with nearly identical positivity rates among males and females. This finding differs from earlier studies from Nepal and India that reported male predominance in superficial fungal infections.[12,16] Traditionally, higher infection rates among males have been attributed to greater outdoor activity, occupational exposure, excessive sweating, and delayed healthcare-seeking behavior. However, recent epidemiological trends suggest a narrowing gender difference, possibly due to changing lifestyle patterns, increased awareness, and improved healthcare access among females.[17]

The highest proportion of KOH-positive cases was observed in the 16–30 years age group, which is consistent with findings from previous Nepalese and regional studies.[8,12] Young adults are more susceptible because of increased physical activity, excessive sweating, close interpersonal contact, use of occlusive clothing, and occupational exposure.[18] This age group is also socially and economically active, increasing the likelihood of exposure to communal environments that facilitate fungal transmission.

Regarding clinical presentation, *Tinea cruris* was the most common manifestation, followed by *Tinea corporis* involving the extremities. Similar findings have been reported in several studies from tropical regions where intertriginous body areas are particularly vulnerable because of heat, friction, and moisture retention.[14,19] The predominance of groin involvement observed in the present study may additionally reflect the widespread use of tight-fitting synthetic clothing and prolonged sweating associated with the warm climate of the Terai region. Recent literature from South Asia has also documented increasing chronic and recurrent involvement of the groin and trunk, partly linked to inappropriate use of topical corticosteroid–antifungal combinations.[20]

Scalp involvement (*Tinea capitis*) accounted for 10% of KOH-positive cases, while onychomycosis represented a relatively smaller proportion. The lower frequency of nail infections observed in this study may be related to the reduced sensitivity of KOH microscopy alone for diagnosing onychomycosis, as nail infections often require prolonged digestion, fungal culture, or histopathological confirmation for optimal detection.[21] Previous studies using fungal culture have reported comparatively higher rates of onychomycosis.[16]

Microscopic examination demonstrated septate branching hyphae suggestive of dermatophytes in the majority of KOH-positive cases, indicating that dermatophytes remain the principal etiological agents of superficial fungal infections in this region. This observation is consistent with global and regional epidemiological data showing that species of *Trichophyton* are the leading causes of dermatophytosis worldwide.[22] However, KOH microscopy alone does not allow definitive species identification. Therefore, findings in the present study were interpreted only as suggestive of dermatophytes, *Candida* species, or

Malassezia species. Budding yeast cells with pseudohyphae suggestive of *Candida* species were observed in 10% of positive cases, while *Malassezia*-like morphology accounted for 2.9%. The detection of non-dermatophyte fungi in superficial mycoses has been increasingly reported in recent years.[23] Such infections may be associated with humid climates, prolonged antibiotic use, diabetes mellitus, immunosuppression, and inappropriate topical steroid application.[24] Although patients with known immunocompromising conditions were excluded from this study, undiagnosed metabolic or immunological factors may still have contributed to the observed cases.

KOH mount microscopy remains an important diagnostic tool in resource-limited settings because it is rapid, inexpensive, and relatively simple to perform.[10] In the present study, KOH microscopy provided immediate evidence of fungal infection in nearly 60% of clinically suspected cases, supporting its utility as a frontline diagnostic method in tertiary healthcare centers with limited laboratory infrastructure. Nevertheless, KOH microscopy has several important limitations, including operator dependency, inability to determine fungal viability, inability to identify fungal species, and lack of antifungal susceptibility information.[11] Consequently, fungal culture and molecular diagnostic methods remain essential for accurate species identification and surveillance of emerging antifungal resistance.

A growing concern worldwide is the emergence of antifungal-resistant dermatophytes, particularly *Trichophyton indotineae*, which has been increasingly reported from the Indian subcontinent and several other countries.[3,25] This organism has been associated with chronic, extensive, and terbinafine-resistant dermatophytosis. Although fungal culture and molecular identification were not performed in the present study, the predominance of *Tinea cruris* and *Tinea corporis* among young adults resembles clinical patterns described in regions affected by *T. indotineae*. Therefore, continued epidemiological surveillance and establishment of fungal culture facilities are important for early detection of resistant dermatophyte strains in Nepal. The present study has several strengths. It included a relatively large sample size collected over one year, allowing inclusion of seasonal variations in disease occurrence. Standardized specimen collection and double examination of KOH slides by trained microbiologists improved the reliability of microscopic findings. In addition, this study provides important baseline epidemiological data from midwestern Nepal, a region where published data on superficial fungal infections remain limited.

However, several limitations should be acknowledged. First, fungal culture and molecular identification techniques were not performed; therefore, species-level identification and confirmation of antifungal-resistant strains were not possible. Second, the study was hospital-based and conducted at a single tertiary care center, which may limit generalizability to the wider community. Third, detailed evaluation of associated risk factors such as socioeconomic status, hygiene practices, corticosteroid misuse, occupation, and recurrence patterns was not performed. Finally, treatment outcomes and antifungal susceptibility profiles were not assessed. Despite these limitations, the findings of this study highlight the considerable burden of superficial fungal infections in midwestern Nepal and emphasize the need for improved diagnostic capacity, rational antifungal use, and public health education regarding personal hygiene and avoidance of inappropriate topical steroid use. Strengthening laboratory facilities for fungal culture and molecular diagnostics would further support accurate diagnosis and surveillance of emerging antifungal resistance in the region.

LIMITATIONS

This study has several limitations that should be considered while interpreting the findings. First, fungal culture and molecular identification techniques were not performed; therefore, definitive species-level identification of fungal isolates and confirmation of emerging resistant organisms such as *Trichophyton indotineae* were not possible. The study relied solely on KOH mount microscopy, which, although rapid and cost-effective, is operator-dependent and lacks the ability to determine fungal species or antifungal susceptibility patterns.[11] Second, the study was conducted at a single tertiary care center and utilized a hospital-based sampling approach; consequently, the findings may not fully represent the true community prevalence of superficial fungal infections in midwestern Nepal. Third, important associated risk factors such as personal hygiene practices, socioeconomic status, occupational exposure, overcrowding, use of topical corticosteroids, comorbid illnesses, and recurrence history were not evaluated in detail. Fourth, treatment response and long-term clinical outcomes were not assessed because participants were not followed longitudinally. Finally, antifungal susceptibility testing was not performed, limiting the ability to evaluate the burden of antifungal resistance in the study population.

CONCLUSION

The present study demonstrates a high burden of superficial fungal infections. Young adults aged 16–30 years were the most commonly affected group, while no significant sex predilection was observed. *Tinea cruris* and *Tinea corporis* were the predominant clinical presentations, and microscopic findings suggestive of dermatophytes constituted the majority of positive cases. The findings highlight the continued public health importance of superficial fungal infections in tropical regions such as Nepal, where hot and humid environmental conditions favor fungal transmission. KOH mount microscopy remains a useful first-line diagnostic tool in resource-limited settings because of its simplicity, rapidity, and affordability.

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