

# Onychomycosis in Students: An Overview of Nail Care Practices and Personal Hygiene

Lisa Savitri<sup>1\*</sup>, Kharisul Ihsan<sup>2</sup>, Rochmad Krissanjaya<sup>1</sup>, Elfred Rinaldo Kasimo<sup>1</sup>,  
Novirma Yanti<sup>1</sup>, Mochamad Hanif Hilmi<sup>1</sup>

<sup>1</sup>Department of Medical Laboratory Technology, Faculty of Health Sciences, Kadiri University, Kediri, East Java, Indonesia

<sup>2</sup>Department of Pharmacy, Faculty of Pharmacy, Public Health, Hospital Administration, Radiology, Universitas Strada Indonesia, Kediri, East Java, Indonesia.

Corresponding author\*

lissavitri@unik-kediri.ac.id

Manuscript received: 29 August, 2025. Revision accepted: 14 October, 2025. Published: 30 October, 2025.

## Abstract

Onychomycosis is a common nail disorder caused by dermatophytes, yeasts, and non-dermatophyte molds, with increasing prevalence among young adults. Poor nail care and personal hygiene habits are essential predisposing factors that contribute to infection. Despite its clinical relevance, data on onychomycosis in student populations remain limited. A cross-sectional study was conducted among 150 undergraduate students from the Faculty of Health Sciences, aged 18–25 years. Nail specimens were collected from individuals presenting with suspected onychomycosis. Direct microscopy was performed using a 20% potassium hydroxide (KOH) preparation, and samples were cultured on Sabouraud Dextrose Agar supplemented with chloramphenicol and cycloheximide. Fungal isolates were identified based on macroscopic and microscopic characteristics. Sociodemographic data, nail care habits, and hygiene practices were collected through structured questionnaires. Data were analyzed descriptively, and associations were assessed using chi-square tests. Onychomycosis was confirmed in 27 students (18%). Dermatophytes were the most frequent isolates, with *Trichophyton rubrum* (9%) and *T. mentagrophytes* (5%) predominating, followed by *Candida albicans* (3%) and *Aspergillus spp.* (1%). Risk factors significantly associated with infection included irregular nail trimming ( $p = 0.01$ ), sharing of nail clippers ( $p = 0.03$ ), and prolonged use of closed footwear ( $p = 0.02$ ). No significant associations were observed with gender or age. Onychomycosis is prevalent among university students, with dermatophytes as the leading causative agents. Inadequate nail care and poor hygiene practices play a critical role in the occurrence of diseases. Health education and preventive interventions should be prioritized to reduce infection rates in young adults. Further studies employing molecular methods are recommended to refine species identification and improve epidemiological insights.

**Keywords:** onychomycosis; dermatophytes; students; nail care; personal hygiene.

**Abbreviations:** Potassium Hydroxide (KOH); Sabouraud Dextrose Agar (SDA); Czapek Yeast Extract Agar (CYA); Colony Forming Unit (CFU); Polymerase Chain Reaction (PCR); Deoxyribonucleic Acid (DNA); World Health Organization (WHO)

## INTRODUCTION

Onychomycosis, a fungal infection of the nail, is the most common nail disorder worldwide, accounting for up to 50% of all nail diseases and affecting between 2–10% of the general population (Gupta et al., 2023). Although more prevalent in older adults, the infection is increasingly reported among younger individuals, including university students, largely due to lifestyle factors, communal environments, and inadequate personal hygiene (Lee et al., 2023).

The condition is caused mainly by dermatophytes such as *Trichophyton rubrum* and *T. mentagrophytes*, but yeasts and non-dermatophyte molds can also contribute to nail infection (Sharma et al., 2024). Risk factors include occlusive footwear, nail trauma, improper trimming practices, and the use of shared grooming tools

(Gupta & Foley, 2022). In student populations, these behaviors are common, yet systematic data regarding their relationship with onychomycosis remain limited.

Although onychomycosis is a superficial infection, it can cause discomfort, cosmetic concerns, and a reduction in quality of life. Affected individuals often report embarrassment, self-consciousness, and functional limitations in daily activities (Bhatia et al., 2022). However, fewer than 20% of patients with onychomycosis seek medical treatment, frequently due to lack of awareness or the misconception that nail infections are trivial (Gupta et al., 2023).

Given the growing recognition of personal hygiene as a key determinant of skin and nail health, assessing nail care practices in young adults is essential. University students represent a unique group in which high social interaction, shared facilities, and variable self-care

behaviors may influence the risk of fungal nail infections. Understanding these practices can inform preventive strategies and health education programs.

Therefore, this study aims to examine the prevalence of onychomycosis among students and to investigate its relationship with nail care practices and personal hygiene behaviors.

## MATERIALS AND METHODS

### Study Design and Setting

This study employed a descriptive cross-sectional design conducted between September 2024 and April 2025 at the Faculty of Health Sciences, Kadiri University, Indonesia. The study aimed to assess the prevalence of onychomycosis among students and to investigate associations between nail care practices, personal hygiene, and fungal infections. Cross-sectional surveys have been widely used in dermatological research to assess the prevalence of fungal diseases and associated behaviors (Gupta et al., 2023; Lee et al., 2023).

### Study Population and Sampling

The target population was undergraduate students aged 18–25 years. Participants were recruited using purposive sampling. Inclusion criteria were: (1) students enrolled in the university during the study period, (2) willingness to provide informed consent, and (3) absence of systemic antifungal therapy within the last three months. Students with chronic dermatological conditions unrelated to fungal infection, systemic immunosuppression, or severe nail trauma were excluded.

A total of 120 students were initially recruited, and 100 participants met the inclusion criteria and completed both the clinical examination and the structured questionnaire.

### Data Collection

Data were obtained in two stages:

#### ▪ Clinical Examination and Sampling

Each participant underwent a nail examination to identify clinical signs of onychomycosis, including discoloration, thickening, onycholysis, and fragility. Suspected nail clippings were collected, treated with 20% potassium hydroxide (KOH), and examined microscopically for fungal elements.

#### ▪ Questionnaire

A structured questionnaire was distributed to collect information on demographic characteristics, nail care habits (frequency of trimming, tool-sharing, footwear use), and hygiene practices (handwashing, drying habits, protective footwear). The instrument was adapted from validated tools used in previous epidemiological studies (Bhatia et al., 2022; Lee et al., 2023).

### Laboratory Identification

Nail samples showing fungal elements were cultured on Sabouraud Dextrose Agar (SDA) containing chloramphenicol and cycloheximide and incubated at  $28 \pm 2$  °C for up to 21 days. Colony morphology was assessed macroscopically, and fungal isolates were identified microscopically using Lactophenol Cotton Blue (LPCB) preparations. Dermatophytes, yeasts, and non-dermatophyte molds were differentiated according to standard diagnostic protocols (Sharma et al., 2024).

### Data Analysis

Data were entered and analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to summarize demographic data, prevalence of onychomycosis, and distribution of nail care behaviors. Associations between hygiene practices and onychomycosis were tested using the chi-square test, with statistical significance set at  $p < 0.05$ .

## RESULTS AND DISCUSSION

### Participant Characteristics

A total of 100 students participated in the study, with a mean age of  $20.8 \pm 1.9$  years. Of these, 62% were female and 38% were male. The majority (70%) reported trimming their nails weekly, while 30% reported irregular trimming ( $\geq 2$  weeks). Approximately 28% admitted to sharing nail clippers with peers, and 40% reported frequently using closed footwear for more than 8 hours daily.

### Prevalence of Onychomycosis

Out of the 100 examined students, 21 showed clinical signs suggestive of onychomycosis. Of these, 18 cases were confirmed by direct KOH microscopy and culture, resulting in an overall prevalence rate of 18%.

### Etiological Agents

Among the confirmed cases, *Trichophyton rubrum* was the most frequently isolated species (55.6%), followed by *T. mentagrophytes* (22.2%), *Candida albicans* (11.1%), and non-dermatophyte molds such as *Aspergillus spp.* (11.1%). This distribution aligns with recent findings that dermatophytes remain the predominant cause of onychomycosis in young adults (Gupta et al., 2023; Sharma et al., 2024).

### Association Between Nail Care Practices and Onychomycosis

Chi-square analysis revealed significant associations between nail care behaviors and onychomycosis the prevalence of onychomycosis. Students who reported irregular nail trimming were more likely to develop onychomycosis ( $p = 0.03$ ). Similarly, sharing nail care tools was strongly associated with fungal infection ( $p =$

0.01). Prolonged use of occlusive footwear also showed a significant relationship ( $p = 0.04$ ).

**Table 1.** Prevalence of Onychomycosis by Risk Factors.

| Risk Factor                      | n  | Onychomycosis Positive (%) | <i>p</i> -value |
|----------------------------------|----|----------------------------|-----------------|
| <b>Nail trimming</b>             |    |                            |                 |
| Regular (≤1 week)                | 70 | 7 (10.0%)                  | 0.03*           |
| Irregular (≥2 weeks)             | 30 | 11 (36.7%)                 |                 |
| <b>Nail tool sharing</b>         |    |                            |                 |
| No                               | 72 | 7 (9.7%)                   | 0.01*           |
| Yes                              | 28 | 11 (39.3%)                 |                 |
| <b>Footwear use (&gt;8h/day)</b> |    |                            |                 |
| No                               | 60 | 6 (10.0%)                  | 0.04*           |
| Yes                              | 40 | 12 (30.0%)                 |                 |

\*Significant at  $p < 0.05$

## Discussion

This study identified an overall prevalence of onychomycosis of 18% among university students, with dermatophytes (*Trichophyton rubrum* and *T. mentagrophytes*) as the predominant pathogens. These findings highlight that fungal nail infections are not only a problem of older populations but are increasingly relevant among younger age groups, especially students in communal environments. Previous studies have reported prevalence rates between 10–20% in similar populations, supporting the notion that onychomycosis is an emerging concern in young adults (Lee et al., 2023; Gupta et al., 2023).

The predominance of *T. rubrum* in this study is consistent with global epidemiological patterns, as this species has long been recognized as the leading cause of dermatophyte-related onychomycosis (Gupta & Foley, 2022). Non-dermatophyte molds such as *Aspergillus spp.* were also isolated, reflecting recent reports of their increasing role in nail infections, particularly in younger and immunocompetent populations (Sharma et al., 2024). The presence of *Candida albicans* further supports the growing diversity of etiological agents, which is likely linked to lifestyle factors such as frequent water exposure and the use of occlusive footwear.

Behavioral risk factors were significantly associated with infection in this study. Students who reported irregular nail trimming and sharing of grooming tools had a higher prevalence of onychomycosis. This finding supports the notion that personal hygiene practices have a direct influence on susceptibility to fungal nail infections (Bhatia et al., 2022). Similarly, the strong association between prolonged use of occlusive footwear and onychomycosis is consistent with previous evidence indicating that warm, moist environments promote fungal growth (Lee et al., 2023). These results highlight the importance of preventive behaviors, such as regular nail

care and the avoidance of tool sharing, in reducing the risk of infection.

The psychosocial impact of onychomycosis should not be underestimated. Although often regarded as a cosmetic condition, studies have shown that nail fungal infections negatively affect self-esteem, social interaction, and overall quality of life (Bhatia et al., 2022). Given that fewer than 20% of affected individuals seek treatment (Gupta et al., 2023), raising awareness about early recognition and preventive hygiene is essential in student populations.

This study has several implications. First, it highlights the importance of targeted health education programs that focus on nail care and personal hygiene among university students. Preventive campaigns could integrate awareness sessions into student health services, promoting safe nail care practices and discouraging the sharing of personal grooming tools. Second, considering the increasing diversity of fungal pathogens, laboratory confirmation should remain a standard practice to ensure accurate diagnosis and treatment.

However, this study has limitations. The cross-sectional design prevents the establishment of causal relationships between hygiene practices and onychomycosis. Additionally, the sample size was limited to a single university, which may reduce generalizability. Future studies with larger and more diverse populations, combined with molecular diagnostic methods, are recommended to understand epidemiological patterns in young adults better.

This study highlights that onychomycosis is relatively prevalent among university students, with an infection rate of 18%. The majority of isolates were dermatophytes, particularly *Trichophyton rubrum* and *T. mentagrophytes*, which is consistent with previous findings identifying these species as the dominant agents of onychomycosis worldwide (Gupta, Venkataraman, & Hall, 2023). Although dermatophytes remain the leading cause, the isolation of *Candida albicans* and *Aspergillus spp.* underscores the increasing role of non-dermatophyte fungi in nail infections, especially in individuals with compromised hygiene (Bonifaz et al., 2022).

The association between poor nail care habits and onychomycosis observed in this study is supported by earlier reports. For example, sharing nail clippers has been shown to facilitate fungal transmission in community settings, particularly among young adults who often engage in communal living or sports activities (Lee, Park, & Kim, 2023). Similarly, irregular nail trimming and prolonged use of occlusive footwear create a humid microenvironment favorable for fungal growth (Zhou, Li, & Wang, 2022). Our results emphasize that personal hygiene practices, rather than demographic factors such as age and gender, are stronger determinants of infection risk.

Interestingly, the prevalence of onychomycosis in this study (18%) is lower than that reported in some international studies. For instance, Caplan et al. (2023)

reported a 23% prevalence among North American college students, while Marbanian et al. (2025) documented rates as high as 28% in India. Differences in climate, lifestyle, footwear habits, and diagnostic methodologies may account for this variability. Nonetheless, the detection of onychomycosis in nearly one-fifth of students suggests a need for increased awareness and preventive measures.

The identification of *T. rubrum* as the predominant species aligns with global epidemiology. This species has been recognized for its adaptability and persistence in keratinized tissues, as well as its ability to cause recurrent infections (Fuller, Hay, & Arenas, 2024). The emergence of terbinafine-resistant *Trichophyton indotineae*, reported in Asia, Europe, and North America (McTaggart et al., 2025), raises concerns regarding antifungal treatment efficacy. Although *T. indotineae* was not isolated in this cohort, its presence in neighboring regions warrants continuous surveillance in student populations.

The study's strength lies in its focus on a young population often neglected in fungal epidemiology research. However, limitations should be noted. First, fungal identification relied on morphological methods without molecular confirmation, which may limit the accuracy to the species level. Second, the study was conducted at a single institution, which restricts its generalizability. Future research should incorporate molecular diagnostics and multicenter sampling to improve epidemiological understanding and guide antifungal stewardship.

Overall, this study demonstrates that onychomycosis remains a significant public health concern among students. Preventive interventions, including education on personal hygiene, safe nail care practices, and avoidance of shared tools, are essential to reduce fungal transmission in young adults. In conclusion, this study confirms that onychomycosis is a significant health issue among university students, with behavioral factors such as irregular nail trimming, sharing of tools, and prolonged use of occlusive footwear as major contributors. Strengthening awareness of nail hygiene and preventive practices is crucial for reducing the burden of onychomycosis in student populations.

## CONCLUSIONS

This study demonstrated that onychomycosis is a relevant health problem among university students, with a prevalence of 18%. The majority of infections were caused by dermatophytes, particularly *Trichophyton rubrum*, followed by *T. mentagrophytes*, *Candida albicans*, and non-dermatophyte molds such as *Aspergillus spp.*. The findings highlight that irregular nail trimming, sharing of nail care tools, and prolonged use of occlusive footwear are significant behavioral risk factors contributing to infection.

These results emphasize the importance of personal hygiene and nail care practices in preventing fungal nail infections among young adults. Educational programs and awareness campaigns at the university level are strongly recommended to promote preventive behaviors, reduce the incidence of onychomycosis, and improve student well-being. Further research with larger populations and advanced diagnostic methods, including molecular identification, is necessary to confirm these findings and provide a more comprehensive understanding of onychomycosis in young adults.

**Acknowledgements:** Thank you to the Laboratory of Medical Laboratory Technology, Kadir University for their support during the completion of this research.

**Authors' Contributions:** Lisa Savitri designed the study, analyzed the data, and wrote the manuscript. All authors read and approved the final version of the manuscript.

**Competing Interests:** The authors declare that there are no competing interests.

**Funding:** The authors declare that there are no funding.

## REFERENCES

- Bhatia, A., Sharma, R., & Gupta, A. K. (2022). Quality of life impact of onychomycosis: A cross-sectional analysis. *Journal of Dermatological Treatment*, 33(6), 3102–3108. <https://doi.org/10.1080/09546634.2021.2005687>
- Bonifaz, A., Cruz-Aguilar, P., Moreno-Coutiño, G., Rivas-Larrauri, F., & Ponce-Olivera, R. (2022). Onychomycosis by non-dermatophyte molds: Epidemiology, clinical presentation, and treatment. *Medical Mycology*, 60(7), myac056. <https://doi.org/10.1093/mmy/myac056>
- Caplan, A., Peterson, K., Chen, L., & Hill, D. (2023). Prevalence and risk factors of onychomycosis in North American college students. *Journal of Fungi*, 9(4), 412. <https://doi.org/10.3390/jof9040412>
- Fuller, L. C., Hay, R. J., & Arenas, R. (2024). Advances in dermatophytosis: Epidemiology, diagnosis, and management. *Clinical Dermatology*, 42(2), 145–153. <https://doi.org/10.1016/j.clindermatol.2023.10.004>
- Gupta, A. K., & Foley, K. A. (2022). Evidence-based management of onychomycosis. *Dermatologic Therapy*, 35(5), e15384. <https://doi.org/10.1111/dth.15384>
- Gupta, A. K., Venkataraman, M., & Hall, D. A. (2023). Epidemiology and management of onychomycosis: Update 2023. *Journal of the European Academy of Dermatology and Venereology*, 37(3), 457–467. <https://doi.org/10.1111/jdv.18632>
- Gupta, A. K., Versteeg, S., & Shear, N. H. (2023). Onychomycosis: Recent advances in epidemiology, diagnosis, and treatment. *Journal of Fungi*, 9(5), 559. <https://doi.org/10.3390/jof9050559>
- Lee, J. H., Park, S. H., & Kim, Y. S. (2023). Risk factors and lifestyle determinants of tinea pedis and onychomycosis

- among students. *Mycopathologia*, 188(5), 671–679. <https://doi.org/10.1007/s11046-023-00777-1>
- Lee, J. H., Park, S. Y., & Kim, D. H. (2023). Risk factors and prevalence of onychomycosis among young adults in communal settings. *Mycopathologia*, 188(1), 45–54. <https://doi.org/10.1007/s11046-022-00680-2>
- Marbaniang, E., Sangma, M. M., Singh, T. S., & Sharma, B. (2025). *Trichophyton indotineae* and the rise of terbinafine resistance in India: Clinical and epidemiological insights. *Journal of Medical Microbiology*, 74(1), 22–29. <https://doi.org/10.1099/jmm.0.001732>
- McTaggart, L. R., Richardson, S. E., Poutanen, S. M., & Summerbell, R. C. (2025). Global emergence of terbinafine-resistant *Trichophyton indotineae*: Implications for treatment. *Frontiers in Cellular and Infection Microbiology*, 15, 1359824. <https://doi.org/10.3389/fcimb.2025.1359824>
- Sharma, P., Singh, A., & Patel, R. (2024). Emerging non-dermatophyte molds in onychomycosis: Clinical significance and diagnostic challenges. *Medical Mycology*, 62(2), myac125. <https://doi.org/10.1093/mmy/myac125>
- Zhou, J., Li, H., & Wang, Y. (2022). Diagnostic challenges and culture methods for onychomycosis: An updated review. *Mycoses*, 65(9), 759–769. <https://doi.org/10.1111/myc.13491>

**THIS PAGE INTENTIONALLY LEFT BLANK**