



Research Article

Prevalence of Onychomycosis among Patients Attending Kwara State University Teaching Hospital, Ilorin, Nigeria

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ABSTRACT

Onychomycosis is an arthropophilic fungal infection of the nail plate, nail bed, and nail folds caused by yeasts, dermatophytes, and non-dermatophyte moulds. Frequent sharing of household materials such as bedding, nail tools, and footwear may facilitate transmission of the disease. This study was conducted to determine the prevalence of onychomycosis and characterize its aetiological agents, infection site distribution, and some patient socio-demographic status. A total of 303 consecutive patients with clinically suspected onychomycosis attending Kwara State University Teaching Hospital, Ilorin, were enrolled. Nail scrapings were collected aseptically and subjected to potassium hydroxide (KOH) for direct microscopy and culture on Saboroud Dextrose Agar (SDA) supplemented with 0.05 mg/mL of streptomycin to inhibit bacterial growth. KOH positivity was 74.92% (227/303) and culture positive was 70.63% (214/303). The predominate isolates were non-dermatophyte moulds (70.09%), followed by dermatophytes (25.23%) and yeasts (4.67%). Males demonstrated a slightly higher prevalence (71.64%) compared to females (68.63%), the difference was not statistically significant. There was no statistically association between age group and Onychomycosis. The distribution of onychomycosis across infection site shows higher prevalence in toenails (73.86%) compared to fingernails (66.32%). Distal and Lateral Subungual onychomycosis (DLSO) was the most common clinical type with 181 cases, accounting for the majority of clinical presentation. These findings highlight the importance of combined mycological culture and KOH microscopy for diagnosis and the predominance of non-dermatophyte moulds as aetiological agents in the study population.

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INTRODUCTION

Onychomycosis is a fungal infection of the finger and toenails that frequently leads to discoloration, thickening, severe itching, pain, and separation of the nail from the plates, bed, and matrix, ultimately resulting in fragility and (Alexander *et al.*, 2020). The disease is caused by numerous aetiological agents, but is most commonly attributed to dermatophytes. Clinical diagnosis includes physical observation, direct microscopy, and fungal culture. Staining with periodic acid – Schiff (PAS) facilitates the sensitivity for the detection of dermatophyte (David *et al.*, 2018). Treatment aims to inhibit fungal growth and restore the healthy appearance of the infected nail (Lipner and Scher, 2019). Frequent removal or cutting of the infected nail may enhance the cure rates (Bertanhan and Chiacchio, 2016). Topical therapy is less effective in the treatment of the disease. The prevalence rate of the disease is increasing due to predisposing factors such as diabetes mellitus, immunological disorders, and peripheral vascular diseases (PVD) in the population (christenson *et al.*, 2018). The risk of tinea unguium is two times higher in patients with diabetes mellitus compared to healthy individuals in the population (Marvlyn *et al.*, 2016). The disease affects 15% - 40% of patients infected with human immunodeficiency virus (HIV) (Ayanlowo and Oladele, 2014). Smokers are vulnerable to onychomycosis, especially those who share common bathing facilities and occlusive footwear (David *et al.*, 2018). It affects toenails more frequently than fingernails because of the moisture contents, darkness, reduced blood supply and fungal growth pattern (Joyce *et al.*, 2019). Predisposing nail conditions include psoriasis, genetic predisposition, recurrent fungal infection, and traumatic nail injury (Gupta *et al.*, 2019). Onychomycosis is caused by *candida* species in patient with chronic mucocutaneous candidiasis and fingernails infection but is predominantly caused by *Trichophyton* species (Shahida *et al.*, 2021). Onychomycosis is classified into different classes based on the fungal morphology and mode of infection. Classification helps to predict the prognosis, diagnosis and treatment of the disease. The classes of onychomycosis include total dystrophic onychomycosis, superficial onychomycosis, distal and lateral subungual

onychomycosis, endonyx subungual onychomycosis and proximal subungual onychomycosis (Alexander *et al.*, 2020). However, some infected nails may display combination features of the infection, thus, the prevalence of endonyx subungual onychomycosis is rare in the population (Hay and Baran, 2011). Standard clinical diagnosis is significant for successful therapy, physical examination alone may not yield a desired results. Chronic nail trauma and psoriasis may cause nail disorder but 50% of it is caused by onychomycosis (Allevato, 2010). However, it is possible to identify the organism within 24 hour by histological analysis (Wilsmann *et al.*, 2011). Periodic acid – Schiff (PAS) staining is the most sensitive test compared to culture and KOH microscopy. Increase in sensitivity is obtained when combining PAS staining with culture (Sato *et al.*, 2010). Onychomycosis can be uncomfortable to the patients due to the rough and dirty physical appearance often caused by the disease (Shiu *et al.*, 2018). It may lead to foot ulcers and cellulitis in some patients (Nourchene *et al.*, 2017). Treatment depends on the organism involved, degree of nail infection and the effectiveness of the drugs. However, because of the poor drugs interaction to the main site of fungal infection of the nail, it may take long time to be completely cured (Gupta *et al.*, 2018). However, upon all the available topical and oral antifungal agents for the treatment of onychomycosis, not all patients with the disease are cured completely. And this contributed to many factors such as incorrect diagnosis and non-adherence to treatment or other advanced disease. For the patients that responded to the treatment and cured completely, risk of recurrent infection is demonstrated. Some risk factors are older age, trauma, concomitant disease, tinea pedis, and occlusive footwear, genetic factors, poor hygiene and moisture (Alexander *et al.*, 2020). Even with appropriate therapy, complete mycological cure is not always achieved, and recurrence is common to failure to achieve mycotic eradication (Piraccini *et al.*, 2010). Despite the clinical and epidemiological significance of Onychomycosis, data on the mycological spectrum and socio-demographic distribution of the disease in Kwara State, north-central Nigeria, are limited. Kwara State University Teaching Hospital serves a diverse patient population from urban and peri-urban

communities in the region, providing an appropriate setting for such study. This study was therefore conducted to determine the prevalence of Onychomycosis and characterise its aetiological agents, infection site distribution, and patient socio-demographic status among patients attending Kwara State University Teaching Hospital, Ilorin.

Materials and Methods

Study Area

The study was conducted at Kwara State University Teaching Hospital, Ilorin, a tertiary level referral centre serving Kwara State and surrounding states in north-central Nigeria.

Sample Size Determination

The minimum sample size was calculated using Cochran's (1977) formula as applied by Jha *et al.* (2021).

$$n = \frac{(Z^2 \times PQ)}{e^2}$$

Where

n = Sample size

Z = 1.96 (95% Confidence Interval)

e = Margin of error (0.07)

P = Estimated prevalence = 63.3% (Idris *et al.*, 2024)

Q = 1 – P = 0.367

Therefore,

$$n = \frac{1.96^2 \times \frac{63.3}{100} \times (1 - \frac{63.3}{100})}{0.07^2}$$

$$n = \frac{3.8416 \times 0.633 \times (1 - 0.633)}{0.0049}$$

$$n = \frac{3.8416 \times 0.633 \times 0.367}{0.0049}$$

$$n = \frac{0.892}{0.0049}$$

$$n = 182.04$$

$$n = 182$$

Therefore, 182 samples were the minimum sample size for the research. To account for incomplete sample collection and potential inadequate specimens (estimated non-response rate of 15%), the adjusted sample size was 182/ (1 – 0.15) = 214. A total of 303 samples were ultimately collected during the study period, exceeding the minimum requirement and providing greater statistical power.

Study Participants

These comprise patients with clinically observed cases of onychomycosis. Written informed consent was obtained from all patients prior to sample collection.

Inclusion criteria: All the clinically suspected cases of onychomycosis were included,

Laboratory analysis was conducted at the Central Research and Diagnostic Laboratory, Ilorin, Kwara State.

Ethical Approval

Ethical approval was obtained from the Ethical Review Committee of Ministry of Health, Kwara State (reference number ERC/MOH/2023/01/087) and from Kwara State University Teaching Hospital (reference number KWASUTH/RC/246/VOL.II/99). Written Informed consent was obtained from all participants prior to enrolment. Participants were fully informed of the objectives and procedures of the study, irrespective of gender and age, in patients who had not been on any topical or systemic antifungal drugs within 5 weeks (Sipra *et al.*, 2022).

Exclusion criteria: Exclusion criteria are patients having lesions other than onychomycosis and had use topical or systemic anti-fungal drugs within 5 weeks will be excluded (Sipra *et al.*, 2022).

Collecting nail scrapings

The nails of the patients were sterilized by applying spirit (70% ethyl alcohol) to them before the sample collection, to avoid bacterial contamination (Baki *et al.*, 2018). The nail scrapings were collected using a new razor blade which were used to scarp the nail plate by sweeping the sharp edge of the blade back and forth, the scrapings were then put in Ziploc bags and were transported to the Central Research and Diagnostic Laboratory Ilorin, for processing.

Microscopy (KOH Preparation)

Direct microscopic examination was carried out on the specimens by dissolving a portion of each sample in freshly prepared 20% KOH (Potassium hydroxide) for 60 minutes and examined under high power objective for the presence of fungal agents such as hyphae, yeast cells, pseudo-hyphae, budding cells, spores and the blast conidia (Bonifaz *et al.*, 2013).

Preparation of media suspension

Primary culture was performed on Sabourad Dextrose Agar (SDA; Oxoid Ltd, Basingstoke, UK), prepared in accordance to the manufacturer's instructions. Sixty-two (62 g/L) of SDA powder was weighed and dissolved in 100 ml of distilled water with heating and then autoclaved at 121°C for 15 minutes. After cooling to approximately 45°C, streptomycin was added to a final

concentration of 0.05 mg/mL to inhibit bacterial contamination. The medium was poured into sterile Petri dishes and allowed to solidify. For enrichment, Sabouraud Dextrose Broth (SDB; Oxoid Ltd) was also prepared 30 g/L of SDB powder was dissolved in distilled water, dispensed into tubes (5 mL per tube), and then autoclaved at 121°C for 15 minutes. Streptomycin was added aseptically after autoclaving to a final concentration of 0.05 mg/mL (Ahmad *et al.*, 2010).

Inoculation and Incubation

Nail scrapping were inoculated directly onto SDA plates and into SDB tubes. Cultures were incubated at 25 - 28°C for 14 days, with macroscopic examination conducted every 2 – 3 days. Culture were considered negative if no fungal growth was observed after 21 days (Clayton, 2006).

Sub-culturing

After 14 days, individual fungal colonies on primary SDA plates were subcultured onto fresh SDA plates. Each morphologically distinct colony was transferred separately to the center of individual SDA plates to obtain pure cultures. Subcultures were incubated at 28°C for additional 7 – 14 days (Gupta *et al.*, 2000).

Fungal Identification

The pure cultures of the isolates obtained was subjected to microscopic examination with the aim of identifying the organisms that are associated with onychomycosis. Clean grease-free glass slide was used for the identification. A drop of lactophenol cotton blue was placed on the center of the slide, a small portion of

the fungal culture with an inoculating needle which were sterilized by heating till red hot and then cooled. The piece was put directly into the lactophenol cotton blue and emulsified. A cover slip was then placed on the slide and mounted on the stage. And was viewed under low (10×) and high-power objective (40×) to observe the morphological characteristics. The isolates were identified to genus and species level based on morphological characteristics in accordance with a standard mycological reference atlas (Paus *et al.*, 2008). As this study relied solely on morphological identification, molecular confirmation was not conducted and this represents a study limitation.

Statistical Analysis

Data were entered and analyzed using Microsoft Excel 2019. Frequencies and percentages were calculated for all categorical variables. Associations between categorical variables were determined using the chi-square test, with a p-value <0.05 considered statistically significant. All analyses were determined at 95% confidence interval.

Results

A total of 303 samples were examined. KOH direct microscopy was positive in 227 (74.92%) samples and negative in 76 (25.08%). Fungal culture was positive in 214 (70.63%) samples and negative in 89 (29.37%). Positivity by one diagnostic method either KOH or culture was 243 (79.87%) samples and 60 (19.80%) were negative by both methods (Table 1).

Table 1: Comparison of Diagnostic Methods for Onychomycosis (n=303)

Test	Positive	Negative
KOH	227 (74.92%)	76 (25.08%)
Culture	214 (70.63%)	89 (29.37%)
KOH and Culture	243 (80.19%)	60 (19.80%)

The most common fungal pathogens examined were non-dermatophyte mould (NDMs), representing 70.09% of all the culture positive samples (150/214). *Aspergillus niger* was the most prevalent species (20.09%), followed by *Aspergillus nidulans* (14.49%), *Aspergillus flavus* (10.75%) and *Penicillium* species (7.94%). Dermatophytes accounted for

25.23% of isolates (54/214), predominantly *Trichophyton rubrum* (13.08%), *Trichophyton mentagrophytes* (6.07%) and *Trichophyton tonsurans* (6.07%). Yeasts comprised 4.67% of isolates (10/214), including *Candida albicans* (2.80%) and *Candida* species (1.87%) which represented in Table 2.

Table 2: Identification and Speciation of Clinical Isolates (n=214)

Fungal Isolates	Frequency	Percentage (%)
Dermatophytes (54) (25.23%)		
<i>Trichophyton rubrum</i>	28	13.08
<i>Trichophyton mentagrophytes</i>	13	6.07
<i>Trichophyton tonsurans</i>	13	6.07
Non-dermatophytes (150) (70.09%)		
<i>Aspergillus niger</i>	43	20.09
<i>Aspergillus flavus</i>	23	10.75
<i>Aspergillus nidulans</i>	31	14.49
<i>Aspergillus fumigatus</i>	18	8.41
<i>Fusarium</i> species	3	1.40
<i>Alternaria</i> species	3	1.40
<i>Neoscytalidium dimidiatum</i>	3	1.40
<i>Cladosporium</i> species	3	1.40
<i>Penicillium</i> species	17	7.94
<i>Scopulariopsis</i> species	3	1.40
<i>Pseudallescheria boydii</i>	3	1.40
Yeast (10) (4.67%)		
<i>Candida albicans</i>	6	2.80
<i>Candida</i> species	4	1.87
Total	214	100

Table 3 revealed no statistically significant association between gender and onychomycosis prevalence ($\chi^2 = 0.30$, $df = 1$, $p = 0.58$). Male

shows a slightly higher prevalence (71.64%) compared to females (68.63%), the difference was not statistically significant (Table 3).

Table 3: Gender wise distribution of Clinical Cases of Onychomycosis

Gender	No. of Samples Examined (%)	No. of Positive Samples (%)	Prevalence (%)	Chi-square	Degree of freedom	p-value	Statistically Significant Difference
Male	201	144	71.64	0.30	1	0.58	NO
Female	102	70	68.63	0.30	1	0.58	NO
Total	303	214	70.63				

Table 4 revealed no statistically significant different in Onychomycosis prevalence across individual age groups when comparing with

the remaining study population ($df = 1$, for all comparisons $p > 0.05$).

Table 4: Age Distribution of Clinical Cases of Onychomycosis

Age Group (Year)	No. of Samples Examined	No. of Positive Samples (%)	Prevalence (%)	Chi-square	Degree of freedom	p-value	Statistically Significant Difference
10 - 19	18	12	66.67	0.11	1	0.74	NO
20 - 29	36	28	77.78	0.86	1	0.35	NO
30 - 39	159	108	67.92	0.70	1	0.40	NO
40 - 49	35	27	77.14	0.64	1	0.42	NO
50 - 59	23	14	60.87	0.86	1	0.35	NO
60 - 69	17	13	76.47	0.28	1	0.60	NO
70 - 79	15	12	80.00	0.58	1	0.45	NO
Total	303	214	70.63				

Table 5 shows there is no statistically significant difference in Onychomycosis prevalence between any specific infection site and the rest of the population. Although the

toenails showed the highest prevalence 73.86%, this difference is not statistically significant.

Table 5: Prevalence of Onychomycosis in Relation to the Site of Infection

Infection site	No. of Samples Examined (%)	No. of Positive Samples (%)	Prevalence (%)	Chi-square	Degree of freedom	p-value	Statistically Significant Difference
Fingernail	95	63	66.32	0.79	1	0.37	NO
Toenail	153	113	73.86	0.75	1	0.39	NO
Both	55	38	69.09	0.06	1	0.81	NO
fingernail and toenail							
Total	303	214	70.63				

Table 6 shows the highest number of DLSO cases (181), accounting for majority of clinical presentations. TDO had fewer examined cases

(41), it shows the highest positivity rate (80.49%), followed by SWO (78.26%), PSO (68.96%) and DLSO (67.96%).

Table 6: Percentage Occurrence of Onychomycosis in Relation to the clinical types of infection.

Clinical features	No. of Samples Examined	No. of Positive Samples (%)	Percentage (%)
Distal and Lateral Subungual Onychomycosis (DLSO)	181	123	67.96
Superficial White Onychomycosis (SWO)	23	18	78.26
Proximal Subungual Onychomycosis (PSO)	58	40	68.96
Total Dystrophic Onychomycosis (TDO)	41	33	80.49
Total	303	214	70.63

DISCUSSION

The KOH positivity (60.83%) and culture positivity (70.63%) showed in the present study are broadly comparable to those reported by Sipra *et al.* (2022), who reported KOH

positivity of 60.83% and culture positivity of 56.94%. Both rate exceed those of Shevov *et al.* (2008) (KOH 53%; culture 35%) but fall below those of Agrawal *et al.* (2015), (KOH 89.23%; culture 84.62%). The predominance

of non-dermatophyte moulds (NDMs) (70.09%) in the current study represents an unusually high proportion compared with the findings of Ye *et al.* (2025) where dermatophytes typically dominate. The tropical climate of Kwara state characterized by high temperature and humidity, promotes high environmental moulds especially *Aspergillus* species, increasing the risk of laboratory and specimen contamination. The patient population may include agricultural workers, immunocompromised individuals, and diabetes mellitus or nail trauma, all of which predispose to NDM infection. Future studies should employ molecular identification (ITS rDNA sequencing) to confirm true nail infection and distinguish contaminants. *Trichophyton rubrum* was the leading dermatophyte in the present study (13.08% of all isolates), the prevalence is lower than the findings of Song *et al.* (2022). The distribution of *Candida* species (4.67%) is lower than the yeast prevalence reported by Ye *et al.* (2025), who found yeasts to be the most common isolates in older patients. There was no statistically association between age group and onychomycosis prevalence in the study population. These findings suggest that age may not be a major determinant of onychomycosis in this tropical setting. This contrasts with the findings of Gupta *et al.* (2000) which reported peak prevalence in the 40 – 60 years range. The relatively uniform distribution across age groups may reflect shared environmental exposures, climates factors and lifestyle practices. In this study, males demonstrated a slightly higher prevalence (71.64%) compared to females (68.63%), the 3% difference is statistically insignificant. Gupta *et al.* (2018) reported higher prevalence in males due to occupation exposure, frequent use of occlusive footwear and outdoor activities. The infections rate was observed to be less common in the age group between 10 - 19 years and between 50 to 59 years. This agreed to the studies evaluated by Agarwalla *et al.* (2017). The risk factors supporting the occurrence of onychomycosis in various studies were found to be age group according to the Hepsari *et al.* (2025). The distribution of Onychomycosis across infection sites revealed a higher prevalence in toenails (73.86%) compared to fingernails (66.32%) and combined infections (69.09%). This correlated with the findings of Nayak *et*

al. (2020) who reported toenail onychomycosis (55.18%) were more predominant than fingernails (32.18%). This may be due to wearing of covered occlusive footwear for long period of time and trauma. Greater toenail was commonly affected than the other toes in the study done by Nayak *et al.* (2020). This may be due to size and shape of big toenail predisposing to increased trauma (Veer *et al.*, 2007). SWO (78.26%) showed a relatively high positivity rate (78.26%) despite low sample size (23 cases). PSO shows moderate prevalence (68.96%). The clinical subtypes of onychomycosis seen in this study correlate with Martinez *et al.* (2014) study and reported that nail infection with DLSO being the predominant clinical presentation of Onychomycosis.

CONCLUSION

The present study shows moderately high prevalence (70.62%) of Onychomycosis among patients attending Kwara State University Teaching Hospital, Ilorin. Non-dermatophyte moulds notably *Aspergillus niger*, *Aspergillus nidulans*, and *Aspergillus flavus* were the predominant aetiological agents, which is an unusual epidemiological pattern providing further investigation with molecular confirmation and selective media. *Trichophyton rubrum* was the most common dermatophyte. Accurate and timely identification of aetiological agents is essential for appropriate patient management and optimal therapeutic outcomes. There is an urgent need to strengthen mycological diagnostic capacity, standardize laboratory protocols and incorporate molecular identification at secondary and tertiary health facilities in Kwara State. These measures will improve diagnostic accuracy, reduce empirical antifungal prescribing, and ultimately lower the disease burden in the population. Further studies should incorporate standardized quality control procedures.

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Conflicts of Interest

There are no conflicts of interest.

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