



# Onychomycosis in India and Other Countries in the Indian Subcontinent

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Onychomycosis is described as the fungal infection of finger or toenails, the nail plate with dermatophytes, non-dermatophytes, or yeasts. It affects approximately 5% of the population worldwide, and the prevalence in India is reported to vary from 0.5% to 5%. Onychomycosis (OM) is an intriguing problem for dermatologists around the world. The commonest dermatophytes causing nail infections are *Trichophyton rubrum*, *T. mentagrophytes* and *Epidermophyton floccosum*. The aim of present review is to describe salient demographic and clinical features of onychomycosis in different countries in the Indian subcontinent. The various factors including occupations predisposing to causing onychomycosis are also dealt with.

**KEYWORDS:** Onychomycosis, Infection, Dermatophytes

## INTRODUCTION

Onychomycosis (OM) though asymptomatic can become chronic requiring long-term treatment. It is a fungal infection of the nail plate or nail bed. It does not usually cure itself and it can trigger more infectious lesions in other parts of the body. The reported prevalence of onychomycosis is increasing in western countries, presumably due to lifestyle changes and the ageing of the population.<sup>1</sup> Approximately 10% of the general population, 20% of the population aged >60 years, up to 50% of people aged >70 years and up to one-third of diabetic individuals have onychomycosis.<sup>1</sup> Onychomycosis (OM) is the commonest cause of dystrophic nails, responsible for up to 50% of cases. Apart from significantly damaging the nails, quality of life, and self-image of the sufferer, it also acts as a reservoir of fungal infections carrying important implications for emerging recalcitrant dermatophytosis.<sup>2</sup> The common causative pathogens are *Trichophyton rubrum*, *T. mentagrophytes*, and *Epidermophyton floccosum*. Yeasts and Non-Dermatophyte Molds (NDM) are considered almost equally responsible for other cases.<sup>2</sup> A review of epidemiology, diagnosis and management of onychomycosis, showed its prevalence in different studies in Delhi varying from 1.2% to 45% and 2.8% in Rajasthan.<sup>3</sup>

## ONYCHOMYCOSIS IN DELHI STATE

In 102 positive cases of OM diagnosed at University College of Medical Sciences and GTB

Hospital Delhi, 561/2040 nails (toenails + fingernails) were involved. Distal Lateral Subungual Onychomycosis (DLSO) was the most common clinical variant observed in 80 (78.43%) patients, followed by mixed variant [DLSO+ Total dystrophic OM (TDO)] in 10 (9.80%) patients.<sup>4</sup> Endonyx OM was present in 5 (4.90%) while TDO, PSO, and SO were present in 4 (3.92%), 1 (0.98%), and 2 (1.97%) cases, respectively.<sup>4</sup> Fungal culture was positive in 57 (55.88%) of which non-dermatophytic moulds (NDMs) constituted approximately half (47.61%) of the isolates, followed by *Candida* species (30.15%) and dermatophytes (22.22%) of the isolates. DLSO was majorly caused by NDMs (51.02%), followed by *Candida* species (28.57%), and dermatophytes (20.40%).<sup>4</sup>

## ONYCHOMYCOSIS IN UTTAR PRADESH

Of the 256 patients with male:female ratio of 3:1 recruited in the study at the Institute of Medical Sciences, Banaras Hindu University, Varanasi, the most affected age group was 20-40 years (52.4%). Tinea corporis et cruris was the most common type observed (27.2%). Potassium hydroxide (KOH) positivity was seen in 211 samples (79.6%) and culture positivity was found in 139 samples (52.4%).<sup>5</sup> The most common species identified was *Trichophyton mentagrophytes* (75.9%). Sensitivity testing was done on fifty isolates of *T. mentagrophytes*. Minimum inhibitory concentrations of itraconazole, ketoconazole, terbinafine and voriconazole were comparable, while



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griseofulvin showed the highest minimum inhibitory concentration. Itraconazole was found to be the most effective drug, followed by ketoconazole, terbinafine and fluconazole. Griseofulvin was the least effective drug among the tested antifungals.<sup>5</sup> In another study conducted in Bareilly, of the 74 cases confirmed by direct microscopy ure in KOH mounts and culture on SDA containing gentamycin and cycloheximide, maximum number of patients (35.1%) were observed in 21-30 years age group followed by 31-40 years (21.6%) and 41-50 years (10.8%).<sup>6</sup> Ten patients were above 50 years age in whom increased physical activity and wet work were predisposing factors. Dermatophytes (43.47%) were the predominant group isolated followed by *Candida spp.*(32.60%) and non-dermatophyte moulds (23.91%) and in the finger nails, *Candida spp.* 6 (11.54%) were the predominant group isolated followed by 4 (7.7%) and non-dermatophyte moulds 3(5.7%).<sup>6</sup>

#### ONYCHOMYCOSIS IN HIMACHAL PRADESH

In a study conducted in Indira Medical College, Shimla, ten cases of tinea unguis including 8 males and 2 females were identified by microscopy of nail scrapings in KOH and culture on SDA containing chloramphenicol (0.004%) and cycloheximide (0.05) (HiMedia). The causal agents were *Trichophyton rubrum* and *T. mentagrophytes*.<sup>7</sup> In another study conducted at Department of Microbiology, Shoolini University of Biotechnology and Management Sciences, Solan, nine patients including 8 females and 1 male were diagnosed to be case of onychomycosis by microscopic examination of nails scrapings in 10% KOH and lactophenol blue mounts of their culture on macrobiotic agar (HiMedia). *Trichophyton mentagrophytes* was identified as the causal agent in 7 cases and *T. rubrum* in 2 cases.<sup>18</sup>

#### ONYCHOMYCOSIS IN BIHAR

Of 152 cases clinically suspected as onychomycosis, 68 patients aged 12-75 years including 42 males and 26 females showed positive results by microscopy in KOH and culture. Majority of the patients (85.29%) were from rural background, with 22 (32.35%) being farmers, (27.94%) being housewives, 18 (26.47%) laborers, and 9 (13.23%) were students. All the patients belonged to the below poverty line income group.<sup>19</sup> There was history of trauma over the involved nail in five patients and repeated contact with detergents. Majority (75%) of the patients were used to wearing chappal. Sixteen patients gave a history of trimming nail with barber and the rest used to do self-trimming. Associated comorbidities were as follows—12 patients had diabetes, two had

hypertension. Paronychia was the most common (20 cases, 29.41%) associated cutaneous finding, followed by dermatophytic infections of palms, soles or other areas (16 cases, 23.53%).<sup>9</sup> Other associated skin disorders were dermatitis (5 cases, 7.35%), psoriasis (2 cases, 2.94%) and leprosy (1 case, 1.47%).<sup>9</sup> The commonest sites of involvement were hands and feet, fingernails being more commonly affected than toenails. Of the causative agents, sole infection by dermatophytes was identified in 52 (76.47%) patients, *Candida albicans* in 8 (11.76%), *Aspergillus niger* in 4 (5.88%) patients and *Acremonium sp.* 1 (1.47%) patient. Mixed infections were found in 3 (4.41%) patients.<sup>9</sup>

#### ONYCHOMYCOSIS IN ANDHRA PRADESH

Of 448 patients with nail abnormalities attending Skin OPD in King George Hospital & Andhra Medical College, Visakhapatnam 102 cases were confirmed to be cases of onychomycosis Trauma was a predisposing factor in 11 27% of the cases. The duration of lesions varied from 3 months to 15 years. In the majority (38.23%) it was less than one year.<sup>10</sup> Candidal onychomycosis was the most prevalent clinical type (58.82%) followed by distal subungual onychomycosis (38.72%). Disease was limited only to fingernails in 57.35% and toenails in 32.35%. Predominant isolates obtained were *Candida spp.* (56.7%), followed by dermatophytes (38.2%) and non-dermatophyte molds (3.37%). 26.96% of the patients had experienced physical, psychosocial and occupational problems.<sup>10</sup>

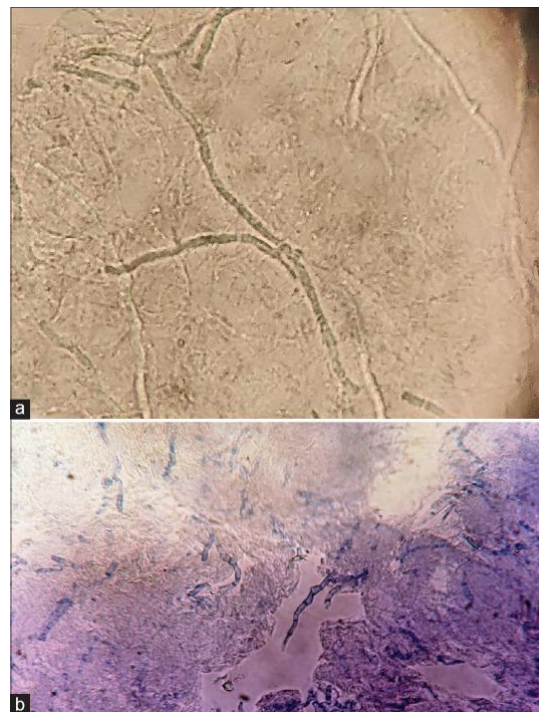
#### ONYCHOMYCOSIS IN KARNATAKA

Till date, five studies of onychomycosis in Karnataka have been reported. In the first study conducted at Yenepoya Medical College Hospital, Yenepoya (Deemed to be University), Deralakatte, Mangalore, 109 patients were confirmed as cases of onychomycosis by microscopic examination of nail scrapings in KOJ mounts and their culture.<sup>11</sup> Toenails were the most frequent site anatomic site involved in 73 (71.57%) cases followed by finger nails in 25 (24.51%) cases and both in 4 (3.92%) cases. Manual laborers, vehicle operators and farmers were the commonest occupational groups. Dermatophytes 25 (48.08%) were the predominant group isolated from toenails followed by non-dermatophyte moulds 8 (15.38%) and *Candida spp.* 2 (3.85%). In the fingernails, *Candida spp.* 6 (11.54%) were the predominant group isolated followed by dermatophytes 4 (7.7%) and non-dermatophyte moulds 3(5.7%).<sup>11</sup> Mixed growth and non-dermatophyte fungi recovered 3(5.7%) cases, included *Aspergillus niger*, *Bipolaris spp.* and *Scopulariopsis*

*brevicaulis* of 2 (3.57%) each and occasionally *Aspergillus terreus*, *A. flavus*, *Alternaria spp.*, *Fusarium spp.*, *Scytalidium spp.* and *Scedosporium apiospermum* of 1 (1.79%) each were isolated. The other group of fungi isolated were the *Candida spp.* 10 (17.86%) with *C. albicans* 6 (10.71%), *C. krusei* 2 (3.57%), *C. tropicalis* and *C. glabrata* of 1 (1.79%) each).<sup>11</sup> In the second study conducted at the Department of Dermatology, 101 patients were diagnosed as cases of onychomycosis by microscopy of KOH mounts of nail scraping/clippings and their culture on SDA with or without antibiotics and histopathologic staining with PAS stain.<sup>12</sup> In the third study conducted by Department of Dermatology Venereology and Leprosy, Yenepoya Medical College Hospital, Yenepoya (Deemed to be University), Deralakatte, of the 80 cases with dermatophytosis, 6 with distal lateral subungual distal onychomycosis were confirmed to be that of hat of tinea unguium.<sup>13</sup> In the fourth study conducted at Department of Microbiology, Yenepoya Medical College, Mangalore, 60 nails were confirmed with a clinical and mycological diagnosis as cases of onychomycosis by examination of nail scrapings in mounts in KOH and Chicago Sky Blue examination.<sup>14</sup> The fifth study deal with a single case of proximal subungual onychomycosis in 60 years- old female with good hygienic practice. Microscopic examination of nail scraping in 40 % KOH showed abundant thin segmented branching hyphae suggestive of dermatophytic infection.<sup>15</sup> Inoculation of nail scrapings on slants of SDA with chloramphenicol and dermatophyte test medium and morphology of colonies after 7 days of incubation and smicrsopic 2was positive of hair penetration in vitro and urea hydrolysis .further confirming tis identification, The patient was successfully treated with oral dosage terbinafine 250 mg daily for 6 weeks.<sup>15</sup>

In the sixth study of 80 patients with current and recurrent derrmatophytosis, six had tinea unguium as demonstrated by presence of hyaline branching septate hyphae or beaded spherical structures (arthrospores) in mounts pf nail scrapings/clippings in 20% KOH and Chicago Sky Blue stain mounts.<sup>15</sup> Sharing of linen, family history, and topical corticosteroid abuse were also freqand histopatholic uent among patients with chronic respiratory disease. Six of the case had tinea.<sup>15</sup> Diagnosis was SDA involved in five of these cases, one of these case was associated with tinea pedis<sup>15</sup>, Patients had indoor work and thirty had outdoor work as their occupations. Cases of tinea unguums had finger nail involvement. Tinea unguium of toenail was also associated with tinea pedis in one patient. Comorbidities noted among cases were hypertension

(10%); diabetes mellitus (8.8%); ischemic heart disease (1.2%); and bronchial asthma (1.2%), forty-two (52.5%) patients gave history of using topical steroid in some form.<sup>15</sup>



**Figure 1.** Nails scrapings showing hyphae with arthrocondida in KOH mount in upper picture (a) and Chicago Sky blue stain in lower picture (b) (Nargis et al.)<sup>13</sup>

#### ONYCHOMYCOSIS IN TELANGANA

There is a report of a case of 87 years old female diagnosed at Pratima Institute of Medical Sciences, Karimnagar. She had history of uncontrolled hypertension for many years, and as a part of her occupation she worked with tobacco leaves.<sup>16</sup> KOH mounts of nal scrapings showed septate hyphae and cultures on SDA after three days showed fast greyish white colonies turning black on 10<sup>th</sup> day, lactophenol blude munts revealed hyphae bearing dark colored curved conidia. Considering the age, present clinical condition, and potential side effects of the antifungal therapy, no treatment was initiated for the patient.<sup>16</sup>

#### ONYCHOMYCOSIS IN WEST BENGAL

In a study in Medical College and Hospital in Midnapur, 126 cases were diagnosed as cases of onychomycosis by microscopy in 20% KOH mounts of nail scrapings and their culture on Sabouraud dextrose agar (SDA) supplemented with antibiotic and cycloheximide and 5% cycloheximide, and

dermatophyte test medium.<sup>17</sup> The commonest dermatophyte was *Trichophyton rubrum* recovered from 31 cases followed by *T. mentagrophytes* recovered from 13 cases and unidentified isolates in 3 cases. Non dermatophytic molds recovered isolates included. *Curvularia spp.*-3, *Aspergillus spp.*-4, *Alternaria spp.*-3 and *Fusarium sp.*-1.<sup>17</sup>

### ONYCHOMYCOSIS IN PUDUCHERRY

The study conducted at Sri Venkateshwara Medical College Hospital and Research Center, Puducherry included 284 confirmed cases of onychomycosis of which 117 (41.1%) were positive for fungal elements by KOH mount 168 (59.1%) samples showed positivity in fungal culture, and 62 (21.8%) samples had positive nail biopsy results.<sup>18</sup> Distolateral subungual OM was the most common clinical type (47.6%). Among the fungal isolates, a predominance of dermatophytes was observed followed by yeasts and non-dermatophytes. The distribution of causative agents as per number of cases was as follows: *Trichophyton rubrum* - 76 cases, *T. mentagrophytes*- 45 cases, *Y. interdigitale* -6 cases, *T. verrucosum* - 4 cases, *Epidermophyton floccosum*, *Aspergillus niger*- 10 cases, *Fusarium spp.*- 6 cases, *Candida albicans*- 17 cases and *C. parapsilosis*-4 cases.<sup>18</sup>



**Figure 2.** Total dystrophy of the nail, picture from a case in Puducherry (Chetna et al 2010)<sup>18</sup>/Septate hyphae in KOH mount scrapings of an infect nail (picture from a case in Puducherry (Chetna et al 2019)<sup>18</sup>



**Figure 3.** Septate hyphae in KOH mount scrapings of an infect nail (picture from a case in Puducherry (Chetna et al. 2019)<sup>18</sup>

In a study from Gangtok, 32 cases were positive for fungal elements by direct microscopy and culture. Young adults in the age group of 21-30 years were mainly affected. The male: female ratio was 1.125:1. Dermatophytes were isolated in 18 cases (64.29%)<sup>[19]</sup> *Trichophyton tonsurans* (44.44%) was the most common isolate followed by *T. mentagrophytes* (22.22%), *T. rubrum* (11.11%), *T. verrucosum* (11.11%) and *Microsporum audouinii* (11.11%). Apart from dermatophytes, *Aspergillus niger* (21.43%) and *Penicillium marneffeii* (14.28%) were also recovered.<sup>19</sup>

### ONYCHOMYCOSIS IN JAMMU AND KASHMIR STATE

Out of 384 culture-positive cases, dermatophytes were isolated in 58.08%, yeast in 26.30%, and non-dermatophyte molds in 12.24%. Of the yeasts, *Candida albicans* was isolated in 59.4% and non-albicans species in 40.59%.<sup>20</sup> Antifungal susceptibility tests showed that most of *Candida* species exhibited 100% susceptibility to most of the antifungal drugs tested, while intermediate resistance to fluconazole and flucytosine was seen in some non- albicans species, viz. *C. krusei*, *C. glabrata*, and *C. guilliermondii*.<sup>20</sup>

### ONYCHOMYCOSIS IN PAKISTAN

Of the 100 cases of onychomycosis confirmed by mycologic culture, 72 were women and 28 men, patients. The various clinical types noted were distolateral subungual onychomycosis (47%), candidal onychomycosis (36%), total dystrophic onychomycosis (12%), superficial white onychomycosis (3%), and proximal subungual onychomycosis (2%).<sup>21</sup> *Candida* was the most common pathogen (46%), followed by dermatophytes (43%) (*Trichophyton rubrum* (31%), *T. violaceum* (5%), *T. mentagrophytes* (2%), *T. tonsurans* (2%), and *Epidermophyton floccosum* (1%) and non-dermatophyte molds (11%) (*Fusarium* (4%), *Scopulariopsis brevicaulis* (2%), *Aspergillus* (2%), *Acremonium* (1%), *Scytalidium dimidiatum* (1%), and *Alternaria* (1%).<sup>21</sup>

### ONYCHOMYCOSIS IN NEPAL

Eighty-two patients of onychomycosis attending the Dermatology outpatient department of a tertiary hospital in Eastern Nepal over a period of one year were confirmed to be cases of onychomycosis by microscopy and culture, The commonest affected age group was 21-40 years. The male: female ratio was 2.7:1. Fifty-one patients had isolated fingernail involvement, while involvement of toenails was seen in 15 patients.<sup>22</sup> Distolateral subungual onychomycosis (67%) was the commonest clinical type followed in decreasing order

by superficial white onychomycosis (14.6%), proximal subungual onychomycosis (9.8%), candidal onychomycosis (7.4%) and total dystrophic onychomycosis (1.2%). *Trichophyton mentagrophytes* (28.8%) was the most common pathogen isolated followed by *Trichophyton rubrum* (21.2%), *Trichophyton tonsurans* (11.5%), *Candida albicans* (11.5%), *Trichosporon beigeli*, (9.6%), *Epidermophyton floccosum* (7.7%), *Trichophyton violaceum* (5.8%), and *Aspergillus flavus* (3.9%). Distolateral subungual onychomycosis was the most common clinical presentation.<sup>22</sup>

In another study in central Nepal, 218 patients attending Tribhuvan University Teaching Hospital, Kathmandu, during November 2006 to March 2008. were confirmed by microscopy and culture as cases of onychomycosis. The age of the patients ranged from 4 to 88 years with mean of 32.8 +/- 15.4. Maximum of the patients were in the age group of 21-30 year.<sup>23</sup> Duration of the disease varied from 1 month to 15 years. Dermatophytes were isolated in 54.9%, yeasts in 39.6% and non-dermatophyte molds in 5.5% cases. *Trichophyton rubrum* was the most common fungal isolate (82%). Yeast infection was more common in females. Yeast was significantly more commonly implicated as a pathogen in fingernail onychomycosis. Dermatophytes were more frequently isolated from toenail onychomycosis. *Trichophyton rubrum* was the most common fungal isolate (82%).<sup>23</sup>

#### ONYCHOMYCOSIS IN BANGLADESH

Out of 87 patients of onychomycosis diagnosed in Bangabandhu Sheikh Mujib Medical University Hospital, Dhaka by microscopy of nail clippings/scrapping and culture on SDA and Dermatophyte test medium 54 patients were diabetic and 33 patients were non-diabetic.<sup>24</sup> *Trichophyton rubrum* isolated from 24 diabetic patients and *Trichophyton mentagrophytes* in 19 diabetic patients. *Candida albicans* and non-albicans *Candida* species were found in 1 and 2 diabetic patients respectively. On the other hand, *Trichophyton rubrum* and *Trichophyton mentagrophytes* were found in 1 and 2 non-diabetic patients respectively. In non-diabetic patients *Candida albicans* was isolated in 8 patients non-albicans *Candida* species were also found in 8 patients.<sup>24</sup>

#### ONYCHOMYCOSIS IN SRI LANKA

In a study of 85 patients of onychomycosis diagnosed by microscopy of nail scrappings/clipping in KOH and their culture on SDA containing chloramphenicol +

gentamycin, and SDA with chloramphenicol and cycloheximide.<sup>25</sup> Eighty-four percent of patients had involvement of their great toes (bilateral- 59, left great toe only-7 and right great toe only-3). Toenails only were involved in 37 percent whereas fingernails only in 12 percent; the thumb nail was the most commonly affected. Both toenails and fingernails were involved in 51% of the cases.<sup>25</sup>

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