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# Pattern of Onychomycosis among Diabetic and Non-Diabetic Patients at a Tertiary Care Hospital in Bangladesh

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**Abstract** **Original Research Article**

Any fungal infection affecting the nail apparatus is referred to as onychomycosis. Onychomycosis is a prevalent nail infection worldwide and is more common among patients with diabetes. A variety of fungus species are responsible for onychomycosis. The purpose of this study was to determine the pattern of onychomycosis among patients with and without diabetes at the Department of dermatology and venereology, Bangabandhu Sheikh Mujib Medical University (BSMMU) Hospital, Dhaka, Bangladesh. In this study, a total of 87 clinically diagnosed patients of onychomycosis with diabetic or non-diabetic were included purposively. The infected nail materials were scraped and then processed in Sabouraud's dextrose agar media (SDA) and Dermatophyte test media (DTM) for microscopy and culture. Clinical features, microscopic examination findings and culture interpretations were recorded and compared between the groups. Out of 87 patients of onychomycosis, 54 patients had diabetic and 33 patients were non-diabetic. Growth of fungus was found significantly higher among diabetic patients (85.19% versus 57.58%, p= 0.004). Dermatophytes were more frequent in diabetic patients, but *Candida albicans* and non-albicans *Candida* species were more common in non-diabetic patients. *Trichophyton rubrum*, and *Trichophyton mentagrophytes* were found in 24 (44.44%) and 19 (35.18%) diabetic patients. On the other hand, *Candida albicans* 8 (24.24%) and non-albicans *candida* species 8 (24.24%) were found majority of the non-diabetic patients. Nail discoloration and disfigurement of nails are the common presentation of onychomycosis. Dermatophytes are significantly more frequent among diabetic patients. The clinical presentation of onychomycosis in patients with diabetes differed from that in non-diabetic subjects.

**Keywords:** Diabetic Patients, Dermatophytes, Non-diabetic Subjects, Onychomycosis, Candida.



## 1. INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder of multiple complications. Chronic diabetes can cause long-term, irreversible functional alterations in body cells, which can result in a number of complications [1]. The elevated glucose concentration in the epidermis of diabetic's skin provides a perfect habitat for saprophytic organisms such as Candida [2]. Superficial fungal infections are prevalent skin conditions that impact a vast number of individuals globally [3]. It was reported that, patients with diabetes are frequently affected by fungal skin infections [4]. The primary fungal species responsible for infecting the skin and its appendages are dermatophytes, Candida and Malassezia [5]. Patients with diabetes have a high incidence of onychomycosis (91.5%), which is thought to be caused by Candida species [2]. In Asian region, Candida species may be the primary cause of onychomycosis in diabetic patients due to a variety of factors [5, 6]. Intense itching, skin irritation, and cosmetic issues are associated with onychomycosis [7]. Onychomycosis in diabetic individuals can lead to secondary bacterial infections that worsen foot ulcers and gangrene. Additionally, thrombophlebitis and recurrent cellulitis can be brought on by onychomycosis [4]. The considerable psychosocial implications of onychomycosis alone warrant comprehensive management in addition to these serious physiological issues [8]. Some studies have indicated a significant prevalence of onychomycosis among people with diabetes [9-11]. Regarding the fungal pathogens, the major species in both diabetic and non-diabetic individuals were dermatophytes, which was predominant

over yeast and non-dermatophytic moulds [11]. In two thirds of the cases of onychomycosis, yeasts were identified, mostly from the fingernails. The most common species were *Candida albicans*, *Candida parapsilosis*, or both of them. In a previous study dermatophytes were found in 18.8% of the samples, particularly in the toenails. The most common species was *Trichophyton rubrum* [12]. Although onychomycosis isn't a life-threatening condition but it has a significant negative impact if it is associated with diabetes. Recent epidemiological study indicated that patients with diabetes are 2.8 times more likely to have onychomycosis than non-diabetic individuals [13]. Diabetic patients are particularly susceptible to nail infection, onychomycosis and diabetic foot. Moreover, treatment pattern of onychomycosis is variable in diabetic patients and non-diabetic individuals. In this background, current study was aimed to determine the pattern of onychomycosis among diabetic and non-diabetic patients at a tertiary care hospital in Bangladesh.

## 2. METHODOLOGY

This cross-sectional study was conducted at Department of Dermatology and Venereology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. A total of 87 patients with suspected onychomycosis of nail were enrolled purposively. Adult patients of both sexes, clinically diagnosed as onychomycosis with or without diabetes mellitus (DM) were selected in this study. Of them, 54 onychomycosis patients had diabetes and 33 onychomycosis patients were without diabetes. Patients with onychomycosis who were under systemic and or topical antifungal treatment for at least 1 month, patients who were in immunosuppressed condition or under immunosuppressive therapy, patients who had onychomycosis like nail disorders (psoriasis, lichen planus, Darier's disease, pityriasis rubra pilaris), patients having thyroid disorder and other systemic auto-immune disorders were excluded from the study. The clinical assessment of participants was done and relevant clinical examination was performed. Specimens were collected for mycological studies.

**Collection of specimens**

The specimens, obtained from clinically abnormal nails after cleaned with 70% alcohol. The collected samples were screened for presence of fungal elements by treating with an aqueous solution 20% KOH.

**Identification of species**

After putting a cover slip over the material, the slide was left for at least one hour in petri dishes, together with a damp piece of filter paper. In microscopic examination; a low power magnification (x 10 objective) was adequate for the detection of fungal hyphae in KOH preparation, but a high power (x 40 objective) was often required to confirm their presence. All the specimen (independent of the KOH test) were cultured in screw - capped test tube containing Sabouraud's dextrose agar (SDA) with supplements (cycloheximide, chlortetracycline and gentamicin) and Dermatophyte test medium (DTM) for primary isolation of fungus. All the tube containing SDA media with supplements and DTM tubes were incubated at room temperature. The inoculated tubes were examined at every alternate day from the day of inoculation. DTM tubes were observed for 14 days and SDA tubes were observed for 4 weeks. The tubes which did not show any evidence of growth after that particular time, were considered negative and discarded. To determine the exact species of fungus urease test and hair perforation test were also performed.

**Data analysis**

All data were compiled accordingly and then analyzed with a windows-based software statistical package for social sciences (SPSS) version 22. The data presented on categorical scale were expressed as frequency with corresponding percentages and the data presented on continuous scale were expressed as mean with standard deviation (SD.) Chi-square ($x^2$) test was done to compare the categorical data. A p value less than 0.05 was considered as significant.

## 3. RESULTS

This study was intended to assess the pattern of onychomycosis among diabetic and non-diabetic patients at a tertiary care hospital in Bangladesh. Total 87 clinically suspected onychomycosis patients were selected. Of them, 54 (62%) study patients had diabetes and 33 (38%) patients were without diabetes (Figure-1).

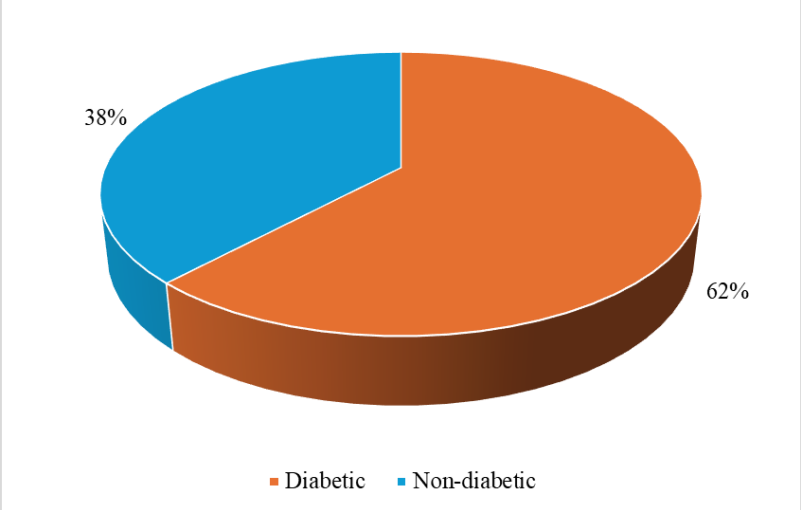


**Figure-1: Distribution of study population on diabetes (N= 87)**

In this study, mean±SD age of the diabetic patients was 53.4±13.28 years and that was 38.4±11.02 years in non-diabetic individuals. Onychomycosis was found in 25(46.29%) male diabetic patients and in 29(53.70%) female diabetic patients, while 16(48.48%) in non-diabetic male and 17(51.51%) in non-diabetic female. The frequency of onychomycosis was more in diabetic patients particularly in female diabetic patients. It was also found that onychomycosis was more frequent in diabetic patients of over 50 years age (Table-1).

**Table-1: Age and sex distribution of the study population (N= 87)**

| Variables | Diabetic (n=54) No. (%) | Non-diabetic (n=33) No. (%) |
|---|---|---|
| **Age group (years)** | | |
| 20-30 | 1(1.9%) | 15(45.5%) |
| 31-40 | 4(7.4%) | 8(24.2%) |
| 41-50 | 16(29.6%) | 8(24.2%) |
| >50 | 33(61.1%) | 2(6.1%) |
| Mean±SD<br>Range (minimum-maximum) | 53.4±13.28<br>(20-64) | 38.4±11.02<br>(21-54) |
| **Gender** | | |
| Male | 25 (46.29%) | 16 (48.48%) |
| Female | 29 (53.70%) | 17 (51.51%) |

Among the study population growth of fungus was found in 46(85.19%) diabetics cases and that was 19(57.58%) in non-diabetic cases. No growth of fungus was seen in 8(14.81%) diabetic patients and 14(42.42%) non-diabetic patients (Table-2).

**Table-2: Growth of fungus among diabetic and non-diabetic patients (N= 87)**

| Growth of fungus | Diabetic (n=54) No. (%) | Non-diabetic (n=33) No. (%) | p-value |
|---|---|---|---|
| Growth present | 46 (85.19%) | 19 (57.58%) | 0.004[s] |
| No growth | 8 (14.81%) | 14 (42.42%) | |
| Total | 54 (100.0%) | 33 (100.0%) | |

Chi-square ($x^2$) test was done, s= significant

It was observed that dermatophytes were found in 43(79.62%) diabetic cases and it was 3(9.09%) in non-diabetic cases. Non albicans candida/Yeast was found in 2 (3.70%) diabetic cases and in 8(24.24%) non-diabetic subjects. Candida was found in 1 (1.85%) diabetic patient and 8(24.24%) non-diabetic subjects. No growth was observed in 8 (14.81%) diabetic cases and among non-diabetic patients no growth was in 14(42.42%) subjects. Dermatophyte was significantly more frequent among diabetic patients ($p<0.001$); but Yeast and Candida were found significantly more among non-diabetic subjects ($p<0.05$) (Table-3).

**Table-3: Presence of dermatophyte, yeast and candida among diabetic and non-diabetic patients**

| Species | Diabetic (n=54) | Non-diabetic (n=33) | p-value |
|---|---|---|---|
| Dermatophyte | 43(79.62%) | 3(9.09%) | <0.001[s] |
| Non-albicans Candida Species/Yeast | 2(3.7%) | 8(24.24%) | 0.004[s] |
| *Candida albicans* | 1(1.85%) | 8(24.24%) | 0.001[s] |
| No growth | 8(14.81%) | 14(42.42%) | 0.004[s] |

Chi-square ($x^2$) test was done, s= significant

Data analysis showed that frequency of *Trichophyton rubrum* was 24(44.44%), *Trichophyton mentagrophyte* was 19(35.18%), *Candida albicans* was 1(1.85%) and non-albicans *candida* was 2(3.70%), while no growth was found in 8(14.81%) diabetic onychomycosis patients. The frequency of *Trichophyton rubrum* was 1(3.03%), *Trichophyton mentagrophyte* was 2(6.06%), *Candida albicans* was 8(24.24%) and non-albicans Candida was 8(24.24%) but no growth was observed in 14(42.42%) non-diabetic onychomycosis subjects (Figure-2).

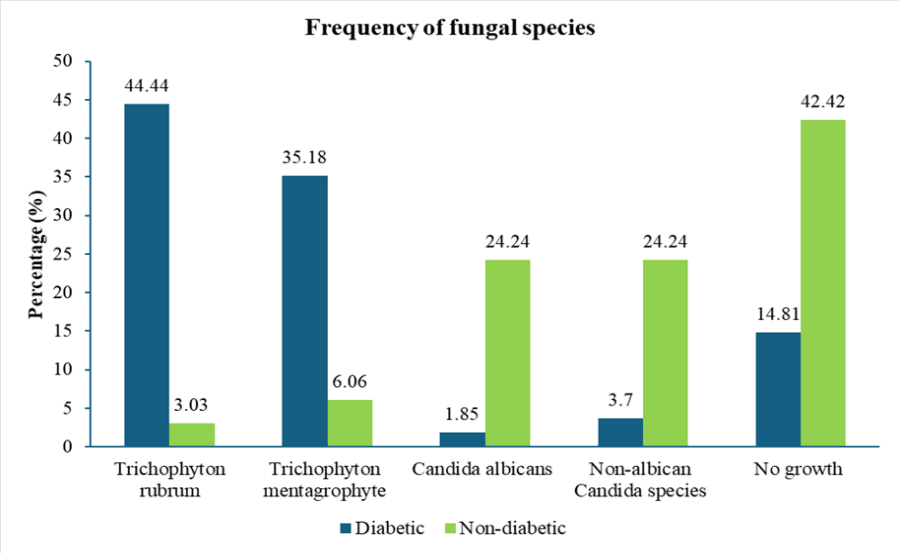


**Figure-2: Frequency of fungal species isolated from diabetic and non-diabetic onychomycosis patients (N= 87)**

Regarding clinical presentation it was observed that; 54 diabetic patients were presented with nail discoloration [25 (46.29%)], disfigurement of nail [13 (24.07%)], both discoloration and disfigurement of nail were in 16 (29.62%). On the other hand, 33 non-diabetic patients were presented with nail discoloration [20 (60.60%)], disfigurement of nail [5 (15.15%)], both discoloration and disfigurement of nail were in 8 (24.24%) non-diabetic subjects (Figure-3).

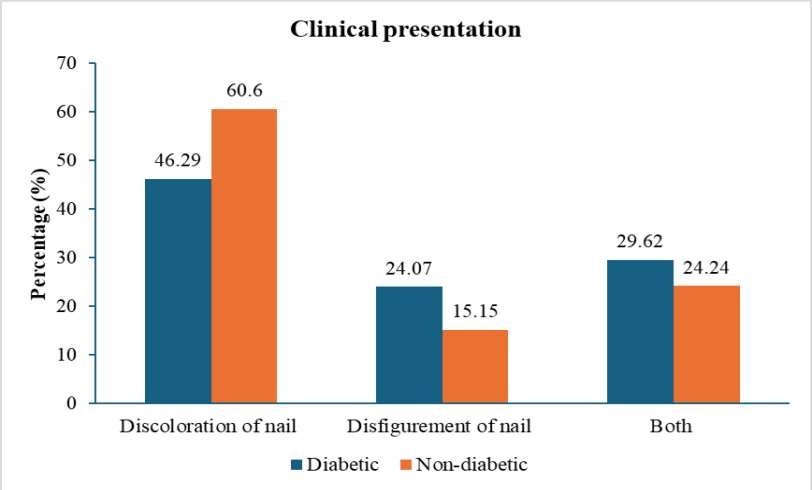


**Figure-3: Clinical presentation of suspected onychomycosis of diabetic and non-diabetic patients (N= 87)**

Figure-4 showed that in diabetic patients, finger nail involved among 40 (74.07%) patients, toe nail involved in 10 (18.51%) patients, both in 4 (7.40%) patients; but in non-diabetic patients, finger nail in 13 (39.39%) cases, toe nail 13 (39.39%) and both among 2 (6.06%) cases.

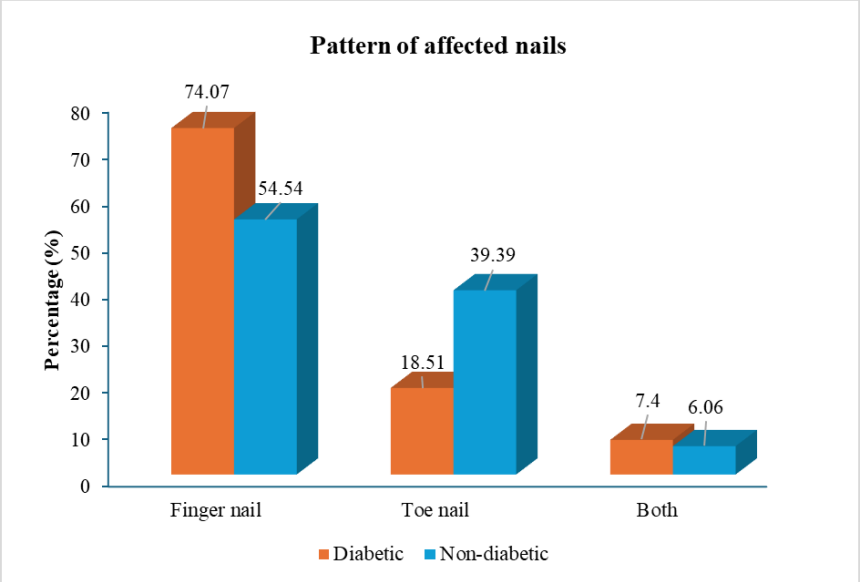


**Figure-4: Pattern of affected nails of diabetic and non-diabetic patients (N= 87)**

Regarding the sites of lesions, it was observed that among the diabetic patients (54); only nail plate was infected in 28 (51.85%) patients. Nail plate, nail bed, matrix and fold were involved in 15 (27.77%) diabetic patients. Nail plate and nail bed were affected in 8 (14.81%) diabetic patients; while nail plate, nail bed, matrix, fold and hyponychium were found in 1 (1.85%) diabetic patient; but nail plate, nail bed and cuticle were observed in 2 (3.70%) diabetic patients. Out of 33 non-diabetic patients, only nail plate lesion was found in 18 (54.54%) patients; nail plate, nail bed, matrix and fold were involved in 10 (30.30%) patients; while nail plate and nail bed were affected in 4 (12.12%) patients; but nail plate, nail bed and cuticle were infected in 1(3.03%) patient (Table-4).

**Table-4: Sites of lesions in suspected onychomycosis among diabetic and non-diabetic patients (N= 87)**

| Sites of lesions | Diabetic (n=54) No. (%) | Non-diabetic (n=33) No. (%) |
|---|---|---|
| Nail plate | 28 (51.85%) | 18 (54.54%) |
| Nail plate, nail bed, matrix, fold | 15 (27.77%) | 10 (30.30%) |
| Nail plate, nail bed | 8 (14.81%) | 4 (12.12%) |
| Nail plate, nail bed, matrix, fold, hyponychium | 1 (1.85%) | 0 |
| Nail plate, bed, cuticle | 2 (3.70%) | 1 (3.03%) |

## 4. DISCUSSION

Any fungal infection that affects the nail apparatus, including the cuticle, nail folds, nail matrix, nail plate, nail bed, and hyponychium, is referred to as onychomycosis [14]. Up to 50% of nail disorder and 30% of superficial skin fungal infections are caused by it [15, 16]. The maximum cases of onychomycosis are caused by dermatophytes. Despite being asymptomatic, onychomycosis can develop into a chronic condition that needs long-term care. In Western nations, the reported incidence of onychomycosis is rising, most likely as a result of changing lifestyles and population aging [17]. It has already been documented that diabetes raises the risk of onychomycosis [2, 4, 10, 11]. The current study enrolled 87 diagnosed cases of onychomycosis to determine the pattern of onychomycosis among diabetic and non-diabetic patients at a tertiary care hospital in Bangladesh.

This current study included total 87 clinically diagnosed patients with onychomycosis, of them 54 were diabetic patients and 33 were non-diabetic patients. The mean age of the diabetic patients was 53.4±13.28 years and that was 38.4±11.02 years in non-diabetic individuals. The frequency of onychomycosis was more common in female diabetic patients and was also more frequent in elderly diabetic patients. These findings were consistent with related previous studies [18, 19].

In this study it was found that presence of growth of fungus was significantly higher among diabetic patients compared to non-diabetic subjects

(85.19% versus 57.58%, p=0.004). This result was comparable with a similar previous study [5]. It was observed that dermatophyte was significantly more frequent among diabetic patients (p<0.001). While Yeast and Candida were significantly more among non-diabetic subjects (p<0.05). In this context Velez A *et al*., showed that yeasts isolated in two thirds of the cases of onychomycosis mainly from fingernails [12]. Dermatophytes were found in 18.8% of the samples, especially from toe nails [12]. In another study it was found that, agents of onychomycosis molds were detected in 9% cases, dermatophytes in 48%, yeasts in 41%, and mixed (two different fungi) in 2% patients [20]. These results were correlate with our study which showed that dermatophytes were the most common isolate (46 among 87 onychomycosis patients) than Candida (9 among 87 onychomycosis patients).

This current study showed that *Trichophyton rubrum* was the most frequent (44.44%) species in diabetic patients followed by *Trichophyton mentagrophyte* (35.18%). This finding was supported by one previous study [12]. However, Pierard GE *et al*., showed that *Trichophyton rubrum* was the predominant species in non-diabetic cases [11]. The most common etiological agents of onychomycosis in our study was dermatophytes, particularly *Trichophyton rubrum*. This can be explained by the fact that the epidemiology of onychomycosis differs depending on the geographical location. Furthermore, the lesser number of diabetics included in this study may have contributed to the lack of candida as a causal agent. It is no longer be considered onychomycosis as a minor cosmetic nuisance exclusive to the nails. Rather, it is a serious and noteworthy illness that can lead to a variety of medical, physiological, and occupational issues, significantly impairing the patient quality of life. Therefore, fungal cultures are crucial in all suspected instances of onychomycosis because accurate identification of the underlying fungal infection is a prerequisite for the administration of an antifungal drug with the right spectrum of activity [21].

Most of the diabetic onychomycosis patients were presented with nail discoloration (46.29%) followed by disfigurement of nail (24.07%), while both discoloration and disfigurement of nail was observed in 29.62% diabetic patients.. Similarly, onychomycosis in non-diabetic subjects was presented with nail discoloration (60.60%) and disfigurement of nail (15.15%), but both discoloration and disfigurement of nail were among 24.24% non-diabetic cases. These findings were consistent with a couple of previous study [18, 22].

In this study the sites of lesion include- only nail plate in 51.85% diabetic patients; nail plate, nail bed, matrix, fold in 27.77% diabetic patients; nail plate, nail bed in 14.81%; nail plate, nail bed, matrix, fold, hyponychium in 1.85% and nail plate, nail bed, cuticle in 3.70% diabetic patients. Among non-diabetic subjects, only nail plate lesion was found in 54.54%; nail plate, nail bed, matrix, fold in 30.30%; nail plate, nail bed in 12.12% and nail plate, nail bed, cuticle in 3.03% non-diabetic patient. Similar findings were observed in related previous studies [21-23].

Patients with fungal nail infections are more vulnerable to potentially significant consequences. Onychomycosis in diabetic individuals can lead to secondary bacterial infections that worsen foot ulcers and gangrene [3]. Additionally, thrombophlebitis and recurrent cellulitis can be brought on by onychomycosis, particularly among diabetic patients [24]. The considerable psychosocial implications of onychomycosis alone warrant comprehensive management in addition to these important clinical issues.

This study documented that, patients with diabetes have a higher chance of developing onychomycosis. These results highlight how crucial it is to treat nail infections in diabetics in order to lower the morbidity that is related to the condition. Systemic antifungal therapy, physical measures and patient education may be necessary for the management of onychomycosis in diabetic patients [25].

## 5. CONCLUSION

This study concluded that dermatophyte is significantly more frequent among diabetic patients. The prevalence of fungal species varies among diabetic and non-diabetic patients of onychomycosis. *Trichophyton rubrum* and *Trichophyton mentagrophytes* are the most frequent species in diabetic patients; but *Candida albicans* and other than non-albicans candida species are more common in non-diabetic subjects. Nail discoloration and disfigurement of nails are the common presentation of onychomycosis. Nail plate, nail bed, matrix, fold, hyponychium and cuticle are the common sites of fungal lesions. Larger sample sizes could be used in future research to find a more precise pattern of onychomycosis in diabetic patients and non-diabetic subjects.

**Conflicts of Interest:** The authors have no conflict of interest regarding this publication.

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