

## Fungal carriage and infection among leprosy patients in Sudan

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**Summary** Leprosy patients often develop wound infections. While clinicians routinely focus on bacterial causes they usually forget the possibility of the presence of co-infection with opportunistic fungi that may cause complications or a delay in the healing process.

**Objective:** This study looked for fungal carriage and co-infection among lepromatous leprosy patients with ulcers in Sudan.

**Methods:** Swabs from infected ulcers, plus swabs from the ear, nose and eye of a sample of lepromatous leprosy patients were collected to look for fungal elements; similar swabs were collected from the ear, nose and eye of leprosy-free, healthy controls. The swabs were examined microscopically using 20% KOH and cultured on Sabouraud's agar. Fungal growth was identified by colony morphology, gram stain, biochemical tests, Chlamydospore formation, API 20 C Aux and needle mount technique.

**Results:** 30 patients with leprosy and 30 healthy controls were recruited. In total fourteen fungal elements were isolated from the infected ulcers, of which seven were *C. albicans* (23%), four *A. fumigatus* (13%), two *A. Niger* (7%) and one *A. flavus* (3%). The total number of different fungal elements recovered from the ear, nose and eyes of leprosy patients was 41 (45.6%) from 90 specimens, the highest number of fungi being isolated from the ear (16/41). The total number of fungal species isolated from leprosy-free healthy controls was 12/90 (13.3%) and the commonest isolate was *A.niger* (7/12). The difference in fungal carriage between the leprosy patients and healthy controls is significant. *A. flavus* was the commonest isolate among all fungal carriage from the eye; 8 (26.7%), nose, 6 (20%) and ear 4 (13.3%), while *A.niger* was the second commonest 5 (16.7%) from the ear.

**Conclusions:** The frequency of fungal isolates from infected wound ulcers and carriage sites was high amongst leprosy patients, as compared to the leprosy-free group. It is recommended that clinicians should consider fungi as a possible cause of infection, especially for corneal ulcers, and to consider antifungal drugs to manage such conditions.

**Keywords:** Fungal, infection, carriage, leprosy, Sudan

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## Introduction

Leprosy is a chronic inflammatory infectious disease that primarily targets the skin and nerves. Clinical presentation occurs across a wide spectrum depending on the competence of the immune system of the patient.<sup>1</sup> The most important complications are disability and deformity. Patients are prone to opportunistic infections, which further complicates their condition. Clinicians and researchers tend to focus on the bacterial infections of ulcers in leprosy patients. In Tamil Nadu in India, culture from infected ulcers showed the presence of *Proteus*, *E. coli* and *Enterococcus*; antibiotics were used to treatment the isolates according to their sensitivity.<sup>2</sup> The prolonged use of antibiotics enhances the growth of fungi; fungal infections can occur as opportunistic infections in certain sites of leprosy patients. In India, patients with corneal fungal infection due to *Alternaria* and patients with mucosal ulceration of the mouth due *Candida* were reported.<sup>3,4</sup> Also, chronic *chromoblastomycosis* of the skin, ear lobes and nostrils, mycetoma and *Tinea barbae* were reported.<sup>5,6</sup> Although *Candida albicans* is the most common human yeast pathogens, other *Candida* species such as *Candida krusei* are now recognized as emerging agents especially in patients with immunodeficiency. In a surveillance study of leprosy patients in northern Thailand, the rate of oral carriage of *C. krusei* was 36%, which was significantly higher than that in the healthy control group (10%).<sup>7</sup>

Although leprosy represents a leading cause of chronic ulceration, secondary fungal infections have not been investigated adequately. This study therefore examined the extent of hidden fungal carriage and infections in lepromatous leprosy patients in Sudan.

## Material and methods

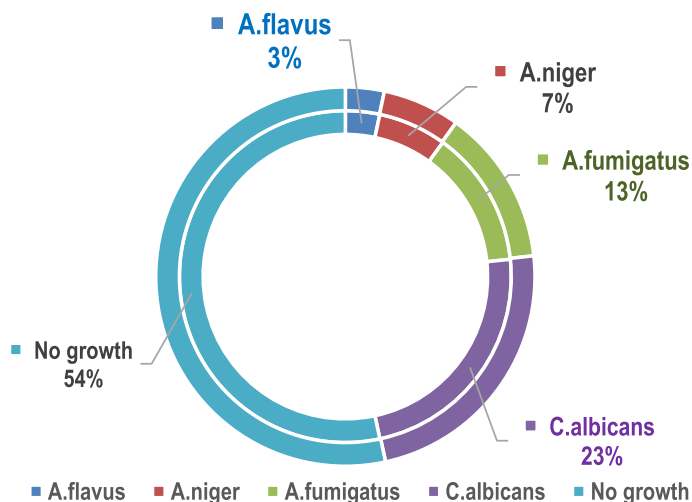
This study was a cross-sectional laboratory-based study carried out in lepromatous leprosy patients with chronic ulcers, and a control group, in Sudan; the patients were under treatment with combined therapy using rifampicin, clofazimine and dapsone. Swabs were collected from the wounds of leprosy patients to look for the presence of fungal elements. Swabs were also collected from the ear, nose and eye of each patient. Similar swabs from healthy individuals free of leprosy were included as the control group. All specimens were examined by direct wet preparation microscopy, using 20% KOH. The swabs were cultured on Sabouraud's agar with chloramphenicol and incubated at 26 °C and 37 °C. The cultures were examined by gram stain. Different mycological tests were applied to identify the organisms. For the identification of yeasts, the germ tube test, Chlamydospore formation and API 20 C Aux were applied. Needle mounts were made to examine colony growth on the medium.

## Results

The total number of the clinical isolates recovered from the 30 leprosy patients with wound infections was 14 (46%). Different *Aspergillus* species and *Candida albicans* were identified (Table 1, Figure 1).

Forty-one different fungal elements were identified from the carriage sites of the patients. The fungal isolates from the eye of the leprosy patients were 10 (33%) mostly *Aspergillus* species (Figure 2). The fungal isolates from the ear were 16 (53%) (Figure 3). The fungal isolates from the nose were 15 (50%) (Figure 4). The commonest fungus isolated from the different carriage sites was *A. flavus*, (Figures 2, 4); followed by *A. niger* (Figure 4).

There was a lower rate of fungal carriage among leprosy-free controls as shown in Table 1, and the total fungal isolates from the eye, ear and nose was 12 out of the ninety swabs from



**Figure 1.** The percentages of fungal species isolated from the ulcers of leprosy patients.

**Table 1.** The number and percentages of the different fungal species isolated from the carriage sites of 90 swabs collected from the eye, ear & nose of 30 leprosy patients and 30 healthy individuals

Species frequency (%)	Eye		Ear		Nose		Total leprosy patients
	Healthy individuals	Leprosy patients	Healthy individuals	Leprosy patients	Healthy individuals	Leprosy patients	
M. Canis	-	-	-	-	-	1(3%)	1(1.1%)
Penicillium species	-	1(3.3%)	-	-	-	-	1(1.1%)
C. albicans	-	-	-	-	-	2(6.7%)	2(2.2%)
T. rubrum	-	-	-	2(6.7%)	-	-	2(2.2%)
A. fumigatus	1	-	-	2(6.6%)	-	2(6.7%)	4(4.5%)
A. terras	0	-	1	3(10%)	1	2(6.7%)	5(5.6%)
<b>A. niger</b>	0	1(3.3%)	2	<b>5(16.7%)</b>	5	2(6.6%)	<b>8(8.9%)</b>
<b>A.flavus</b>	0	<b>8(26.7%)</b>	1	4(13.3%)	1	<b>6(20%)</b>	<b>18(20%)</b>
No growth	<b>29</b>	20(66.7%)	<b>26</b>	14(46.7%)	<b>23</b>	15(50%)	<b>49(54.4%)</b>
Total	30	30(100%)	30	30(100%)	30	30(100%)	90(100%)

this group. There was a significant difference between the fungal frequencies identified among the leprosy patients compared with healthy controls ( $p < 0.05$ ).

## Discussion

In leprosy endemic areas, the facilities for KOH microscopy and fungal culturing either do not exist or are too expensive to be undertaken as a routine investigation for chronic ulcers, including corneal ulcers. Fungal infections of the cornea (fungal keratitis or keratomycosis) may constitute 6–53% of all cases of ulcerative keratitis; the vast majority of cases of fungal keratitis are due to septate filamentous saprophytic fungi.<sup>8</sup>

In a study of 63 leprosy patients presenting with keratitis in South India, 19 gave a history of trauma, while a gram stain showed bacteria in 13 cases and fungi in 5 cases.<sup>9</sup> Although

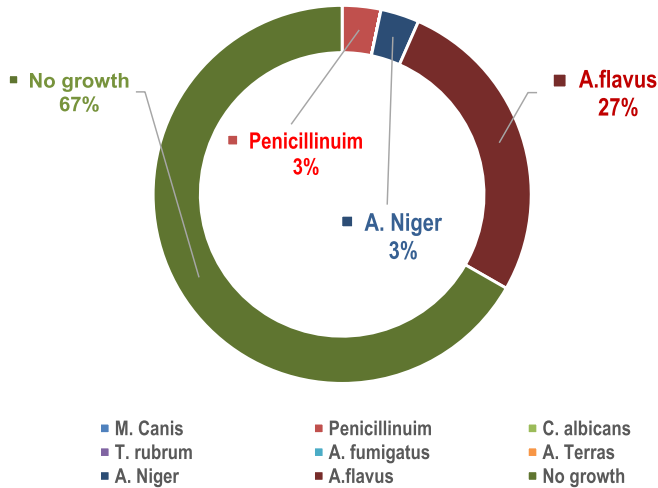


Figure 2. The frequency of fungal carriage in the eye of leprosy patients.

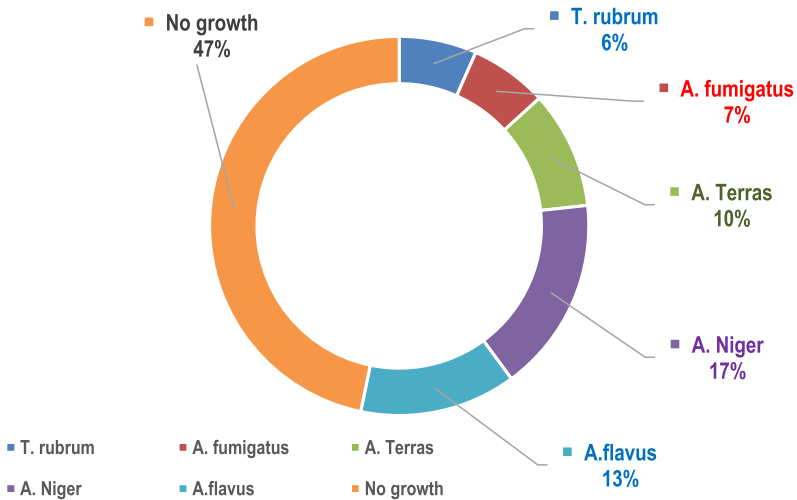
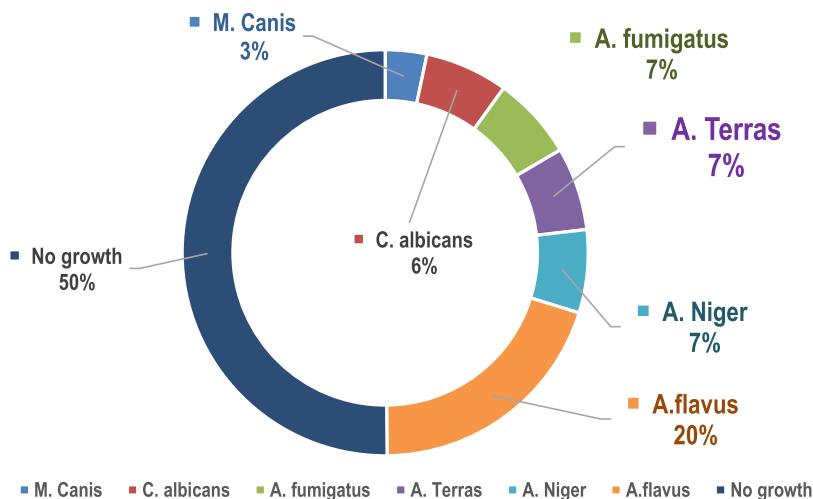


Figure 3. The frequency of fungal carriage in the ear of leprosy patients.

*Aspergillus* species were the most commonly isolated, rare pathogens like *Volutella* and *Alternaria* were seen. It is important to study the pathogenicity of fungi in deep tissues and their contributions to delayed wound healing. The role of antifungal agents in wound management needs to be evaluated. In our study of 30 lepromatous patients the predominant fungal species recovered from infected wounds were *C. albicans*, 7 (23.3%), followed by *A. fumigatus*, 4 (13.3%) and *A. niger*, 2 (6.6%). The prevalence rate and spectrum of fungi infecting leprosy-related wounds have not been previously studied. However, studies on diabetic ulcers reveal the presence of fungal agents which can affect the process of healing.<sup>10</sup> In a randomized controlled study of 75 diabetic patients with wound infections in the deep tissues of the foot, a control group was given standard care of the wound without antifungal treatment, while the test group



**Figure 4.** The frequency of fungal carriage in the nose of leprosy patients.

was given the standard care with antifungal treatment. After 4 weeks it was found that the mean wound surface areas were remarkably smaller in the fungal treatment group compared with the control group.<sup>11</sup>

Our study indicates that carriage of fungal elements in the ear, nose and eye was high among lepromatous leprosy patients. Different fungi were isolated with *A. flavus* being the most common. The carriage of fungi in leprosy patients may be related to the infection of ulcers, especially ulcers of the cornea, which may add to the pathology of the infected area and the development of blindness.

The frequency of fungal carriage among lepromatous leprosy patients was significantly higher than the leprosy-free control group. Therefore, it would be prudent to consider the possibility of fungal infection in all such ulcers and wounds.

## Conclusions

Patients with leprosy often develop wounds and ulcers, which may become chronic, and which are susceptible to opportunistic infection for various reasons. This study suggests that the carriage of fungi among leprosy patients is common compared with leprosy-free individuals; a higher percentage of fungal carriage could lead to increased exposure to infection of ulcers with fungal elements. A number of fungal elements were isolated from wounds or ulcers on the hands and feet, and it is therefore important to think of fungal infection when wounds appear to be clinically infected; this is especially true for corneal ulcers. Clinicians should consider antifungal treatment in the management of infected wounds in a leprosy patient whenever there is suspicion of fungal colonization, especially in cases of corneal ulcers or in immunocompromised patients. Laboratory confirmation of a fungal infection would be ideal. Further research is needed to uncover and fill gaps in our knowledge of fungal carriage, to validate any possible role of fungi in wound infections and to offer effective therapy to leprosy patients.

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## Contributors

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Performed the laboratory tests and analyzed the data: Mervat Samaan.

Reviewed the manuscript: Mohammed Ibrahim Saeed.

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