

Mycoflora of the Interdigital Spaces Among Girl Students in Ahvaz, Iran

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Background: Fungi have been extensively isolated and investigated from skin in various parts of the world. Determining the mycoflora of normal people is important when the role of skin is considered as a reservoir for microorganisms.

Objectives: The current study aimed to investigate the incidence of fungal flora on interdigital spaces of the human foot.

Patients and Methods: Samples were collected from interdigital spaces of 865 girl students who lived in the dormitories of Ahvaz Jundishapur University of Medical Sciences. A part of the sample was digested with 20% KOH and screened by a light microscope for fungal elements. Another part of the sample was cultured on Sabouraud glucose agar (SGA) and SGA containing 0.05 mg/mL chloramphenicol and 0.5 mg/mL cycloheximide. The fungal colonies were identified based on morphological and microscopic characteristics and biochemical tests.

Results: In the current study, out of the 865 samples, 616 (71.2%) were positive in direct examination or culture. Of these, 267 samples (30.9%) were positive in direct examination. The most common fungal isolates in direct test were yeast (29.4%), followed by conidia (0.92%), melanised hypha (0.35%) and non-septated hyphae (0.23%). *Trichophyton mentagrophytes* was isolated in one of the specimens.

Conclusions: The present study demonstrated the incidence of fungal flora on interdigital spaces of human foot. The current study results showed that fungi can survive on surfaces of skin without showing the sign of infection.

Keywords: Mycoflora; Interdigital Spaces; Foot

1. Background

Fungi have been extensively isolated and investigated from skin in various parts of the world. Fungal diseases have markedly increased during the recent years (1); although more increase is observed in opportunistic mycoses. Determining the mycoflora of normal people is important when the role of skin is considered as a reservoir for microorganisms. Infectious diseases, mostly the ones that affect the epidermal or mucous membrane, are serious troubles all over the world because of hygiene and education deficiency. Microbiome of human skin refers to complete collection of microorganisms comprising bacteria, fungi and virus. The kind and quantity of skin microbes are different from one individual to another depending on the location of the body. Fungi are among the most significant groups of these skin pathogens (2).

Cutaneous mycoses refer to skin infection and its appendages are involved in yeasts and filamentous fungi. This infection group contains dermatophytosis, candidiasis and tinea versicolor. They have the affinity to parasitized tissues with rich keratin and create the skin inflammatory responses and cause severe itching, burning and redness. Moreover, these diseases cause cosmetic outcomes. Candidiasis includes the infections that vary from superficial; for example, oral thrush and vulvovaginitis, to visceral and potentially life-threatening diseases.

Superficial infections of dermal inflammation and discomfort are frequent in numerous human societies.

Skin presents good patterns of different microenvironments. Toe webs harbor fungi more than the less occluded parts such as trunk, legs, and arms (2). At present a normal healthy skin in adults is expected to transmit a number of representatives of the genera *Candida*, *Malassezia* and *Geotrichum* as well as few anthropophilic dermatophytes as inhabitants of the normal skin. Direct examination, and culture and molecular analyses are employed to recognize the skin microbial inhabitants. Direct examination is based on finding the microbial elements such as unicellular yeast, mycelium and pseudohyphae.

The presence of *Malassezia* spp. in healthy human skin was identified in previous investigation in the nineteenth century. The incidence and density of colonization depended on the activity of sebaceous gland and age. Several surveys have focused on the specific distribution of *Malassezia* spp. in normal skin (3-5). The species most commonly associated with this disease are, *Malassezia globosa*, *M. furfur* and *M. sympodialis* (3-5). This disorder could be observed in temperate climates, particularly during summer in humid months. The *Malassezia* yeast form generates dicarboxylic acids similar to azelaic acid which prohibit tyrosine kinase that consequences in hypopigmentation of skin (4). This condition can be es-

pecially apparent and distressing in people with darker skin. Diagnosis of this disease is clinically easy and it is confirmed by microscopic examination of skin scraping on potassium hydroxide or using scotch tape.

Conversion from yeast form of *Malassezia* to mycelia form was promoted with warm and humid weather. Immunodeficiency, poor hygiene, diabetes and poor nutrition are other factors related to pityriasis versicolor. The seborrheic areas are chest, back, abdomen, neck, and proximal arms. The lesions possess different colors such as yellow, brown, pink, red or hypo pigmented. Keratinophilic fungi are the groups which could infect the skin, hair and nail in human (6, 7). The dermatophytes invade the keratinized tissues in humans. Anthropophilic type of these fungi can apparently live in healthy human skin which may contribute to transmission of the fungi (8, 9).

2. Objectives

The current study aimed to investigate the incidence of fungal flora on interdigital spaces of the human foot.

3. Patients and Methods

Samples were collected from toe webs of 865 girl students who lived in the dormitories of Ahvaz Jundishapur University of Medical Sciences in autumn 2008. The tested web spaces did not show any signs of infection such as erythema, scaling, blistering and itching. The samples were collected into sterilized clean pockets and transferred immediately to the mycology medical laboratory. A part of the samples were digested with 20% KOH and screened by a light microscope for fungal elements. Another part of the samples were cultured on Sabouraud glucose agar (SGA) and SGA containing 0.05 mg/mL chloramphenicol and 0.5 mg/mL cycloheximide. The plates were incubated at room temperature up to 4 weeks. The fungal colonies were identified based on morphological and microscopic characteristics. The filamentous fungi were identified after slide culturing according to their gross and morphological features. Yeasts were identified on the bases of germ tube formation, morphology on the corn meal agar medium, and assay of unase activity.

4. Results

Out of the 865 samples, 616 (71.2%) were positive in direct examination or culture. Of these, 267 samples (30.9%) were positive in direct examination. The culture was positive in 349 (40.3%) specimens; and 22 (% 2.5%) samples were also positive for both direct examination and culture. The most common fungal isolates in direct test were yeast (29.4%), followed by conidia (0.92%), melanised hypha (0.35%) and non-septated hypha (0.23%). The most common isolated fungi in the culture were *Penicillium spp.* (27.6%), *Rhizopus spp.* (18.5%), *Alternaria spp.* (13.4%), yeast (9.6%) and *Cladosporium spp.* (9.4%). *Trichophyton mentagrophytes* was isolated in one of the specimens. Table 1 presents the fungal elements recovered from direct

Table 1. Frequency of Fungal Elements Isolated From Interdigital Spaces in Girl Students

Fungal structure	Positive Samples, No. (%)	Total Samples, %
Yeast	254 (95.1)	29.4
Conidia	8 (3)	0.92
Melanised hypha	3 (1.1)	0.35
Non-septated hypha	2 (0.8)	0.23
Total	267 (100)	30.9

Table 2. Frequency of Isolated Fungi in the Culture From Interdigital Spaces in Girl

Fungi	Value ^a
<i>Penicillium spp.</i>	115 (27.6)
<i>Rhizopus spp.</i>	77 (18.5)
<i>Alternaria spp.</i>	56 (13.4)
Yeast	40 (9.6)
<i>Cladosporium spp.</i>	39 (9.4)
<i>A. flavus</i>	27 (6.5)
<i>A. niger</i>	18 (4.3)
<i>Aspergillus spp.</i>	14 (3.4)
<i>Candida spp.</i>	10 (2.4)
<i>Rhodotorula spp.</i>	6 (1.4)
<i>A. terreus</i>	3 (0.7)
<i>Drechslera spp.</i>	3 (0.7)
<i>Mucor spp.</i>	2 (0.5)
<i>Monilia spp.</i>	2 (0.5)
<i>Mycelium striata</i>	2 (0.5)
<i>Ulocladium</i>	1 (0.2)
<i>Eurebasidium spp.</i>	1 (0.2)
<i>T. mentagrophytes</i>	1 (0.2)
Total	417 (100)

^a value is No. (%)

examination of skin. Table 2 shows the most commonly obtained genus of fungi in the culture.

5. Discussion

Human skin is not principally a living place for microorganisms. Skin surface is moderately dry, fairly acidic and dead cells are the prime source of nutrition. Skin has an environment which inhibits the growth of numerous microorganisms, however, some have adapted to living on the skin. *Candida* and *Malassezia* species are two good examples that inhabit on the skin (3, 4, 10, 11). The current study performed a comprehensive and quantitative analysis of the mycoflora on the surface of interdigital

skin of girl students. Four kinds of fungal structures were diagnosed in direct examination. Overall fungal structure was found on the skin of 30.9% of the students in the direct examination with KOH. The rates of the total yeast counts were much higher than those of molds in samples of skin in the direct examination.

Yeasts are excellent examples of microorganism that inhabit on skin. The species of *Candida* live on skin and cause the frequent skin infection named candidiasis. *Candida* species were isolated from 1.2% of interdigital spaces of people in the current study. Although skin candidiasis is not life threatening, it can affect the emotional and physical status of the patients.

Another well-known member of the normal skin flora is *Malassezia* species. This yeast is so adaptable that can live in many parts of the body. *Malassezia* species is considered as an opportunistic fungus, since it stays benign until the conditions that convey it to cause infection are provided.

In the current study, various fungi which can be considered as possible agents for skin diseases were isolated. In the present study, *T. mentagrophytes* was an isolated dermatophyte, as a well-known anthropophilic dermatophyte. Various fungi were isolated from the skin which could be considered as possible causes of skin diseases. Compared to many fungal diseases, host-fungus association in dermatophytosis was significant because dermatophytes affect immunocompetent persons; however they usually invade just superficial keratinized tissues. Currently, not much has been recognized from the relevant factors which mediate adherence of these fungi to host. The capability of *T. rubrum* to adhere to epithelial cells is a trait to carbohydrate-specific adhesin on microconidia (12). Morphological observation detected the fibrillar projections in *T. mentagrophytes* through the adherence stage (13, 14). In the current research various saprophytic fungi were isolated from the skin. Fungal spores represent an important fraction of airborne bioparticles. Actually, many of the fungal spores recovered from the skin can be found in the atmosphere. Numerous studies are conducted on the airborne fungal spores (15-17). The present study demonstrated the incidence of fungal flora on interdigital spaces of human foot. The obtained results showed that fungi can survive on the surfaces of skin without showing the sign of infection.

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