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Epidemiologic surveillance of cutaneous fungal infection and its causative agents in patients referred to Razi laboratory, Rasht, Iran: A retrospective study from 2016-2021

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Abstract

Introduction: Information on epidemiologic trends of dermatophytosis and its causative agents is essential for the healthcare system to improve its knowledge of associated complications. The main purpose of this study was to determine the distribution of fungal strains and the infection sites of patients with dermatophytosis.

Materials and Methods: In this cross-sectional study, the demographical data and clinical characteristics of 641 patients with a positive fungal culture who were referred to Razi pathobiological laboratory, Rasht, Iran, between 2016-2021 were collected. All data were analyzed using SPSS software version 21 by a significant level of < 0.05.

Results: Out of 641 patients, 70% were female and the mean age of patients was 43.98 ± 16.99 years. Laboratory analysis demonstrated that Candida Albicans (44/9%), Aspergillus (31/8%), and Dermatophytes (18%) were the most common causes of superficial cutaneous fungal infections. Among the dermatophytes, the most common pathogens were Trichophyton mentagrophytes (53%) and Trichophyton Rubrum (20.8%), also, the most common site of infection was nail (64.4%).

Conclusion: Considering the high prevalence of Candida Albicans and Aspergillus, especially in females, it is important to determine preventive protocols for fungal infections and better clinical management of the patients involved.

Keywords: Dermatophytosis, Fungal Infections, Trichophyton, Candida, Aspergillus, Tinea

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Introduction

Fungal infections of the skin, hair, and nails are common with an increasing trend all over the world. The most important and common fungal infection is dermatophytosis (1). The globally increased prevalence of superficial and endemic fungal infections over the past 4–5 years with a rise in recurrent episodes, frequent exacerbations, and a severe chronic course has been observed (2). This infection is mainly limited to the surface layers of the epidermis, stratum corneum, and its appendages including hair and nails. Dermatophyte infections are classified according to the affected body site, including tinea capitis (scalp), tinea corporis (body), tinea bar-bae (beard area), tinea pedis (feet), tinea cruris (groin, perineum, and perineal areas), tinea unguium (nails), and tinea manuum (hands) (3–6). Dermatophyte infections are caused by Epidermophyton, Trichophyton, and Microsporum, with 41 species. The frequency of the disease and its type varies in different regions, and this variation depends on the living conditions and geography of that region and other factors such as occupation, age, level of personal hygiene, contact with animals, soil, etc. (7,8).

Another common cause of skin fungal infection is Candida albicans, which is a part of the normal flora of the digestive system in humans that can cause infection on the skin. This type of fungal infection usually starts from the perianal area and can spread to the perineum, lower abdomen, groin, and skin. Candida species can also lead to chronic fungal infection, onychomycosis, or even fungal infective dermatitis (8,9). Several factors play a role in the pathogenicity of fungal infection (Candida, etc.) including aging, obesity, long-term use of antibiotics, and a history of underlying diseases (10,11).

Aspergillus is another fungus that is a part of the human normal flora found in the upper respiratory tract and is also found in the surrounding environment (soil, dust, tobacco plants, water, and, food) (12,13). Therefore, a positive Aspergillus fungal culture can indicate a secondary infection that has superimposed on a primary skin lesion (caused by excessive washing, a wound, or any other skin injury). Patients with primary infection of cutaneous Aspergillosis also usually have a history of contact of the damaged skin with an infected object. All types of Aspergillosis are more common in patients with a weak immune system (14–16).

In Guilan, Iran, due to the humidity of this region as well as the prevalence of agriculture and rice farming in this province, the prevalence of skin fungal infections is very high and it brings a lot of diagnostic and treatment costs for the people of the community as well as the healthcare system. The solution to this problem includes obtaining more information about this disease, its widespread prevalence in the province, especially in the hot seasons of the year, and the infectious strains. In this regard, we conduct this study to evaluate the prevalence of various dermatophytosis in Guilan province, Iran.

Materials and Methods

Study design and variables

In this retrospective cross-sectional study, demographical data and clinical characteristics of 641 patients with a fungal positive culture who were referred to Razi pathobiological laboratory, Rasht, Iran, from 2016 to 2021, were collected. The data included gender, age, types of infection site (feet, groin, body, nails, hands, scalp, face, perineum, and perineal areas), the strains of the infection (Trichophyton mentagrophytis, Trichophyton rubrum, Epidermophyton flucosum, Microsporum canis, Trichophyton verrucosum, Microsporum gypsum, Trichophyton tonsurans, Trichophyton violaceum, Trichophyton schönleini, Candida, Aspergillus, Fusarium, Mucor, Penicillium, Cladosporium, Acremonium, Pseudoalcheria boidei, Mystoma, Rhizopus, and Alternaria), and the year of sampling. All patients with positive fungal culture were included and the patients with incomplete data or negative fungal culture were excluded from the study. This study design was approved by the ethical committee of Guilan University of Medical Sciences (IR.GUMS.REC.1400.457).

Statistical Analysis

Mean and standard deviation are used to describe quantitative variables with normal distribution. Qualitative variables are described using numbers and percentages. The normal distribution of quantitative

study data has been measured using Kurtosis, Skewness, Q-Q Plot, and Shapiro-Wilk test. Also, Chi-Square and Fisher exact tests were used to determine the association between demographical data and comorbidities in LPP patients. Statistical calculations were performed using the IBM SPSS Statistics version 21 with a significant level of less than 0.05.

Results

In this present study, 88 patients (13.7%) in 2016, 92 patients (14.4%) in 2017, 114 patients (17.8%) in 2018, 121 patients (18.0%) in 2019, 96 patients (15.0%) in 2020, and 130 patients (20.3%) in 2021 were diagnosed to have dermatophytosis with a positive fungal culture. Out of 641 patients, 192 (30%) were male and 449 (70%) were female. The mean age of patients was 43.98±16.99 (3-93) with a mean of 44 years old (Table 1). According to the distribution of fungal infection in patients in scalp 25 (3.9%), body 46 (7.2%), hand 28 (4.4%), feet 66 (10.3%), nail 413 (64.4%), groin 42 (6.6%), face 15 (2.3%), and perineum and perineal

areas 6 (0.9%), nail was the most frequent site of fungal detection.

Table 1. Age frequency of studied patients.

Variables	Prevalence	Percentage
0-10	18	%2.8
11-20	32	%4.9
21-30	101	%15.7
31-40	123	%19.2
41-50	126	%19.7
51-60	128	%20.0
61-70	80	%12.5
71-80	26	%4.1
81-90	4	%0.6
91-100	3	%0.5

The frequency of fungal strains in patients represented that Candida and Aspergillus were most frequent in the nail, feet, body, and hand; and Candida and Trichophyton mentagrophytes were most frequent in the groin. While in the scalp, the most frequent fungal strains were Trichophyton mentagrophytes and Candida (Table 2).

Table 2. Frequency of fungal strains.

Fungal strains		Infection site							
		Nail n (%)	Feet n (%)	Body n (%)	Groin n (%)	Hand n (%)	Scalp n (%)	Face n (%)	Perineal areas n (%)
Candida	288 (44.9)	193 (46.7)	24 (36.4)	17 (37.0)	23 (54.8)	12 (42.9)	6 (24.0)	8 (53.3)	5 (83.3)
Aspergillus	204 (31.8)	162 (39.2)	18 (27.3)	9 (19.6)	2 (4.8)	5 (17.9)	3 (12.0)	5 (33.3)	0 (0.0)
Trichophyton mentagrophytis	61 (9.5)	19 (4.6)	10 (15.2)	7 (15.2)	11 (26.2)	5 (17.9)	7 (28.0)	1 (6.7)	1 (16.7)
Trichophyton rubrum	24 (3.7)	10 (2.4)	7 (10.6)	3 (6.5)	2 (4.8)	0 (0.0)	2 (8.0)	0 (0.0)	0 (0.0)
Trichophyton verrucosum	14 (2.2)	5 (1.2)	1 (1.5)	4 (8.7)	1 (2.4)	3 (10.7)	0 (0.0)	0 (0.0)	0 (0.0)
Mucor	11 (1.1)	6 (1.5)	2 (3.0)	1 (2.2)	1 (2.4)	1 (3.6)	0 (0.0)	0 (0.0)	0 (0.0)
Trichophyton tonsurans	10 (1.6)	2 (0.5)	0 (0.0)	1 (2.2)	8 (0.0)	0 (0.0)	6 (24.0)	1 (6.7)	0 (0.0)
Penicillium	7 (1.1)	3 (0.7)	2 (3.0)	1 (2.2)	1 (2.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Rhizopus	5 (0.8)	2 (0.5)	2 (3.0)	0 (0.0)	0 (0.0)	1 (3.6)	0 (0.0)	0 (0.0)	0 (0.0)
Fusarium	4 (0.6)	4 (1.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Pseudoalcheria boidei	3 (0.5)	1 (0.2)	0 (0.0)	2 (4.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Epidermophyton flucosum	2 (0.3)	2 (0.5)	0 (0.0)	0 (0.0)	0 (0.00)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

	Total	Nail	Feet	Body	Groin	Hand	Scalp	Face	Perineal areas
Microsporum gypsum	2 (0.3)	2 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Cladosporium	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.6)	0 (0.0)	0 (0.0)	0 (0.0)
Acremonium	1 (0.2)	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Mystoma	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Trichophyton verrucosum	1 (0.2)	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Trichophyton schönleini	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.0)	0 (0.0)	0 (0.0)
Alternaria	1 (0.2)	0 (0.0)	0 (0.0)	1 (2.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	641 (100)	413 (64.4)	66 (10.3)	46 (7.2)	42 (6.6)	28 (4.4)	25 (3.9)	15 (2.3)	6 (0.9)

A significant association was reported between the gender and age of the patients and the infection site (*P*=0.001), Table 3.

Table 3. Comparison the association between age and gender, and infection site.

Infection site	Age (year)		*P* value	Gender		*P* value
	<44	**44 ≤**		**Male**	**Female**	
Nail	413 (64.4) / 183 (57.4)	230 (71.4)		82 (42.7)	331 (73.7)	
Feet	66 (10.3) / 27 (8.5)	39 (12.1)		24 (12.5)	42 (9.4)	
Body	46 (7.2) / 27 (8.5)	19 (5.9)		18 (9.4)	28 (6.2)	
Groin	42 (6.6) / 30 (9.4)	12 (3.7)		27 (14.1)	15 (3.3)	
Hand	28 (4.4) / 17 (5.3)	11 (3.4)		11 (5.7)	17 (3.8)	
Scalp	25 (3.9) / 23 (7.2)	2 (0.6)	0.001	20 (10.4)	5 (1.1)	0.001
Face	15 (2.3) / 8 (2.5)	7 (2.2)		6 (3.1)	9 (2.0)	
Perineal areas	6 (0.9) / 4 (1.3)	2 (0.6)		4 (2.1)	2 (0.4)	
Total	641 (100) / 319 (49.8)	322 (50.2)		192 (30)	449 (70)	

While, this association was not observed between the gender and age of the patients and the fungal strains (*P*>0.05), Table 4.

Table 4. Comparison the association between age and gender, and fungal stains.

Fungal strains		Age (year)		*P* value	Gender		*P* value
		>44	**44 ≤**		**Male**	**Female**	
Candida	288 (44.9)	142 (44.5)	146 (45.3)		83 (43.2)	205 (45.7)	
Aspergillus	204 (31.8)	89 (27.9)	115 (35.7)		50 (26.0)	154 (34.3)	
Trichophyton mentagrophytis	61 (9.5)	41 (12.9)	20 (6.2)		25 (13.0)	36 (8.0)	

Trichophyton rubrum	24 (3.70)	8 (2.5)	16 (5.0)		8 (2.5)	16 (5.0)	
Trichophyton verrucosum	14 (2.2)	9 (2.8)	5 (1.6)		4 (2.1)	10 (2.2)	
Mucor	11 (1.7)	3 (0.9)	8 (2.5)		3 (1.6)	8 (1.8)	
Trichophyton tonsurans	10 (1.6)	10 (3.1)	0 (0.0)		7 (3.6)	3 (0.7)	
Penicillium	7 (1.1)	3 (0.9)	4 (1.2)	0.999	2 (1.0)	5 (1.1)	0.999
Rhizopus	5 (0.8)	3 (0.9)	2 (0.6)		3 (1.6)	2 (0.4)	
Fusarium	4 (0.6)	3 (0.9)	1 (0.3)		0 (0.0)	4 (0.9)	
Pseudoalcheria boidei	3 (0.5)	3 (0.3)	0 (0.0)		1 (0.5)	2 (0.4)	
Epidermophyton flucosum	2 (0.3)	1 (0.3)	1 (0.3)		1 (0.5)	1 (0.2)	
Microsporum gypsum	2 (0.3)	2 (0.6)	0 (0.0)		1 (0.5)	1 (0.2)	
Cladosporium	1 (0.2)	0 (0.0)	1 (0.3)		1 (0.5)	0 (0.0)	
Acremonium	1 (0.2)	0 (0.0)	1 (0.3)		0 (0.0)	1 (0.2)	
Mystoma	1 (0.2)	1 (0.3)	0 (0.0)		0 (0.0)	1 (0.2)	
Trichophyton verrucosum	1 (0.2)	0 (0.0)	1 (0.3)		0 (0.0)	1 (0.2)	
Trichophyton schönleini	1 (0.2)	1 (0.3)	0 (0.0)		1 (0.05)	0 (0.0)	
Alternaria	1 (0.2)	0 (0.0)	1 (0.3)		1 (0.5)	0 (0.0)	
Total	641 (100)	319 (49.8)	322 (50.2)		192 (30)	449 (70)	

Discussion

The prevalence of surface and skin fungal infections in 20-25% of the world's population indicates the importance of this type of skin disease. The most prevalent fungal infections among the studied patients were candida, aspergillus, and dermatophytes with the majority of Trichophyton mentagrophytes. According to our results, the most common infected sites were nails, feet, and body respectively. It has been identified that in males, the most common infected sites were the nail, groin, and leg; and in females were nails, leg, and groin, which can be related to the type of jobs (farmer), excessive washing of hands and feet, contact with detergents, cosmetic-beauty procedures, obsessive compulsive disorders, and anxiety, which more exposed some parts of the body to fungal strains.

In a study by Salari et al. on Kerman's population, Iran, it was demonstrated that dermatophyte infections were more common in men, with the majority of tinea unguium and Trichophyton mentagrophytes. Also, the most common non-dermatophyte strain in that study was reported to be Aspergillus species (17), while in our study, Candida species were more common. Another study by Ebrahimi's et al., in Mashhad, Iran, reported that the most common types of infection were tinea corporis (32%), tinea cruris (27%), and tinea capitis (12%) (18), that was in contrast with our results, which can be due to the difference in climate and humidity of the two provinces, as well as the difference in common jobs in these two provinces, while the most common dermatophytes in both studies was reported to be Trichophyton mentagrophytes.

In the current study, the most involved age groups were upper than 44 years, which may be due to skin structural changes, antibiotics and other drug

consumption, higher prevalence of underlying disease, as well as occupational issues and related challenges. Trichophyton mentagrophytes were more prevalent in the age group below 44 years old and Trichophyton rubrum was more common in people over 44 years old. The scalp was the only site of infection where dermatophyte strain was preferred over non-dermatophyte types with 64%. But in face and perineal areas, Candida was the most common cause of infection with a prevalence of 53% and 83%, respectively. Considering that the primary form of Candidiasis and Aspergillosis infections generally occur in cases of immunodeficiency or existence predisposing underlying diseases such as diabetes, the high prevalence of these pathogens on the primary skin lesion (damage caused by excessive washing, moisture, wounds, burns, etc.) have grown secondary.

Zamani et al. reported that the prevalence of fungal strains was higher in males rather than females, while the majority of the study's patients were women. The most common type of infection was tinea pedis (30%), thigh dermatophytosis (29%), and body dermatophytosis (15); and the most common fungal strain was Epidermophyton flucosum (31%), Trichophyton rubrum (26%), and Trichophyton mentagrophytes (20%) (19). In a study by Antouri et al., the most common dermatophyte pathogen isolated was reported to be Trichophyton rubrum (76%) and Trichophyton mentagrophytes (11%); also, the most common site was nail (40%). Another investigation demonstrated that Trichophyton rubrum, Trichophyton interdigital, and Microsporum canis were the most frequently detected fungal strains in patients with the majority of tinea pedis and tinea unguium (20). The differences between reported common fungal strains and the site of infection refer to the geographical variation in different regions and also different lifestyles, which makes people susceptible to certain fungal infections. On the other hand, the immunogenic diversity of individuals should be considered in vulnerability to infections, especially opportunistic ones (21,22).

Conclusions

According to our results, females had a higher frequency of Candida and Aspergillus in nails, feet, body, and hands, and Trichophyton mentagrophyte was

observed more in the scalp, which mostly refers to the type of their everyday activity. Therefore, the public access to some healthcare protocols can be helpful for better clinical management for the prevention and treatment of fungal infections.

Author contribution

KGH and **RGH** participated in the research design and writing the first draft; **HE**, **AD**, and **RR** participated in the performance of the research and analytic tools; **NA**, **ME**, and **PJ** participated in data analysis. All author reviewed and confirmed the final manuscript.

Acknowledgments

We would like to thank all hospital staff and specialists for their assistance with conforming and recording cases.

Conflict of interest

No potential conflict of interest was reported by the authors.

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