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Some Diagnostic Aspects of Dermatophytes in Mongolia

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Objectives: We sought to determine the distribution of the different dermatophyte species diagnosed in Ulaanbaatar, Mongolia. **Methods:** A total of 281 participants were suspected of having dermatomycotic lesions. Material collected from skin, hair, and nails were submitted to direct microscopy examination using KOH, cultured in Sabouraud dextrose agar, to identify the 131 dermatophytes isolated. **Results:** 142 (50.5%) of 281 participants were males and 139 (49.5%) were females. The mean (±SD) age of the patients was 29.92 ± 21.73 years. Among the 281 mycological suspects cases, 131 patients had dermatophyte infections based on culture. Tissues with positive cultures were the skin (41%, 73), nails (20.7%, 37), and hair (11.8%, 21). The fungal infection locations were the nails (20.79%, 37), followed by the face (11.24%, 20), soles in the feet (11.24%, 20), and body (7.87%, 14). Onychomycosis (13.1%, 37) was the common clinical form of dermatomycosis, followed by tinea corporis (18.8%, 53), tinea capitis (7.5%, 21), and tinea pedis (7.1%, 20). The most common fungal infection was onychomycosis caused by the anthropophilic species *Trichophyton Rubrum*. The most isolated dermatophyte was *Trichophyton Rubrum* (26.7%, 35), followed by *Microsporum Canis* (19.8%, 26) and *Trichophyton Tonsurans* (13.7%, 18). **Conclusion:** Our data provide a valuable baseline on which to assess future efforts directed toward preventing dermatophytosis infections in our epidemiological setting.

Keywords: Mongolia, Dermatophytes, Trichophyton, Microsporum, Epidermophyton

Introduction

There are more than 120,000 fungal species globally, and indeed, a number of them can cause fungal diseases in humans, animals, and plants [1]. Dermatophytosis is an infection of keratinized tissue, including the skin, hair, and nails, caused by various dermatophytes [2-4]. Dermatophyte infections are prevalent worldwide [2, 5]. They are believed to affect 20-25% of the world's population [6-10]. Furthermore, the location of the infection and type of organism depends on the geographical environment [3, 7, 8, 10-15]. The causes for the difference in skin mycoses may be found in the public's socioeconomic status and

poor hygiene and sanitary conditions [16]. The etiologic agents of dermatomycosis (ringworm) are classified into three genera: *Epidermophyton*, *Microsporum,* and *Trichophyton*. Within this group, the dermatophytes are the most frequently isolated etiological agents, and the corresponding infections are referred to as tinea in the clinic. Tinea infection can affect any part of the body. Tinea capitis occur on the head, and its clinical appearance is scalp ringworm. It is very contagious but rare in the adult. Body ringworm may appear anywhere on the body or the face. But it is more common in skin folds. It is also more common in warmer climates. Tinea pedis is a common infection on the feet and between the toes. It may be caused by sweating, not drying the feet after swimming or bathing, wearing tight socks and shoes and warm weather. Onychomycosis is an infection of the toe and fingernails. It causes thickened, deformed, and discolored nails instead of a rash.

Dermatomycosis can occur in any age group, yet the anthropophilic and zoophilic fungal disease is more common among children and adolescents [15]. Anthropophilic dermatophytes are restricted to human hosts and produce a mild, chronic inflammation [2]. Zoophilic organisms are found primarily in animals and cause marked inflammatory reactions in humans who have contact with infected cats, dogs, cattle, horses, birds, or other animals. Infection may also be transmitted via direct contact with animals, such as their hair. [2]

The trend of living in communities in close contact with animals, the use of antibiotics, corticosteroids, and antineoplastic drugs contribute to the increase in the risk of infection by fungi, especially by dermatophytes [16]. In 1965, 1987, 2006, Mongolian researchers studied dermatophyte clinical manifestations and epidemiological prevalence and found that zoophilic dermatophyte infection was the dominant infection of this time [17-19]. In1965, dominant dermatophytes were *M.canis* (55.5%), *T.rubrum* (31.7%), and chronic inflammatory zoophilic Trichophyton (8.7%) [17]. But from 1964 to 1986, the dermatophyte species changed; zoophilic species were dominant 51.4%-55.5%, followed by the anthropophilic species (Trichophyton) 31.7%-33.1% [18]. In 2006, the dermatophyte species detected were *C.albicans* 34.7%, follow *Pityrosporium orbiculare* 28.7%, and *M.canis* 14.7% [19].

As the epidemiology of dermatophytosis is changing over time, it is important to review periodically the distribution of dermatophyte infection [2]. According to many researchers' studies, the distribution of fungal infections in Mongolia has not been studied for a 5-10 year period. For this reason, the study of the dermatophyte in Ulaanbaatar was initiated. We sought to determine the distribution of the different dermatophyte species diagnosed in Ulaanbaatar from 2019 to 2020.

Materials and Methods

Sampling

A total of 281 participants with dermatophyte lesions were examined between October 1, 2019, and March 1, 2020, in an analytical study conducted at the National Dermatology Center of Mongolia. In this study, we chose the participants who were evaluated in the outpatient clinic with no history of applying topical antifungal treatment for the lesion and who did not bathe for 24 hours before the examination. Samples of skin, hair, and nails were taken from patients using scalpels, forceps, and glass slides that had been washed in ethanol and sterilized with a Bunsen burner. Samples were examined using 10% KOH to detect fungal spores and mycelium on a microscope after specimens were collected from the body and head lesions by scraping and hair samples. The specimen from nail debridement were macerated for 2-4 hours using 20% KOH and then placed on a microscope slide to determine fungal elements.

Direct microscopy

Direct microscopy examination was carried out using 20% KOH for nails and 10% KOH for hair and skin. Then, the samples were examined under low (x100) and the high (x400) magnification of the light microscopy for the presence of arthroconidia, mycelium or spores and their distribution pattern. Direct microscopic observation of the samples was carried out by examining the material in 10% KOH.

Culture

Clinical specimens were cultured on Petri dishes of Sabouraud dextrose agar (SDA) containing 50 mg in a one-to-one ratio of chloramphenicol and cycloheximide (SCC). The inoculated Petri dishes were incubated at 25^0C and examined after 7, 14, 21, and 28 days. Positive cultures were sub-cultured on plates of SCC. We studied the colonies to determine their morphological and microscopic characteristics. The macroscopic features studied were colony morphology, color, texture, growth rate

and pigmentation. Microscopic examination of the suspected colonies was carried out using a lactophenol cotton blue mount to examine hyphae structure and the shape, and presence and arrangement of microconidia and macroconidia. Differential diagnostic methods, such as pigment production, hair perforation test, special nutritional requirements, urea hydrolysis, temperature tolerance and temperature enhancement test were also performed if necessary [3].

Statistical analysis

The ages of the participants in male and female groups were compared using unpaired t-tests. The Chi-square test was used for comparing the categorical variables. A critical p-value of < 0.05 was used. SPSS version 24 software (SPSS Inc., Chicago, IL, USA) was used for statistical analyses.

Ethical statement

Ethical approval for this study was obtained from the Research Ethics Committee of Mongolian National University of Medical Sciences (No. 2019/3-08). Informed consent was obtained from all the participants.

Results

A total of 281 participants with dermatophyte lesions were examined. The general characteristics of the study population are shown in Table 1.

One hundred forty-two (50.5%) of 281 participants were males, and 139 (49.5%) were females. The mean (±SD) age of the patients was 29.92 ± 21.73 years. There were statistical significant differences between the mean age of patients in this study and their mycology culture results ($p = 0.004$). The age range was 1-87 years. There was no significant statistical difference between the frequencies of dermatophyte species in males and females ($p = 0.271$). Infected sites were the skin (41%, 73), nails (20.7%, 37), and hair (11.8%, 21), and these frequencies differed significantly ($p = 0.009$). The most commonly infected body parts were nails (20.79%, 37), followed by the face (11.24%, 20), soles of the feet (11.24%, 20), and the trunk (7.87%, 14). The area with the lowest frequency of superficial infection was the groin (4.49%, 8) ($p = 0.053$).

Table 2 shows the gender distribution of patients with dermatophytosis according to the type of tinea. Males were mostly infected with tinea corporis (20%), onychomycosis

Table 1. General characteristics of the study population.

	Result of culture			
Variables	**Positive (n=178)**	**Negative (n=103)**	**Total (n=281)**	**p-value**
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	
Age	32.74 ± 21.75	25.05 ± 20.92	29.92 ± 21.73	0.004†
Gender	N (%)	N (%)	N (%)	
Male	85 (47.8)	57 (55.3)	142 (50.5)	0.271*
Female	93 (52.2)	46 (44.7)	139 (49.5)	
Sites				
Skin	73 (41.0)	60 (58.3)	133 (47.3)	0.009*
Nail	37 (20.7)	17 (16.5)	54 (19.2)	
Mucosa	47 (26.4)	12 (11.7)	59 (20.9)	
Hair	21 (11.8)	14 (13.6)	35 (12.5)	
Body part				
Mucosa	47 (26.41)	12 (11.65)	59 (38.06)	0.053*
Nail	37 (20.79)	17 (16.51)	54 (19.22)	
Soles on the feet	20 (11.24)	13 (12.62)	13 (12.6)	
Body	53 (29.78)	47 (45.64)	100 (35.59)	
Head	21 (11.8)	14 (13.59)	35 (12.46)	

†unpaired t-test, *Chi-square test

Table 2. Gender distribution of patients with dermatophytosis according to tinea types.

Gender				
Tinea types	**Male (n=142)**	**Female (n=139)**	**Total (n=281)**	**p-value***
	N (%)	**N (%)**	**N (%)**	
Tinea capitis	21 (7.5)	14 (5)	35 (12.5)	0.033
Tinea corporis	56 (20)	44 (15.6)	100 (24.6)	
Tinea pedis	16 (5.6)	17 (6.05)	33 (11.65)	
Onychomycosis	21 (7.5)	33 (11.75)	53 (19.25)	
Candida	28 (9.9)	31 (11.1)	59 (21)	

*Chi-square test

Table 3. Isolated dermatophyte species according to tinea types.

Result of culture				
Tinea types	**Positive (n=178)**	**Negative (n=103)**	**Total (n=281)**	**p-value***
	N (%)	**N (%)**	**N (%)**	
Tinea capitis	21 (7.5)	14 (5)	35 (12.5)	0.046
Tinea corporis	53 (18.8)	47 (16.7)	100 (35.5)	
Tinea pedis	20 (7.1)	13 (4.6)	33 (11.7)	
Onychomycosis	37 (13.1)	17 (6)	54 (19.1)	
Candida	47 (16.7)	12 (4.3)	59 (21)	

*Chi-square test

(7.5%) and tinea capitis (7.5%). Females were more affected by onychomycosis (11.75%) and tinea corporis (15.6%) (p = 0.033).

Table 3 shows the clinical forms of dermatophytosis. Of these, onychomycosis of the most common (13.1%, 37), followed tinea corporis (18.8%, 53), tinea capitis (7.5%, 21), tinea faciei (7.1%,20), tinea pedis (7.1%, 20), and statistically significant differences between tinea types were identified (p = 0.046).

Among the 281 mycologically suspects cases, 131 participants had dermatophyte infections based on culture. *T.rubrum* (22.8%) was the main etiological agent of the nail infection. *M.canis* (17.5%), *T.mentagrophytes* (10.6%), and *T.tonsurans* (7.6%) were a dominant agent of skin infection.

Discussion

The dermatophyte species of superficial fungal infections differ in different geographical areas and changes over time. Our study showed that among the patients surveyed, onychomycosis was the most common form of the disease (16.79%). In our survey, onychomycosis was caused by *T.rubrum* 30 (22.9%), *Epidermophyton floccosum* 6 (4.6%), and *T.interdigitale* 1 (0.7%). *T.rubrum* was the most common pathogen responsible for tinea unguium and onychomycosis.

Onychomycosis is also the most prevalent dermatophytoses in northern Greece, the USA, Finland and the Czech Republic [20-24]. It has been found that onychomycoses account for about one-half of all nail diseases [25]. Tightly fitting shoes increased exposure to the causative agents, and the dissemination of different fungal strains worldwide has contributed to the increased incidence of onychomycosis [25].

In our study, tinea capitis ranked the second most common and constituted 16.03% of all infections. Tinea capitis was mainly generally caused by *T.tonsurans* (6.1%, 8), *T.violaceum* (5.35%, 7), *M.canis* (2.29%, 3), *T.interdigitale* (0.7%, 1), *T.gypseum* (0.7%, 1), and *T.verrucosum* (0.7%, 1). In some European countries, there has been an increasing incidence in the number of anthropophilic scalp infections, with the largest increase being observed in *Trichophyton tonsurans* [26]. In

contrast to Europe, *T.tonsurans* remain almost the exclusive agent accounting for > 95 % of scalp ringworm in the USA [24]. These figures indicate similar trends to those reported for tinea capitis in the USA, where anthropophilic infections have become the dominant cause of infection, with *T.tonsurans* as the main cause of disease in urban populations.

Tinea corporis constituted 10.69% of all infections, and *M.canis* (7.6%, 10), *P. orbiculare* (3.8%, 5), and *Epidermophyton floccosum* (8.39%, 11) was the etiological agents. In general, lesions were caused by anthropophilic species. Various studies have indicated that in Northern Greece, Central Europe and Mediterranean countries, *M.canis* was the predominant species causing tinea corporis [2, 13, 27, 28]. *M. canis* is predominant agent of the tinea corporis.

In our study, tinea faciei constituted 20 (15.27%) of all infections and *M.canis* 8 (6.1%), *T.tonsurans* 7 (5.3%), *T.mentographytes* 4 (3%), and *T.violaceum* 1 (0.8%) were the main organisms. According to reports from Stockholm, Sweden and other countries, *M.canis* is the predominant agent of the tinea faciei [13].

In this study, tinea pedis constituted 15.2% all infections, *T.mentagrophytes* 6.9%, *T.rubrum* 3.8%, *M.canis* 3.8%, and *T.interdigitale* 0.8% were organisms. Of the 18 positive patients with tinea pedis, *T.mentagrophytes* (23.1%) and *T.rubrum* (14.3%) were the most frequently isolated species in Teran, Iran [16]. *T.mentagrophytes* were the dominant etiological agent of the tinea pedis. The zoophilic dermatophyte species in villages occur in such animals as cats, dogs, horses, and sheep [29]. These animals are considered to be a source of human infection since they are natural carriers of the zoophilic dermatophytes. Furthermore, some factors such as wearing socks and stocking may influence the development of tinea pedis.

Major advances have been made over the years in the identification and diagnosis of dermatophytes. However, some limitations, such as the lack of a complete database for the identification of pathogenic fungi, and number of participants, lack of age groups, and season characteristics are still an obstacle. These are potential areas for future study. Performing such studies in individual countries and regions is important for the continued analysis of fungal pathogens. This will help to identify changing trends that will influence local guidelines and hence clinical practice.

Conclusion

In our survey, the anthropophilic species *Trichophyton Rubrum* was the most common dermatophyte as a causative agent of tinea unguium and onychomycosis (26.7%). Of the zoophilic species, *Microsporum canis* was the most common dermatophyte causing tineas (19.8%). Our data provide a valuable baseline on which to assess future efforts directed toward preventing dermatophytosis infections in our epidemiological setting.

Conflict of Interest

The authors declared no conflict of interest. This work was supported by grants from the Ministry of Education, Science, and Sports (No.2019/35).

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