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ORIGINAL ARTICLE

Medicine Science International Medical Journal

Medicine Science 2023;12(1):244-52

The investigation of dermatophyte agents in patients with dermatophytosis diagnosis

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Received 11 December 2022; Accepted 01 February 2023
Available online 28.02.2023 with doi: 10.5455/medscience.2022.12.264

Abstract

The aim of our study was to investigate the features and agents in patients with dermatophytosis and to evaluate the dermatophyte flora changes in our area in recent years. Patients and Methods: Patients with dermatophytosis were included in our study. The age, gender, social life area, animal contact history of the patients and the clinical types of dermatophytosis were recorded. 443 native preparation positive species were cultured and their pathogens were investigated. There were 367 cases with an age range between 1-79 years. The animal contact history was present in 23,7% and rural area living anamnesis was present in 21.2% of the species having dermatophytosis diagnosis. The ratio of clinical type distributions were determined as follows; T.pedis %41.5, T.unguium on foot+hand %29.2, T.capitis %9.9, T.inguinalis %7.2, T.corporis %6.1, T.manum %3.6, T.facialis %2.0 and T.barba %0.5. The agent could be identified in 76.5% of the species with the rates of T.rubrum 62.5%, T.mentagrophytes 16.8%, T.verrucosum 9.4%, M.canis 4.7%, E.floccosum 3.2%, T.violaceum 1.8%, T.tonsurans 0.9%, M.nanum 0.3 % and T.schonlein 0.3 %. T.rubrum was the most frequent agent causing T.pedis, T.unguium, T.inguinalis. Also T.verrucosum was the most frequent agent in T.capitis, T.corporis and T.barba and it was considered that this could be arised from our animal husbandry region. There have been differentiations in dermatophytosis and their agents today versus their status in 20 years ago in our region. Although they were decreased in comparison to the past, cases with T. capitis have remained their importance at present.

Keywords: Dermatophyte, dermatophytosis, tinea

Introduction

A significant portion of patients applying to dermatology policlinic have fungal diseases, and most of them are superficial fungal diseases. In this group of diseases, we most commonly see dermatofyte group fungi. Fungal infections on keratinized tissues such as the epidermis, hair, and nails that dermatophytes cause are called dermatophytosis [1]. Superficial fungal infections have affected more than 25% of the world's population in the last 50 years and have become one of the most common types of infections [2]. Dermatophytosis makes up about one-tenth of dermal diseases [3]. Even though epidemiologic data about dermatophytosis is limited, it is reported that dermatophytosis infections are more common than they were in the past because the number of gyms, spas, saunas, hammams and similar places have increased and the fungi's capability to change their enzyme systems and reproduction types and the ability to adapt to different conditions and spread [4].

The variety and prevalence of dermatophytosis in the world

CITATION
Melikoglu M, Ozdemir S, Uslu H. The investigation of dermatophyte agents in patients with dermatophytosis diagnosis. Med Science. 2023;12(1):244-52.

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DOI: 10.5455/medscience.2022.12.264

differs depending on the climate of the region, geographic structure, lifestyle and activity of the society [5]. Each region has its own dermatophyte flora and this flora can change over time. Things such as the development of tourism, adventures, and migration cause the spread of fungal infections, from one region to another and the settling of new species in the region. For this reason, at certain times some dermatophytes can be more dominant and gain epidemiological properties.

Significant changes have occurred in the twentieth century in the epidemiological data of dermatophytes [6]. Even in our own region, a study conducted in 1979 detected that the clinical types and species of dermatophytes have changed compared to 10-12 years ago [7]. Identifying the agent at a species level, following up on dermatophytes, determining the ecology and epidemiology and knowing the endemic areas are important for controling infections and public health. This will help contribute to treatment and actions to be taken [5]. In light of these data, we aimed to determine the recent dermatophyte flora and changes of dermatophytoses in our region.

Patients and Methods

Patients and samples

Informed consent was obtained from all patients, and the local ethical commitee approved the study protocol (Ataturk University School of Medicine ethics comitee 09.02.2007/17).

Materials for our study consisted of samples taken from 443 body parts of 367 patients diagnosed with dermatophytosis who applied to Atatürk University School of Medicine Dermatology polyclinic. Native preparations including 20% of potassium hydroxide (KOH) were prepared from the samples. After finding cases that were positive upon examination of native preparation, age, gender, clinical diagnosis (location), contact with animals, and social living spaces were recorded.

Culture methods prepared from clinical samples and diagnosis of fungi

Sabouroud Dextrose Agar (SDA), Dermatophyte Test Medium (DTM) and MDA (Mycobiyotic Dextrose Agar) and Potato Dextrose (PDA) agar medium cultivations were performed for each culture sample. To reproduce slow reproducing dermatophytes, sikloheksimidsiz SDA medium was used, too. Two mediums were used for each sample. One cultivated medium was left at room temperature (260C), and the others were incubated at 370C. Cultures were checked for fungal reproduction 2-3 times a week for at least four months. At the end of this period, cultures that showed no reproduction except dermatophytes, yeasts and other fungi were evaluated as negative. From the colony mitchels of the tubes that had complete breeding, a sample was taken with "cellophane tape" or a loop. Fungal elements were stained with Lactophenol Cotton Blue. They were examined at 400x magnification by microscope. The differentiation of species was performed by evaluating the colonies macroscopically and microscopically. To distinguish T. rubrum and T. mentagrophytes, hair perforation test was used.

Data were entered to SPSS 11.0 statistical program and evaluated with the chi-square test. Values that are $p<0.05$ were accepted as statistically significant.

Results

Our study included 367 patients diagnosed with dermatophystosis and culture and evaluation results of 443 dermatophysitosis diagnosed samples from different sites. The ages of the patients were between 1-79 years (36.67± 12.45 mean ± standard deviation; SD). 248 patients were males (67.57%) and 119 (32.43%) were females. In 340 samples (76.5%), breeding of the cultures was obtained. 87 patients were (23.7%) from rural areas, 280 patients (76.7%) were from urban areas. 98 (26.7%) patients had history of contact with animals, and 269 (73.3%) patients had no history of contact with animals. Demographic data, history of contact with animals, living spaces and reproduction rates of the samples in the cultures are given in Table 1.

Table 1. Demographic data, history of contact with animal, living spaces and culture medium positivity of the samples

	n	%
Patients	367	
Samples	443	
Dermatophystosis **In a single site/ In multiple sites**	296 /71	80/ 20
Gender **Female/ Male**	119/ 248	32.4/ 67.6
Culture medium positivity of samples **+ / -**	339/ 104	76.5/ 23.5
Animal contact **Yes/ No**	98/ 269	26.3/ 73.3
Living spaces **Rural/ Urban**	87/ 280	23.7/ 76.3

9 different dermatophysitoses were detected in our study. Dermatophysitoses detected clinically, factors that can be identified and their distributions are demonstrated in Table 2.

As the 339 dermatophytes total obtained from the culture results were evaluated, 311 (91.8%) of them were Trichophyton type, 17 (5%) were Mycrosporum type and 11 (3.2%) of them were determined to be Epidermophyton type. 6 species were identified as belonging to the Trichophyton type, 2 species belong to the Microsporum type, and one species belongs to the Epidermophyton type. T. rubrum was the most commonly identified agent among the dermatophytes at a rate of (62.5%). T. mentagrophytes (16.8%) was second, and T. verrucosum was third (9.4%). Distributions of the detected dermatophytes are demonstrated in Table 3.

DOI: 10.5455/medscience.2022.12.264

Table 2. Dermatophytoses detected clinically, dermatophyt that can be identified and their distributions

Dermatophysitoses	Number of cases/ %	Number of cases with dermatophyt identification	Dermatophyt	number/ %
T. pedis	184/ 41.5	152	T. rubrum	116/ 76.3
			T.mentagrophytes	26/ 17.1
			M. canis	4/ 2.6
			E. floccosum	3/ 2.0
			T. violaceum	2/ 1.3
			T. verrucosum	1/0.7
T. ungium-foot	115/ 26.0	72	T. rubrum	59 /81.9
			T.mentagrophytes	11/ 15.3
			T. violaceum	2/ 2.8
T. ungium- hand	14/ 3.2	6	T. rubrum	5 /83.3
			T.mentagrophytes	1/ 16.7
T. capitis	44/ 9.9	36	T. verrucosum	15/ 41.6
			T. mentagrophytes	6/ 16.6
			M. canis	5/ 13.9
			T. rubrum	4/ 11.1
			T. tonsurans	2/ 5.6
			T. violaceum	2/ 5.6
			T. schonlein	1/ 2.8
			M. nanum	1 /2.8
T. inguinalis	32/ 7.1	27	T. rubrum	13/ 48.1
			E. floccosum	8/ 29.6
			T.mentagrophytes	5/ 18.5
			M. canis	1/ 3.7
T. corporis	27/ 6.1	25	T. verrucosum	13/ 52
			T. rubrum	6/ 24
			M. canis	4/ 16
			T.mentagrophytes	1/ 4
			T. tonsurans	1/ 4
T. manum	16/ 3.6	10	T.mentagrophytes	5 /50
			T. rubrum	4/ 40
			M. canis	1/ 10
T. facialis	9 /2.0	9	T. rubrum	5/ 55.5
			T.mentagrophytes	2/ 22.2
			M. canis	1/ 11.1
			T. verrucosum	1/11.1
T. barba	2 / 0.005	2	T. verrucosum	2

DOI: 10.5455/medscience.2022.12.264

Table 3. Distributions of the detected dermatophytes

Dermatophytes	number	%
T. rubrum	212	62.5
T. mentagrophytes	57	16.8
T. verrucosum	32	9.4
T. violaceum	6	1.8
T. tonsurans	3	0.9
T. schonlein	1	0.3
M. canis	16	4.7
M. nanum	1	0.3
E. floccosum	11	3.2
Total	**339**	**100**

In our study, while dermatophysitosis was detected in a single site in 296 patients, 71 patients dermatophysitosis were detected in multiple sites. Distributions of these dermatophysitosis are demonstrated in Table 4.

Table 4. Distributions of dermatophysitosis that were detected in multiple sites in 71 patients

Dermatophysitoses	n	%
T. pedis+ T. unguium (hand)	42	59.2
T. pedis+ T. ingiunalis	8	11.3
T. pedis+ T. unguium (foot)+ T. unguium (hand)	4	5.6
T. unguium (foot)+ T. unguium (hand)	3	4.2
T. unguium (foot)+ T. ingiunalis	3	4.2
T. pedis+ T. manum	3	4.2
T. capitis+ T corporis	2	2.8
T. unguium (foot)+ T. manum	2	2.8
T. capitis+ T. facialis	1	1.4
T. manum+ T. facialis	1	1.4
T. unguium (foot)+ T. Facialis	1	1.4
T. pedis+ T. ingiunalis+ T. corporis	1	1.4
Total number of cases	**71**	**100**

History of contact with animals existed in 100% of the T.barba cases, 81.8% of the T.capitis cases, 77.8% of T.corporis cases and 66.7% of T. Facialis cases. All of the T. barba cases, 84.1% of T. capitis cases, and 67% of T. facialis cases were patients from rural areas. In the distribution of agents, T. verrucosum (93.8%), M. canis (87.5%) and T. violaceum (66.7 %) were forefront in patients from rural areas.

Discussion

Each region has its own dermatophyte flora and this flora can vary epidemiologically in time. In our study, we tried to determine recent dermatophyte flora in our region and changes of dermatophysitoses.

As the demographic data of our study were evaluated, we observed the female/male ratio to be about ½. Simlarly, in studies conducted in our country, the number of male patients was found to be higher than the number of female patients, and this ratio was found to vary in range from ½ to 1/6 in different studies [8-10]. The reason there are more male patients with dermatophysitosis is thought to be that they are in more contact with the external environment, and they meet more often with common contagious agents [11]. Also the ages of our patients were between 1-79 years in accordance with the knowledge that dermatophytosis can be seen at any age [12].

In our study, nine different dermatophysitosis were detected in 443 samples. Among these, the most common clinical state was Tinea pedis with an occurance of 41.5%. Parallel to our study, studies conducted in different regions of our country reported T. pedis as the most frequent clinical state. The close rates suggest that regional factors do not primarily affect the incidence of T. pedis [8, 9, 12-14]. In our study the dermatophysitosis that cause T. pedis were identified as T. rubrum, T. mentagrophytes, M. Canis, E. Floccosum, T.violaceum and T. verrucosum with decreasing frequency. Recently, both in our country and in other countries, the most common agents for T. pedis have been reported as T. rubrum, T. mentagrophyes and E. floccosum, which are antrophophilic species [6, 15]. As we evaluated studies conducted in our region, in the 1980s, M. canis was the dominating agent in T. pedis. T. mentagrophytes passed to the forefront in the 1990s and T. rubrum in the beginning of the 2000s [1, 16-18]. We determined that the frequency of T. rubrum increased compared to 8 years ago. M. canis was found at a lower rate than in the past in our study [16, 17]. Also in T. pedis cases, E. Floccosum, T.violaceum and T. verrucosum were detected as rare agents. Our results were compatible with the E. Floccosum rates in the study of Uslu in the recent past, and the rate of E. Floccosum has decreased when compared to the older study of Ak [16, 18]. When all the data are taken into consideration, there have been epidemiologic changes in T. pedis agents in our region.

As we compare T. pedis agents in recent studies conducted in our country, the most common agents have been detected as T. rubrum and T. Mentagrophytes similar to our results [8, 13,

DOI: 10.5455/medscience.2022.12.264

19]. In our study, we determined that M. Canis, E. Floccosum, T.violaceum and T. Verrucosum are also seen as less common agents. However, in our region we did not detect M. audouinii, T. tonsurans and M. gypseum as agents of T. pedis. The observation of T. rubrum as the most common agent and T. mentagrophytes as a second agent is a change parallel within our country and across the world.

Similar to our study, numerous data have been obtained from other studies conducted in our country suggesting that T. pedis followed by T. unguium [8, 13, 19]. In other words, T. ungium is commonly seen in patients with T. pedis [11]. T. ungium on the hand is rarer than the foot. Since it's not given as a separate entity in most of the studies, it does not give us a chance to discuss in detail. In our study, the most common three agents in T. Ungium were detected as T. rubrum, T. mentagrophytes and T.violaceum. The international data for T. Unguium report that, T. rubrum was seen with higher incidences, T. mentagrophyes was the second most common agent and E. floccosum can be very rarely seen [6, 13, 15, 18]. In terms of the first two agents, it can be concluded that there wasn't any significant change compared to the past. Also we detected T. violaceum sporadically in our study. This is compatible with classical knowledge that it is a rare agent [20].

In our study, we found that T. capitis was the most common dermatophysitosis in childhood. T. capitis was seen in lower socioeconomic level societies, and zoophilic factors play an important role in this infection [6]. Our region has relatively low socio-economic conditions. 23.7% of our patients are from rural areas and a history of contact with animals was reported in 81% of patients with T. capitis. Even though we identified T. capitis as the third most frequent dermatophysitosis in our study, it was the most frequent one in the past years [7, 17,18]. Epidemiologic studies of dermatophysitosis support that the current change may be parallel to the changes in our country and region [6, 15, 21]. Similar to the older data of our region, T. capitis profunda (kerion selsi) has emerged as the most common type of T.capitis in our region [17]. A total of seven dermatophytes detected in T. capitis in our study; T. verrucosum, T. mentagrophytes, M. canis, T. rubrum, T. tonsurans, T. violaceum, T. schonlein and M. nanum. Zoophilic species were dominant in our agents. Except M. nanum isolated from only one case in our study, we observed that all these agents were also detected in previous studies in our region [17, 18]. M. Nanum was very rarely reported in studies conducted in our country [12, 13]. In our study, T. verrucosum was the main agent for T. capitis and a significant portion of patients had a history of animal contact. Parallel to our study, the most common agent in T. capitis cases was T. violaceum in Southern East Anatolia and Cukurova and T. verrucosum in Middle Anatolia and Eastern Anatolia [15]. In recent studies conducted in the Eastern Anatolia region, among the T. capitis agents, T. rubrum was reported to be approximately between 7%-23%, and the percentage of 11% in our study was found compatible with these data [18, 22]. In past studies conducted in our region, T. capitis favosa was commonly seen and T. schonlein was detected as the first or second agent [10, 17, 23]. However, Ergenekon emphasized, even in his 1976 study, that T. capitis favosa decreased when compared to previous years [23]. In our study, T. capitis favosa was detected in only one case, and T. schonlein was cultivated in the culture. From this point, we can state that T. capitis favoza has decreased in our region and is a rare clinic type. The most recent epidemiologic studies report that T. capitis favosa and T. schonlein as agents are gradually decreasing [6]. One of the biggest reasons for this may be the socioeconomic developments in our country and region compared to 20-30 years ago. Also, we can state that the flora of T. capitis in our region has different properties and T. Capitis had epidemiologic changes in recent years. Because the characteristics of our region include working with livestock, we determined that the effects of zoophilic types are on going. While T. schonlein was once the most common in T. capitis cases, recently it became a more rare type and T. verrucosum became the most common type. Determinations of T. rubrum and M. nanum, which were not identified before, showed us that we meet with different species over time. Agents of T. capitis have changed compared to 20-30 years ago, and these changes may be the result of the development of social conditions.

Seebacher et al have mentioned that T. pedis, T. unguium and T. capitis are three epidemiologic problems that cannot be solved until recent day. While T. pedis was in first place in central and northern Europe, in southern Europe and particularly in Islamic countries, T. capitis and zoophilic types were in the forefront [6]. Our study seems to be compatible with this data from the aspect that our country is geographically settled between east and west, the existence of T. Pedis and T. unguium as the most common, and the increase of T. Capitis, particularly in the east.

Another clinical state we determined was T. Inguinalis. In our study, we made the differential diagnosis by using wood light and included only the positive native preparation samples. Thus, we only included the patients whoose clinical and laboratory findings were compatible. This method can explain the lower numbers of T. inguinalis compared to the studies conducted with sample numbers depending on preliminary diagnosis. T.inguinalis, which was determined to be the third agent in studies by Uslu and Aktaş conducted in our region, was determined as the fourth agent in our study [18, 24]. In our study, the agents in T. inguinalis cases were determined as T. rubrum, E. floccosum, T. mentagrophytes and M. canis, respectively. Generally, the most common agents in T. inguinalis cases were reported as E. floccosum, T. rubrum and T.mentagrophytes [11, 20]. When we revieved recent studies in our country, there were studies that were determined E. Floccosum as the most common, different from our study, and in many studies, similar to our study, T. rubrum was seen as the most common agent in T. Inguinalis [8-10, 12-14, 19]. T. inguinalis occurs with contaminated properties, rarely with direct contact, and with autoinoculation when there is a dermatophysitosis in another site of the body. When transmission is by autoinoculation, the agent is commonly T. rubrum. In our

DOI: 10.5455/medscience.2022.12.264

study, in 12 of 27 cases in which we produced the agent, there was dermatophytosis in another region with T. inguinalis. From this point, our rate of T. rubrum and producing T. rubrum as the first and E. floccosum as the second agent seem compatible with classical knowledge [9]. When we reviewed previous studies in our region, the first agent was seen as T. rubrum, parallel to our study [1, 18]. Different from these studies, we determined a few cases of M. canis in our study. Fındık et al determined the agent of M.canis in T. inguinalis, similar to our study. İnci et al mentioned that T.inguinalis cases due to M. canis should not be surprising [25, 26].

We determined T. Corporis as the fifth dermatophysitosis in our study. The rates in our study are close to the rates of previous studies in our country and region [7-9, 12, 14, 18,19,24]. One of the reasons we found T. corporis lower in ranking is that we did not include T. facialis to T. corporis cases methodologically, and our cases consisted of positive native preparation samples, from the cases in which differential diagnosis was made and were clinically diagnosed as dermathophysitosis. In our study, we detected the agents of T. Corporis according to frequency, respectively, as T. Verrucosum, T. Rubrum, M. Canis, T.mentagrophytes and T. tonsurans. Generally, it is reported that mostly zoophilic and geophilic agents are detected in T.corporis, autoinoculation can develop mainly due to T. rubrum, and T. mentagrophyes and rarely E. floccosum can be determined [11]. When T. corporis is seen in childhood, mostly zoophilic species are found as agents [20]. In our study, more than half of the T. corporis cases were children (0-15 years). This was compatible with the detection of T.verrucosum in our study, which is the most common zoophilic agent. In studies by Arpalı and Çakıroğlu, which are the previous data from our region, we see that zoophilic agents were determined in children, similar to our data [17, 27]. However, we can mention that even M. canis, dominant in those years, still exists, but yet isn't the dominant type today. Recently, we determined that M. canis was replaced by T. verrucosum. The reason that zoophilic agents were not detected in other studies in our region could be because there weren't pediatric patients or the number of child cases was lower [1, 18]. The second most common agent we detected in T. Corporis cases was T. rubrum. Seebacher et al reported that the most common agent in T. corporis cases around the world is T. rubrum [6]. Similarly, the most common agent in T. corporis in our country is reported to be T. Rubrum [8, 9,13,19]. In our region, both Özdemir et al and Uslu et al have determined it as the first agent [1, 18]. Determination of T. rubrum as the second agent, in our study, states that T. rubrum protects its importance in T. corporis in our region. T. corporis is the second agent among childhood cases, and as the zoophilic properties are forefront, support that age groups and regional characteristics (livestock) are important for T.corporis.

The frequency and incidence of T. Manum in our study is similar to previous data in our region and other regions of our country [12, 18, 24]. In our study, of the 10 T. manum cases, T.mentagrophytes were detected in 5 cases, T. rubrum was detected in 4 cases, and M. canis was detected in one case. 3 cases were T. pedis et manum cases. In 2 cases, T. Unguium and T. manum were found together. In several domestic and foreign references, T. rubrum is reported as the most common agent in T. manum cases and is mentioned that this was followed by T. mentagrophytes [11, 20]. The low number of T.manum cases, and the agents we determined in our study seem to be compatible with previous data from our region and similar environments [8, 18,27]. T. rubrum, which was not detected 30 years ago, could be increasing gradually in T. manum cases.

Tinea facialis and T. Barba, rare among dermatophyitosis, are not detected in many studies clinically in our country and detected as the least common in our study [9, 11,19,25]. T. facialis was detected in 9 patients in our study. In various studies, zoophilic factors are indicated to be forefront in T. facialis cases [11]. Besides zoophilic factors, it is reported that Trichophyton species are common and can occur as a result of autoinoculation if there is dermatophysitosis in any other site [28]. The numbers we detected in our study are compatible with mentioned resources for the type of agent and frequency. Even though zoophilic factors are dominant in T. facialis in our region, it being the most frequent agent of T. rubrum is a condition that should be considered. T. Barba was detected in two cases in our study. We reproduced T. Verrucosum as the agent in both cases. It is more commonly seen in farmers, veterinarians, and in people with similar jobs that engage bovine animals. The agent is commonly reported to be T. verrucosum, followed by T. mentagrophytes [9]. Since we are in a livestock region and in light of the above knowledge, to determine T. verrucosum as the agent in both cases was an expected result. T.manum, T. facialis, and T. barba were isolated less in our study; our results seem to be compatible with the previous studies for frequency and type of agent. However, since the number of cases was insufficient in previous studies and our study, it was not possible to discuss the data in detail.

Of the total 339 dermatophyte species obtained from the culture results in our study, 91.8% belong to the Trichophyton species, 5% belong to the Microsporum species and 3.2% belong to the Epidermophyton species. In this study, the overall frequency of dermatophytes was determined as T. rubrum, T. mentagrophyte, T. verrucosum, M. Canis, E. Floccosum, T. violaceum, T. tonsurans, M. Nanum and T. Schonlein, respectively. When we reviewed studies conducted in our region, Kot et al reported this sorting in 1979 as M.canis, T. schonlein, T. violaceum, T. mentagrophytes and T. verrucosum [7]. Parallel to clinic types, the ranking of these agents are not compatible with our study and can be explained by the epidemiological change in our region since 1979. This epidemiologic change is parallel to socioeconomic developments in our country and region. T. rubrum growing in dominance among all species, similar to other studies in our country, is an important factor [8, 10, 13, 14, 21, 25]. In studies conducted in more recent years in our region, Aktaş et al reported the order of dermatophyte frequency as T.

DOI: 10.5455/medscience.2022.12.264

rubrum, T. mentagrophytes, T. violaceum, T. verrucosum and M. canis. Uslu reviewed the later data and reported a distribution of 138 agents. The isolated the order of frequency as T. rubrum, T. mentagrophytes, T. schonleinii, T. violaceum, T. tonsurans, M. canis and E. floccosum [18, 24]. In these studies, T. rubrum was isolated as the most common agent and was followed by T. mentagrophytes. Our study is compatible with both studies, conducted 10 years ago, for the first two agents. We suggest that the reason we isolated more agents than the other studies is because of our high number of cases (339).

In studies conducted in our country, as we reviewed the data close to our region geographically, T. violaceumis was more common in southeast Anatolia region than our region, and T. verrucosum is more common in our region [29]. As we compared our study with studies in the Mediterranean region, the detection of T. rubrum as the most common agent in both our region and Mediterranean region studies seem to be compatible [19]. However, T. violaceum is generally more common in the Adana and Mersin region than what we detected in our study (1.8%). The ratio of T. verrucosum was 9.4% in our study and was significantly higher than the rate in the Adana and Mersin region. T. verrucosum is a zoophilic agent and particularly of bovine origin [11]. The source of livelihood is our region is farming. These reasons support the higher rates of T. verrucosum in our region. As we considered the studies conducted in the Middle Anatolia region, we see T.rubrum and T. Mentagrophytes as the first two agents [30]. This finding is supported by the other studies of this region [12]. Again, the results of the study from this region conducted in Konya by Fındık et al- the findings, number of samples that have reproduction, frequency of the dermatophysitosis, isolated agents, and number of species are similar with our study [25]. However, the detection of T. verrucosum at 9.4% in our study suggested that it originated from livestock in our region. Generally, our study seems to be compatible with studies conducted in the Middle Anatolian Region in which T. rubrumis was the more common agent followed by T. mentagrophytes. As we reviewed the studies conducted in the Black Sea region, the most common agent is T. rubrum, as in our study [8-10]. In the studies conducted in the Black Sea region, E. floccosum is more common than in ours and many other regions, and not finding M. canis is noteworthy. The lower rate of T. inguinalis cases in our study and higher rates in the Black Sea region can be explained by the high rates of E. floccosum. Besides, climate characteristics of the Black Sea region can be a factor. Studies from the Aegean Region were similar with our region's first ranking agents; however, T. rubrum was more common in the Aegean region, and T. verrucosum was detected to be more common in our region than the Aegean region [31, 32]. As we reviewed literature for the Marmara region, even though we didn't find recent or detailed data, T. rubrum and T. mentagrophytes were the most common, as in our study [32, 33].

In foreign studies, T. rubrum is epidemiologically the most common agent recently, except in underdeveloped regions [2, 15, 21]. In the United States of America, T. rubrum is reported as the most common agent except T. capitis. T. capitis is the most common agent among dermatophysitosis agents; its incidence is gradually increasing and T. tonsurans is reported as its most common agent [35]. When we look at Europe, T. rubrum was reported at 1% among the dermatophysitosis agents in Germany in 1926. By gradually increasing over the years, it reached to 82.6% in 1993 [6]. One reason partially explaining this increase is that the clinical types of T. pedis and T. unguium have become the most common clinical types. Through the recent use of systemic antifungal agents, T. schoenlein and M. audouinii seem to be eradicated in Germany. M. canis is still observed at a rate of 3.1% in a study conducted in Berlin in 1993 [6]. T.rubrum is the most common agent, and T. pedis and T. unguium are presented as the most common clinical types in central Europe and North Europe, except Poland. In Croatia, Slovenia and Italy, the Mediterranean countries of Europe, M. canis major presents as a dermatophyte. This is a strong example of the effect of climate characteristics epidemiologically [6]. In Africa, the situation is totally different from Europe. Both socioeconomic conditions and climate are thought to be responsible for this situation. In Africa, the group most affected by dermatophytes is children. T. capitis is very common. Even though it changes according to geographical conditions, M. audouinii is one the most common agents in Africa. T. violaceum and T. soudanense are also two common agents. T. pedis and onycomycosis are rarely observed in the rural areas of Africa, and the low incidence of diabetes and walking with bare feet are suggested as the reasons for this state. Rare incidences of T. rubrum and T. mentagrophytes have been linked to the lower numbers of T. pedis and onycomycosis cases [2]. In Asia, similar to Europe, T. rubrum and T.mentagrophytes are stated as the two most common agents, respectively, and T. pedis and T. unguium cases are stated as the most common two clinical types. However, conversely to Europe, in Asia the clinical types following these are T. capitis and T. corporis, and the most common agent is stated as T. violaceum [2]. In our study, the most common two clinical types are T. pedis and T. ungium, respectively, and the most common two agents are T. rubrum and T. mentagrophyte. This is compatible with both Europe and Asia from this aspect. In Europe, M. canis is the most common agent in T. capitis cases. In the western part of our country, the Aegean region, M. canis is identified as the most common agent in T. capitis. In the Southeastern Anatolian region, T. violaceum, and in the Eastern Anatolian region, T. verrucosum, are the prominent agents [21]. Like the results from the Asian continent, in our eastern neighbour, Iran, T. capitis is one of the most commonly seen clinical types, and the most common agents are T. violaceum and T. verrucosum [36, 37]. In our study, conducted in our region (on the Asian continent and in the eastern part of our country), we found T. capitis as the third clinical type and the most common agent in this clinical type was detected as T. verrucosum, similar to the study in Iran.

In our study, in about twenty percent of the patients dermatophysitosis was detected in more than one site. The

DOI: 10.5455/medscience.2022.12.264

rate of having dermatophysitosis in more than one site varies between 17-37% in various studies, and, in these studies, T.pedis and T. unguium are reported as the most common comorbid dermatophysitosis, as in our study [8, 9, 14]. The rate of T. pedis+T. unguium cases in more than one dermatophysitosis patient were reported as 78.26% by Metin et al (8), 57.8% by Saniç et al (9) and 67.3% by Baysal et al [14]. Similarly, in our study, we determined that, of the cases having dermatophysitosis in more than one site, 59.2% were T. pedis+T. unguium, and this was detected as the most common comorbidity. The second most frequent comorbidity we detected was T. pedis+T. inguinalis with a rate of 11.2%. All of the three mentioned studies this comorbidity was observed in our study as the most frequent second comorbidity with a various rate between 6.52%-29.2% [8, 9, 14].

With lower and close frequencies, we detected comorbidities of T. inguinalis+T. unguium, T.pedis+T. manum, and T.unguium hand+T. unguium foot cases. From this aspect, our study was compatible with previous study data [8, 9, 14, 20].

In our study, of the 443 dermatophysitosis diagnoses, 23.7% had history of animal contact. These rates were marked significantly by 100% for T.barba, 81.8% for T.capitis, 77.8% for T.corporis and with 66.7% for T. facialis.

History of animal contact was remarkable, in 96.9% cases reproducing T. verrucosum, 87.5% cases reproducing M. canis, 66.7% cases reproducing T. violaceum, and 1 case reproducing M.nanum. Zoophilic dermatophytes are infections originating from mammals and poultry, mostly cat, dog, bovine, horse and rodents, transmitted from animals to humans and commonly seen in humans [15]. In the studies conducted, it was reported that the epidemiology of zoophilic agents may change, for instance in England, with industrial development and less contact with animals, cases occurring by T. verrucosum decreased [38]. As for zoophilic agents, in our study, we determined four species- T. verrucosum, M. canis, M. nanum, and T. mentagrophytes. The characteristic that our region deals mainly in livestock supported our findings. Particularly, in our cattle-breeding region, T. verrucosum was forefront among agents. In our study 21.2% of the cases were from rural areas, and 78.8% were from urban areas. All of the T. barba cases, 84.1% of T. capitis cases and 67% of T. facialis cases were in patients from rural areas. In patients from rural areas, T. verrucosum, M. Canis and T. violaceum were predominant as the agent. In our study, social living space, contact with animals, and zoophilic agents supported our findings.

Conclusion

Comparing previous studies, it was determined that the ethiologic and epidemiologic characteristics of dermatophysiyoses have changed in the last 8-10 years, and they have exhibited prominent differences compared to 20-30 years ago. Also, some differences in our region compared to the other regions of our country were determined. All these differences suggest that these changes may be related to lifestyles of the society, livelihood sources, and social conditions. We hope that the results of our study can shed even a small amount of light on the measures to be taken by public health providers, preventive and curative medical services, and further studies necessary. We suggest that, in order to obtain better data, multidisciplinary and more comphrehensive studies are needed.

Conflict of interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical approval
Informed consent was obtained from all patients, and the local ethical commitee approved the study protocol.

References

1. Ozdemir S, Aktas E, Erdem T, et al. Clinical and mycological features in cases with Tinea pedis, tinea cruris and tinea corporis TURKDERM 1996;30:23-6.
2. Havlickova B, Czaika VA, Friedrich M. Epidemiological trends in skin mycoses worldwide. Mycoses 2008;4:2-15.
3. Pişkin S; The defence mechanisms and allergic reactions in dermatophyte infections. J Int Med Sci 2005;1:12-5.
4. İnci R. Factors and Epidemiology in Dermatomycoses. 1st National Fungal Diseases and Clinical Mycology Congress, Congress Book1999:87-94.
5. Weitzman I, Summerbell RC. The dermatophytes. Clin Microbiol Rev 1995;8:240-59.
6. Seebacher C, Bouchara JP, Mignon B. Updates on the Epidemiology of Dermatophyte Infections, Mycopathologia 2008;166:335-52.
7. Kot S, Ergenekon G. The Incidence of the 343 Fengal Infections According to Sex and Age. Eurasian J Med.1979;11:87-93.
8. Metin A, Turanlı AY, Peksarı Y, Cantürk M.T. Dermatophytic flora of Samsun and vicinity. Turkiye Klinikleri J Dermatol 1997;7:27-32.
9. Saniç A, Günaydın M, Durupınar B, et al. Turanlı AY, Pekbay A, Seçkin D, Leblebicioğlu H. Dermatophyotes in Samsun Region. Mikrobiyol Bült 1996;30:57-63.
10. Parlat P, Bahadır S, Alpay K, et al. Dermatophytic Structure of Trabzon and Its Surroundings. TÜRKDERM, 2000;34:100-3.
11. Braun-Falco O, Plewig G, Wolff HH, Burgdorf WHC. Fungal Diseases. Dermatolgy, 2nd ed. Berlin: Springer; 2000:313-56.
12. Bilgili ME, Sabuncu İ, Saraçoğlu NZ, et al. Dermatophyte types isolated from patients presented with dermatophytosis in our clinic. Turkiye Klinikleri J Dermatol 2001;11:185-90.
13. Ergin C, Ergin S, Yaylı G, Baysal V. Factors of Dermatophytosis in Patients Applying to the Department of Dermatology, Faculty of Medicine, Süleyman Demirel University. Turk Mikrobiyol Cem Derg 30:121-4.
14. Baysal V, Özçelik N, Yıldırım M. Clinical and Mycological features of dermatophytoses in Isparta region. SDU Tıp Fak Derg. 1997;4:31-5.
15. Dursun R. Superficial and Deep Fungal Infections of the Skin: Epidemiologic Characteristics in the World and Turkey. Türkiye Klinikleri J Dermatol-Special Topics 2008;1:3-12.
16. Ak ME. Tinea pedis Infection and Its Causes in Secondary and Higher Education Dormitories Atatürk University Faculty of Medicine,

DOI: 10.5455/medscience.2022.12.264

Department of Skin and Venereal Diseases, Specialization Thesis Erzurum, 1980.

17. Arpalı H. Dermatophyte Infections and Results of Tuberculin Skin Test in These Infections. Atatürk University Faculty of Medicine, Department of Dermatology and Venereal Diseases, Specialization Thesis Erzurum 1980.

18. Uslu H. Factors of dermatophytosis isolated from patients with superficial fungal infections in our region. Atatürk University Institute of Health Sciences Department of Microbiology and Clinical Microbiology: Doctoral Thesis, Erzurum, 2002.

19. Köktürk A, Delialioğlu N, Kaya Tİ, et al. Dermatophylic flora of Mersin. Turkiye Klinikleri J Dermatol 2002;12:135-9.

20. Öztürk G. Clinical manifestations of dermatophyte infections of the trunk and extremitıes. Turkiye Klinikleri J Int Med Sci 2005;1:6-11.

21. İkizoğlu G. Changes in dermatophyte infections epidemiology in milenium. Turkiye Klinikleri J Dermatol 2002;12:165-72.

22. Metin A, Subaşı Ş, Bozkurt H, Çalka Ö. Tinea capitis in Van Turkey. Mycoses 2002;45:492-5.

23. Ergenekon G. Causes of Scalp Fungal Infections. Atatürk University, Faculty of Medicine, Department of Dermatology and Venereal Diseases Specialization Thesis, Erzurum, 1976.

24. Aktaş A, Akdeniz N, Atasoy M, et al. Causative Agents of Dermatophytosis in Erzurum. 9. JEADV(Journal of the European Academy of Dermatology and Venereology), Abstract book Switzerland, 2000;10-30:168.

25. Fındık D, Mevlütoğlu İ, Kaya M, et al. Agents Isolated at the Mycology Laboratory of Selcuk University, from Patients with an Initial Diagnosis of Dermatophytosis Between 1994 and 2000 ADÜ Tip Fakültesi Dergisi 2001;2:19-22.

26. İnci R, Hilmioğlu S, Tümbay E, et al. Microsporum canis infections in Izmir and the surrounding area. Turkish Journal of Infection 1996;10:1-5.

27. Çakıroğlu C. Fungal Infections in Erzurum Central Primary Schools. Atatürk University Faculty of Medicine, Department of Dermatology, Specialization Thesis, Erzurum: 1977.

28. Melikoglu M, Özdemir Ş, Atasoy M, Erdem T. A case of tinea facialis with the appearance of polymorphous light eruption XXII. National Dermatology Congress, Abstarct book, 2008 Konya, 316.

29. Özekinci T, Özbek E, Gedik M, et al. The Agent o Dermatophytosis in Patients Attending to the Mycrobiology Laboratory of Dicle University Medical Faculty. Dicle Tıp Dergisi 2006,33:19-22.

30. Kolemen F. Dermatophytic Flora of Ankara. Dermatologica 1981;162:260-4.

31. Özkütük AA. Typing of Dermatophytes Isolated from Dermatomycosis Cases and Their Sensitivity to Antifungal Agents. Dokuz Eylul University Faculty of Medicine Department of Microbiology: Doctoral Thesis. İzmir, 1999.

32. Değerli K, Özbakkaloğlu B, Tümbay E, Özbilgin A. Dermatophyte Species Isolated in Manisa and Its Surroundings. 1st National Fungal Diseases and Clinical Microbiology Congress Abstract book, İzmir, 1999:295.

33. Yeğenoğlu Y, Azizlerli G, Kavala M, et al. Fungi causing onychomycosis and skin infections in patients admitted to the department of dermatology, İstanbul Faculty Of Medicine, during the last two years, in Publication of the Turkish Microbiological Society. Proceedings, Edt. by Tümbay E, İzmir, 1988;13:277-84.

34. Kiraz M, Kasımoğlu Ö, Aktan G. Susceptibility of dermatophyte to antifungal agents. Ankem Derg. 1990;4:273.

35. Foster WK, Ghannoum MA, Elewski BE. Epidemiologic surveillance of cutaneous fungal infection in the United States from 1999 to 2002. J Am Acad Dermatol 2004;5:748-52.

36. Falahati M, Akhlaghi L, Lari AR, Alaghehbandan R. Epidemiology of dermatophytoses in an area south of Tehran, Iran. Mycopathologia 2003;156: 279-287.

37. Jahromi BS, Khaksar AA. Aetiological agents of tinea capitis in Tehran (Iran). Mycoses 2005;49:65-67.

38. Arca E, Akar A, Gür AR. The retrospectıve clinical evaluation of superficial fungal diseases in Erzıncan and related regions between 1997 and 1999. Turkiye Klinikleri J Dermatol 2001;11:195-200.