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ZOOPHILIC AND GEOPHILIC DERMATOPHYTOSES AMONG FARMERS AND NON-FARMERS IN EASTERN POLAND

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Abstract: The study was aimed at assessing the frequency of zoophilic and geophilic fungal infections among farmers compared to non-farmers in eastern Poland. The study was carried out on adult patients with a suspicion of fungal infection of skin or its appendages. Skin scrapings or nail fragments were cultured on Sabouraud agar with chloramphenicol and cycloheximide for at least 3 weeks, and then identified based on macroscopic and microscopic morphology. In total, 116 subjects were included into the farmers group, 67 females and 49 males, aged 18–88 (median 53) years. Dermatophyte infection was found in 64 farmers (55.2%). Anthropophilic dermatophytes were identified in 61 farmers (52.6%), whereas zoophilic or geophilic dermatophytes – in only 5 farmers (4.3%). *Trichophyton verrucosum* was found in 3 cases, while *T. terrestrae* and *Microsporum gypseum* – 1 case each. The control group comprised 74 non-farmers, 40 females and 34 males, aged 18–93 (median 47) years. Among them, dermatophyte infection was found in 35 (47.3%) patients. Anthropophilic dermatophytes were identified in 30 (40.5%), whereas zoophilic or geophilic dermatophytes in 6 persons (8.1%): *M. canis* in 2 patients, and *T. verrucosum, T. mentagrophytes var. mentagrophytes (granulosum), M. nanum,* and *T. terrestrae* – 1 case each. There were no significant differences between farmers and non-farmers. Zoophilic and geophilic fungi identified in our study were responsible either for superficial mycosis and/or onychomycosis, no case of deep mycoses or scalp infections were found. Our data suggest that zoophilic and geophilic dermatophytoses are not frequent among eastern-Polish farmers.

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Key words: occupational hygiene, work-related infections, farmers, zoophilic and geophilic dermatophytes, superficial mycoses, onychomycosis, *Trichophyton verrucosum, Trichophyton mentagrophytes var. mentagrophytes (granulosum), Trichophyton terrestrae, Microsporum canis, Microsporum nanum, Microsporum gypseum*.

INTRODUCTION

Dermatophytoses are mycoses (fungal infections) of skin caused by dermatophytes – filamentous fungi which have the ability to invade the epidermis and keratinized structures derived from it such as hair or nails. They comprise three genera: *Trichophyton*, *Epidermophyton* and *Microsporum*, and are related to organisms in the soil which are capable of digesting keratinous material [16]. Zoophilic dermatophytoses are sporadic infections of man caused by dermatophytes typically invading animals [22]. The potential source of these fungi can be pets, farm animals, or wild animals. Farmers are believed to be at higher risk of zoophilic dermatophytoses because they are in regular contact with farm animals, as well as wild animals (rats, mice, etc.) which can also transfer fungal infection. Similarly, because of their occupational contact with soil, farmers and gardeners are thought to be at higher risk of geophilic dermatophytoses, i.e. mycoses caused by keratinophilic fungi typically developing in the soil. In the past, zoophilic and geophilic dermatophytoses were frequent among farmers in certain European countries

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and farm animals were the major source [6]. In contrast, results of other studies may suggest that farm animals are not an important source of dermatophytoses [8]. In Poland, during the last 8 years no cases of occupational disease caused by zoophilic or geophilic dermatophyte infections were registered by the Farmers' Insurance Fund [10].

The present study was aimed at assessing the frequency of infections with zoophilic and geophilic species among farmers with dermatophytoses compared to non-farmers.

STUDY POPULATION

The study was carried out in patients seen at our dermatology outpatient department between 1 April 1997 –31 October 2000. The patients were divided into 2 groups: farmers, and non-farmers as a control group. The following were the criteria for inclusion into the farmers group: 1) active or retired farmer, 2) age of 18 years or more, 3) suspicion of a fungal infection of skin or its appendages. The criteria for including a patient in the control group were: 1) no history of farm working, 2) 18 years of age or more, 3) suspicion of a fungal infection of skin or its appendages. Only residents of Lublin Voivodeship (one of the 16 Polish administrative districts) were enrolled into this study. Lublin Voivodeship is a mostly agricultural district, located in eastern Poland, which borders the Ukraine and Byelorussia.

In total, 116 subjects were included into the farmers group, 67 females and 49 males, aged 18–88 (median 53) years. The control group comprised 74 non-farmers, 40 females and 34 males, aged 18–93 (median 47) years.

METHODS

In each patient, scrapings of the diseased skin or nail fragments were inoculated on Sabouraud agar with chloramphenicol and cycloheximide (Mycoline, bioMerieux, France), and kept in the incubator at 27°C for at least 3 weeks. After colonies developed, species of the cultured fungus was identified based on its macroscopic and microscopic morphology [12, 20, 25]. The following dermatophyte species were classified as zoophilic: *Trichophyton verrucosum*, *Trichophyton mentagrophytes var. mentagrophytes* (*granulosum*), *Microsporum nanum*, and *M. canis* [16]. The fungus *Microsporum gypseum* was classified both as zoophilic and geophilic (the rationale is given in the discussion), and *Trichophyton terrestrae* was considered geophilic species. For assessing the differences between results found in both groups, the chi-square test was used, with the significance level $p = 0.05$.

RESULTS

Table 1 presents an overview of the main results. More detailed data on zoophilic and geophilic dermatophytoses in both groups are shown in Table 2, and for anthropophilic dermatophytoses – in Table 3. The observed differences between groups did not differ significantly.

Table 1. Dermatophytes in farmers and non-farmers from eastern Poland*.

Group	Farmers	%	Non-farmers	%
Number of patients included	116	100.00	74	100.00
Patients with dermatophytosis	64	55.17	35	47.30
Patients with zoophilic or geophilic dermatophytosis	5	4.31	6	8.10
Patients with anthropophilic dermatophytosis	61	52.59	30	40.54

* Note that the sum of numbers of patients with anthropophilic and zoophilic/geophilic infections is higher than the total numbers of infected patients in each group – this results from the fact that there were persons with parallel zoophilic and athropophilic infections.

Table 2. Zoophilic or geophilic dermatophyte species found in examined patients.

Microorganism	116 farmers	%	74 non-farmers	%
Trichophyton verrucosum	3	2.59	1	1.35
T. mentagrophytes var. mentagrophytes	0	0	1	1.35
T. terrestrae	1	0.86	1	1.35
Microsporum nanum	0	0	1	1.35
M. canis	0	0	2	2.70
M. gypseum	1	0.86	0	0
Infected with zoophilic or geophilic dermatophytes	5	4.31	6	8.10

Table 3. Antropophilic dermatophyte species found in examined patients.

Microorganism	116 farmers	%	74 non-farmers	%
T. mentagrophytes var. interdigitalis	18	15.52	12	16.22
T. rubrum	36	31.03	8	10.81
T. tonsurans	2	1.72	4	5.40
T. violaceum	2	1.72	0	0.00
Epidermophyton floccosum	15	12.93	10	13.51
Total persons infected with antropophilic dermatophytes*	61*	52.59*	30*	40.54*

* Note that these numbers are lower than the sum of numbers of patients infected by separate species, because some patients were infected with more than one dermatophyte species.

Dermatophyte infection was found in 64 of 116 farmers (55.17%). 52 farmers were infected each with one species, 10 farmers – each with 2 different dermatophytes, and a further 2 farmers – each with 3 species. Zoophilic or geophilic dermatophytes were identified in 5 farmers (4.31%), whereas the anthropophilic dermatophytes – in 61 farmers (52.59%). Detailed information about farmers with zoophilic or geophilic infections is given in Table 4.

Table 4. Farmers with zoophilic or geophilic dermatophytoses.

Patient	Infected site	Identified species	Possible source
ŚR, m, 40*	finger web	*T. terrestrae*	unknown (soil?)
NF, m, 81	toe nail	*T. verrucosum*	unknown
MD, f, 38	leg	*M. gypseum*	unknown
KT, f, 42	toe web	*T. verrucosum*	unknown (cattle?)
BI, f, 68	toe nail	*T. verrucosum*	unknown

* This patient had additionally a toe nail infection with the anthropophilic *T. rubrum*, and is therefore also presented in Table 6.

Table 5. Non-farmers with zoophilic or geophilic dermatophytoses.

Patient	Infected site	Identified species	Possible source
DK, m, 29*	groin	*T. verrucosum* + *E. floccosum*	dog
NZ, m, 45	toe nail	*M. nanum*	unknown
SE, m, 58	toe nail	*T. mentagrophytes var. mentagrophytes*	unknown
OM, f, 18	forearm	*M. canis*	hamster
ŻG, f, 43	foot	*T. terrestrae*	unknown (soil?)
KT, f, 45	forearm	*M. canis*	cat

* Because of a mixed infection with *T. verrucosum* and the anthropophilic *E. floccosum*, this patient is also presented in Table 7.

Among the 74 non-farmers, dermatophyte infection was found in 35 (47.30%). 31 non-farmers were infected each with one dermatophyte species, 3 persons – each with 2 different dermatophytes, and 1 non-farmer was infected at the same time with 3 dermatophytes. Zoophilic or geophilic dermatophyte infections were diagnosed in 6 persons (8.10%), whereas anthropophilic infections – in 30 (40.54%). Non-farmers with zoophilic or geophilic infections are presented in detail in Table 5.

In 12 farmers and 4 non-farmers, infections with more than one dermatophyte species were seen. Detailed information about farmers infected with more than one dermatophyte is given in Table 6; and about non-farmers – in Table 7.

DISCUSSION

Typical dermatophytes infecting farm animals, which may be transferred to farmers are *T. verrucosum*, *T. mentagrophytes var. mentagrophytes (granulosum)*, *T. equinum*, *M. equinum*, *M. nanum* and *M. gallinae* [4]. Typical hosts of *M. canis* are cats and dogs, however, the spread of the infection to swine has also been described [13]. *T. mentagrophytes var. mentagrophytes (granulosum)* typically invades wild animals; however, the infections are more prevalent among farmers than in other professions [6]. *T. mentagrophytes var. granulosum* is classified as zoophilic, however, a case of geophilic infection with this

Table 6. Farmers with infections caused by more than one dermatophyte species.

Patient	Infected site	Identified species
ŚR, m, 40*	finger web	*T. terrestrae*
	toe nail	*T. rubrum*
MJ, m, 50	toe nail	*T. rubrum*
	toe web	*T. mentagrophytes var. interdigitalis*
	finger nail	*T. mentagrophytes var. interdigitalis*
KS, m, 50	toe nail	*T. mentagrophytes var. interdigitalis* + *T. tonsurans*
KM, m, 51	right hand palm	*E. floccosum* + *T. rubrum*
	left hand palm	*E. floccosum* + *T. rubrum*
CS, m, 53	toe web	*T. mentagrophytes var. interdigitalis*
	toe nail	*T. rubrum*
GE, m, 59	toe nail	*T. rubrum* + *E. floccosum*
ST, m, 65	toe web	*T. rubrum* + *E. floccosum*
	toe nail	*T. rubrum*
KT, f, 39	foot sole	*T. violaceum*
	toe web	*T. mentagrophytes var. interdigitalis*
GM, f, 45	finger nail	*T. rubrum* + *E. floccosum*
MM, f, 48	toe web	*T. mentagrophytes var. interdigitalis* + *E. floccosum*
GL, f, 60	toe web	*T. mentagrophytes var. interdigitalis* + *E. floccosum*
	toe nail	*T. rubrum*
CH, f, 65	right hand palm	*E. floccosum*
	toe nail	*E. floccosum* + *T. rubrum*
	toe web	*T. mentagrophytes var. interdigitalis* + *T. rubrum*

* Because of geophilic infection with *T. terrestrae*, this patient is also presented in Table 4.

Table 7. Non-farmers with infections caused by more than one dermatophyte species.

Patient	Infected site	Infected site
DK, m, 29*	groin	*T. verrucosum* + *E. floccosum*
KJ, m, 39	back	*T. mentagrophytes var. interdigitalis* + *E. floccosum*
	sternum	*T. mentagrophytes var. interdigitalis* + *E. floccosum*
ZC, m, 93	toe web	*T. mentagrophytes var. interdigitalis* + *T. rubrum* + *E. floccosum*
BJ, f, 25	hand palm	*T. mentagrophytes var. interdigitalis* + *E. floccosum*

* Because of zoophilic infection by *T. verrucosum*, this patient is also presented in Table 5.

species in a gardener has also been documented [23]. Most authors classify the species *M. gypseum* as geophilic [5, 16, 25], and there are descriptions of occupational infections with this fungus from soil [2]; however, *M. gypseum* infections in cattle, horses, and dogs have also been described [3, 17]. This shows that the division of dermatophytoses into zoophilic and geophilic is arbitrary and should be revised in each case. *T. terrestrae* is classified as geophilic and we are not aware of any reported transmission of this fungus from animals.

Farm work is generally associated with higher risk of developing fungal infections, both due to contact with many potential sources of fungal infection (animals, soil) as well as to hygienic conditions at the workplace (wet work, rubber boots) which promote infection, both with zoophilic, geophilic, or anthropophilic dermatophytes [22]. Working in rubber boots, due to retention of humidity, especially promotes fungal infections of feet – among 184 farmers in northern Poland, *tinea pedum* was found in 45 [18]. In the past, zoophilic dermatophyte infections presented a major problem in agricultural occupational medicine in some European countries. In Slovakia, in the years 1967–1972 they constituted 27.5–48.2% of all registered occupational skin diseases [7]. On the other hand, in Germany occupational zoophilic mycoses are considered rare enough to be published as case reports [11].

It seems that in Poland, zoophilic or geophilic dermatophytoses are not frequent in agriculture. During the last 8 years, no cases of zoophilic or geophilic occupational dermatophyte infections were registered by the Polish Farmers' Insurance Fund [10]. In Poznań Voivodeship (western Poland) – a region with large arable areas and animal production, among 671 patients with mycoses diagnosed in the years 1984–1988 in the Dermatology Clinic, 94 (14%) were infected with zoophilic fungi: 70 patients with *T. mentagrophytes var. mentagrophytes (granulosum)*, 22 with *M. canis* and 2 with *T. verrucosum* [1]. This percentage is higher than figures found in our patients. In contrast, cases of zoophilic and geophilic dermatophytoses are very rare in the industrialised city of Kraków (Cracow) and its surroundings (southern Poland): from a total of 1,479 dermatophytoses diagnosed during 1988–1997, there were only 39 infections with *M. canis*, 4 with *T. terrestrae* and 2 with *M. gallinae*, which constituted altogether less than 1% [15].

In industrialised area of Gdańsk (northern Poland), among 705 children with dermatophytoses, zoophilic infection with *M. canis* was identified in 267 cases, with *T. mentagrophytes var. mentagrophytes (granulosum)* – in 110 cases, with *T. verrucosum* – in 7 cases, and with *M. gypseum* – in 1 case. In Kraków and Nowa Huta, an "epidemic" of *M. canis* infection was described, which affected 44 persons, among them 33 children and 11 adolescents and adults [21]. These data suggest that nowadays in Poland the group most frequently infected with zoophilic dermatophytes are children [24]. This hypothesis is supported by another study on zoophilic *tinea capitis* which has shown that among 101 *M. canis*-infected children all transmissions occurred from pets (cats, dogs, hamsters, guinea pigs); however, among 73 *T. mentagrophytes*-infected children, 55 transmissions occurred from farm animals (cattle, swine, goats) and 18 – from pets (cats, dogs, hamsters) [15]. This suggests that the most important sources of infections are pets. This is in accordance with a study from the UK suggesting that even in typically agricultural areas, domestic pets are a more important source of infection than the farm animals [8].

Zoophilic dermatophytoses can clinically appear as mycosis of scalp *(tinea capitis)*, superficial skin mycosis or deep cutaneous infection with formation of pustules, inflammatory infiltrate and soft nodes *(kerion Celsi)* are also possible. The latter changes typically appear in the beard region in men, however, also less typical localisation on forearms and chest was described in farmers [19]. Zoophilic dermatophytes may also infect the nails (onychomycosis) [9]. In our patients, we have seen only superficial skin mycoses and onychomycosis. It is also interesting that none of the farmers was able to clearly indicate a possible source of infection, although all of them gave a history of tending farm animals. Among 5 non-farmers infected with zoophilic dermatophytes, 3 were able to trace the possible sources – domestic pets in all cases.

CONCLUSIONS

Zoophilic and geophilic dermatophytoses are not frequent among eastern-Polish farmers.

All identified cases of zoophilic and geophilic dermatophytoses had clinical forms of superficial mycoses and onychomycoses.

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