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Original scientific paper

Epidemiology of Superficial Mycosis (Tinea Pedis, Onychomycosis) in Elementary School Children in Istanbul, Turkey

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ABSTRACT

The purpose of this study is to determine the prevalence of tinea pedis and onychomycosis in children of elementary school age and to examine the socio-demographic attributes that may be effective in correlation of both mycoses. 3,390 female and 3,768 male children between ages 6–14 have been examined in seven schools. Skin scrapings and nail samples were taken from 13 students who were suspected to have tinea pedis and from 49 students who were suspected to have onychomycosis. According to direct microscopy (10–15% KOH+calcofluor white) and culturel examination (Sabouraud dextrose agar and dermatophyte test medium) 11 students were diagnosed as tinea pedis and 24 were diagnosed as onychomycosis. Trichophyton rubrum *was isolated in 3 students with tinea pedis whose culture was positive and five* Candida albicans*, five* Candida glabrata *and one* Candida tropicalis *cases were isolated from 11 samples with onychomycosis. Tinea pedis prevalence has been found to be 3.3%0. Differences between onychomycosis prevalence based on age have been found to be significant ($p<0.001$). In conclusion, it has been determined that the prevalence of tinea pedis and onychomycosis among children is low.* Candida spp. *was isolated from all of the 14 samples diagnosed as onychomycosis. Our study shows similar results with previous studies done in Turkey and that* Trichophyton rubrum *continues to be the most isolated agent.*

Key words: *tinea pedis, onychomycosis, superficial mycosis, epidemiology, elementary school children, Istanbul, Turkey*

Introduction

The real prevalence rate of tinea pedis and onychomycosis is not known because patients do not seek a medical advice unless their quality of life is affected, as these are not life threatening diseases[1,2]. This may be one of the reasons why we see differences in prevalence rates among various studies. Other factors are the differences in methodology, population sample (healthy general population or dermatological patients) and size in these studies[2,3]. Gupta et al.[4] have shown the prevalence of onychomycosis in adults to be 6.5% and worldwide prevalence in adults varies from 0.1% to 13.8%[4,5]. In Spain, tinea pedis prevalence is 2.9% and onychomycosis prevalence is 2.8% in general population[3]. Tinea pedis and onychomycosis prevalence rates are also affected by social status, occupation, climate, travel, living environment, age and predisposing factors[1,2,3,4].

Tinea pedis is less common in children than adults and rare before four years[6]. Gupta et al[5] reports that the onychomycosis prevalence rates in children are 30 times less than adults.

In this study we aim to find the prevalence rates, aetiology and the effect of age, sex and social status on the prevalence rates of tinea pedis and onychomycosis in elementary schools children in Istanbul.

Materials and Methods

Study population

This is a prospective study, carried out in Istanbul, between September 2000 and May 2002. Istanbul has a population over ten million and it is the most crowded

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city in Turkey. For this study seven elementary schools with different socio-economic status (SES) were selected by random sampling. Two schools with middle and higher SES were on the European side and two were on the Asian side. One school with lower SES was on the Asian side and two were on the European side. Istanbul Board of Education and the school managements granted permission for this study.

From each school approximately 1,000 students between the ages of 7 and 14 were randomly selected and we had a study population with 7,158 students. 100 students, ages 11 and up from each school (total 700) selected randomly[7] and filled a survey form about their SES. This survey helped us evaluate the socio-economic differences between the schools. In the questionnaire there have been questions on the educational background of the parents, the situation of their residence and monthly income.

Survey methods

The public health physicians, pediatricians and microbiologists from Istanbul University Medical Faculty did students' physical examinations during the school hours. Any areas suspicious for tinea pedis and onychomycosis were first cleaned with 70% alcohol and then samples were taken from skin (by scraping) and nail. Specimens were collected into small sterile Petri dishes and sent to Istanbul University Microbiology Department laboratory. Suspicious skin scrapings and nails were clarified in 10–15% KOH + calcofluor white through the direct microscopic method and then examined under a fluorescent microscope and assessed as positive or negative according to the existence of mycelium and / or spores. Afterwards, these samples were placed on test cultivation places onto Sabouraud dextrose agar (SDA) and dermatophyte test medium (DTM) and incubated for a period of 21 days at 26–30°C.

The identification and specification of the agents was made according to their morphological, microscopic and specific test characteristics of growing colonies[8].

Statistical methods

Statistical analyses were done at the Istanbul University Department of Public Health. The survey forms filled by 100 students from each school were statistically analyzed and the socio-economic differences between the schools were evaluated. SES, mycosis prevalence according to age and sex and 95% confidence interval was defined. χ^2 test was used in order to define the relationship between the categorized variables. (The measurement level of SES variable is 'ordinal' so SES level and tinea pedis and onychomycosis prevalence relations were analyzed by 'χ^2 test for trend')[9]. P values less then 0.05 were considered as statistically significant.

Results

7,158 students; 2,100 from higher, 1,830 from middle and 3,228 from lower SES were examined for mycosal infections. Students were between 6 and 14 years old and 3,390 of them (47.3%) were female and 3,768 of them (57.7%) were male. 62 students were clinically suspicious for mycosal infections (13 tinea pedis, 49 onychomycosis) and samples were taken from skin, finger and toe nails.

100 students, ages 11 and up from each previously selected schools (total 700) filled a survey form about their SES in order to evaluate the socio-economic differences between the schools. According to the survey results the SES differences between the schools were statistically significant ($p<0.001$, $p=0.05$, $p=0.001$ respectively, Table 1).

In our study tinea pedis prevalence was 1.5% and onychomycosis prevalence was 3.3%.

TABLE 1
QUESTIONNAIRE RESULTS HELD IN SCHOOLS WITH DIFFERENT SOCIO-ECONOMIC STATUS

SES	H level (N=200)		M level (N=200)		L level (N=300)		Total (N=700)		p value
	n	%	n	%	n	%	n	%	
Educational level of mother									
≤ 5 year	144	72	154	77	–	–	298	42.5	<0.001
> 5 year	56	28	46	23	300	100	402	57.5	
Educational level of father									
≤ 5 year	164	82	176	88	102	34	442	63.1	<0.001
> 5 year	36	18	24	12	198	66	258	36.9	
House									
Self belonging	160	80	116	58	234	78	510	72.8	≤0.05
Leased property	40	20	84	42	66	22	168	27.2	
Monthly average income (TL)*	750 million		250 million		175 million		298 million		≤0.001

H – high, M – medium, L – low, SES – socio-economic status

Tinea pedis prevalence was 0.98% for 5,090 students aged 11 years and younger, 2.9% for 2,068 students older than 11 years. Onychomycosis prevalence was 1.4% for students aged 11 years old and younger and 8.2% for students older than 11 years. For both tinea pedis and onychomycosis the rates were higher in the students 11 years up. The relationship between age and tinea pedis prevalence was not statistically significant, but the relationship between age and onychomycosis prevalence was highly significant (95% confidence interval 4.8–13.1, $p<0.001$, Table 2).

In Table 3, sex versus tinea pedis and onychomycosis prevalence is shown. The prevalence rates for both tinea pedis and onychomycosis were higher in females but these were not statistically significant. Three female students had co-existing tinea pedis and onychomycosis infection.

In Table 4 tinea pedis and onychomycosis prevalence is shown in schools with different socio-economical background. Although the prevalence rates in schools with lower SES are higher than the schools with middle and upper SES, the differences between prevalence rates of schools with any of three economic status were not statistically significant.

In the laboratory diagnosis of fungal diseases, microscopic and cultural methods should be performed together. If the direct microscopic examination is positive but cultural examination is negative than these findings are not taken into consideration. In our study, 62 clinical findings comply with mycosis. 37 of 62 clinical findings are only positive with direct microscopic examination with the rate of 59% while 14 of 62 findings are both positive with direct microscopic examination and cultural examination with the rate of 22%.

However, during the physical examinations, meetings are held with the students and the school directory and seen that 21 of 37 students were already diagnosed with mycoses whether during health check ups previously realized in the school or in hospitals they have been taken by their parents. These students were still using antifungal medicine orally and topically. So regarding that antifungal medicines inhibit reproduction of fungi were considered as mycoses by clinical and microscopic examination, 16 cases, all of which have positive clinical and microscopic examination, were not taken into prevalence calculation.

8 samples taken from 13 students clinically suspicious for tinea pedis were diagnosed by direct microscopy and 3 samples were diagnosed by both direct microscopy and

TABLE 2
CUTENOUS MYCOSIS ACCORDING TO AGE

Mycosis	Age≤11		(N=5,090)	Age>11		(N=2,068)	p^b value
	n	%	(95% CI)	n	%	(95% CI)	
Tinea pedis	5	0.98	(0.73–1.29)	6	2.9	(1.1–6.3)	0.123
Onychomycosis	7	1.4	(0.6–2.8)	17	8.2	(4.8–13.1)	<0.001

[b]Yates' χ^2 test, CI – Confidence interval

TABLE 3
CUTENOUS MYCOSIS ACCORDING TO SEX

Mycosis	Female (N=3,390)			Male (N=3,768)			p^b value
	n	%	(95% CI)	n	%	(95% CI)	
Tinea pedis	8	2.4	(1.0–4.0)	3	0.8	(0.2–2.3)	0.166
Onychomycosis	16	4.7	(2.7–7.2)	8	2.1	(0.9–4.2)	0.091

[b]Yates' χ^2 test, CI – Confidence interval

TABLE 4
CUTENOUS MYCOSIS PREVALENCE IN DIFFERENT SOCIO-ECONOMIC STATUS

Mycosis	High SES (N=2,100)			Medium SES (N=1,830)			Low SES (N=3,228)			p^a value
	n	%	(95% CI)	n	%	(95% CI)	n	%	(95% CI)	
Tinea pedis	2	1.0	(0.1–3.4)	3	1.6	(0.3–4.8)	6	1.9	(0.7–4.0)	0.421
Onychomycosis	4	1.9	(0.5–4.9)	5	2.7	(0.9–6.4)	15	4.6	(2.6–7.7)	0.152

[b]Yates' χ^2 test, CI – Confidence interval, SES – socio-economic status

TABLE 5
DISTRIBUTION OF TINEA PEDIS AND ONYCHOMYCOS ISOLATED STRAINS

Mycosis	S	M. pos.	M. pos. left out evaluation	M. pos. C. pos.	M. neg. C. neg.	*Trichophyton rubrum*	*Candida albicans*	*Candida glabrata*	*Candida tropicalis*
Tinea pedis	13	8	2	3	–	3			
Onychomycosis									
Finger	18	4	5	4	5		1	2	1
Toe	31	9	9	7	6		4	3	
Total	62	21	16	14	11	3	5	5	1

S. – clinically suspicious, M. – microscopic exam, C. – cultural exam, pos. – positive, neg. – negative

culture. *Trichopyton rubrum* was isolated from these 3 samples.

49 students were clinically suspicious for onychomycosis. 4 finger nail samples taken from 18 students were diagnosed by direct microscopy and the other 4 were diagnosed by both direct microscopy and culture. From these; 1 *Candida albicans*, 2 *Candida glabrata* and 1 *Candida tropicalis* were isolated. Toe nail samples were taken from 31 students. 9 samples were diagnosed as onychomycosis by direct microscopy, 7 samples were diagnosed as onychomycosis by both direct microscopy and culture. 4 *Candida albicans* and 3 *Candida glabrata* were isolated from the samples (Table 5).

Discussion

In this research, the study population consists of 7,158 students between the ages of 6 and 14. 62 of these students were considered suspicious for mycosal infections after the physical examinations and samples were taken. 21 (33%) of the samples were diagnosed by direct microscopy as mycosis and 14 (22%) of them were diagnosed by both direct microscopy and culture. Tinea pedis prevalence was 1.5%, onychomycosis prevalence was 3.3% (8 finger nails, 16 toe nails).

In studies done in school age children Inanir et al.[10], Popescu et al.[11], Ruiz-Esmenjaud et al.[12], Bahamdan et al.[13], Schmeller et al.[14], Leibovici et al.[15], show tinea pedis prevalence between 0 to 6.9%, Inanir et al.[10], Gupta et al.[4], Schmeller et al.[14], show onychomycosis prevalence between 0 to 0.2%. Gupta et al.[16] chose a study population among patients from a dermatology clinic and despite this, found a very low onychomycosis rate (0.44%) in children 18 years old and younger.

Our study shows similarities with other studies and low prevalence rates are also seen. However in contrast to other studies, we found onychomycosis prevalence rate higher than the tinea pedis prevalence rate.

Tinea pedis prevalence was 0.98% for students aged 11 years old and younger, 2.9% for students older than 11 years old. This is not statistically significant. Onychomycosis prevalence was 1.4% for students aged 11 years old and younger and 8.2% for students older than 11 years old. This is highly significant ($p<0.001$). Ogasawara et al.[2], Leibovici et al.[15] Gupta et al.[16], Han et al.[17], Reichart-Penetrat et al.[18] show that tinea pedis and onychomycosis prevalence rate increase in children older than 10 years. In Spain, in general population as the age increases tinea unguium prevalence rate increases, but there is no such correlation with tinea pedis[3]. In Australia the Tinea pedis prevalence rates are 2.1% between 4 and 6 years olds and 9.7% between 16 and 18 years olds[19].

Madhuri et al.[1] report that the onychomycosis incidence rate is highest between 21 and 30 years olds. In a study done in general population, onychomycosis incidence rate differences are highly significant between the ages 0–14, 15–34 and 35 and up[20].

Ogasawara et al.[2], Evangeline et al.[21] show high prevalence rates in 50 years olds and up. Reasons for the age-related increase in onychomycosis may include poor peripheral circulation, diabetes, repeated nail trauma, longer exposure to pathogenic fungi, suboptimal immune function, inactivity or the inability to cut the toenails or maintain good foot care[1].

In our study tinea pedis is seen in 2.4% of female students and 0.8% of male students. Onychomycosis prevalence is 4.7% in female students and 2.1% in male students. The prevalence rates are higher in female students for both types of mycosis, but this is not statistically significant. It is known that tinea pedis and onychomycosis are seen more in males[2,3,22], but in contrast Madhuri et al.[1], Bramono et al.[23], Gupta[4], Koussidu et al.[24] found higher prevalence rates in females.

According to some researchers, life style is more determinative than social status for tinea pedis and onychomycosis infections[2]. They are seen more often in people who do wet work[1,23], use swimming pools, go to gyms[22], wear tight and close shoes[1,12,25], immunosuppressed[26], wash their feet frequently and in Muslim population as they need to wash their feet five times a day [15,20] and in boarding school students[27]. They are seen rarely in populations who do not wear shoes[14]. On the other hand, Inanir et al.[10,] Metintas et al.[27] stress out that like in other skin infections, lower socio-economical status, bad hygiene, lower mother education levels and lower income are important factors in having cutaneous tinea infections.

In our study tinea pedis prevalence in schools with different SES are; 1.0%, 1.6%, 1.9% respectively and onychomycosis prevalence are 1.9%, 2.7% and 4.6%. These differences are not statistically significant, but especially the onychomycosis prevalence rates draw our attention.

The reasons for superficial mycosis are dermatophyte, yeast and non-dermatophyte filamentous fungi. Yeast and non-dermatophyte filamentous fungi are resistant to antifungal medicines and the identification of their types are very important for infection control and public health. In literature we see that different dermatophyte types (etiological agents) show differences from year to year and region to region. These differences are due to geographical and climate conditions and immigration[21,28–31.]

In this study, tinea pedis was recovered from 11 samples and 3 of these were diagnosed by culture. *Tricvhophyton Rubrum* was isolated in all. *Trichophyton rubrum* is the major agent for tinea pedis and onychomycosis. In studies carried out in Turkey, Inanir et al.[10], Sahin et al.[20], Metintas et al.[27], Erbagci et al.[32], Findik et al.[33] show *Trichophyton rubrum* as the most common agent seen in dermatophytoses other than tinea capitis. In other studies carried out in different parts of the world *Trichophyton rubrum* is also the most commonly isolated agent[2,19,22,28,34–37].

Candida spp. (*5 Candida. albicans*, 5 *Candida. glabrata*, 1 *Candida. tropicalis*) was isolated from all of the 14 samples diagnosed as onychomycosis. *Candida albicans* is the most common species causing candidal onychomycosis. According to Elewski[26] unless there is immunsupression (acquired immunodeficiency syndrome, chemotherapy, and congenital immunodeficiency syndromes), extensive cutaneous mycosis (tinea capitis or pedis) or a strong family history of onychomycosis it is very rare to see onychomycosis in children.

Bramano et al.[23], Brilhante et al.[25], Tan H. H[37], report that candidal onychomycosis is seen more in finger nails than toe nails and more in females than in males. Domestic activity involving wet work associated with constant trauma to the nails could probably explain higher prevalence among women[1]. Candidal onychomycosis was the most prevalent clinical type (58.82%) followed by distal subungual onychomycosis[1]. In Singapore, candidal onychomycosis is reported as the most prevalent clinical type[37]. Madhuri et al.[1] isolated most commonly *Candida* spp. from finger nails and dermatophyte from toe nails. In Turkey, Kiraz et al.[38] show that *Candida* spp is the most commonly isolated agent from finger nails and *Trichophyton rubrum* is the most commonly isolated agent from toenails.

Conclusion

In our study Tinea pedis and onychomycosis are observed rarely in children. The differences between prevalence rates of tinea pedis according to age, gender and socio economic status were not found significant. But the differences between prevalence rate of onychomycosis according to age is highly significant ($p<0.001$). Prevalence rate is high in above 11 years olds. Tr*ichophyton rubrum* is the agent isolated from Tinea pedis and *Candida* spp. is the agent isolated from Onychomycosis. Our study shows similar results with previous studies done in Turkey and that *Trichophyton rubrum* continues to be the most isolated agent. Since superficial mycosis is not fatal, in Turkey and in many other countries the treatment of these diseases is neglected. Adversely in our study concerned behaviors of parents and school directors were remarkable.

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EPIDEMIOLOGJA POVRŠINSKIH MIKOZA (TINEA PEDIS, ONYCHOMIKOSIS) U ŠKOLSKE DJECE U ISTANBULU, TURSKA

S A Ž E T A K

Cilj ove studije je odrediti prevalenciju tineae pedis i onychomikoze u djece osnovnoškolske dobi te ispitati sociodemografske značajke koje bi mogle biti vezane uz obje mikoze. Ispitano je 3,390 djevojčica i 3,768 dječaka u dobi od 6–14 godina u sedam škola. Strugotine kože i uzorci noktiju uzeti su od 13 učenika za koje se sumnjalo da imaju tineu pedis te od 49 učenika za koje se sumnjalo da imaju onychomikozu. Direktnim mikroskopiranjem (10–15% KOH+kalcij-fluorid) te ispitivanjem kulture (Sabouraud dextrose agar and dermatophyte test medium) u 11 učenika je dijagnosticirana tinea pedis, a u 24 onychomikoza. *Trichophyton rubrum* izoliran je u 3 učenika s tineom pedis. Od 24 uzoraka s onychomikozom u pet ih je izolirana *Candida albicans,* u pet *Candida glabrata* a u jednoj *Candida tropicalis.* Ustanovljena je zastupljenost tinee pedis od 3.30%. Također su ustanovljene značajne razlike ($p<0.001$) u prevalenciji onychomikoze s obzirom dob. Rezultati pokazuju kako je prevalencija tinee pedis i onychomikoze među djecom niska. *Candida spp.* izolirana je u 14 uzoraka dijagnosticiranih sa onychomikozom. Ova studija pokazala je rezultate koji se podudaraju sa prethodnim istraživanjima provedenih u Turskoj kao i činjenicu da je *Trichophyton rubrum* i dalje najprisutnija mikoza.