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An epidemiologic study of the fungal skin flora among the elderly in Alexandria

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SUMMARY

The fungal skin flora of a sample of 205 elderly persons in Alexandria, drawn by cluster sampling probability technique, was investigated. Pathogenic yeasts were isolated from 18·6% and 10·3% of skin and nails respectively. *Candida albicans* (16·1% and 7·3%) was prominent. A low prevalence of dermatophytes grown on agar (2·4% from skin and 2·9% from nails) was observed. In contrast, saprophytic filamentous fungi comprised 45·4 and 50·7% of skin and nails samples respectively. This study showed no statistically significant effect of sociodemographic variables (sex, marital status, crowding index, and income *per capita*) on the skin flora. There was no statistical significant difference between elderly diabetics and non-diabetics as regards fungal skin flora.

INTRODUCTION

A marked increase in mycoses has been observed in all branches of medicine during the last decade; even more pronounced has been the increase in opportunistic fungal infections. Determining the fungal flora of normal elderly persons is important when considering the role of skin as a resevoir from which infection of a susceptible host can occur (Raab, 1980).

MATERIALS AND METHODS

The Alexandrian population comprises about 4 millions in a stable and homogeneous coastal community. The estimated population over 55 years old residing the area is around 200000 (Ministry of Health, 1985).

Cluster probability sampling technique was used to identify successively census enumeration districts, blocks and finally households. The map of Alexandria's residential area was divided geographically into six zones. A cluster was chosen from each zone. In each cluster a house to house survey was performed to detect those aged 55 years and over. At least 30 persons were drawn from each cluster. During the visit basic epidemiologic data was collected. An appointment for an examination at a special clinic was given, and if the subject was frail or ill, an

appointment was made for an examination at home. During the examination, samples were taken from the toe webs and toe nails. A sample of blood was withdrawn for glucose estimation.

The fourth toe webs (Noble & Somerville, 1974) of the feet were scraped without previous washing (English & Gibson, 1959) using the edge of glass slides (Gilchrist, 1979). Nails were cut or pared using sterile scissors or the edge of the glass slides respectively. Portions of the samples from both skin and nails were mounted in 10–30% KOH, according to specimen thickness, and used for direct microscopic examination. The rest of the material was inoculated on Sabouraud dextrose agar (SDA) with and without antibiotics (glucose 10 g, peptone 10 g, agar 15·5 g, 0·4 g of cyclohexamide, 0·05 g chloramphenicol per litre substrate, and 1000 ml distilled water) and incubated at 28 °C for up to 6 weeks before being considered negative (Ajello *et al.* 1963). Filamentous fungal isolates were identified by morphology and the tests described by Al Doory (1980). Yeasts were identified using API 20 system.

Glucose was determined spectrophotometrically at a wave length of 505 nm using enzymatic PAP technique. The presence of diabetes mellitus was considered when fasting glucose level was 140 mg/dl or more or the patient gave a history of diabetes (WHO, 1985).

Z test (to compare between two proportions) and Student's *t* test (to compare between two means) were used as tests of significance at 5% level of significance (England, 1975).

RESULTS AND DISCUSSION

The sample included 87 males and 118 females with an age range from 55 years to 85 years (mean 64·8 ± 7·5 years).

Fungi recovered

Direct KOH examination revealed fungal elements in 132 (64·4%) skin samples and in 123 (60%) nail samples.

Table 1 shows the fungi isolated from skin and nails. Yeasts were isolated from 20·6 and 12·3% of skin and nails respectively. *Candida albicans* (16·1% of skin and 7·3% of nails) predominated. This is in accord with the results of Noble & Somerville (1974) who reported that *C. albicans* was more common on the skin in adults over 65 years of age. Marples & Somerville (1968) reported an increased incidence of yeasts on the skin, especially *C. albicans*, in tropical countries. They reported a prevalence of 21% for *C. albicans* carriage in an old people's home.

Mock & Silva (1984) reported the recovery of fungi from 10% of healthy inhabitants of three Amazonia communities. Most of the isolates were of pathogenic potential such as *C. albicans*, *C. guilliermondii*, *C. parapsilosis*, *C. stellatoidae*, *C. tropicalis*, *Rhodotorula rubra*, *Torulopsis glabrata*, *Trichosporon cutaneum* and *Trichophyton tonsurans*.

The low prevalence of isolated dermatophytes in the present study (2·4% from skin and 2·9% from nails) is in agreement with Noble & Somerville (1974). In several surveys, a pathogenic fungus has been isolated from apparently normal skin (Marples & Baily, 1957; Gentles & Holmes, 1957). Lopez Martinez (1981) in

Table 1. *Fungi isolated from skin and nails among 205 elderly subjects in Alexandria*

Organisms	Skin No.	Skin (%)	Nails No.	Nails (%)
Pathogenic organisms				
Yeasts				
Candida albicans	33	16·0	15	7·5
C. tropicalis	2	1·0	2	1·0
C. parapsilosis	3	1·5	4	2·0
Subtotal	38	18·5	21	10·0
Hendersonula toruloidea	9	4·5	12	6·0
Dermatophytes				
Trichophyton mentagrophytes	5	2·5	5	2·5
T. equinum	0	0·0	1	0·5
Subtotal	5	2·5	6	3·0
Saprophytic organisms				
Yeasts				
Saccharomyces spp.	4	2·0	4	2·0
Filamentous fungi				
Aspergillus fumigatus	10	5·0	12	6·0
A. niger	25	12·0	41	20·0
Penicillium species	58	28·0	51	25·0
Subtotal	93	45·5	104	51·0
Negative for fungi	55	27·5	58	28·0

Table 2. *Fungi isolated from skin and nails among the elderly by sex*

Organisms	Skin Male No.	Skin Female No.	Z*	Nails Male No.	Nails Female No	Z
Pathogenic						
Yeasts	21	17	1·772	9	12	0·041
H. toruloidea	3	6	0·565	3	9	1·260
Dermatophytes	2	3	0·112	3	3	0·380
Saprophytic						
Yeasts	1	3	0·713	2	2	0·309
Filamentous	34	59	1·552	38	66	1·735
Negative	25	30	0·529	32	26	1·956
Total	86	118		87	118	

* *Z* test to compare between two proportions, none are significantly different ($P > 0·05$).

Mexico City found that the older the person the lower the frequency of *T. tonsurans* and *T. mentagrophytes*. On the other hand he found that the frequency of *Microsporum canis* rose steadily with age of the host but the number of cases was too small to be of any statistical significance.

In the present study *T. mentagrophytes* and *T. equinum* were the only dermatophytes species isolated. Though *T. equinum* is the frequent cause of ringworm

Table 3. *Fungi isolated from skin and nails among 205 elderly subjects by marital status*

	Skin					Nails				
	Married		SDW*			Married		SDW		
Organisms	No.	(%)	No.	(%)	Z	No.	(%)	No.	(%)	Z
Pathogenic										
Yeasts	24	18	14	20	0·317	12	9	9	13	0·803
H. toruloidea	4	3	5	7	1·349	6	5	6	9	1·513
Dermatophytes	2	2	3	4	1·207	2	2	4	6	1·674
Saprophytic										
Yeasts	1	1	3	4	1·714	3	2	1	1	0·409
Filamentous	61	46	32	45	0·602	74	55	30	42	1·767
Negative	42	31	13	18	1·904	37	28	21	30	0·297
Total	134	—	70	—	—	134	—	71	—	—

* SDW, single, divorced and widowed elderly subjects.
† *Z* test to compare between two proportions, none are significantly different ($P > 0·05$).

infection in horses, human dermatophytosis caused by this species has been reported for example by Takatoni & Ichijo (1985). Lopez & Rivera (1984) isolated several species of dermatophytes (*T. rubrum*, *T. mentagrophytes*, *M. canis* and *Epidermophyton floccosum*) from foot samples covering various age groups.

The presence of dermatophytes may facilitate colonization by *Staphylococcus aureus* and the two organisms together appear to initiate the development of itching and discomfort (Marples & Bailey, 1957).

The importance of isolation of dermatophytes from apparently healthy elderly persons lies in that sharing beds and towels among the members of a family and the tradition of rearing younger generations may result in transmission of such organisms in the community with public health sequalae. In a study of tinea pedis in Alexandrian families, Badie *et al.* (1983) found that cross infection within families appeared in 45·5% of the sample and that involvement of *T. mentagrophytes* var *granulare* besides *T. verrucosum* indicated possible intrafamilial transmission.

In the present study *Hendersonula toruloidea* constituted 4·4 and 5·9% of skin and nails samples respectively. In the elderly subjects from which *H. toruloidea* were isolated their interdigital skin showed scaling and erosions (9 subjects) while nails showed opacification and nail plate thickening (8 subjects) and hyperkeratosis and onycholysis (4 subjects). However no itching or other complaints were recorded and the elderly people considered all the previously mentioned signs as a manifestation of old age. The presence of such organisms has special importance since it can cause infection of nails (Campell *et al.* 1973) and in patients with deficient cell mediated immunity, it can spread to other parts of the body such as the face (Liautaud & Marill, 1984). In UK, Hay & Moore (1984) found that all their patients showing clinical appearance of infection by *H. toruloidea* originated from the tropics or subtropics.

The present study shows that saprophytic filamentous fungi comprises 45·4 and 50·7% of skin and nails samples respectively. Filamentous non dermatophytic fungi can invade moribund skin although more frequently causing infections of

Table 4. *Fungi isolated from skin and nails among 205 elderly subjects by crowding index*

	Mean crowding index					
	Skin			Nails		
Organisms	Mean	S.D.	*t**	Mean	S.D.	*t*
Pathogenic						
Yeasts	2·4	1·4	0·623	2·8	1·6	1·621
H. toruloidea	2·1	0·6	0·184	1·6	0·9	1·421
Dermatophytes	1·6	0·8	0·824	1·4	0·9	1·365
Saprophytic						
Yeasts	1·6	0·6	0·741	2·3	1·3	0·139
Filamentous	2·2	1·6	0·000	2·2	1·6	0·000
Negative	2·2	1·6	—	2·2	1·6	—

**t*, Student's *t* test to compare mean index for positives with that of the negative, none are significantly different ($P > 0·05$).

Table 5. *Fungi isolated from skin and nails among 205 elderly subjects by income per capita*

	Mean income *per capita*					
	Skin			Nails		
Organisms	Mean	S.D.	*t*	Mean	S.D.	*t*
Pathogenic						
Yeasts	16·1	14·1	1·631	10·3	5·5	1·648
H. toruloidea	17·0	18·0	0·742	15·5	9·2	0·069
Dermatophytes	15·8	10·5	0·701	17·2	11·4	0·410
Saprophytic						
Yeasts	25·8	39·0	0·298	31·0	3·61	1·916
Filamentous	18·2	7·6	1·769	16·7	15·2	0·723
Negative	22·4	20·7	—	15·0	12·6	—

* t, Student's *t* test to compare mean income *per capita* of positives with that of negative, none are significantly different ($P > 0·05$).

the toe nails and finger nails (English, 1968; Rush-Munro *et al.* 1971). The species involved are generally *Aspergillus niger*, *A. fumigatus*, *Allescheria boydii* and *Fusarium spp.* Cahill *et al.* (1967) reported a case of primary cutaneous asperigillosis lasting over 10 years which has been mistaken for lepromatous leprosy.

More than a quarter of the skin and nails samples (26·8 and 28·4% respectively) were negative for fungi. Marples & Bailey (1957) reported that from a large proportion of those showing scaling and maceration of toe webs, no fungus can be cultured and no mycelium can be seen in their skin scraping.

Table 6. *Fungi isolated from skin and nails among 205 elderly subjects by presence of diabetes mellitus**

	Skin					Nails				
	Diabetic		Non-diabetic			Diabetic		Non-diabetic		
Organisms	No.	(%)	No.	(%)	Z†	No.	(%)	No.	(%)	Z
Pathogenic										
Yeasts	8	20·0	30	18·2	0·265	4	10·0	17	10·3	0·057
H. toruloidea	2	5·0	7	4·2	0·210	4	10·0	8	4·8	1·245
Dermatophytes	0	0·0	5	3·0	—	0	0·0	6	3·6	
Saprophytic										
Yeasts	2	5·0	2	1·2	1·554	1	2·5	3	1·8	0·280
Filamentous	15	37·5	78	47·3	1·114	16	40·0	88	53·3	1·513
Negative	13	32·5	42	25·4	0·902	15	37·5	43	26·1	1·441

* 40 diabetics diagnosed by history or fasting blood glucose level above 140 mg/dl (WHO, 1985).
† Z test to compare between two proportions, none are significantly different ($P > 0·05$).

Sociodemographic variables and fungal skin flora

It is evident from Table 2 that there was no significant difference between the sexes as regards fungal isolates. This was in agreement with Somerville (1969) who stated that only in the young adults was the normal cutaneous flora influenced by sex.

Studying other sociodemographic variables such as marital status (Table 3), crowding index (Table 4) and income *per capita* (Table 5), no statistical significant difference was found in relation to fungal flora.

Diabetes mellitus and fungal skin flora

The present study showed that there was no significant difference between elderly diabetics and non-diabetics as regards fungal carriage on their feet and in nails (Table 6). Noble & Somerville (1974) reported that obesity associated with diabetes mellitus may also provide an environment favourable for the multiplication of *C. albicans*. However, unexpectedly Somerville & Lancaster-Smith (1973) did not find a high incidence of yeasts on the diabetic skin. This agrees with the results of the present study.

REFERENCES

AL DOORY, Y. (1980). *Laboratory Medical Mycology*, pp. 208–219. Philadelphia, London: Lea and Febiger.

AJELLO, L., GEORG, L., KAPLAN, W. & KAUFMAN, L. (1963). *Laboratory Manual* for Medical Mycology. Public Health Service Publication No. 994. Washington: U.S. Government Printing Office.

BADIE, N., KHAIRY, A., YOUSSEF, N., RAKHA, A. & TANTAWI, A. (1983). Tinea pedis in Alexandria families. *The Bulletin of the High Institute of Public Health* **XIV**, 175–182.

CAHILL, K., EL MOFTY, A. & KAWAGAUCHI, T. (1967). Primary cutaneous aspergillosis. *Archives of Dermatology* **96**, 545–549.

CAMPELL, C., KURWA, A., ABDEL-AZIZ, A. & HODGSON, H. (1953). Fungal infections of skin and nails by *Hendersonula toruloidea*. *British Journal of Dermatology* **89**, 45–52.

ENGLAND, M. (1975). *Medical Research. A Statistical and Epidemiological Approach*. pp. 59, 68. Edinburgh, London and New York: Churchill Livingstone.

ENGLISH, M. (1968). Invasion of the skin by filamentous non-dermatophyte fungi. *British Journal of Dermatology* **80**, 282–286.

ENGLISH, M. & GIBSON, M. (1959). Studies in the epidemiology of tinea pedis. *British Medical Journal* i, 1442–1443.

GENTLES, J. & HOLMES, J. (1957). Foot ringworm in coal miners. *British Journal of Industrial Medicine* **14**, 22–29.

GILCHRIST, B. (1979). Common skin disorders in children. Part II. *Journal of Continuing Education in Family Medicine* **25**, 4–19.

HAY, R. & MOORE, M. (1984). Clinical features of superficial fungal infections caused by *Hendersonula toruloidea* and *Scytalidium hyalinum*. *British Journal of Dermatology* **110**, 677–683.

LIAUTAUD, B. & MARILL, F. (1984). The dermatophytic disease. Recent observation in Algeria. *Bulletin de la Societe de Pathologie Exotiques et de Filiales* **77**, 637–648.

LOPEZ MARTINEZ, R. (1981). Isolation of dermatophytes from natural sources. *Proceedings of the Fifth International Conference of the Mycoses*. Scientific Publication No. 396. Pan American Health Organization.

LOPEZ MARTINEZ, R. & RIVERA, L. (1984). Investigation of dermatophytes from healthy skin from different parts of the human body. *Revista Latino-americana de Microbiologia* **26**, 365–369.

MARPLES, M. & BAILEY, M. (1957). A search for the presence of pathogenic bacteria and fungi in the interdigital spaces of the foot. *British Journal of Dermatology* **69**, 379–388.

MARPLES, M. & SOMERVILLE, D. (1968). The oral and cutaneous distribution of *Candida albicans* and other yeasts in Rarotonga, Cook Islands. *Transactions of The Royal Society of Tropical Medicine and Hygiene* **62**, 256–262.

MINISTRY OF HEALTH (1985). ARAB REPUBLIC OF EGYPT. Alexandria Governorate. Annual Health Report.

MOCK, W. & SILVA, M. (1984). Mycoflora of the human dermal surfaces. *Canadian Journal of Microbiology* **30**, 1205–1209.

NOBLE, W. C. & SOMERVILLE, D. A. (1974). *Microbiology of Human Skin*, 1st edn. pp. 279–289. London: Saunders.

RAAB, W. (1980). *The Treatment of Mycosis with Imidazole Dervatives*. Berlin, Heidelberg: Springer Verlag.

RUSH-MUNRO, F., BLACK, H. & DINGLEY, J. (1971). Onychomycosis caused by *Fusarium oxysporum*. *Australian Journal of Dermatology* **12**, 18–29.

SOMERVILLE, D. (1969). The normal flora of the skin in different age groups. *British Journal of Dermatology* **81**, 248–258.

SOMERVILLE, D. & LANCASTER-SMITH, M. (1973). The aerobic cutaneous microflora of diabetic subjects. *British Journal of Dermatology* **89**, 395–400.

TAKATONI, K. & ICHIJO, S. (1985). Human dermatophytosis caused by *Trichophyton equinum*. *Mycopathologia* **90**, 15–19.

WHO (1985). Diabetes Mellitus-Report of WHO study group. *Technical Report Series* No. 727.