

Onychomycosis in Icelandic Swimmers

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We investigated visitors to a swimming pool in Reykjavik to determine whether onychomycosis of the toenails is more prevalent in swimmers than in the general population, where the prevalence is believed to be between 3 and 8%. A total of 266 swimmers over the age of 17 years were interviewed and examined. When an onychomycosis was suspected a nail specimen was taken for mycological examination. Onychomycosis was clinically suspected in 105 cases (40%). In 60 cases (23%) a dermatophyte infection was confirmed by culture and 14 cases (5%) were microscopy-positive only. The prevalence of culture-positive onychomycosis was 15% in women and 26% in men. Our results suggest that onychomycosis of the toenails is at least 3 times more prevalent in swimmers than in the rest of the population. **Key words:** onychomycosis; swimmers.

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Onychomycosis is seldom a primary infection of the nail but is more often secondary to fungal infections of the toe-clefts or the soles of feet (1). It has been stated that 20% of those who suffer from tinea pedis also have fungal infections of the toenails. There is a high prevalence of tinea pedis among those who frequently attend swimming pools and other communal bathing facilities. Studies on adult swimmers suggest a prevalence of 15–20% (2–4). The prevalence of tinea pedis in marathon runners is 22% (5) and studies of men undergoing military service and workers in coal-mines have found even higher prevalence figures. All these groups share bathing facilities with others and it has therefore been considered plausible that dermatophyte infections of the feet spread in such places. Measurements have confirmed the presence of dermatophyte contamination on the floors of swimming pools (6) and other communal bathing places (7, 8), showing this to be a possible route of infection.

Previous studies have shown the prevalence of onychomycosis to be 2–8% (9–11). Due to the recent introduction of new systemic antifungal drugs (12) an increasing number of people are now treated for onychomycosis. Epidemiological studies are necessary to determine which preventive measures are appropriate and thus reduce the increasing cost to society of this condition. The aim of this study was to assess the prevalence of onychomycosis among swimmers.

MATERIAL AND METHODS

Patients

The study took place in a large swimming pool in Reykjavik, Iceland that has 600,000 visitors per year. The study was carried out during a period of 14 days in March and April 1997, 6 h each day. Every tenth visitor over 17 years of age was invited to participate in the study. Of the 355 swimmers invited to participate, 266 (75%) agreed to

participate, 183 men and 83 women. The majority of the participants (95%) visit the swimming pool at least once a week. The participants completed a questionnaire and both feet were examined by one of the authors (GG). If there was any suspicion of onychomycosis, such as onycholysis, discoloration and hyperkeratosis, a nail specimen was taken for direct microscopy and fungal culture. The sample was taken with a sterilized scalpel and nail scissors and placed in an envelope to be taken to the laboratory.

Mycological examination

Direct examination of specimens was performed after nail scrapings had been immersed in 5% KOH solution containing dimethyl sulphoxide and chlorazol black E. Specimens were inoculated on Sabouraud's glucose agar (Oxoid) containing chloramphenicol 0.05 g/l and on Mycobiotic agar (Difco). Plates were incubated at 30°C for 3 weeks and examined at weekly intervals. Positive cultures were identified by gross colony characteristics and microscopy morphology. Slide cultures on potato dextrose agar, subcultures on thiamine enriched medium and urease test were carried out when appropriate. Dermatophytes were identified to species level and moulds which have been reported to cause nail infections to genus level.

RESULTS

Of the 266 persons examined, onychomycosis of the toenails was suspected by clinical examination in 105 cases. In 60 of these a mycotic infection was confirmed by culture and 14 were microscopy-positive only (Table I). Culture yielded *Trichophyton rubrum* in 55 cases and *Trichophyton mentagrophytes* in 5 cases. A non-dermatophyte (*Scopulariopsis* species) was isolated in 1 case.

Onychomycosis was more frequent in the elderly; 40% of visitors over 70 years old had positive mycotic culture (Table I). The prevalence of culture-positive onychomycosis

Table I. Clinical and mycological results of 266 swimmers studied

Age (years)	n	Clinically suspected onychomycosis	Culture-positive cases	Culture-and/or microscopy-positive cases
Men				
17–29	12	0	0	0
30–49	69	15	10	11
50–69	76	40	23	29
>70	26	21	15	19
Total, men	183	76 (42%)	48 (26%)	59 (32%)
Women				
17–29	4	0	0	0
30–49	23	4	1	1
50–69	29	11	6	7
>70	27	14	5	7
Total, women	83	29 (35%)	12 (15%)	15 (18%)
Total, men and women	266	105 (40%)	60 (23%)	74 (28%)

in men was almost double that in women. In 70% of the culture-positive cases the large toenails were infected, making this the most common site of infection. Discoloration, onycholysis and hyperkeratosis were present in the majority (92%) of culture-positive cases, the rest displayed only 1 or 2 symptoms. Of the 206 cases that were culture-negative 18% had all 3 symptoms.

Of the 235 persons who completed the questionnaire, 57% claimed they had experienced symptoms of tinea pedis, such as fissures and desquamation of the toe-clefts or soles of the feet. Of those who had onychomycosis, 75% had experienced these symptoms. Six women and 14 men had previously received successful oral treatment for onychomycosis, making the prevalence even higher.

DISCUSSION

According to a recent Icelandic study (13) the prevalence of onychomycosis in swimmers, as shown in this study, is almost 3 times as high as that in the general population of Iceland. Previous studies have shown similar results regarding the increase of onychomycosis with age (9–11), but they differ somewhat in regard to the difference between the sexes. Roberts found no notable difference between men and women (11), but Heikkilä & Stubb showed onychomycosis to be more prevalent in men, which they explained by their assumption that men exercise more (9). Sais et al. (10), on the other hand, found a higher prevalence in women, which they thought was due to womens' tight shoes. We have no certain explanation for the high prevalence in men in our study.

The high total prevalence figures we got in this study can partly be explained by the fact that there were more men attending the swimming pool and few people in the youngest age group participated in the study. On the other hand, it is possible that the prevalence is somewhat underestimated because it is thought that fungal culture is negative in 30% of dermatophyte infections (14). Also, 20 persons (7.5%) had previously received successful treatment for onychomycosis, making the prevalence even higher.

Those who are aware of having onychomycosis may be embarrassed to show their feet. If we were to assume that

none of those who refused to participate were infected, which is highly unlikely, the prevalence of onychomycosis in swimmers would be 17%, which is roughly double the prevalence in the general population.

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