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Fungal Contamination in Indoor Swimming Pools in Zanjan-Iran 2005

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Abstract: In this study fungal contamination of five indoor public swimming pools in Zanjan was investigated using membrane filtration and sterile carpet sampling methods. Nine samples from water and related areas of each swimming pool were tested for the presence of the fungi and final diagnosis was done by slide culture technique to determine the species. The most common fungi isolated from swimming pools included Dermatophyte (*Trichophyton mentagrophytes* and *Epidermophyton floccosum*) 0.4%, Yeasts 21.8% and filamentous fungi 77.7%. Out of saprophyte fungi 24.8% were separated from pools margin, 22.6% from dressing rooms, 16.8% from pools water and 11.4% from shower-bath. Also yeasts fungi were separated from pools water 7.3% and from shower-bath 3.1% and Dermatophytes were separated from dressing room 0.2%. The fungal contamination of these swimming pools under specific condition could be an alarm for induction of infections and allergy in immunocompromised hosts.

Key words: Swimming pools, fungal infection, dermatophytes, keratomycosis, asthma, allergy

INTRODUCTION

Indoor swimming pools are one of the recreations and training centers which many people use every time, therefore, they can be infected by infectious agents such as bacteria, virus, fungi and other microorganism (Detant and Norlan, 1988). The water in swimming pools can not be good carrier for transmission of fungal disease, but can be a suitable source of fungi, thus environmental surfaces may be infected by many species of fungi and fungi can be dangerous for swimmers. As it is seen obviously, fungi are world wide distribution in all around the world and fungi are depending on various factors. The most important of which is human association (Magahazy and Abdel-Mallek, 1989; Zaror *et al.*, 1985). In order to control this endemic problem, adequate preventive measures should be taken. Researching has shown that swimming pools may contribute to the spread of fungi and to be a source of mycosis, due to these results. Such as Dermatophytosis, Keratomycosis, Otomycosis, etc (Zayni *et al.*, 2003). Dermatophytosis is one of the main fungal infection that caused by dermatophyt which can attached to hair, skin and nail in swimmers. Also other fungi such as *Rhizopus*, *Aspergillus*, *Penicillium* and

Candida have pathogenicity and sensitivity for swimmers. Many researchers have shown that fungi can be in swimming pools and caused a lot of diseases like dermatophytosis, Aspergillus, candidiasis, Asthma and allergy (Shadzi *et al.*, 2004; Rippon, 1988; Mangiarotti and Curette, 1994; Fisher, 1982).

In the present study, concerning the problems created by lack of hygiene in indoor swimming pools which are popular in various seasons and existence of fungi plus lack of proper sewage systems and disinfectant in these place made us investigation on fungal infection of five indoor swimming pools in Zanjan city and also people to observe health regulation to control and prevent the fungal disease.

MATERIALS AND METHODS

In this study that was descriptive study, five indoor swimming pools including (swimming pools No. 1, 2, 3, 4 and 5) of Zanjan city were taken in summers season in the same condition in 2005. The reasons for this selection is that the average daily number of swimmers during summer season were more than others. Nine samples of each swimming pools including (500 mL water that were taken

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of 0.5, 1.5 and 2.5 m from surface of the water, respectively) were collected from disinfected swimming pools in compliance with American Public Health Association standard methods APHA. (1985). A sufficient amount of sodium thiosulfate was present in the sampling bottles to neutralize the chlorine residual in the samples. All samples transferred immediately to the faculty of medical sciences of Zanjan in mycological department and processed upon arrival, samples were filtered through Millipore filters with 0.45 μm size. Filters were transferred to three different culture media including Mycosel Agar (Sabouraud Dextrose Agar + Chloramphenicol and Cycloheximide) and Sabouraud Dextrose Agar and Brain Heart Infusion Agar. The plates were incubated at 27-30°C for 3 weeks and checked frequently (Zayni *et al.*, 2003; Rippon, 1988). Nine samples from related areas of each swimming pools including (dressing room, pools margin, shower-bath and sauna) were taken by sterile carpet (a piece of sterilized carpet in the size of 4x6 cm²). Sampling from dried surfaces that were rubbed against the surfaces and then wrapped again in sterile aluminum foil and transferred to the mycology laboratory. All carpet pieces were shaken over the culture media under the biological hood. The plate were incubated for 3 weeks at 27-30°C and tested at frequent intervals and fungal growth was determined by the routine laboratory methods. Specially slide culture (Magahazy and Abdel- Mallek, 1989; Rippon, 1988; Campbell and Stewater, 1980).

RESULTS

The fungi isolated from swimming pools included dermatophytes (pathogenic filamentous fungi: *Trichophyton mentagrophytes* and *Epidermophyton floccosum*) 0.4%, Yeast species 21.8% and saprophytic filamentous fungi 77.7%. As mentioned in Table 1 the frequency and percentage of above fungi in each swimming pool is different to each other. In totally, 2075 fungi colony were isolated from Zanjan swimming pools. One thousand seven hundred and sixteen colony, 435 colony and 9 colony out of 2075 were belong to filamentous fungi, yeast fungi and dermatophytic fungi, respectively. Finding indicated that no dermatophytes were recovered from water samples, indeed the fungi isolated from water samples were common saprophytic flora and their presence in swimming pools were not important. Results asserted that swimming pool No. 5 and 2 have high rate of yeast, 134 and 124 colony, respectively. From filamentous fungi point of view, swimming pool No. 1 have high rate of fungi, approximately 714 colonies (Table 1).

Figure 1 shows from filamentous fungi point of view swimming pools No. 1 and 3 have 192 and 162 colonies in

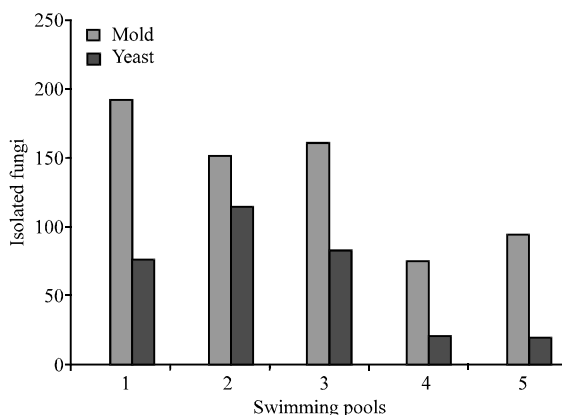


Fig. 1: Frequency of fungal contamination in water of indoor swimming pools

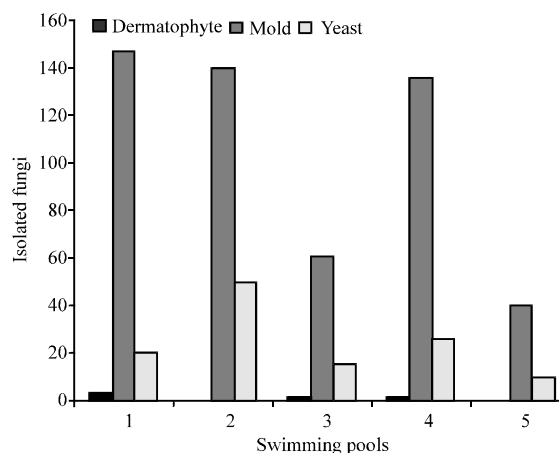


Fig. 2: Frequency of fungal contamination in dressing rooms of indoor swimming pools

liter, respectively. Concerning yeast fungi, swimming pools No. 2 with 114 and swimming pool No. 3 with 84 colonies in liter had much contamination. Swimming pool No. 4 had little fungal infection (Fig. 1).

The amount of infectious fungal inoculums present differed among the dressing room sampled: a swimming pool No. 1 was higher than other swimming pools. Dermatophytic fungi *Trichophyton mentagrophytes* and *Epidermophyton floccosum* were the most important fungi isolated from dressing room. Three dermatophytic colonies were isolated from dressing room swimming pool No. 1 and one colony was isolated from dressing room swimming pool No. 3 and 4 (Fig. 2).

Three dermatophytic colonies were isolated from shower bath swimming pool No. 1 and one dermatophytic colony was isolated from shower bath swimming pool No. 3.

According to results, fungi species, such as *Aspergillus* sp. *Penicillium* sp. *Cladosporium* sp.

Table 1: Frequency and percentage of fungal contamination in five indoor swimming pools in Zanjan city 2005

Swimming pools No.	<i>T. mentagrophytes</i>		<i>E. floccosum</i>		Yeasts sp.		Filamentous fungi		Totally	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
1	5	0.6	1	0.1	77	9.70	714	89.6	797	100
2	0	0.0	0	0.0	124	27.10	335	72.9	459	100
3	2	0.7	0	0.0	76	26.20	212	73.1	290	100
4	0	0.0	1	0.4	42	15.40	230	84.2	273	100
5	0	0.0	0	0.0	134	52.30	122	47.7	256	100

Alternaria sp. and *Candida* sp. were in high frequency that was isolated from environmental surface and water.

DISCUSSION

Resulting finding showed that fungal contamination of these indoor swimming pools under specific condition could be an alarm for induction of infections and allergy for immunocompromised hosts. Many researchers have showed that the sanitary quality of indoor public swimming pools is a concerns for swimmers due to swallowing and contact with water. In addition, it has been shown that swimming pools contribute to the spread of fungi and other organism like bacteria, virus, etc. because of their common usage (Detant and Norlan, 1988; Lee *et al.*, 2001). Therefore the environmental sanitation of swimming pools is crucially important. Testing of some factors such as: pH, temperature and residual chlorine are critical for swimming pools. American researchers have indicated that, assessing that above factors with 95% confidence level can justify the contamination of swimming pools (Roy, 1972). Fisher (1982) announced that normal concentration of chlorine does not inhibit the growth of fungi.

Increasing these factors more than the standard level may create growing of biological agent in the swimming pools. Feuerman (1977) showed that in swimming pools which have been disinfected with chlorine, no dermatophytes were isolated. Some authors have done studies concerning the presence of dermatophytes in water and different place of swimming areas (Detant and Norlan, 1988; Fisher, 1982; Lee *et al.*, 2001). Many studies were carried out in 40 swimming pools in Tehran and 105 dermatophytes were isolated (Nomayendeh, 1993). Shadzi *et al.* (2001) has investigated 4 indoor swimming pools in Isfahan and concluded that dermatophytes were only isolated from dressing rooms and bath rooms, furthermore the occurrence of dermatophytes and some fungal species which are known to be more opportunistic pathogen might be related to the low concentration of disinfectants. Daily average of swimmers and attendance of bathers with fungal infections in public swimming pools (Shadzi *et al.*, 2001). A study was carried out in 4 swimming pools in Uromia by Nanbakhsh *et al.* (2004). They mentioned that dermatophytes and yeasts were isolated from dressing rooms (Nanbakhsh *et al.*, 2004). In

Egypt, Magahazy and Abdel Mallek (1989) isolated Dermatophytes from water of two swimming pools. In other study Kraus and Tiefenbrunner (1975) were isolated *T. mentagrophytes* and *T. verrucosum* from water swimming pools.

In present study two strains of dermatophytic fungi: *T. mentagrophytes* and *E. floccosum* were isolated from dressing room and shower bath area. Presence of these dermatophytes could be related to contact of swimmers with *Tinea pedis* or other type of dermatophytosis to floor or walls of the room.

In Australia some fungi were isolated from the floor of swimming pools and dressing rooms through carpet sampling methods (Kraus and Tiefenbrunner, 1975). Some authors believed that, swimmers with *Tinea pedis* could spread debris containing dermatophytes on the floor of pools (Reiffers and Laugier, 1977; Attye *et al.*, 1990). Bolanos *et al.* (1991) reported that among students enrolled in swimming courses at university pools *tinea pedis* was determined on twelve of swimming pools and he noticed that *T. rubrum* is one of the main agents of *Tinea pedis*, whereas infection by *T. mentagrophytes* and *E. floccosum* were less common.

In another study following dermatophytes were isolated from student's feet: *T. mentagrophytes* 70%, *T. rubrum* 17.6% and *Candida albicans* 11.8%.

Authors indicated that, isolation of dermatophytes might be a continuous contamination of the swimming pool water by fungi through air, soil and human bodies.

In present study, no dermatophytes were isolated from water; the reasons for this happening may be related to the different techniques used for research or residual chlorine in water. Present finding showed that, swimming pools have a lot of saprophytic fungi and yeasts, therefore, we strongly recommended that these fungi can be dangerous under specific condition in Immunocompromised hosts and caused a lot of fungal infection such as keratomycosis, otitis, asthma and allergy (Rippon, 1988; Al-Doory and Domson, 1984). Through this study we can elucidate that pathogenic fungi in swimming pools are rarely related to high control of hygiene of pools, efficiency of residual chlorine for inhibiting growth of these fungi. Although it is suggested that, the managers of swimming pools have to pay attention to the control of swimming pools based on standard level and environmental sanitation of swimming

pools because of high frequency of saprophytic filamentous fungi and yeasts from water of swimming pools.

To sum up, we recommended that manager must learning about hygiene of fungal infection and if they see each lesions in swimmers body, they must prevent of swimmers to inter to the water.

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