

Epidemiology, causative agents, and risk factors affecting human otomycosis infections

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Background/aim: Otomycosis, or fungal otitis externa, has typically been described as fungal infection of the external auditory canal, with infrequent complications involving the middle ear. This study assessed a mycological analysis of fungal debris from external auditory canals of patients at Tanta University Hospital, Gharbia Governorate, Egypt.

Materials and methods: The samples were collected over a year from the 110 patients that were clinically diagnosed to have otomycosis. The samples were then inoculated and culture plates were examined for the presence of fungal growth.

Results: The results showed that *Aspergillus niger* was the most common fungus causing otomycosis. It was more common among males aged 21–40 years. The incidence was higher in the summer and spring seasons. Manual workers and students had the highest frequency based on occupational incidence. The most common presenting complaint was itching. Trauma to the external auditory canal was the most common predisposing factor.

Conclusion: The epidemiological profile of otomycosis infection varied according to different factors in the study population.

Key words: Otomycosis, *Aspergillus niger*, clinical features

1. Introduction

Otomycosis is a subacute or chronic fungal infection of the external auditory canal with some complications involving the middle ear.

There are several factors that play important roles in otomycosis infection, such as humidity, moisture, high temperature, the entrance of water into the ear during swimming or sweat secretions, increased use of topical antibiotics, weak immune function, and cleaning of ear wax (1).

Molds and yeasts are common in the auditory canals of otomycosis patients. The predominance of thermophile *Aspergillus* and *Candida* species are related to the inflammatory processes of the ear. The molds mostly isolated from the ear are *Aspergillus niger*, *Aspergillus fumigatus*, *Aspergillus flavus*, *Aspergillus nidulans*, *Aspergillus terreus*, *Mucor* species, and *Penicillium* species (2).

Otomycosis has a worldwide distribution. It is estimated that approximately 25% of the total cases of ear infections are due to fungi, and the disease was more prevalent in warm and humid climates. Otomycosis

infection is prevalent in Brazil and constitutes about 30% of the mycotic diseases of the external auditory canal (3). Otomycosis is also frequently seen in Turkey (4). In Egypt, there has been no recent survey on otomycosis epidemiology, risk factors, and complications. The last study recorded was that of Hammad (5) on otomycosis in the El-Minia University hospitals, where he locally diagnosed otomycosis through direct examination by otoscope, and collected 250 otomycotic fungal samples over a 12-month period without any detailed identification studies or new approaches in the treatment with natural products.

2. Materials and methods

2.1. Study group

Mycological analysis was carried out on debris, scrapings, or exudate samples from the auditory canals of 110 patients clinically diagnosed to have otomycosis infection. This was achieved by visiting the outpatient clinic of the otorhinolaryngology department twice a week during a year from January 2011 to December 2011 at Tanta University Hospital, Gharbia Governorate, Egypt.

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Data collected and analyzed included duration of follow-up, presenting symptoms, disease complications, fungal species identified, history of patients, and prior treatments. Statistical analysis was carried out using a Pearson chi-square test to evaluate the significance of all the studied factors and the spread of otomycosis.

2.2. Collection of samples

The samples were collected from patients that were clinically diagnosed to have otomycosis under aseptic conditions with the help of a sterile cotton swab from the external auditory canal or a sterile scalpel blade (6).

2.3 Culture

Samples were inoculated on Sabouraud dextrose agar medium; the plates were incubated at 25 °C. The culture plates were examined for the presence of growth after 3–4 days (7).

2.4 Identification

All cultured plates were examined under microscope (400× and 1000×), photographed, and identified according to methods previously described (8–12).

3. Results

Otomycosis was clinically diagnosed in 110 patients and confirmed by positive culture results for fungal growth.

Table 1 shows that the most common fungi isolated from otomycosis cases during the present survey was *A. niger* (it was positively isolated from 100 cases), followed by *A. flavus*, which was isolated from 10 cases of otomycosis and showed a low incidence in the present study.

Figures 1A and 1B show the otoscopic direct examinations of external ear canals of different otomycosis patients. Subfigure 1 of Figure 1A shows one of the severe cases of otomycosis with tympanic membrane perforation due to *A. niger* infection. Subfigure 1 of Figure 1B presents otomycosis due to *A. flavus* infection. In addition, subfigures 2 and 3 of Figures 1A and 1B represent the pure culture and the microscopic examination of isolated

A. niger and *A. flavus*, respectively. Table 2 shows the distribution of otomycosis among different age groups, as 10 cases of otomycosis were detected in the age group of <10 years old, while 40 cases were detected in the age group of 11–20 years, 50 cases were detected in the age group of 21–40 years, and 10 cases were detected in the age group of >40 years. Figure 2 shows that otomycosis was more common in males (63.5%) compared to females (36.5%).

Statistical analysis revealed that the differences between the patient’s age and sex were highly significant at P <0.001. The data represented in Table 3 shows that otomycosis was more common among manual workers (50 cases), followed by students (40 cases) and housewives (15), but less common among farmers (5 cases). The highest incidence of otomycosis was observed in summer (60 cases), followed by spring (28 cases). Autumn (15 cases) and winter (7 cases) showed a low incidence of otomycosis (Figure 3). Figure 4 shows that the predominant complaint of the patients was itching (100%), followed by pain (41%) and hearing loss (31.8%), and the least common complaint was ear discharge (18.2%). Nine percent of patients had all complaints.

The most common predisposing factor was traumatic injury to the ear canal (59%), followed by water entry during swimming (45%) (Table 4). Table 4 also shows the high percentage of antibiotic ear drop treatment (59%) affecting the incidence of otomycotic infection and that it was more common in patients with systemic diseases (e.g., hypertension, diabetes, or an immune disease) .

Finally, wax was absent in 91% of cases and present in 9% of cases. This means that wax plays an important role in protecting patients against otomycosis (Figure 5).

All these studied factors were found to be highly significant at P < 0.001 in distinguishing the variation among otomycosis cases, which was confirmed by a chi-square test as shown.

Table 1. Distribution of fungal isolates among otomycotic cases during the year of the survey (2011).

Fungal isolate	No. of cases	Percentage of total cases
<i>Aspergillus niger</i> (Tiegh, 1867)	100	91
<i>Aspergillus flavus</i> (Link, 1809)	10	9
Total	110	100
Chi-square	χ^2	72.009
	P-value	<0.001*

*P-value is statistically highly significant at the 0.001 level.

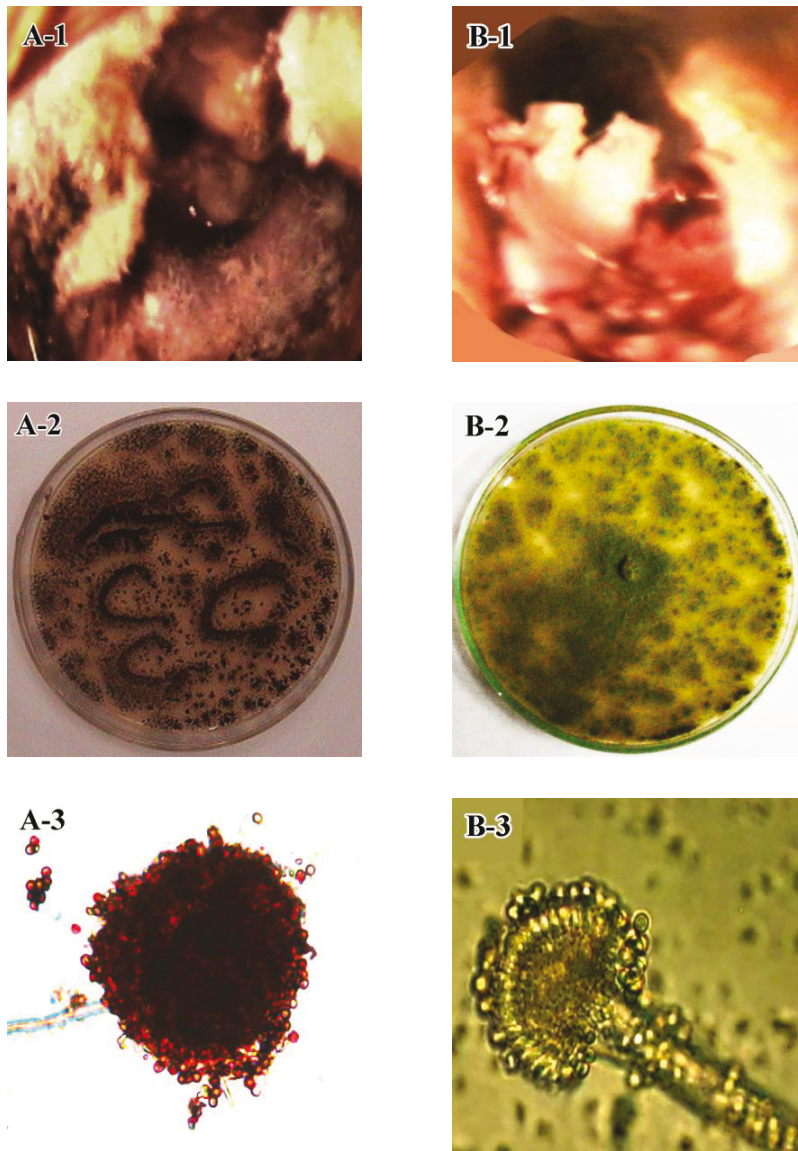


Figure 1. Otopscopic, culture, and microscopic appearance of *A. niger* (A-1, -2, and -3) and *A. flavus* (B-1, -2, and -3).

Table 2. Distribution of otomycosis among different sex and age groups during the year of the survey (2011).

Age group	No. of cases			Percentage of total cases
	Sex		Total	
	Male	Female		
≤10	5	5	10	9.0
11–20	15	25	40	36.5
21–40	40	10	50	45.5
41–60	10	0	10	9.0
Total	70	40	110	100
Percentage of total cases	63.5	36.5	100	100
Chi-square	χ^2	24.112		
	P-value	<0.001		

*P-value is statistically highly significant at the 0.001 level.

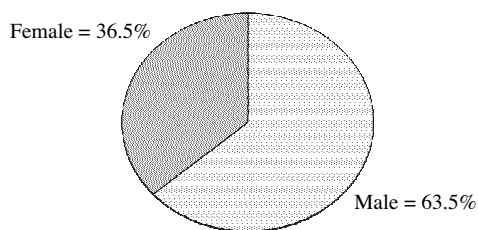


Figure 2. Percentage of otomycosis among different sexes during the year of the survey (2011).

Table 3. Distribution of otomycosis among different occupational careers during the year of the survey (2011).

Occupational career	No. of cases	Percentage of total cases
Manual workers	50	45.5
Students	40	36.5
Housewives	15	13.5
Farmers	5	4.5
Total	110	100
Chi-square	χ^2	48.182
	P-value	<0.001*

*P-value is statistically highly significant at the 0.001 level.

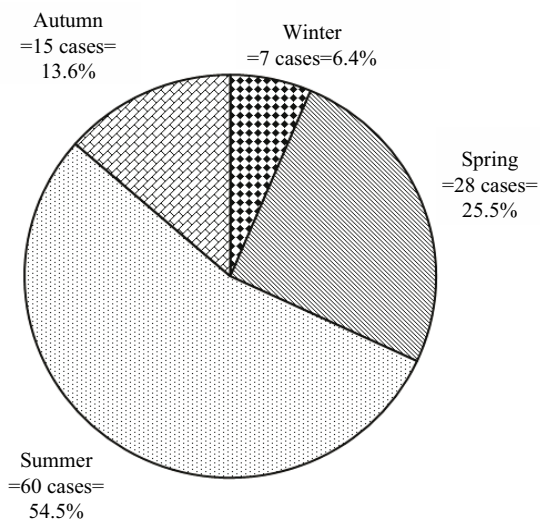


Figure 3. Seasonal incidence of otomycosis during the year of the survey (2011).

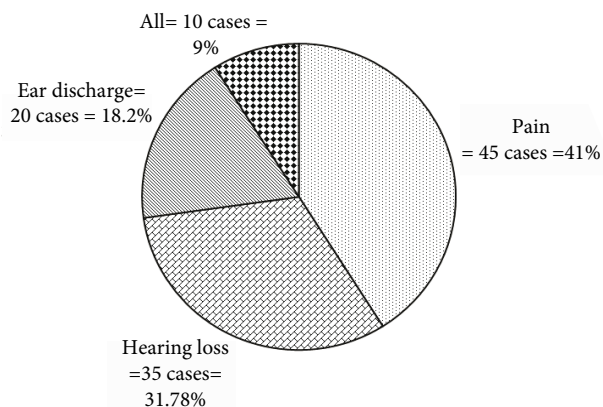


Figure 4. Incidence of different complications accompanying otomycosis during the year of the survey (2011).

4. Discussion

Otomycosis has been observed to be a common disease in patients applying to the outpatient clinic of the otorhinolaryngology department at Tanta University Hospital, Tanta, Egypt. In the present survey, a total of 110 cases were recorded with otomycosis over 12 months (January–December 2011). Fungal infection was the

common reason for all otomycosis cases representing many complications. These records were similar to those of Tang et al. (13), as they recorded 90 cases of otomycosis in Texas over 12 months. Moreover, Ashish (14) stated that the incidence of otomycosis was noticeable in India; he reported 102 cases of otomycosis during 1 year. On the other hand, only 26 cases of otomycosis were recorded in

Table 4. Effect of different predisposing factors on the incidence of otomycotic infections during the year of the survey (2011).

Predisposing factors	Study parameters	No. of cases	Percentage of total cases
Source of infection	Water entry during swimming	45	41.0
	Traumatic injury of canal wall	65	59.0
	Total	110	100
Chi-square	χ^2	3.28	
	P-value	0.07	
Eardrop treatment	Antibiotic	65	59.0
	Wax solvent	25	22.8
	None	20	18.2
	Total	110	100
Chi-square	χ^2	33.182	
	P-value	<0.01	
Associated systemic diseases	Diabetes	60	54.5
	Hypertension	30	27.3
	None	20	18.2
	Total	110	100
Chi-square	χ^2	9.344	
	P-value	0.002	
Wax formation	Wax present	10	9.0
	Wax absent	100	91.0
	Total	110	100
Chi-square	χ^2	72.009	
	P-value	<0.003	

*P-value is statistically significant at the 0.005 level and highly significant at the 0.001 level.

New York by Jackman et al. (15) in about 12 months. This may be due to the high humidity in the eastern region throughout the year. The epidemiology of otomycosis varies geographically, but it commonly occurs in warm and tropical climates.

The most common fungal species isolated from otomycosis cases in the present survey was *A. niger* (91%), followed by *A. flavus* (9%). This was similar to many screening reports for otomycosis in many regions of the world. Hoshino and Matsumoto (16) isolated *A. niger* as an abundant causative organism of otomycosis from all their cases. This was contrary to the observations of Jackman et al. (15), as they revealed that *Candida albicans*

was the most common isolated species in otomycosis, followed by *A. fumigatus*. These differences could be due to the geographic patterns of fungi in different places, but limited epidemiological data are available for comparison.

Regarding the age and sex distribution, the present survey revealed that otomycosis was more common among patients between 21 and 40 years of age (45.4%) and higher in males (63.6%) than females (36.4%). That could be explained by the increased outdoor activities of males compared to females in Egypt; thus, males are more exposed to the risks of diseases. This result could also be attributed to the difference in surface lipids between males and females, as surface lipids are under the control of sex

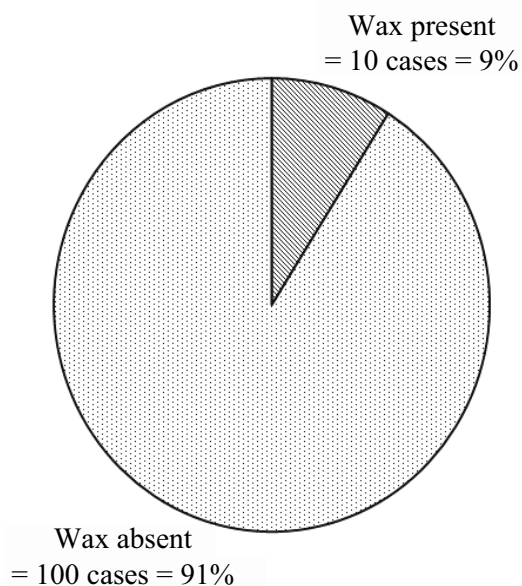


Figure 5. Effect of wax formation on the incidence of otomycotic infections during the year of the survey (2011).

hormones. These findings were relatively close to those of a previous study in Texas, which recorded that the incidence of otomycosis in males (56%) was higher than that in females (44%) aged up to 30 years old (13). In contrast, Ahmed (17) found that otomycosis affected female patients at the ages of 11 to 30 years more than males. The ages of patients with otomycosis varied in several reports, and this could be explained by the periodic activity of sebaceous glands, eccrine glands, and apocrine glands. Changes in the water content and the pH of the ear canal have also been shown to affect the survival of fungus.

The distribution of otomycosis among patients of different occupations could be explained by the greater possibility of manual workers to be exposed to otomycosis, as they are faced with surroundings such as machinery, foundries, and moving parts of machines, which generate heat and thus prepare the conditions to become an ideal hot, humid, and dusty atmosphere, suitable for initiation of the disease. This was followed by students, who play sports on playgrounds where dust containing fungal spores mixes with the air of the atmosphere and acts as a predisposing agent for the initiation of the disease. The next group of moderate incidence is housewives from surrounding villages and towns, as they frequently clean and sweep the house floors and are exposed to a similar environment, followed by farmers. All these findings were supported by Ahmed (17).

This study shows that otomycosis was more common in the summer (54.5%) and spring (25.5%) than in autumn or winter (13.6 and 6.4%, respectively). That

could be explained by the warmer climate, wind, and other environmental factors suitable for fungal growth and the establishment of infection. All the patients in our study (100%) presented with itching, and other common complaints were pain (41%), hearing loss (31.8%), and ear discharge (18.2%). The aforementioned complaints and their incidence were in accordance with the findings of Ashish (14). Although pain tended to be the dominant complaint in bacterial infections, the most common complaint in otomycosis was severe itching sensations deep inside the canal.

The predisposing factors taken into consideration were a history of swimming or water entering the ear canal while bathing, normal or ritualistic dips in rivers or ponds, the use of local antibiotic or steroid drops, trauma to the external canal, or any associated medical disease. The most predominant predisposing factors were trauma to the external canal, swimming, and the use of antibiotic drops. Trauma was caused by use of match sticks or finger tips to clean the external canals, aural syringing, or poorly maintained mastoid cavity. The percentage of patients in this group was 70%. A history of swimming in local ponds or swimming pools was present in 50% of cases as a predisposing factor, and these findings were in accordance with the study of Ahmed (17), who found 72% of cases due to trauma and 45% due to swimming. The lipid mantle layer formed by the cerumen in the external canal has long been considered as the key factor for the protection of the canal wall, and its removal by frequent irrigation of the external layer is thought to be the reason why frequent bathing in tropical climates is incriminated as a cause of recurrent otomycosis.

In the present study, 65% of the patients had a history of the use of antibiotic drops. This was in accordance with the study of Fasnunla et al. (18), who found 42% of cases with the same predisposing factor. However, this was not similar with Pontes et al. (19), who noted that there has been no significant increase in the incidence of otomycosis with the widespread use of topical combinations of antibiotic and steroid drops. There is also a weak relationship between otomycosis infection and other systemic diseases such as diabetes, hypertension, and pregnancy, as supported by Ahmed (17). Furthermore, 91% of otomycotic cases in the present study had no cerumen in the external canal and this was in accordance with the study of Pontes et al. (19), who showed that ear wax contains numerous amino acids and lysozymes that have an inhibitory effect on fungi.

It was concluded that the overall clinicomycological and epidemiological profile of otomycosis infection observed at Tanta University Hospital, Tanta, Egypt, does not differ significantly from those observed by previous researchers around the world, and any variation is probably due to the differences in climates of the different study populations.

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