ORIGINAL RESEARCH PAPER

Epidemiology

EPIDEMIOLOGICAL AND CLINICAL STUDY OF OTOMYCOSIS AT SOURÔ SANOU UNIVERSITY HOSPITAL IN BOBO-DIOULASSO, BURKINA FASO

KEY WORDS: Otomycosis, epidemiology, clinic, Bobo-Dioulasso, Burkina Faso.

Fructueux Modeste Amona*	Laboratory of Parasitology-Mycology, Higher Institute of Health Sciences, Nazi Boni University, Burkina Faso *Corresponding Author
Sondo K Apoline	Unit of Infectious Diseases, University Hospital Yalgado Ouedraogo, Ouagadougou, Burkina Faso
Richard W-L Ouedraogo	Department of Oto Rhino Laryngology, Higher Institute of Health Sciences, Nazi Boni University,University Hospital Sanou Souro, Bobo-Dioulasso, Burkina Faso
Adama ZIDA	Laboratory of Parasitology-Mycology, University Hospital Yalgado Ouedraogo, Ouagadougou, Burkina Faso
Ibrahim Sangare	Laboratory of Parasitology-Mycology, Higher Institute of Health Sciences, Nazi Boni University, University Hospital Sanou Souro, Bobo-Dioulasso, Burkina Faso.
Mamoudou Cisse	Laboratory of Parasitology-Mycology, Higher Institute of Health Sciences, Nazi Boni University, Burkina Faso
Abdoulaye Elola	Department of Oto Rhino Laryngology, Higher Institute of Health Sciences, Nazi Boni University,University Hospital Sanou Souro, Bobo-Dioulasso, Burkina Faso
Sanata Bamba	Laboratory of Parasitology-Mycology, Higher Institute of Health Sciences, Nazi Boni University, University Hospital Sanou Souro, Bobo-Dioulasso, Burkina Faso.

ABSTRACT

Otomycosis is a fungal infection, which leads to a damage of the external auditory canal. The objective was to study the epidemiological and clinical aspects of otomycosis at Sourô SANOU University Hospital in Bobo-Dioulasso. A prospective study was performed in the Department of Oto Rhino Laryngology and the Department of Parasitology-Mycology. Using sterile swabs under otoscopic examination allowed collecting samples. Germ tube Test, Chromogenic Medium and Latex Reagents for Rapid identification Test were performed identifying yeast fungi. Filamentous fungi were identified on macroscopic and microscopic criteria. Out of 216 patients with infectious otitis, 159 showed a positive culture in 73.6% (159/216). The prevalence of otomycosis was 59.3%. A female predominance was observed in 53.5% with a sex ratio of 0.9. The age group from 0 to 20 years old was mostly involved in 49,7% of cases followed by the age group from 21-40 years old (22%). The most commonly isolated species were *Candida albicans* (20.9%), *Aspergillus niger* (20.3%), *Aspergillus fumigatus* (19%), *Aspergillus flavus* (16%), and *Candida* non-albicans (7.9%). Management of otomycosis should include clinical as well as mycological diagnosis and information for changing behavior patterns leading to infection.

Otomycosis is a fungal infection of the external auditory canal, which can reach the middle ear *via* perforation of the tympanic membrane (Desai et al., 2012; Kaieda et al., 2008). Clinically it has the benign prognosis, however, the disease can be complicated by malignant fungal otitis externa, which is rare and seen primarily, but not exclusively, in severely immunocompromised individuals (Finer et al., 2002; Harley et al., 1995).

Otomycosis is mainly related to environmental saprophytic fungi, which colonize the external auditory canal when immune is compromised by some predisposing factors like use of topical antibiotic eardrops and corticoids, ear self-cleaning, frequent swimming, malnutrition, immunocompromised host. (Anaissie et al., 2003; Kumar et al., 2005; Yehia et al., 1990).

The most prominent disease symptoms are otorrhea, otalgia, pruritus (Fasunla et al., 2007; Kaur et al., 2000). Otomycoses is worldwide in distribution frequently found in tropical and subtropical areas (Kaur et al., 2000; Singh et al., 2017). Diagnosis of otomycosis is primarily based on clinical presumption and mycological confirmation, combining direct microscopy with culture to identify the causative fungal agent (Aboulmakarim et al., 2010).

In Burkina Faso, few studies have been reported on epidemiological and clinical aspects of this pathology (Ouedraogo, 2015). The objective was to study the epidemiological and clinical aspects of otomycosis at Sourô SANOU University Hospital in Bobo-Dioulasso.

MATERIALS AND METHODS

A total of 216 patients with infectious otitis attending the Department of Otolaryngology-Head and Neck Surgery at Sourô SANOU University Hospital in Bobo-Dioulasso. This was a prospective, descriptive and cross-sectional study, performed over an eleven months' period between August 2016 and June 2017.

***Inclusion Criteria*:** 159 patients with clinically diagnosed otomycosis were included in the study. All participants who gave written informed consent were included base on suspicion of an etiological fungal otitis, and external otitis or relapse otitis media despite well-conducted antibiotic therapy.

Exclusion Criteria: We excluded all patients whose samples collected were negative for mycological examinations included direct examination and culture.

Further, a detailed clinical history was obtained from all patients. However, patients were questioned about the presence of itching, otalgia, otorrhea, aural discharge, and fungal debris. A complete otorhinolaryngological examination was performed. Other detailed were also recorded from patients such as socio-demographic status (age, sex, residence and occupation), some predisposing factors (use of topical antibiotic eardrops and corticoids, swimming, ear self-cleaning, malnutrition, immunocompromised host), and the results of mycological examination.

Clinical specimens were collected under otoscopic examination in the Department of Oto Rhino Laryngology by means of sterile cotton swabs. They were sent with a detailed clinical history of patients to the laboratory within a maximum of 24 hours for mycological examination or conserved into 0.9% NaCl between 2şC and 8şC prior to being processed.

The diagnosis of otomycosis is based on a set of evidence, patient's clinical history, and physical examination with an otoscope, and mycological examinations. Although clinical symptoms are not specific, the mass of fungal elements that grow on the floor of the ear canal can be easily observed by means of otoscopic examination.

The mycological examination included direct microscopic examination and culture was carried out in the Department of Parasitology-Mycology at Sourô SANOU University Hospital in Bobo-Dioulasso. Specimens were sown on Sabouraud-Chloramphenicol agar medium (a selective medium that incorporates chloramphenicol to inhibit bacterial growth), incubated at 30-37° C for 48h to 72h.

Identification of filamentous fungi was based on the macroscopic and microscopic criteria. Concerning yeasts of *Candida* genus, the identification was based on Germ-tube testing, followed by isolation on a chromogenic medium and latex agglutination testing.

Data analysis

Data collection and Data analysis were performed using Epi Info 6.04 en (CDC, Altanta, USA) software and R software (version 3.4.2). Categorical variables were compared using the Pearson Chi-2 test or Fisher's exact test. The tests were considered significant at $p < 0.05$.

Ethical Considerations: Patients were aware and agreed to the research. All information was saved in a private place.

Results

One hundred and fifty-nine (159) patients with the clinical diagnosis of otomycosis were processed in this study. Only 128 patients were positive for mycological examination included direct examination and culture for an overall otomycosis prevalence of 59.3%. From these patients we observed a predominance of the female in 85 cases (53.4%) for 74 cases of males (46.6%), with a sex ratio of 0.9. Patient's ages ranged from 0 to 82 years with an average age of 25.5 ± 23.6 years. The highest incidence of otomycosis was seen in the age group of 0-20 years (50.3%) followed by the age group of 21-40 (22%) (Table 1).

Further the majority of the patients showed symptoms of otomycosis between August to September [i.e. dry season and rainy season] with respectively in 11.3% and 17% of cases followed by 10.1% of cases in January and February.

The most frequent symptom was itching of the ear (71.7%), followed by otalgia (67.9%), and a blocked ears sensation (54.7%).

The otoscopic appearance at physical examination showed a clinical suspicion of otomycosis in 51.6% of cases including white debris (40.9%), black debris (5.03%), yellow debris (1.3%) and brown debris (4.4%) (Table 2). Clinically, otomycosis was found to be predominantly unilateral in 88.8% of cases (*p=0.02*) followed by bilateral cases (11.3%) (Table 2).

The ear self-cleaning was the most predisposing factor in 68.6% of cases (*p=0.02)* followed by the use of topical antibiotic eardrops in 34% of cases *(p=0.059)*. However swimming and use of corticoids were respectively observed in 5.7% and 1.9% of cases without a statistical difference in both cases (Table 1). According to the history of treatment, the occurrence of otomycoses was statistically more frequent in patients who had used an antibiotic-based eardrop treatment before diagnosis (34%) and in those who had used corticoids treatment (1.9%). It was found in 64.2% of cases in patients who had no history of antibiotic treatment (Figure 1).

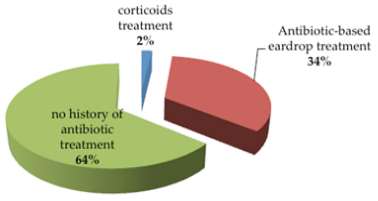

Figure 1: Distribution of cases according to the history of treatment

According to the clinical field (terrain), arterial hypertension was the most common (4.4%) followed by malnutrition and diabetes in 2.5% of cases, and HIV/AIDS (1.3%). However, acute bacterial meningitis, auto-immune dermatitis, infectious cellulitis and gastric ulcer were found at less than 1% each other's.

From a biological standpoint, over 128 positives patients, 98 patients had otomycosis without mixed fungal and bacterial infection and 30 patients had mixed fungal and bacterial infection. Further 163 fungal species were isolated from the cultures (n=98). The most commonly isolated fungal species were Candida albicans (21%), Aspergillus niger (20.3%) and Aspergillus fumigatus (19%). (Tabel3)

Table 1: Epidemiological Characteristics of patients with positive fungi-culture

Epidemiological characteristics	Number of patients n (%)	Positive Patients * n (%)	*p*	Relative Risk (RR) [CI 95%]
Sex	**159**	**128 (80.5)**		
Male	74 (46.5)	61 (71.8)	***0.63***	1
Female	85 (53.5)	67 (90.5)		0.84 [0.44 – 1.60]
Age in years	**159**	**128 (80.5)**	***0.70***	1
0-20	80 (50.3)	65 (81.3)		
21-40	35 (22)	28 (80)		
41-60	27 (17)	20 (74.1)		
61-82	17 (10.7)	15 (88.2)		
Predisposing factors	**159**	**128 (80.5)**		
Current habits	**159**	**128 (80.5)**		
Swimming	9 (5.6)	9 (100)	***0, 08***	5.33 [0.65-43.74]
Ear self-Cleaning	109 (68.6)	92 (84.4)	***0,017***	2.29 [1.15-4.54]
None (without factors)	41 (25.8%)	27 (21,1)		1
Therapeutic attitudes	**159**	**128 (80.5)**		
Use of corticoids	3 (1.9)	3 (100)	***0.168***	1
Use of antibiotic-based eardrops	54 (33.9)	47 (87)	***0.04 9***	2.03 [0.99 - 4.12]
None (without factors)	102 (64.2)	78 (60.9)		1

Positive Patients *: Patients whose direct examination and fungi-culture were positive
Child *: patient ≤15 years

Discussion

Fungal infections are common in tropical and subtropical regions. The disease is worldwide in distribution; however, it mainly leads to the alteration of the external auditory canal and may occur in the middle ear in case of the perforated tympanic membrane. The prevalence of otomycosis is related to geographic area and depends on countries. Further diagnosis of otomycosis is commonly caused a problem because of a saprophytic fungal flora, and observation of pathogenic agent in slide fungi-culture does not allow to consider inflammations of the external auditory canal as a fungal infection (Barati et al., 2011; Kaur et al., 2000; Paulose et al., 1989). In this current study, only positive cases of mycological examination including direct examination and fungi-culture were taken to determine the prevalence of otomycosis.

However, in the study of Ozcan *et al*. (Ozcan et al., 2003) fungi-culture showed only a growth of *Candida albicans* isolated in the control group (only 2.5% of healthy patients). They concluded that a positive fungi-culture may reflect probably otomycosis rather than saprophytic growth (Chin et al., 1982; Araiza et al., 2006; Kaur et al., 2000; Ozcan et al., 2003).

In this study, a presumed diagnosis of otomycosis was confirmed by mycological examination (positive direct examination and fungi-culture) in the laboratory in 59.3%. Thereby we obtained a prevalence of 59.3% of otomycosis at Sourô SANOU University Hospital in Bobo-Dioulasso. Overall, the prevalence rate is extremely variable depending on studies and countries.

However authors reported the prevalence rates of 5-50% in France (Rousseau et al., 2005), 25% in Poland (Kurnatowski et al., 2001), 30.4% in Germany (Vennewald et al., 2010) and 42.6% in the Ivory Coast (Yavo et al., 2004). In contrast, in Nigeria, higher rates have been reported ranging from 72.7% to 74.7% (Enweani et al., 1998; Fasunla et al., 2007). Higher rates were also reported by Adoubryn et *al.* in Ivory Coast (80 %) (Adoubryn et al., 2014).

Table 2: Distribution of patients by otoscopic appearance, clinical symptomatology and localization of fungal otitis

Clinical data	Number of patients n (%)	Positive patients * n (%)	*p*
Clinical symptomatology			
Itching (pruritus)	**159**	**128 (80.5)**	
Yes	114 (71.7)	96 (84.2)	***0.06***
No	45 (28.3)	32 (71.1)	
Otalgia	**159**	**128 (80.5)**	
Yes	108 (67.9)	84 (77.8)	***0.21***
No	51 (32.1)	44 (86.3)	
Blocked ears sensation	**159**	**128 (80.5)**	
Yes	87 (54.7)	67 (77)	***0.22***
No	72 (45.3)	61 (84.7)	
Otorrhea	**159**	**128 (80.5)**	***<0,0001***
Yes	77 (48.4)	50 (64.9)	***5,229 10^{-12}***
No	82 (51.6)	78 (95.1)	
Relapse of otorrhea	**159**	**128 (80.5)**	
Yes	78 (49.1)	68 (87.2)	***0,037***
No	81 (50.9)	60 (74.1)	
Laterality of the otomycosis	**159**	**128 (80.5)**	
Right ear	58 (36.5)	51 (87.9)	***0.02***
Left ear	83 (52.2)	60 (72.3)	
Bilateral	18 (11.3)	17 (94.4)	
Otoscopic appearance of otomycosis	**159**	**128 (80.5)**	***<0,0001***
Purulent aural discharge	77 (48.4)	50 (64.9)	***5,229 10^{-12}***
White debris	65 (40.9)	63 (96.9)	
Black debris	8 (5)	7 (87.5)	
Yellow debris	2 (1,3)	2 (100)	
Brown debris	7 (4.4)	6 (85.7)	

Positive Patients*: Patients whose direct examination and fungi-culture were positive

This prevalence rates variation is related to several predisposing factors involved in determining the prevalence of otomycosis. Indeed, the climatic conditions, environmental hygiene, the combined action of hot and humidity are the predisposing factors promoted the growth of fungal agents.

In agreement with some environmental factors, the prevalence of otomycosis is greater in the tropical and subtropical regions, in hot and humid climates, than in cold and arid climates (Hueso Gutiérrez et al., 2005; Kumar et al., 2005; Munguia et al., 2008; Stern et al., 1988). The prevalence rate (59.3%) recorded in this study highlights the importance of etiological fungal agents involved in infectious otitis.

Table 3: Distribution of isolated fungal species in crops

Fungal species isolates	Number (n)	Percentage (%)
***Aspergillus niger** **	33	20.3
***Aspergillus fumigatus** **	31	19
Aspergillus flavus	26	16
Aspergillus terreus	5	3.1
Rhizopus oryzae	2	1.2
Aspergillus nidulans	1	0.6
Curvularia lunata	1	0.6
Exophiala dermatitidis	1	0.6
Candida albicans	34	21
Candida krusei	8	4.9
Candida dubliniensis	3	1.8
Geotrichum candidum	2	1.2
Candida glabrata	1	0.6
Candida non albicans (other yeasts)	13	7.9
Scytalidium hyalin	1	0.6
Sporothrix schenkii	1	0.6
Total	163	100

***Aspergillus niger**, Aspergillus fumigatus** and Candida albicans**:** pathogenic species

In general, the distribution by sex is not significant. Indeed, Males and females are affected in equal properties. A female predominance was noted in 53.5% of cases. These results are similar to those of Ouédraogo et al. in Burkina Faso who reported a female predominance with a sex ratio of 0.84 at Yalgado University hospital in Ouagadougou (Ouedraogo, 2015). Other African authors such as Yavo et al. in Ivory Coast as well as Fayemiwo et al. in Nigeria and Aboulmakarim et al. in Morocco reported the same results like us with a female predominance and variable sex ratios according to each studies (Aboulmakarim et al., 2010; Fayemiwo et al., 2010; Yavo et al., 2004).

In this study, the high incidence of otomycosis in the female group was also reported by others studies (Aneja et al., 2010; Pontes et al., 2009; Ghiacei et al., 2001). This female predominance could be explained by a high number of women attending health services. It could also show the gender distribution of the general population with more women than men.

Moreover, age was not also a contributing factor since managed to set up a distribution that is not uniform according to the age group considered, with the greater incidence between of 21-40 years in our series. In contrast to bacterial otitis, the authors reported that mycotic otitis is common in adults (Mahmoudabadi

et al., 2006; Moharram et al., 2013; Nowrozi et al., 2014). However, they have a distribution that is not homogeneous according to the age group considered, with the greatest incidence between 20-40 years. These results are similar to those of Adoubryn *et al.* in Ivory Coast (Adoubryn et al., 2014), Aboulmakarim *et al.* in Morocco (Aboulmakarim et al., 2010), and Surinder *et al*. in India (Singh et al., 2017) who reported a prevalence of otomycosis in the same age group. Some authors like Aneja et *al.* (Aneja et al., 2010), Fasunla et *al* (Fasunla et al., 2007), and Pontes *et al.* (Pontes et al., 2009) reported also the same results. This age group is the most active stage of life.

All these studies agree that otomycosis occur mostly in young adult people. Indeed, their greater susceptibility to externa otitis is related to the narrowness and more bent of their external auditory canal. The juvenile trait of this pathology seems unanimous, although its importance depends on areas.

Further, otomycosis was more prevalent in August and September than in January and February. This can be explained by the fact that, the first period corresponds to the rainy season and the second represents the harmattan season with dry and dusty winds in Burkina Faso. Moisture, observed in the rainy season, is an important factor favoring dissemination and growth of fungi in the environment. Also, dusty winds are one of the vehicles spreading fungi spores (molds). These two conditions together could prove the higher incidence of otomycosis in the rainy season and the harmattan in our study.

In addition, the authors reported that, fungal infections mainly occur during the hot season (Hueso Gutiérrez et al., 2005), particularly because a warm climate favoring the practice of water sports (Pradhan et al., 2003) The importance of hot as a growth factor of fungi has been demonstrated by the greatest growth of fungi-cultures at 37°C in this study. Indeed, this was confirmed during the clinical observation of otomycosis, by the constant presence of fungal colonies. The highest prevalence of otomycosis was also reported during summer by Paulose et *al.* (Paulose et al., 1989), Ozcan et *al.* (Ozcan et al., 2003), Ghiacei et *al.* (Ghiacei et al., 2001) and Pontes et *al.* (Pontes et al., 2009). One other hand otomycosis were also commonly noted during the rainy season. Some authors in literature have been reported the prevalence of otomycosis during overwintering and in humid conditions (Pradhan et al., 2003; Singh et al., 2017). Indeed, Aneja and *al.* (Aneja et al., 2010), Desai et *al.* (Desai et al., 2012) and Surinder et *al* (Singh et al., 2017). In India reported a high incidence of otomycosis during the rainy season. Thereby seasonal influence is the greatest factor involved in the pathogenesis of ear infections in general and otomycosis particularly.

In our survey, the most common symptom was itching (71.7%) followed by otalgia (67.9%), ear blocked sensation (54.7%), and otorrhoea (48.4%). These results are comparable to those of Adoubryn *et al.* in Ivory Coast, who reported a predominance of itching (70.9%), followed by otalgia (50%) as the main reasons for patients attending to the Oto Rhino Laryngology department (Adoubryn et al., 2014). Aboumakarim et *al*. in Morocco reported itching (82%), otalgia (54%), ear blocked sensation (45%) and otorrhoea (36%) as the most common symptom found in patients (Aboulmakarim et al., 2010).

According to most of the studies on the prevalence of symptoms reported in fungal external otitis, itching (91.7%) was the most common symptom which is similar with the results of our study, followed by ear blocked sensation (55.6%), otorrhea (51.4%), and otalgia (40.3%) (Klossek et al., 2003). Therefore, Itching and otalgia are the most common clinical manifestations of otomycosis. However, all these symptoms are no specific to fungal infection, which should be confirmed by mycological examination.

In this current study, the otoscopic appearance showed otomycosis in 51.6% of cases including white debris, black debris, brown debris and yellow debris. Aboulmakarim *et al.* in Morocco reported at the otoscopic examination otorrhea (60%) with various aspects, including white or creamy debris, gray or black debris (Aboulmakarim et al., 2010).

Thereby otoscopy is an important clinical examination because it allows setting the clinical diagnosis of otomycosis. Indeed, it gives a clinical orientation according to the aspect of debris observed in the external auditory canal on the genus of the causative fungal agent of otomycosis.

In this investigation, otomycosis was predominantly unilateral associated with slight bilateral cases (11.3%). These results are similar to those of Nowrozi et *al* in Iran who reported most cases of unilateral otomycosis associated with one case of bilateral otomycosis (Nowrozi et al., 2014). Ozcan *et al*. in Turkey reported mainly cases of unilateral otomycosis associated with slight cases of bilateral otomycosis (11.5%) (Ozcan et al., 2003). As for Desai *et al*, otomycoses were unilateral in 100% of cases (Desai et al., 2012). However, in our series, we noted slight cases of bilateral otomycosis (11.3%). Bilateral otomycosis rates were reported by Paulose et *al.* (13%) (Paulose et al., 1989), Kurnatowski *et al.* (20.8%) (Kurnatowski et al., 2001), Sagnelli *et al.* (16.6%), (Sagnelli et al., 1993) , Chander *et al.* (10%) (Jagdish Chander et al., 1996), and by Lohoue (5.7%) (Lohoue et al., 1996). Mishra *et al*. reported a case of bilateral otomycosis with *Aspergillus niger* (Mishra et al., 2004).

All these authors agree that otomycosis is mostly unilateral or associated with slight cases of bilateral otomycosis. This indicates that it is not a very contagious pathology without predilection for one side of the ear. However, these slight cases of bilateral otomycosis, in this study, indicate secondary contamination through the inadequate materials of ear cleaning commonly used for both ears like cotton buds, feathers or any other objects. In addition, the exposure of both ears to the same risk factors would justify unilateral or bilateral localization of otomycosis.

Generally, predisposing factors are those of externa otitis, otomycosis is often associated with bacterial infection, to which are added some specific factors for fungi growth. Indeed, it is mostly association of several predisposing factors that lead to otomycosis. In this investigation, incidence of otomycosis was significantly *(p=0.017)* favored by ear self-cleaning. Indeed, the risk of contracting otomycosis was twice higher in subjects who cleaned their ears. These results are similar to those of Adoubryn *et al*. in Ivory Coast, who reported the risk of contracting otomycosis four times higher in subjects who cleaned their ears (Adoubryn et al., 2014). Similarly Yavo *et al.* reported that 59.6% of patients with otomycosis used to clean their ears daily with sticks, cotton buds, hairpins or feathers (Yavo et al., 2004).

Untimely cleaning of the external auditory canal is an important factor favoring otomycosis in our study. Loh et *al.* (1998) considered it as an important factor trigger otomycosis (Loh et al., 1998). This Untimely cleaning of the ear can lead to mechanical damage of the skin barrier, via the use of cotton buds or any other objects (Oliveri et al., 1984; Yavo et al., 2004). Firstly, the cotton buds remove the protective barrier of earwax, thereby leading to abrasion of the external auditory canal skin, and causing the introduction of any pathogens. Secondly, it can lead to trauma, associated with an imbalance of microbial flora in the ear canal constituting predisposing factors for externa otitis (Jahn et al., 1998).

However, the other factors favoring otomycoses cannot be neglected because the presence of one or other does not exclude their influence on the otomycoses. In this study, swimming was a predisposing factor of mycotic otitis. Indeed, the risk of contracting otomycosis was five times higher in swum subjects. Further Garcia- Martos reported that 90% of fungal infections were related to swimming at sea, 40% to topical antimicrobial treatments and 27.5% to trauma. As for other authors, the highest level of moisture and trauma change the natural protection of the ear canal (Garcia-Martos et al., 1993). In Ivory Coast, the risk of contracting otomycosis was three times higher in subjects who commonly bathed in natural water reservoirs or swimming pools (Yavo et al., 2004).

In addition, saturation of the stratum corneum of external auditory canal skin lead to intercellular edema, occlusion of pilosebaceous units, and finally causing otitis (Klossek et al., 2003; Paulose et al., 1989). Moisture within the external auditory canal creates the appropriate environment conditions for fungal growth. Indeed, the high level of hot and humidity leads to skin maceration (Gray et al., 2005), which may be due to the wearing of headgear. In Turkey, otomycosis is more common among women (80.5%), which may be related to the fact that a large majority of women (74.7%) wear headgear (Ozcan et al., 2003). In India, otomycosis is more common in men who are used to wearing turban (Kaur et al., 2000).

According to the history of the treatment, factors such as the use of topical antibiotic eardrops (34%) and the use of corticoids (1.9%) were observed with slight frequencies in our series. The risk of contracting otomycosis was twice higher in subjects who use eardrops in this study. However it was nine times higher in patients who used eardrops containing antibiotics and corticoids (Oliveri et al., 1984).

Indeed, the use of eardrops whatever its nature, promotes the occurrence of otomycosis by not only unbalancing the commensal flora in favor of fungi, but also by promoting the proliferation of fungi through the moistening of the external auditory canal. The use of eardrops increases the incidence of fungal infections. In fact, Chander *et al.* in 1996 (45 patients over 80 patients with otomycosis) reported that 56.3% of the patients used eardrops (Jagdish Chander et al., 1996), also 59.8% of the ears studied by Pradhan *et al.* in 2003 (64 ears over 107 with clinical signs of fungal otitis) used eardrops (Pradhan et al., 2003). These eardrops may be based on antibiotics. Indeed the use of antibiotics has been reported by Chander *et al.* in 15% of patients mainly amicin and ciprofloxacin (Jagdish Chander et al., 1996). Similarly the use of eardrops steroid-based has been reported by Munguia *et al.* (about 10% of the ears) (Munguia et al., 2008).

This antibiotic or corticosteroid therapy may be local or general: The use of antibiotics and corticosteroids, without prophylactic measures, is one of the main causes of otomycosis, when it is a chronic inflammation of the ear. In fact, these treatments inhibit the body's natural protection and cause an imbalance of the bacterial flora of the ear in favor of opportunistic fungi (Jackman et al., 2005). Further Haruna *et al.* described immunosuppression and antibiotic therapy, not as contributing factors, but as a necessary history of fungal infections (Haruna et al., 1994).

Tang Ho et *al.* reported in 2006 that almost half (45%) of patients with otomycosis were treated with drugs before otologic diagnosis; ciprofloxacin and neomycin-polymyxin (B-hydrocortisone) were the most commonly prescribed drugs (Ho et al., 2006). Similarly, Jackman *et al.* showed that 26 patients with myopathic otitis had used all, before diagnosis, topical antibiotics, for a presumed episode of chronic otitis media or acute otitis externa (Jackman et al., 2005). Ozcan *et al.* reported for only 3.4% of patients with otomycosis who had a history of long-term antibiotic therapy (Ozcan et al., 2003). Aboulmakarim *et al.* in Morocco reported a significantly difference between the occurrence of otomycosis and the use of eardrops whether they are anti-inflammatory or topical antibiotics (Aboulmakarim et al., 2010). However, the misuse of antibiotic-based drugs could lead to an imbalance of the local commensal bacterial flora in favour of opportunistic fungi.

Depending on the terrain, the majority of our patients had no medical history in 84.9% of cases. Medical history was encountered with slight frequencies in our series. Thus diabetes and sickle cell disease were reported in 2.5% of cases followed by malnutrition (1.9%) and HIV / AIDS (1.3%). These results are similar to those of Ouédraogo *et al*. in Burkina Faso who reported a predominance of no medical history (58.3%) followed by diabetes (19.55%) and HIV / AIDS (6.52%) (Ouedraogo, 2015).

In addition, Ho et *al* reported 5% of diabetics among patients with otomycosis (Ho et al., 2006). As for Panchal *et al*. in India reported 13.04% of diabetics in patients with otomycosis (Panchal et al., 2013). Indeed, diabetes seems to favour the occurrence of otomycosis and probably their severity. Since the commensal flora of the external auditory canal in diabetic patients is normal, the increased risk of otomycosis is probably due to other factors such as an imbalance of local flora and inflammation (non-specific) of the ear (Enweani et al., 1998; Klossek et al., 2003; Malard et al., 2005). In Nigeria, 6% of patients with otomycosis had a history of diabetes mellitus (Fasunla et al., 2007). Also, the importance of malnutrition on the occurrence of otomycosis in children aged 5-10 years was emphasized by Enweani *et al*. in Nigeria in their study (Enweani et al., 1998). Furthermore, the authors reported the history of immunosuppression such as AIDS in patients with otomycosis (Dior et al., 1998; Klossek et al., 2003; Oliveri et al., 1984; Strauss et al., 1991; Yates et al., 1997). In our series, the history of HIV/AIDS in patients with otomycosis was reported in 1.3% of cases.

Culture allowed us to isolate 163 fungal species with a predominance of *Candida albicans* (21%), *Aspergillus niger* (20.3%), and *Aspergillus fumigatus* (19%). In Iran, Kiakojuri *et al.* (Kiakojuri et al., 2015) and Kazemi et *al*. (Kazemi et al., 2015) reported the same results with a predominance of *Aspergillus niger, Aspergillus fumigates,* and *Candida albicans* . In India, Kaur et *al*. reported a predominance of *Aspergillus fumigatus* and *Candida albicans* respectively in 41.4% and 13.7% of cases (Kaur et al., 2000).

However, Singh *et al.* reported that *Aspergillus flavus* was the most common fungal pathogen followed by *Aspergillus niger*, *Aspergillus fumigatus,* and *Aspergillus nidulans* (Singh et al., 2017). Araiza *et al.* also reported *Aspergillus flavus* to be the most isolated species in Mexico (Araiza et al., 2006). In Turkey, *Aspergillus* was the most isolated species with a predominance of *Aspergillus niger* (44.8%), *Aspergillus flavus* (17.9%), and *Aspergillus fumigatus* (17.9%) (Ozcan et al., 2003). In Iran, *Aspergillus niger* was the most common species involved in otomycosis (Kazemi et al., 2015; Mahmoudabadi et al., 2010; Ghiacei et al., 2001; Schapowal et al., 2002).

Species belonging to *Aspergillus genus* are the most common pathogens found in mycotic otitis (Lmimouni et al., 2003; Kumar, 2005). *Aspergillus fumigatus* exist in decomposing organic materials such as grain silos and hay bales. This species is common in soil and air (Chabasse et al., 2002). It is found commonly in tropics and subtropics areas. Its thermotolerance up to 57°C explains its abundance. In addition, as in our series, studies reported in warm and humid regions, also showed *Aspergillus niger* as the most common pathogen involved in otomycosis (Aneja et al., 2010; Moghaddam et al., 2009; Ozcan et al., 2003; Stern et, 1988). Further species belonging to *Candida* genus are responsible for 5-40% of fungal infections of the external auditory canal whose *Candida albicans* is the most involved species (Enweani et al., 1998; Gutiérrez et al., 2005; Kaur et al., 2000; Kurnatowski et al., 2001; Pradhan et al., 2003). These observations reflect the variability of mold species involved in otomycosis.

Conclusion

Otomycosis is a common pathology at Sourô SANOU University Hospital in Bobo-Dioulasso. Indeed, fungal agents take an important place in the etiologies of otitis externa. The disease occurs at any ages, without sex discrimination (sex ratio of 0.9), but with clear juveniles' predominance. Itching, otalgia, and otorrhoea commonly represent clinical manifestations of this disease in our series. However prophylactic measures are primary needful. Therefore, clinicians should advise patients on environmental and personal hygiene for changing behavior patterns such as the untimely use of cotton buds for cleaning, which could significantly reduce the occurrence of fungal infections.

Acknowledgement

We thank the participants for their technical assistance and collaboration, the staff of the ENT Department and Laboratory of Parasitology-Mycology of Sourô SANOU University Hospital of

Bobo-Dioulasso, Burkina Faso.

Author Contributions : Fructueux Modeste Amona conceived the paper, analyzed and collected the data, wrote the manuscript. Sanata Bamba, Richard W-L Ouedraogo and Abdoulaye Elola conceived the paper, writing and revision of the manuscript. Sondo Apoline, Adama ZIDA, Ibrahim Sangare', and Mamoudou Cisse writing and revision of the manuscript

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

References

1. Aboulmakarim, S., Tligui, H., Mrini, M. El, Zakaria, I., Handour, N., & Agoumi, A. (2010). Otomycoses : étude clinique et mycologique de 70 cas. *Journal de Mycologie Medicale*, *20*, 48–52. Doi: 10.1016/j.mycmed.2010.01.002. [CrossRef]
2. Adoubryn, K. D., N'Gattia, V. K., Kouadio-Yapo, G. C., Nigué, L., Zika, D. K., & Ouhon, J. (2014). Épidémiologie des otomycoses au centre hospitalier et universitaire de Yopougon (Abidjan-Côte d'Ivoire). *Journal de Mycologie Medicale*, *24*(2), 7. https://doi.org/10.1016/j.mycmed.2013.07.057. [CrossRef]
3. Anaissie, E. J.; Mack-Ginnis, M. R.; Pfaller, M. A. (2003). Clinical Mycology. *Elsevie, Philadelphia*, 2003, *2*.
4. Aneja, K. R., Sharma, C., & Joshi, R. (2010). Fungal infection of the ear: a common problčm in the north eastern. *International Journal of Pediatric Otorhinolaryngology*, *74*, 604–607. Doi.org/10.1016/j.ijporl.2010.03.001. [CrossRef] [PubMed]
5. Araiza, J., Canseco, P., & Bonifaz, A. (2006). Otomycosis: clinical and mycological study of 97 cases. *Revue de Laryngologie - Otologie - Rhinologie*, *127*(4), 251–254. [CrossRef] [PubMed]
6. Barati, B., Okhovvat, S. A. R., Goljanian, A., & Omrani, M. R. (2011). Otomycosis in central iran: a clinical and mycological study. *Iranian Red Crescent Medical Journal*, *13*(12), 873–876. [CrossRef] [PMC]
7. Chabasse, D., Bouchara, J.-P., Gentile, L. de, Brun, S., Cimon, B., & Penn, P. (2002). Les moisissures d'interęt médical. In *CAHIER Formation Biologie médicale, N°25* (p. 160). [CrossRef]
8. Chin, C. S.; Jegathesan, M. (1982). Fungal isolates in otomycosis. *Malays J Pathol*, *5*, 45–47. [PubMed]
9. Desai, K. J., Malek, S. S., Italia, I. K., Jha, S., Pandya, V., & Shah, H. (2012). Fungal Spectrum In Otomycosis At Tertiary Care Hospital. *NJIRM*, *3*(5), 58–61. [CrossRef]
10. Dior, E. M., Schachern, P. A., & Paparella, M. M. (1998). Acquired immunodeficiency syndrome with massive Aspergillus fumigatus infection. *Otolaryngol Head Surg*, *118*, 283–285. [CrossRef] [PubMed]
11. Enweani, I. B., & Igumbor, H. (1998). Prevalence of otomycosis in malnourished children in Edo State, Nigeria. *Mycopathologia*, *140*(2), 85–87. [CrossRef] [PubMed]
12. Fasunla, J., Ibekwe, T., & Onakoya, P. (2007). Otomycosis in western Nigeria. *Mycoses*, *51*, 67–70. Doi.org/10.1111/j.1439-0507.2007.01441.x. [CrossRef] [PubMed]
13. Fayemiwo, S. A., Ogunleye, V. O., Adeosun, A. A., & Bakare, R. A. (2010). Prevalence of otomycosis in Ibadan: a review of laboratory reports. *African Journal of Medicine and Medical Sciences*, *39 Suppl*, 219–222. [CrossRef] [PubMed]
14. Finer, G., Greenberg, D., Leibovitz, E., Leiberman, A., Shelef, I., & Kapelushnik, J. (2002). Conservative treatment of malignant (invasive) external otitis caused by Aspergillus flavus with oral itraconazole solution in a neutropenic patient. *Scand J Infect Dis*, *34*(3), 227–229. Doi.org/10.1080/00365540110077137. [CrossRef] [PubMed]
15. Garcia-Martos, P., Delgado, D., Marrin, P., & Mira, J. (1993). Analysis of 40 cases of otomycosis. *Enferm Infecc Microbiol Clin*, *11*(9), 487–489. [CrossRef] [PubMed]
16. Ghiacei, S. (2001). Survey of otomycosis in north-western area of Iran. *Med J Mashhad Uni Med Sci*, *43*, 85–7.
17. Gray, R. F., Sharma, A., Vowler, S. L. (2005). Revue de Laryngologie - Otologie - Rhinologie. *Clinical Otolaryngology*, *30*, 105–111.
18. Gutiérrez, P. H., Álvarez, S. J., Sañudo, E. G., & García, L. M. G. (2005). Presumed diagnosis : Otomycosis . A study of 451 patients. *Acta Otorrinolaringol Esp*, *56*, 181–186. Doi.org/10.1016/S0001-6519(05)78597-6. [CrossRef] [PubMed]
19. Harley, W. B., Dummer, J. S., Anderson, T. L., & Goodman, S. (1995). Malignant External Otitis Due to Aspergillus flavus with Fulminant Dissemination to the Lungs. *Clin Infect Dis*, *20*, 1052–1054. Doi.org/10.1093/clinids/20.4.1052. [CrossRef] [PubMed]
20. Haruna, S., Haruna, Y., Schachern, P. A., Morizono, T., Paparella, M. M. (1994). Histopathology Update : Otomycosis. *Am J Otolaryngol*, *15*(1), 1994. Doi.org/10.1016/0196-0709(94)90045-0. [CrossRef] [PubMed]
21. Ho, T., Vrabec, J. T., Yoo, D., & Coker, N. J. (2006). Otomycosis: Clinical features and treatment implications. *Otolaryngology - Head and Neck Surgery*, *135*(5), 787–791. https://doi.org/10.1016/j.otohns.2006.07.008. [CrossRef] [PubMed]
22. Hueso Gutiérrez P1, Jiménez Alvarez S, Gil-Carcedo Sañudo E, Gil-Carcedo García LM, Ramos Sánchez C., Vallejo, V. L. (2005). Presumption diagnosis: otomycosis. A 451 patients study. *Acta Otorrinolaringol Esp.*, *56*(5), 181–186. Doi.org/10.1016/S0001-6519(05)78597-6. [CrossRef] [PubMed]
23. Jackman, A., Ward, R., April, M., & Bent, J. (2005). Topical antibiotic induced otomycosis. *International Journal of Pediatric Otorhinolaryngology*, *69*, 857–860. Doi.org/10.1016/j.ijporl.2005.01.022. [CrossRef] [PubMed]
24. Jagdish, C., Sangeeta, M., & Subha, S. A. H. (1996). Otomycosis - a clinico-mycological study and efficacy of mercurochrome in its treatment. *Mycopathologia*, *135*, 9–12. [CrossRef] [PubMed]
25. Jahn, A. F., Ludman, H., & Wright, T. (1998). "Infection and inflammation of the external ear." In *Diseses of the Ear , Eds Arnold, London, UK* (pp. 314–315).
26. Kaieda, S. (2008). Fungal infection in the otorinolaryngologic area. *Nihon Rinsho J J Clin med*, *66*(12), 2290–2293. [CrossRef] [PubMed]
27. Kaur, R., Mittal, N., Kakkar, M., Aggarwal, A. K., & Mathur, M. D. (2000). Otomycosis: A clinicomycologic study. *Nose Throat J*, *79*(8), 606–609. [CrossRef] [PubMed]
28. Kazemi, A., Majidinia, M., Jaafari, A., Ayatollahi, S. A., Mahmoudabadi, A. Z., & Alikhah, H. (2015). Etiologic Agents of Otomycosis in the North-Western Area of Iran. *Jundishapar J Microbiol*, *8*(9), e21776. https://doi.org/10.5812/jjm.21776. [CrossRef] [PMC]
29. Kiakojuri, K., Rajabnia, R., Jalili, B., Khafri, S., & Omran, S. M. (2015). Otomycosis in Adolescent Patients Referred to the Therapeutic Centers in Babol City, Iran. *Jundishapar J Microbiol*, *8*(5), e17138. Doi:10.5812/jjm.8(5)2015.17138. [PMC] [PubMed]
30. Klossek, J. M., & Serrano, E. (2003). Les Mycoses en ORL. *éditeur : Société Française d'ORL et de chirurgie de la face et du cou*, 41-62 p
31. Kumar, A. (2005). Fungal Spectrum in Otomycosis Patients. *JK SCIENCE*, *7*(3), 152–155. [CrossRef]
32. Kurnatowski, P., & Filipiak, A. (2001). Otomycosis: prevalence, clinical symptoms, therapeutic procedure. *Mycoses*, *44*, 472–479. [CrossRef]
33. Lmimouni, B. E.; Amarouch, N.; Lahlou, I. A.; Baaj, A.; El Mellouki,. W. (2003). Otomycose aspergillaire ŕ Aspergillus niger. *Maroc Médicale*, *25*(2), 116–118.
34. Loh, K. S., Tan, K. K., Kumarasinghe, G., Leong, H. K., Yeoh, K. H. (1998). Otitis externa--the clinical pattern in a tertiary institution in Singapore. *Annals of the Academy of Medicine, Singapore*, *27*(2), 21. [CrossRef] [PubMed]
35. Lohoue, J. P., Bengono, G. T., & Founda, A. O. (1996). A study of otomycoses in Yaound. *Revue de Laryngologie - Otologie - Rhinologie*, *117*(2), 119–121. [PubMed]
36. Mahmoudabadi, A. Z. (2006). Mycological studies in 15 cases of otomycosis, *22*(4), 2005–2007. [CrossRef]
37. Mahmoudabadi, A. Z., Masoomi, S. A., & Mohammadi, H. (2010). Clinical and mycological studies of otomycosis. *Pak J Med Sci*, *26*(1), 187–190. [Google Scholar]
38. Malard, O., Montreuil de Beauvillain, C., Legent, F. (2005). Pathologie acquise de l'oreille externe. *EMC - Oto-Rhino-Laryngologie*, *2*(3), 263–289. Doi.org/10.1016/j.emcorl.2005.04.002. [Google Scholar]
39. Mishra, G. S.; Mehta, N.; Pal, M. (2004). Chronic bilateral otomycosis caused by Aspergillus niger. *Mycoses*, *47*, 82–84. Doi.org/10.1046/j.0933-7407.2003.00935.x. [CrossRef] [PubMed]
40. Moghaddam AY, Asadi MA, Dehghani R, H. H. (2009). The prevalence of otomycosis in Kashan, Iran, during 2001-2003. *Jundishapur J Microbiol*, *2*, 18–21. [Google Scholar]
41. Moharram, A., Ahmed, H., & Nasr, S. A.-M. (2013). Otomycosis in Assiut , Egypt. *Journal of Basic and Applied Mycology*, *4*, 1–11. [CrossRef]
42. Munguia, R., & Daniel, S. J. (2008). Ototopical antifungals and otomycosis : A review. *International Journal of Pediatric Otorhinolaryngology*, *72*, 453–459. https://doi.org/10.1016/j.ijporl.2007.12.005. [CrossRef] [PubMed]
43. Nowrozi, H., Arabi, F. D., Mehraban, H. G., Tavakoli, A., & Ghooshchi, G. (2014). Mycological and clinical study of otomycosis in Tehran , Iran. *Bulletin of Environment, Pharmacology and Life Sciences*, *3*(2), 29–31. [CrossRef]
44. Oliveri, S., Capello, G., Napolitano, M. G., Triolo, C., Grillo, C. (1984). Otomycosis: etiology and analysis of predisposing factors. *Bollettino Dell'Istituto Sieroterapico Milanese*, *63*(6), 537–542. [CrossRef] [PubMed]
45. Ouedraogo, R. (2015). Otomycoses dans le service d'ORL du CHU Yalgado Ouedraogo de Ouagadougou: aspects epidemiologiques, diagnostiques et thérapeutiques. *Rev. Cames Sante*, *3*(1), 30–33. [CrossRef]
46. Ozcan, K., Ozcan, M., Karaarsian, A., & Karaarsian, F. (2003). Otomycosis in Turkey ; Predisposing Factors, Etiology and Therapy. *Laryngol & Otol*, *117*, 39–42. [CrossRef] [PubMed]
47. Panchal, P., Pethani, J., Patel, D., Rathod, S., & Shah, P. (2013). Analysis of various fungal agents in clinically suspected cases of otomycosis. *Indian Journal of Basic and Applied Medical Research*, *2*(8), 865–869. [CrossRef]
48. Paulose, K. O., Khalifa, S. A. L., Shenoy, P., & Sharma, R. K. (1989). Mycotic infection of the ear (otomycosis): A prospective study. *J Laryngol Otol*, *103*(March 1988), 30–35. Doi.org/10.1017/S0022215100107960. [CrossRef] [PubMed]
49. Pontes, Z. B. V. da S., Débora, A., Silva, F., Lima, E. de O., Guerra, M. de H., Maria, N., … Guerra, F. S. Q. (2009). Otomycosis: a retrospective study. *Braz J Otorhinolaryngol*, *75*(3), 367–370. https://doi.org/10.1016/S1808-8694(15)30653-4. [CrossRef] [PubMed]
50. Pradhan, B., Ratna Tuladhar, N., & Man Amatya, R. (2003). Prevalence of otomycosis in outpatient department of otolaryngology in Tribhuvan University Teaching Hospital, Kathmandu, Nepal. *Annals of Otology, Rhinology and Laryngology*, *112*(4), 384–387. Doi: 10.1177/000348940311200416. [CrossRef]
51. Rousseau, A., Cornet, M., Carnot, F., Brasnu, D., Bruneval, P., & Badoual, C. (2005). Les mycoses ORL. *Ann Pathol*, *25* :(2), 104–116. Doi.org/10.1016/S0242-6498(05)86174-7. [CrossRef] [PubMed]
52. Sagnelli, M., Cristalli, G., Bruno, E., Marzullo, C., Abramo, A., Pollastrini, L. (1993). Otomicosis: estudio microbiologico sobre 147 casos de otitis externa. *An Otorrinolaringol Ibero Am*, *20*(5), 521–530.
53. Schapowal A. (2002). Otitis externa : a clinical overview. *Ear Nose Throat J*, *81*(8 Suppl 1), 21–22. [CrossRef] [PubMed]
54. Singh, S., Singh, H., & Kaur, A. (2017). Otomycosis - A clinical and mycological study. *Indian Journal of Otolaryngology*, *6*(2), 271–275. https://doi.org/10.1007/BF03047899. [CrossRef]
55. Stern JC, L. F. (1988). Otomycosis. *Ear Nose Throat J*, *67*(11), 804–805, 809–810. [PubMed]
56. Strauss, M., & Edward, F. (1991). Aspergillus otomastoiditis in acquired immunodeficiency syndrome. *American Journal of Otology*, *12*(1), 49–53. [CrossRef] [PubMed]
57. Vennewald, I., & Klemm, E. (2010). Otomycosis : Diagnosis and treatment. *Clinics in Dermatology*, *28*(2), 202–211. Doi.org/10.1016/j.clindermatol.2009.12.003. [CrossRef] [PubMed]
58. Yates, P., Upile, T., & Axon, P. (1997). Aspergillus mastoiditis in a patient with acquired immunodeficiency syndrome. *The Journal of Laryngology and Otolog*, *111*, 560–561. Doi.org/10.1017/S0022215100137909. [CrossRef] [PubMed]
59. Yavo, W., Kassi, R. R., Kiki-Barro, P. C., Bamba, A., Kplé, T., Menan, E. I. H., … Koné, M. (2004). Prévalence et facteurs favorisants des otomycoses traitées en milieu hospitalier ŕ Abidjan (Côte d'ivoire). *Medecine Tropicale*, *64*(1), 39–42. [CrossRef]
60. Yehia, M., AL-Habib, H. M., Shehab, N. (1990): Otomycosis : A common problem in North Iraq. *J Laryngol Otol*, *104*, 387–389. Doi.org/10.1017/S0022215100158529. [CrossRef] [PubMed]