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Comparison of Clinical Symptoms and Microbiological Results of Otomycosis Due to Candida SP. and Aspergillus SP. Infection in ENT Patients in Denpasar

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Abstract

Otomycosis is a superficial fungal infection of the external auditory canal that commonly occurs in tropical countries, including Indonesia. The disease is primarily caused by *Aspergillus* spp. and *Candida* spp., which exhibit distinct clinical manifestations and therapeutic responses. This study aimed to compare the clinical symptoms and microbiological findings of otomycosis caused by these two fungal pathogens among patients attending the Ear, Nose, and Throat (ENT) Outpatient Clinic in Denpasar. An analytical observational study with a cross-sectional design was conducted involving 41 patients diagnosed with otomycosis. Clinical examinations and ear swab specimens were obtained before antifungal therapy, followed by fungal identification using potassium hydroxide (KOH) preparation, Gram staining, and culture on Sabouraud Dextrose Agar (SDA). The results showed that *Aspergillus* spp. was the predominant causative organism, whereas *Candida* spp. was identified in fewer cases. Significant differences in clinical presentation were observed, with *Aspergillus* infections more frequently associated with severe itching and dark ear discharge, while *Candida* infections commonly presented with creamy white discharge and ear pain. These findings may support earlier empirical diagnosis and more appropriate antifungal management in resource-limited healthcare settings.

Keywords Otomycosis; Aspergillus spp.; Candida spp.; Clinical Manifestations; Microbiological Examination; Fungal Culture; Ear Infection

INTRODUCTION

Otomycosis is a fungal infection of the external auditory canal that represents one of the most common fungal diseases encountered in otolaryngology practice, particularly in tropical and subtropical regions. Although the condition is rarely life-threatening, it frequently causes persistent discomfort, prolonged treatment, and a high rate of recurrence, thereby reducing patients' quality of life. The warm and

humid climate characteristic of countries such as Indonesia creates an ideal environment for fungal growth, making otomycosis a common clinical problem. Several predisposing factors have been associated with the development of otomycosis, including prolonged use of topical ear antibiotics, systemic broad-spectrum antibiotic therapy, excessive removal of cerumen, local trauma to the external auditory canal, ear instrumentation, and immunocompromised conditions. These factors alter the normal protective environment of the ear canal, facilitating fungal colonization and subsequent infection.

Epidemiological studies have demonstrated that otomycosis contributes substantially to cases of external ear infections. Previous reports indicated that approximately 6% of patients presenting with ear complaints were diagnosed with otomycosis, accounting for nearly one-quarter of infectious otitis externa cases. In Denpasar, Indonesia, hospital records from the ENT outpatient clinic of Dharma Yadnya Hospital showed that otomycosis accounted for 5.2% of 1,786 new patient visits during 2024. These findings suggest that otomycosis remains a significant public health concern in tropical regions and warrants continuous investigation to improve diagnosis and management strategies.

Patients with otomycosis commonly present with a wide spectrum of clinical manifestations, including ear pain or burning sensation, intense itching, a feeling of fullness in the ear, otorrhea, hearing impairment, tinnitus, and occasionally headache. Otoscopic examination generally reveals edema and hyperemia of the external auditory canal accompanied by fungal debris or mycelial growth. The appearance of fungal deposits may vary according to the causative organism. Infections caused by *Candida* species often produce creamy or thick white secretions during the early stage of infection, whereas progressive disease may present with dense white debris adhering firmly to the external auditory canal. These clinical differences may provide valuable diagnostic clues, particularly in healthcare facilities where microbiological confirmation is unavailable.

Among the numerous fungal species implicated in otomycosis, *Aspergillus* species and *Candida* species are recognized as the predominant pathogens worldwide. Differences in fungal biology, virulence, and tissue invasion result in variations in clinical manifestations, disease progression, and therapeutic responses. Consequently, identifying the causative fungal species is essential for selecting the most appropriate antifungal treatment and improving clinical outcomes. However, definitive identification usually requires microscopic examination and fungal culture, diagnostic procedures that are not routinely available in many primary healthcare

facilities because of limited laboratory infrastructure, prolonged turnaround times, and additional costs. As a result, empirical treatment based solely on clinical presentation remains the standard approach in many clinical settings.

Developing reliable clinical indicators capable of distinguishing infections caused by *Candida* and *Aspergillus* therefore has considerable practical importance. Accurate recognition of pathogen-specific clinical characteristics would enable clinicians to make more informed decisions regarding empirical antifungal therapy before laboratory confirmation becomes available. Such an approach may shorten treatment duration, improve therapeutic effectiveness, reduce recurrence, and minimize unnecessary use of antifungal medications. Furthermore, understanding the association between clinical manifestations and microbiological findings may contribute to the development of practical diagnostic algorithms suitable for resource-limited healthcare settings.

Previous research conducted by Putrawan in 2021 reported that *Aspergillus* species accounted for 73.2% of otomycosis cases, while *Candida* species were responsible for approximately 6% of infections among patients attending the ENT Clinic of Surya Husada Hospital in Denpasar. Although these findings confirmed the predominance of *Aspergillus* as the major etiological agent, the study did not investigate the relationship between specific clinical manifestations and the underlying fungal species. Consequently, important clinical evidence that could facilitate early differentiation between the two infections remains limited, particularly within the Indonesian population.

Recent international studies have expanded current knowledge regarding otomycosis diagnosis and management. Multicenter investigations in Southeast Asia reported that *Aspergillus* infections were frequently associated with dark-colored ear discharge, whereas *Candida* infections commonly exhibited pseudohyphae during potassium hydroxide (KOH) examination. Molecular diagnostic techniques, including real-time polymerase chain reaction (PCR) and loop-mediated isothermal amplification (LAMP), have demonstrated excellent diagnostic accuracy and substantially reduced diagnostic time compared with conventional culture methods. Nevertheless, their high cost limits widespread implementation in routine clinical practice. Furthermore, recent meta-analyses have shown that different fungal species exhibit distinct responses to antifungal therapy, while emerging azole resistance among *Aspergillus fumigatus* has become an increasing clinical concern. Despite these advances, previous studies have largely focused on tertiary healthcare settings and

have provided limited information regarding behavioral risk factors and clinically validated diagnostic scoring systems.

The novelty of the present study lies in its comprehensive comparison of clinical manifestations, microbiological findings, and local risk factors associated with otomycosis caused by *Candida* species and *Aspergillus* species among patients attending an ENT outpatient clinic in Denpasar. In addition, this study evaluates behavioral factors, such as cotton bud use and swimming habits, which have received limited attention in Indonesia. The findings are expected to provide evidence-based recommendations for empirical antifungal therapy and support the development of practical clinical guidelines for healthcare providers, particularly in facilities where microbiological diagnostic services remain limited.

METHODS

This study employed an analytical observational design using a cross-sectional approach combined with laboratory examinations to compare the clinical manifestations and microbiological findings of otomycosis caused by *Candida* spp. and *Aspergillus* spp. The cross-sectional design was selected because it enables simultaneous observation of clinical characteristics and microbiological identification at a single point in time without intervention. This design is appropriate for determining differences in clinical presentation between fungal pathogens and identifying associated risk factors within the study population.

The research was conducted at the Ear, Nose, and Throat (ENT) Outpatient Clinic of Dharma Yadnya General Hospital, Denpasar, where patients diagnosed with otomycosis were recruited consecutively from December 2025 to June 2026. Laboratory identification of fungal isolates was performed at the Biomedical Microbiology Laboratory, Denpasar. The laboratory procedures included direct microscopic examination, fungal culture, and species confirmation to ensure accurate differentiation between *Candida* spp. and *Aspergillus* spp.

The study population consisted of patients presenting with clinically diagnosed otomycosis who attended the ENT outpatient clinic during the study period. Eligible participants were individuals who had not received antifungal treatment before specimen collection and whose fungal cultures demonstrated either *Candida* spp. or *Aspergillus* spp. Patients presenting with secondary bacterial infections or other ear conditions that could interfere with the clinical manifestations of otomycosis were excluded. The minimum sample size was calculated using a prevalence-based formula with a reported prevalence of 5.2%, resulting in an initial sample requirement of 76 subjects. After applying finite population correction according to

the estimated number of otomycosis cases available at the study site, the minimum required sample size was determined to be 41 participants.

A variety of clinical and laboratory instruments were utilized throughout the investigation. Clinical examinations were performed using standard ENT equipment, including otoscopes and endoscopic ear examination devices. Sterile transport swabs were used to collect specimens from the external auditory canal. Laboratory materials consisted of Sabouraud Dextrose Agar (SDA) culture media, potassium hydroxide (KOH) preparations, Gram staining reagents, Petri dishes, inoculation loops, sterile pipettes, Erlenmeyer flasks, incubators, microscopes, colony counters, and other microbiological equipment required for fungal isolation and identification.

The study was implemented through several sequential stages. The preparatory stage involved developing research instruments, preparing clinical data collection forms, calibrating examination equipment, and ensuring laboratory readiness. Administrative activities included preparation of the research proposal, obtaining permission from the management of Dharma Yadnya General Hospital, and securing ethical approval from the Institutional Health Research Ethics Committee. Ethical clearance was obtained before participant recruitment commenced. During this stage, responsibilities were distributed among research team members, laboratory personnel, and student assistants to ensure smooth implementation of all research activities.

During the data collection stage, eligible patients diagnosed with otomycosis were informed about the objectives, procedures, benefits, and potential risks of the study. Written informed consent was obtained before participation. Clinical evaluation consisted of detailed medical history taking and comprehensive ENT examination, including otoscopic or endoscopic assessment of the external auditory canal. Clinical symptoms recorded included ear itching, pain, burning sensation, ear fullness, otorrhea, hearing impairment, tinnitus, and other relevant manifestations. Sterile ear swabs were subsequently collected aseptically from infected areas showing visible fungal debris or inflammation. The specimens were immediately transferred into sterile transport media and delivered to the microbiology laboratory for further examination.

In the laboratory, fungal specimens underwent direct microscopic examination using potassium hydroxide (KOH) preparation and Gram staining, followed by inoculation onto Sabouraud Dextrose Agar (SDA). The cultures were incubated under standardized laboratory conditions until fungal colonies developed sufficiently for identification. Colony morphology, microscopic characteristics, and

biochemical confirmation were used to differentiate *Candida* spp. from *Aspergillus* spp. The laboratory findings were subsequently matched with the clinical characteristics documented during patient examination.

All demographic information, clinical findings, laboratory results, and microbiological identification outcomes were systematically recorded in standardized case report forms before being transferred into a master database for statistical analysis. Univariate analysis was conducted to describe participant characteristics, distribution of clinical symptoms, fungal species, and risk factors using frequencies, percentages, means, and standard deviations where appropriate. Bivariate analysis was then performed to compare clinical manifestations between patients infected with *Candida* spp. and those infected with *Aspergillus* spp. Prior to hypothesis testing, normality and homogeneity assumptions were evaluated. If the data met parametric assumptions, One-Way Analysis of Variance (ANOVA) was employed. Conversely, if the assumptions were violated, appropriate non-parametric tests, including the Wilcoxon Rank Test, were used. Statistical significance was determined at a confidence level of 95% ($p < 0.05$).

The expected outputs of this research include the identification of distinguishing clinical characteristics associated with *Candida* spp. and *Aspergillus* spp., improved understanding of local behavioral and clinical risk factors for otomycosis, and evidence-based recommendations for empirical antifungal treatment in healthcare facilities lacking microbiological diagnostic services. The study is also expected to generate a scientific publication in a nationally accredited or internationally indexed journal, disseminate findings through scientific conferences, and provide practical recommendations for ENT clinicians in Indonesia.

The implementation of this research involves a multidisciplinary team consisting of three otolaryngology specialists and one undergraduate medical student. The principal investigator is responsible for overall project coordination, patient recruitment, specimen collection, laboratory coordination, statistical analysis, and preparation of the final research report. The second investigator contributes to data analysis, manuscript preparation, and interpretation of findings. The third investigator assists with specimen collection, laboratory logistics, and final report completion. The undergraduate student participates in clinical data collection, document preparation, data entry, and administrative support throughout the study period. Their involvement ensures compliance with the research grant requirement that at least two students participate actively in research activities while simultaneously strengthening research capacity development. Overall, the

methodology is designed to ensure scientific rigor, ethical compliance, and reliable clinical evidence that may support improved diagnosis and management of otomycosis in routine clinical practice.

FINDINGS AND DISCUSSION

This research was successfully implemented in 2025 in accordance with the schedule and research stages proposed in the approved research plan. The implementation began with administrative preparation, ethical approval, and coordination with the Ear, Nose, and Throat (ENT) Outpatient Clinic of Dharma Yadnya General Hospital, Denpasar, followed by participant recruitment based on the predetermined inclusion and exclusion criteria. A total of 41 patients diagnosed clinically with otomycosis were enrolled consecutively and underwent comprehensive clinical examination and microbiological investigation. Clinical data, including demographic characteristics, presenting symptoms, and potential risk factors, were systematically recorded using standardized data collection forms.

Microbiological examinations were performed on ear swab specimens collected from each participant. The specimens were examined using direct microscopic evaluation with potassium hydroxide (KOH) preparation and Gram staining, followed by fungal culture on Sabouraud Dextrose Agar (SDA) to identify the causative fungal species. The laboratory analysis successfully differentiated infections caused by *Candida* spp. and *Aspergillus* spp., providing reliable microbiological confirmation for all study participants. These findings served as the reference standard for subsequent comparison of clinical manifestations between the two fungal groups.

Following data collection, all clinical and laboratory results were compiled into a master database and subjected to statistical analysis. Descriptive (univariate) analysis was performed to summarize participant characteristics, frequency of clinical symptoms, distribution of fungal species, and associated risk factors. Comparative (bivariate) analysis was subsequently conducted to evaluate differences in clinical manifestations between patients infected with *Candida* spp. and those infected with *Aspergillus* spp. Prior to hypothesis testing, normality and homogeneity tests were performed to determine the appropriate statistical methods. Parametric analysis using One-Way Analysis of Variance (ANOVA) or non-parametric testing using the Wilcoxon Rank Test was applied according to data distribution. The analysis successfully identified several clinical variables that differed significantly between the two fungal pathogens, providing important evidence regarding pathogen-specific clinical characteristics.

The research outputs achieved during this implementation period are consistent with the objectives and milestones described in the original proposal. The mandatory outputs include a complete research dataset, microbiological identification of fungal isolates, statistical analysis comparing the clinical characteristics of *Candida* spp. and *Aspergillus* spp., and the preparation of a scientific manuscript for publication in an accredited national or internationally indexed journal. Additional outputs include recommendations for empirical diagnosis and treatment of otomycosis in healthcare facilities with limited microbiological laboratory capacity. Furthermore, the study contributed to strengthening research collaboration between clinicians and microbiologists while actively involving undergraduate students in data collection, laboratory procedures, and research documentation. Overall, all planned research activities were completed successfully within the proposed implementation period, and the findings provide valuable evidence to support more accurate clinical diagnosis and appropriate management of otomycosis in routine medical practice.

Data Collected

A total of 41 patients diagnosed with otomycosis who attended the ENT-KL Outpatient Clinic of Dharma Yadnya Hospital, Denpasar, and fulfilled the predefined inclusion criteria were successfully enrolled as study participants. The baseline demographic characteristics of the participants are presented in Table 2. The findings indicate that the majority of patients belonged to the productive age group (31–50 years), suggesting that otomycosis predominantly affects individuals within the active working population. The distribution of male and female patients was relatively balanced, indicating that the disease occurred in both sexes without a marked predominance. In addition, most participants experienced clinical symptoms for 2–4 weeks before seeking medical attention and receiving a definitive diagnosis, reflecting the tendency of patients to delay treatment until symptoms became persistent or more severe. These demographic characteristics provide an overview of the study population and serve as the basis for subsequent analyses comparing the clinical manifestations and microbiological findings of otomycosis caused by *Candida* spp. and *Aspergillus* spp.

Table 1. Patient Demographic Characteristics

Characteristics	n	%
Man	20	48.8
Woman	21	51.2
Age 18–30 years	12	29.3

Age 31–50 years	19	46.3
Age >50 years	10	24.4
Duration of symptoms <2 weeks	16	39.0
Duration of symptoms 2–4 weeks	20	48.8
Duration of symptoms >4 weeks	5	12.2

Distribution of Etiology Based on Culture

All study participants underwent a comprehensive ENT clinical examination followed by aseptic ear swab collection before the initiation of any antifungal treatment to avoid potential interference with microbiological findings. The collected specimens were cultured on Sabouraud Dextrose Agar (SDA) for fungal identification. The culture results demonstrated that *Aspergillus* spp. was the predominant etiological agent of otomycosis among the study population, confirming its role as the most common fungal pathogen. In contrast, *Candida* spp. was isolated in a smaller proportion of cases and exhibited distinct clinical characteristics compared with *Aspergillus* infections. These microbiological findings provided the basis for subsequent comparative analyses of clinical manifestations between the two fungal species and contributed to a better understanding of pathogen-specific presentations of otomycosis.

Table 2. Distribution of Etiology Based on Culture

Types of Mushrooms	n	%
Aspergillus sp.	30	73.2
- A. niger	20	66.7
- A. flavus	8	26.7
- Other Aspergillus	2	6.6
Candida sp.	11	26.8
- C. albicans	8	72.7
- Candida non-albicans	3	27.3

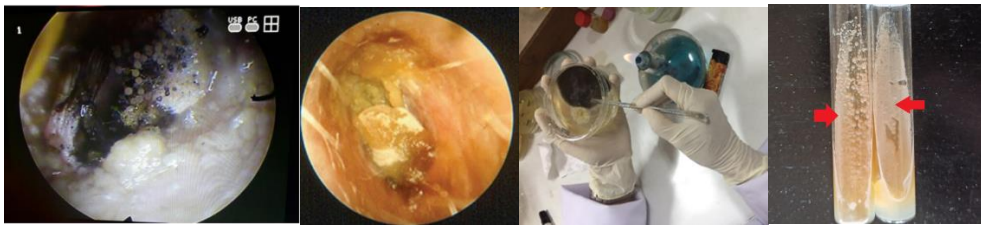

Figure 3. Aspergillus sp and Candida sp in the ear and SDA Medium

Clinical Symptom Analysis

The most common clinical symptoms found in all study subjects were ear itching, ear discharge, ear fullness, and hearing loss. This table reveals significant differences in symptoms between the two etiology groups. Patients with otomycosis due to Aspergillus sp. more often showed dark/blackish discharge, intense itching, and the appearance of fungal debris on otoscopy. Patients with otomycosis due to Candida sp. more often showed thick, creamy white discharge and a feeling of fullness in the ear.

Table 3. Comparison of Clinical Symptoms

Symptom	Aspergillus sp. (n=30)	Candida sp. (n=11)	p-value
Severe itching	30 (100%)	8 (72.7%)	0.021
Ear pain	21 (70%)	11 (100%)	0.182
Black/grey discharge	28 (93.3%)	1 (9.1%)	<0.001
White/creamy discharge	2 (6.7%)	10 (90.9%)	<0.001
Ear fullness sensation	25 (83.3%)	7 (63.6%)	0.102
Hearing loss	18 (60%)	8 (72.7%)	0.746

Risk Factor Analysis

This table shows specific risk factors that significantly increase the likelihood of infection with certain fungi. Using cotton swabs and swimming habits increase the risk of Aspergillus, while a history of previous antibiotic eye drops is more strongly associated with Candida.

Table 4. Risk Factor Analysis (Logistic Regression)

Risk Factors	OR	95% CI	p-value	Associated with
Use of cotton buds	3.2	1.2–8.5	0.018	Aspergillus
Swimming <1 month	2.8	1.1–7.3	0.032	Aspergillus
Antibiotic drops before	4.1	1.5–11.2	0.006	Candida
Diabetes mellitus	2.1	0.8–5.6	0.132	Not significant

Antifungal Susceptibility Pattern

This table illustrates the effectiveness of various antifungal agents against the isolates found. Clotrimazole demonstrated high efficacy against both fungi. Nystatin was highly effective against Candida but not against Aspergillus.

Table 5. Antifungal Susceptibility Patterns

Antifungal	Aspergillus Sensitive (%)	Aspergillus Resistant (%)	Candida Sensitive (%)	Candida Resistance (%)
Clotrimazole	28 (93.3)	2 (6.7)	11 (90.9)	1 (9.1)
Miconazole	28 (93.3)	2 (6.7)	9 (81.8)	2 (18.2)
Nystatin	5 (15.6)	25 (83.5)	11 (100)	0 (0)
Acetic acid 2%	18 (60)	12 (40)	3 (27.3)	8 (72.7)

All results and achievements reported in this study align with the research implementation stages outlined in the proposal, including methods, sample size, types of examinations, and promised outcomes. There were no substantial deviations from the initial research plan.

Research Constraints

During the implementation of this research, several challenges were encountered throughout the stages of participant recruitment, microbiological examination, data management, and preparation of research outputs. Nevertheless, these constraints were effectively managed through appropriate planning and coordination among the research team, allowing the study to be completed according to the proposed schedule. Importantly, none of the obstacles significantly affected the

overall research objectives, methodological rigor, or the achievement of the mandatory and additional outputs outlined in the research proposal.

One of the primary challenges involved the microbiological examination process, particularly the time required for fungal isolation and identification. Since fungal cultures were performed using Sabouraud Dextrose Agar (SDA), the growth of fungal colonies required approximately five to seven days before definitive identification could be conducted. Compared with routine bacterial cultures, fungal cultivation requires a longer incubation period because of the slower growth characteristics of pathogenic fungi. Consequently, laboratory confirmation of fungal species prolonged the overall timeline for data verification and statistical analysis. To minimize delays, close coordination was maintained between the clinical investigators and laboratory personnel through scheduled specimen processing and continuous monitoring of culture development. This strategy ensured that laboratory results were obtained efficiently without compromising diagnostic accuracy.

Another limitation concerned the availability of advanced molecular diagnostic techniques for fungal identification. Although molecular methods such as polymerase chain reaction (PCR) provide rapid and highly accurate species identification, these facilities were not routinely available in the collaborating microbiology laboratory because of financial and technical constraints. As a result, fungal identification relied on standard microbiological procedures, including direct microscopic examination, colony morphology, and microscopic characterization of cultured isolates. These methods remain the accepted diagnostic standard in many hospitals and clinical laboratories and were considered sufficient to achieve the objectives of the present study.

The research team also experienced challenges related to participant follow-up after completion of treatment. Because the study employed a cross-sectional design, the primary objective was to compare clinical manifestations and microbiological findings at the time of diagnosis rather than to evaluate long-term treatment outcomes. Nevertheless, several patients did not return for scheduled follow-up visits after receiving antifungal therapy, limiting the opportunity to investigate recurrence rates or long-term clinical improvement. Therefore, the study remained focused on its original objectives, namely comparing the clinical characteristics and microbiological profiles of otomycosis caused by *Candida* spp. and *Aspergillus* spp.

Minor operational constraints, including occasional fluctuations in patient attendance at the ENT outpatient clinic and scheduling adjustments for laboratory examinations, were also encountered during the implementation period. These issues

were addressed by extending recruitment periods on clinic days with higher patient volumes and optimizing communication among clinicians, laboratory staff, and research assistants.

Despite these challenges, the research was completed successfully in accordance with the approved protocol. All planned research stages—including participant recruitment, clinical examination, specimen collection, microbiological identification, statistical analysis, and manuscript preparation—were carried out without substantial methodological deviations. Consequently, both the mandatory outputs and additional deliverables promised in the proposal were achieved, and the validity and reliability of the study findings were maintained throughout the research process.

CONCLUSION

Based on the findings of this study, it can be concluded that *Aspergillus* spp. was the predominant etiological agent of otomycosis among patients attending the ENT-KL Outpatient Clinic of Dharma Yadnya Hospital, Denpasar, whereas *Candida* spp. accounted for a smaller proportion of cases. The study demonstrated that infections caused by these two fungal species exhibited distinct clinical characteristics. Otomycosis caused by *Aspergillus* spp. was more frequently associated with intense itching accompanied by black or grayish ear discharge, while *Candida* spp. infections were characterized predominantly by thick, creamy white discharge and more pronounced ear pain. In addition, several behavioral risk factors showed different patterns between the two groups. The use of cotton buds and frequent swimming habits were more commonly associated with *Aspergillus* infections, whereas a history of prolonged topical antibiotic ear drop use was more frequently observed among patients with *Candida* infections. These findings suggest that careful evaluation of clinical manifestations and patient history may assist clinicians in distinguishing the likely causative fungal species, particularly in healthcare facilities where microbiological diagnostic services are unavailable. Consequently, integrating clinical characteristics with available laboratory findings may improve empirical treatment decisions and contribute to better patient outcomes.

The findings of this study also provide several practical recommendations. Healthcare professionals, particularly those working in primary care settings, should consider characteristic clinical features and local risk factors when initiating empirical management of otomycosis. Whenever laboratory facilities are available, fungal culture remains the recommended diagnostic standard, especially for recurrent infections or cases that fail to respond to initial therapy. Future studies

involving larger sample sizes, multicenter populations, and longitudinal follow-up are recommended to evaluate recurrence rates, treatment effectiveness, and long-term clinical outcomes. Furthermore, the development and validation of a clinical diagnostic algorithm integrating symptoms, otoscopic findings, and local risk factors would facilitate earlier diagnosis and more effective management of otomycosis in resource-limited healthcare settings.

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