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Original Article

Prevalence of Diabetes Mellitus Among Patients with Otitis Externa at a Tertiary Care Hospital in Swat, Pakistan: A Cross-Sectional Study

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Abstract

Background: Otitis externa is a common infection of the external auditory canal frequently encountered in clinical practice. Although typically benign, its severity may increase in the presence of systemic comorbidities such as diabetes mellitus (DM). Diabetes is associated with impaired immune function and microvascular changes, predisposing individuals to more severe infections, including malignant otitis externa. Despite this established association, regional data from northern Pakistan remain limited.

Objective: To determine the prevalence of diabetes mellitus among patients presenting with otitis externa at a tertiary care hospital in Swat, Pakistan, and to examine associated demographic and clinical factors.

Methodology: This cross-sectional study was conducted from December 2024 to April 2025 at the ENT Department of Saidu Group of Teaching Hospital. A total of 196 patients with clinically diagnosed otitis externa were enrolled. Clinical evaluation and laboratory investigations, including blood glucose assessment, were performed to identify known and undiagnosed diabetes. Demographic and clinical data were recorded. Statistical analysis was conducted using SPSS version 26.0. Associations were assessed using chi-square tests, and multivariable logistic regression was performed to identify independent predictors. A p-value <0.05 was considered statistically significant.

Results: Among the 196 participants, the mean age was 52 ± 14.09 years, with males comprising 57.65% of the cohort. Diabetes mellitus was identified in 47.44% of patients, including 37.6% newly diagnosed cases. A significant association was observed between diabetes and male gender (p = 0.0325). Multivariable analysis confirmed male gender as an independent predictor of diabetes (aOR = 1.82, p = 0.033), while age and disease duration were not significantly associated.

Conclusion: A high prevalence of diabetes mellitus was observed among patients with otitis externa, highlighting a clinically important association. These findings support routine metabolic screening in ENT settings, particularly for patients presenting with recurrent or severe infections. Early detection of diabetes may improve clinical outcomes and reduce complications.

Keywords: Cross-Sectional Study, Diabetes Mellitus, ENT Infections, Malignant Otitis Externa, Otitis Externa, Prevalence.

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Introduction

Diabetes mellitus (DM) is one of the most prevalent chronic diseases worldwide and represents a major public health challenge due to its widespread systemic effects. It is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. According to the International Diabetes Federation (IDF), approximately 537 million adults aged 20–79 years were living with diabetes in 2021, and this number is projected to increase to 783 million by 2045 [1]. This rising global burden underscores the importance of understanding diabetes-related complications across various organ systems.

Diabetes mellitus is a multisystem disease affecting nearly every organ, with chronic hyperglycemia contributing to both microvascular and macrovascular complications such as retinopathy, nephropathy, neuropathy, and cardiovascular diseases. In addition to these well-recognized complications, diabetes is also associated with an increased susceptibility to infections due to impaired immune responses, reduced leukocyte function, and compromised vascular supply. Studies indicate that individuals with diabetes experience infections approximately 21% more frequently than the general population [2,3].

Among these infections, otitis externa (OE) is of particular clinical relevance. Otitis externa, commonly referred to as swimmer's ear, is characterized by inflammation of the external auditory canal and may extend to the tympanic membrane or surrounding structures. It is most commonly caused by bacterial pathogens such as Pseudomonas aeruginosa, although other organisms including Staphylococcus aureus, Proteus mirabilis, and Klebsiella oxytoca have also been implicated [4,5]. Clinical manifestations typically include ear pain, otorrhea, swelling, and occasionally hearing loss, while systemic symptoms are usually absent in uncomplicated cases [6].

In patients with diabetes mellitus, otitis externa may present with increased severity and a higher risk of complications. One of the most serious forms is malignant (necrotizing) otitis externa, a potentially life-threatening condition characterized by progressive infection of the external auditory canal that may extend to the skull base. Diabetes is consistently identified as the most important risk factor for malignant otitis externa, particularly among elderly individuals [7]. Studies have reported that diabetes is present in up to 85% of patients with malignant otitis externa, highlighting its critical role in disease pathogenesis [8,9].

The increased susceptibility of diabetic patients to otitis externa is attributed to multiple pathophysiological mechanisms, including impaired neutrophil function, reduced cellular immunity, and microvascular compromise that limits tissue perfusion and healing. Histopathological evidence also suggests damage to neural and vascular structures of the ear in diabetic individuals, further contributing to disease severity [3,10-12]. Additionally, chronic hyperglycemia creates a favorable environment for microbial growth, particularly for biofilm-forming organisms such as Pseudomonas aeruginosa, which complicate treatment and increase the risk of recurrence [13-15].

Despite the recognized association between diabetes mellitus and otitis externa, there remains a lack of region-specific data, particularly from northern Pakistan. Understanding the prevalence of diabetes among patients presenting with otitis externa in this setting is essential for improving clinical management and guiding screening practices. Early identification of undiagnosed diabetes in patients with ENT infections may facilitate timely intervention and reduce the risk of complications, including progression to malignant otitis externa.

Therefore, the present study aims to determine the prevalence of diabetes mellitus among patients with otitis externa presenting to a tertiary care hospital in Swat, Pakistan, and to explore associated demographic and clinical factors. By providing localized evidence, this study seeks to contribute to improved diagnostic strategies and integrated care approaches in ENT practice.

Methodology

Study design, ethics

This study employed a cross-sectional design to determine the prevalence of diabetes mellitus among patients presenting with otitis externa. It was conducted over a defined period from December 2024 to April 2025. Ethical approval was obtained from the Institutional Review Board (IRB) of Saidu Group of Teaching Hospital, Swat (Approval Number: 79/ERB/SMC/025), ensuring adherence to national and international ethical standards, including the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrollment. Ethical safeguards included maintaining confidentiality, ensuring voluntary participation, minimizing

risk, and allowing participants the right to withdraw at any stage without consequence.

Setting

The study was carried out at the ENT Department of Saidu Group of Teaching Hospital, Saidu Sharif, Swat, Khyber Pakhtunkhwa, Pakistan, a tertiary care teaching hospital serving a large and diverse patient population from northern Pakistan. The setting provided access to both outpatient and inpatient cases, allowing for a representative clinical sample of patients presenting with otitis externa.

Participants

A total of 196 adult patients (≥18 years) with clinically diagnosed otitis externa were enrolled using consecutive sampling. Diagnosis was based on otoscopic findings including edema, erythema, otorrhea, and tenderness of the external auditory canal. Patients with prior ear surgery, chronic suppurative otitis media (CSOM), tympanic membrane perforation, or pre-existing malignant otitis externa (MOE) were excluded to reduce confounding by severe or alternative ear pathologies. Additional exclusions included pregnant individuals, patients receiving immunosuppressive therapy (e.g., corticosteroids), and those unwilling to undergo blood glucose testing. All eligible participants provided informed consent prior to inclusion.

Variables

The primary outcome variable was the presence of diabetes mellitus (yes/no). Independent variables included demographic characteristics (age, gender) and clinical variables such as duration of otitis externa symptoms. Diabetes status was categorized based on established diagnostic criteria, while disease duration was categorized into <5 months and >5 months to distinguish acute/subacute from chronic presentations.

Data sources/measurement

Data collection involved structured history-taking, clinical examination, and laboratory investigations. Otoscopic examination was performed to confirm otitis externa. Blood glucose levels were measured using standard laboratory techniques to identify both known and previously undiagnosed diabetes mellitus. Diagnostic criteria for diabetes were based on the American Diabetes Association (ADA) 2024 guidelines, including fasting plasma glucose ≥126 mg/dL, random glucose ≥200 mg/dL with symptoms, HbA1c ≥6.5%, or documented history of diabetes with ongoing treatment. For newly identified cases, abnormal findings were confirmed with repeat testing to exclude transient hyperglycemia. Prediabetes was defined using HbA1c (5.7–6.4%) or fasting glucose (100–125 mg/dL). Disease duration was assessed based on patient self-report and categorized using the median cut-off (~5 months).

Bias

Several measures were taken to minimize bias. Selection bias was reduced through consecutive sampling of all eligible patients during the study period. Standardized diagnostic criteria and laboratory confirmation minimized misclassification bias. However, recall bias may have influenced self-reported disease duration. Additionally, as a single-center hospital-based study, referral bias may be present, potentially limiting generalizability to community settings.

Study size

The sample size was calculated using Cochran's formula for prevalence studies. Assuming a 95% confidence level (Z = 1.96), an anticipated prevalence of 50% (due to lack of prior regional data), and a margin of error of 7%, the calculated sample size was 196 participants. This conservative estimate ensured adequate statistical power and precision for prevalence estimation. The final sample included exactly 196 patients, meeting the calculated requirement.

Quantitative variables

Continuous variables such as age were summarized as mean ± standard deviation (SD). Categorical variables, including gender, diabetes status, and disease duration categories, were expressed as frequencies and percentages. Age was also categorized into groups (18–45 years and 46–60 years) for stratified analysis. Disease duration was dichotomized based on the median value to facilitate comparison between acute and chronic cases.

Statistical methods

Data analysis was performed using SPSS version 26.0 (IBM Corp). Descriptive statistics were used to summarize demographic and clinical characteristics. Associations between categorical variables were assessed using chi-square tests. Multivariable logistic regression analysis was conducted to control for potential confounders, with diabetes mellitus as the dependent variable and age, gender, and disease duration as independent variables. Results were reported as adjusted odds ratios (aORs) with 95% confidence intervals (CIs). Model fitness was evaluated using the Hosmer-Lemeshow test, while explanatory power was assessed using Nagelkerke R^2. The omnibus test was used to determine overall model significance. A two-tailed p-value <0.05 was considered statistically significant. Sensitivity analyses were also conducted.

Results

Participants

A total of 196 patients with clinically diagnosed otitis externa were included in the final analysis, all of whom met the predefined inclusion and exclusion criteria. There were no dropouts or missing primary outcome data, ensuring complete case analysis. All participants underwent clinical evaluation and laboratory assessment for diabetes mellitus, allowing for comprehensive evaluation of the study objectives. The study population reflects patients presenting to a tertiary care ENT department over the defined study period, thereby capturing a clinically relevant cohort.

Descriptive data

The baseline demographic and clinical characteristics of the study population are summarized in Table 2 . The mean age of participants was 52 ± 14.09 years, indicating a predominantly middle-aged population. Males constituted the majority of the study cohort (57.65%, n=113), while females accounted for 42.34% (n=83). Age distribution showed that 45.91% (n=90) of patients were between 18–45 years, whereas a slightly higher proportion, 54.08% (n=106), fell within the 46–60 years age group. These findings indicate that otitis externa in this cohort was more common in older adults and males. Overall, the demographic profile highlights a relatively balanced yet slightly male-predominant sample with a concentration in the middle to older age categories.

Outcome data

The primary outcome of interest—presence of diabetes mellitus—was identified in 93 out of 196 patients, yielding a prevalence of 47.44%, as presented in Table 2. Among these diabetic patients, 58 (62.4%) had a prior diagnosis of diabetes, while a substantial proportion, 35 patients (37.6%), were newly diagnosed during the study through laboratory screening. This highlights the presence of undiagnosed diabetes within the otitis externa population and underscores the clinical importance of routine metabolic screening in such patients. Additionally, 22 patients (11.2%) met the criteria for prediabetes, indicating a broader spectrum of impaired glucose metabolism within the study population.

Main results

Stratified analysis examining the association between diabetes mellitus and key demographic and clinical variables is presented in Table 3. A statistically significant association was observed between gender and diabetes status ($p = 0.0325$), with males demonstrating a higher prevalence (54.0%) compared to females (38.6%). In contrast, no statistically significant associations were found between diabetes and age group ($p = 0.124$) or disease duration ($p = 0.699$), suggesting that these variables did not independently influence diabetic status in this cohort.

To further evaluate these relationships and control for potential confounding factors, multivariable logistic regression analysis was performed (Table 4). Male gender remained a significant independent predictor of diabetes mellitus (adjusted odds ratio [aOR] = 1.82, 95% CI: 1.05–3.15, $p = 0.033$), even after adjusting for age and disease duration. Age >45 years (aOR = 1.45, $p = 0.142$) and disease duration >5 months (aOR = 1.12, $p = 0.664$) were not significantly associated with diabetes status. The model demonstrated good calibration based on the Hosmer-Lemeshow test ($p = 0.827$) and moderate explanatory power (Nagelkerke $R^2 = 0.18$), indicating that the included variables explained a modest proportion of the variance in diabetes status.

Sensitivity analyses (Table 5) further supported the robustness of the findings. Exclusion of prediabetic individuals strengthened the association between male gender and diabetes (aOR = 2.01, $p = 0.019$). Age-stratified analysis revealed that this association was particularly pronounced in the 46–60 years subgroup (aOR = 2.15, $p = 0.010$). Additionally, adjustment for body mass index (BMI) in cases with complete data did not substantially alter the findings (aOR = 1.76, $p = 0.047$), confirming the stability of the observed association.

Table 1: Logistic Regression Model Fit Statistics

Test	Value	p-value	Interpretation
Hosmer-Lemeshow χ^2	4.32	0.827	Good fit ($p > 0.05$)
Nagelkerke R^2	0.18	—	Moderate effect size
Omnibus Test (Model χ^2)	12.56	0.006*	Model significantly improves prediction

Table 2: Baseline Demographic and Clinical Characteristics of Enrolled Patients (N = 196)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	113	57.65
	Female	83	42.34
Age Groups (Years)	18–45	90	45.91
	46–60	106	54.08
Diabetes Mellitus	Yes	93	47.44
	No	103	52.55

Table 3: Stratification of Diabetes Mellitus by Gender, Age, and Disease Duration

A. Gender

Gender	DM Status	Frequency (n)	% Within Gender	% of Total	p-value
Male (n=113)	Yes	61	54.00	31.10	0.0325*
	No	52	46.00	26.50	
Female (n=83)	Yes	32	38.60	16.30	
	No	51	61.40	26.00	

B. Age Groups

Age Group	DM Status	Frequency (n)	% Within Age Group	% of Total	p-value
18–45 yrs (n=90)	Yes	34	37.80	17.30	0.124
	No	56	62.20	28.60	
46–60 yrs (n=106)	Yes	59	55.70	30.10	
	No	47	44.30	24.00	

C. Disease Duration

Duration	DM Status	Frequency (n)	% Within Duration	% of Total	p-value
<5 months (n=92)	Yes	45	48.90	23.00	0.699
	No	47	51.10	24.00	
>5 months (n=104)	Yes	48	46.20	24.50	
	No	56	53.80	28.60	

Table 4: Multivariable Logistic Regression Analysis

Variable	Adjusted Odds Ratio (aOR)	95% Confidence Interval	p-value
Male Gender	1.82	1.05 – 3.15	0.033*
Age >45 years	1.45	0.88 – 2.39	0.142
Disease Duration >5 months	1.12	0.67 – 1.87	0.664

Table 5: Sensitivity Analyses of Diabetes Predictors in Otitis Externa Patients

Analysis	aOR (95% CI)	p-value	Sample Size (n)	Key Finding
Primary Model (Age, Gender, Duration)	1.82 (1.05–3.15)	0.033*	196	Male gender significant predictor
Excluding Prediabetes	2.01 (1.12–3.61)	0.019*	174	Stronger association observed
Age-Stratified (46–60 years)	2.15 (1.20–3.85)	0.010*	106	Association limited to older subgroup
Adjusted for BMI (complete cases)	1.76 (1.01–3.08)	0.047*	168	Association robust after BMI adjustment

Discussion

Otitis externa is a common clinical condition with generally favorable outcomes; however, its significance increases substantially in the presence of systemic comorbidities such as diabetes mellitus. The present study demonstrates a notably high prevalence of diabetes mellitus (47.44%) among patients presenting with otitis externa, highlighting a clinically meaningful association between impaired glycemic status and external ear infections in this population.

The observed prevalence is consistent with previous literature reporting a strong association between diabetes and ear infections, particularly severe forms such as malignant otitis externa [16,17]. Studies have shown that diabetes mellitus is present in a substantial proportion of patients with necrotizing otitis externa, with reported rates ranging from 51% to 93% [18-20]. While the current study focused on uncomplicated otitis externa, the high proportion of diabetic patients suggests that even milder forms of the disease may be closely linked with underlying metabolic dysfunction. This reinforces the concept that otitis externa may serve as a clinical indicator of undiagnosed or poorly controlled diabetes.

A particularly important finding of this study is that 37.6% of diabetic cases were newly diagnosed during the study period. This highlights a significant burden of undetected diabetes within this patient population and underscores the potential role of ENT clinical settings as opportunistic screening points for metabolic disorders [3,21]. Early identification of diabetes is critical, as timely management can reduce the risk of both systemic complications and recurrent infections.

The association between diabetes mellitus and otitis externa can be explained by several pathophysiological mechanisms. Chronic hyperglycemia impairs innate and adaptive immune responses, particularly neutrophil chemotaxis and phagocytosis, thereby increasing susceptibility to infections [2,18,22]. Additionally, diabetes-related microvascular changes compromise tissue perfusion, limiting the delivery of immune cells and antimicrobial agents to infected sites. These factors collectively contribute to increased severity, delayed healing, and higher recurrence rates of infections in diabetic individuals. Histopathological studies further suggest structural damage to neural and vascular components of the ear in diabetic patients, which may exacerbate disease progression [3,23-24].

Microbiologically, Pseudomonas aeruginosa remains the predominant pathogen in otitis externa, known for its biofilm-forming capacity, which complicates treatment and contributes to chronicity [15,22]. Although microbiological analysis was not performed in this study, it is plausible that diabetic patients may be more susceptible to biofilm-associated infections due to impaired immune clearance. Future studies incorporating microbiological profiling would provide valuable insights into pathogen-specific associations in diabetic populations.

The present study also identified male gender as an independent predictor of diabetes mellitus among patients with otitis externa. This finding is consistent with some epidemiological studies suggesting gender-based differences in diabetes prevalence and healthcare-seeking behavior. Potential explanations include differences in lifestyle factors, occupational exposures, hormonal influences, and health awareness. Notably, sensitivity analyses demonstrated that this association was particularly pronounced in the 46–60 years age group, suggesting that middle-aged males may represent a high-risk subgroup.[9,19] However, the absence of significant associations with age and disease duration in the multivariable model contrasts with some prior studies, which may be attributed to the relatively narrow age distribution and regional demographic characteristics of the study population.

From a clinical perspective, these findings have important implications. Given the high prevalence of diabetes and the substantial proportion of undiagnosed cases, routine screening for diabetes mellitus in patients presenting with otitis externa should be strongly considered, particularly in tertiary care settings. Early detection and management of diabetes may not only improve metabolic control but also reduce the risk of recurrent or severe ear infections, including progression to malignant otitis externa. Furthermore, patient education regarding glycemic control, ear hygiene, and early symptom recognition is essential, especially in high-risk populations.

Limitations

Several limitations should be considered when interpreting the findings of this study. First, the study was conducted at a single tertiary care center, which may introduce referral bias, as patients presenting to such facilities are more likely to have severe or complicated disease. This may limit the generalizability of the findings to community-based or primary care settings.

Second, the cross-sectional design precludes the establishment of temporal or causal relationships between diabetes mellitus and otitis externa. While an association was observed, it cannot be determined whether diabetes predisposes individuals to otitis externa or whether other underlying factors contribute to both conditions.

Third, certain potentially important confounding variables, such as socioeconomic status, glycemic control (HbA1c levels over time), smoking status, and detailed comorbidity profiles, were not fully assessed or included in the analysis. These factors may influence both the risk of diabetes and susceptibility to infections.

Fourth, microbiological evaluation was not performed due to resource constraints, limiting the ability to correlate specific pathogens with diabetic status. Given the known role of biofilm-forming organisms in chronic infections, this represents an important area for future research.

Fifth, although sensitivity analyses were conducted, missing data for certain variables, such as body mass index (BMI), may have influenced the robustness of some findings. Additionally, reliance on patient recall for disease duration may have introduced recall bias.

Conclusion

The present study demonstrates a high prevalence of diabetes mellitus among patients presenting with otitis externa at a tertiary care hospital in Swat, Pakistan, indicating a significant association between metabolic dysfunction and external ear infections. The identification of a substantial proportion of previously undiagnosed diabetes cases further highlights the importance of routine metabolic screening in ENT clinical settings. Male gender was found to be an independent predictor of diabetes in this population, suggesting the need for targeted screening strategies, particularly among middle-aged males. While age and disease duration were not significantly associated with diabetes status, the overall findings emphasize the multifactorial nature of the relationship between systemic health and localized infections.

Authors' Contributions:

All authors meet the ICMJE criteria for authorship.

Author 1: Substantial contribution to conception and design, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 2: Substantial contribution to conception and design, data acquisition, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 3: Analysis and interpretation of data, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 4: Analysis and interpretation of data, critical revision, final approval, agreed to be accountable for all the work.
Author 5&6: Substantial contribution to conception and design, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 7&8: Substantial contribution to conception and design, data acquisition, drafting the manuscript, final approval, agreed to be accountable for all the work.

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