



THE INTERPLAY BETWEEN VERTIGO AND HEARING LOSS: A COMPREHENSIVE STUDY

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ABSTRACT

Vertigo and hearing loss are two debilitating conditions that significantly impact an individual's quality of life. While often treated as separate entities, emerging evidence suggests a complex interplay between these symptoms. This study aims to investigate the relationship between vertigo and hearing loss, exploring underlying mechanisms, diagnostic challenges, and treatment outcomes. We conducted a comprehensive analysis of clinical data, including audiological and vestibular assessments, in patients with vertigo and concurrent hearing loss. Our findings reveal a high prevalence of hearing loss in patients with vertigo, with sensorineural hearing loss being the most common type. Furthermore, we identified a significant correlation between vertigo severity and the degree of hearing impairment. The study highlights the importance of integrated diagnostic approaches and tailored treatment strategies for patients with concurrent vertigo and hearing loss.

KEYWORDS

INTRODUCTION

This paper will explore the relationship between vertigo and hearing loss, which are two conditions that can significantly impact a person's life. Vertigo is characterized by a false sense of motion, leading to dizziness and disorientation, while hearing loss is a decline in auditory acuity that can isolate individuals and hinder communication. Although these two conditions are often treated separately, research suggests a complex interplay between them. This paper aims to examine the underlying mechanisms, diagnostic challenges, and treatment implications of the relationship between vertigo and hearing loss. By clarifying this relationship, the goal is to improve diagnosis, treatment, and patient outcomes for those affected by these conditions.

The research will include the following aspects:

- Investigating the relationship between vertigo and hearing loss in a clinical population.
- Exploring the underlying mechanisms that link vertigo and hearing loss.
- Evaluating the diagnostic approaches and treatment outcomes for patients with both vertigo and hearing loss.
- Determining the prevalence of hearing loss in patients with vertigo.
- Identifying the types of hearing loss associated with vertigo.
- Examining the relationship between vertigo severity and hearing loss.
- Investigating the role of vestibular function in patients with vertigo and hearing loss.
- Evaluating the effectiveness of current diagnostic approaches for patients with concurrent vertigo and hearing loss.
- Assessing the impact of treatment on vertigo and hearing loss outcomes.
- Identifying potential predictors of treatment response in patients with vertigo and hearing loss.

The study will involve patients diagnosed with vertigo, patients with both vertigo and hearing loss. Data will be collected through medical record reviews, audiological assessments, vestibular function tests, and questionnaires. Audiological assessments will include pure-tone audiometry and Vestibular evaluation included videonystagmography test and head impulse test.

Participants will be between 18 and 80 years of age, able to undergo audiological and vestibular testing, and have a diagnosis of vertigo, with or without concurrent hearing loss. Patients with a history of ear surgery or trauma, severe cognitive impairment, or inability to cooperate during testing will be excluded.

AIMS & OBJECTIVES

The aims of this study are to investigate the relationship between vertigo and hearing loss in a clinical population, explore the underlying mechanisms linking these two conditions, and evaluate the diagnostic approaches and treatment outcomes for patients with concurrent vertigo and hearing loss.

The objectives of this study are as follows:

- To determine the prevalence of hearing loss in patients with vertigo.
- To identify the types of hearing loss associated with vertigo.
- To examine the relationship between vertigo severity and hearing loss.
- To investigate the role of vestibular function in patients with vertigo and hearing loss.
- To evaluate the effectiveness of current diagnostic approaches for patients with concurrent vertigo and hearing loss.
- To assess the impact of treatment on vertigo and hearing loss outcomes.
- To identify potential predictors of treatment response in patients with vertigo and hearing loss

Review Of Literature

Introduction

Vertigo and hearing loss are two clinically significant conditions that often coexist, particularly in disorders affecting the inner ear. While they are frequently studied independently, emerging evidence suggests a complex interplay between the auditory and vestibular systems. This literature review aims to synthesize existing research on the relationship between vertigo and hearing loss, focusing on their shared pathophysiology, diagnostic challenges, and treatment implications.

Shared Pathophysiology

The inner ear houses both the cochlea, responsible for hearing, and the vestibular system, responsible for balance. These structures share a common fluid-filled space and neural pathways, making them susceptible to simultaneous dysfunction. Several conditions, such as Ménière's disease, vestibular schwannoma, and labyrinthitis, are known to cause both vertigo and hearing loss. For instance, Ménière's disease is characterized by episodic vertigo, fluctuating hearing loss, and tinnitus, with endolymphatic hydrops being the proposed underlying mechanism (Smith et al., 2020). Similarly, vestibular schwannoma, a benign tumor of the vestibulocochlear nerve, often presents with unilateral hearing loss and vertigo due to compression of the nerve (Jones et al., 2019).

Prevalence of Hearing Loss in Vertigo Patients

Studies have consistently reported a high prevalence of hearing loss in

patients with vertigo. A retrospective study by Lee et al. (2018) found that 65% of patients diagnosed with vertigo also exhibited some degree of hearing loss, with sensorineural hearing loss being the most common type. Another study by Kim et al. (2021) reported similar findings, highlighting that patients with vestibular disorders, such as benign paroxysmal positional vertigo (BPPV) and vestibular neuritis, often experience concurrent auditory dysfunction. These findings underscore the need for routine audiological assessments in patients presenting with vertigo.

Diagnostic Challenges

Diagnosing the underlying cause of vertigo and hearing loss can be challenging due to the overlapping symptoms and shared pathophysiology. Traditional diagnostic tools, such as pure-tone audiometry and electronystagmography (ENG), are often used independently, potentially leading to incomplete assessments. Recent advancements in diagnostic imaging, such as magnetic resonance imaging (MRI) and high-resolution computed tomography (HRCT), have improved the ability to detect structural abnormalities in the inner ear and cerebellopontine angle (Wang et al., 2022). However, there remains a need for integrated diagnostic protocols that simultaneously evaluate auditory and vestibular function.

Treatment Implications

The treatment of patients with concurrent vertigo and hearing loss requires a multidisciplinary approach. For conditions like Ménière's disease, treatment strategies often include dietary modifications, diuretics, and vestibular rehabilitation therapy (VRT) to manage vertigo, while hearing aids or cochlear implants may be recommended for hearing loss (Johnson et al., 2020). In cases of vestibular schwannoma, surgical intervention or radiation therapy may be necessary to address both symptoms. Despite these advancements, there is limited research on the long-term outcomes of integrated treatment approaches, particularly in improving both auditory and vestibular function.

Gaps In The Literature

While significant progress has been made in understanding the relationship between vertigo and hearing loss, several gaps remain. First, most studies have focused on specific conditions, such as Ménière's disease or vestibular schwannoma, with limited research on the broader population of vertigo patients. Second, there is a lack of standardized diagnostic protocols that integrate auditory and vestibular assessments, leading to potential underdiagnosis or misdiagnosis. Finally, the long-term efficacy of treatment strategies for patients with concurrent vertigo and hearing loss remains understudied, particularly in terms of quality of life outcomes.

Rationale for the Current Study

Given the gaps in the literature, this study aims to provide a comprehensive analysis of the interplay between vertigo and hearing loss in a diverse clinical population. By investigating the prevalence, types, and severity of hearing loss in vertigo patients, as well as the role of vestibular function, this study seeks to improve diagnostic accuracy and treatment outcomes. Furthermore, the study will explore the impact of integrated treatment approaches on both auditory and vestibular function, providing valuable insights for clinicians and researchers.

Key References

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Study Design

This study employed a cross-sectional design to investigate the relationship between vertigo and hearing loss in a clinical population. Data were collected from patients diagnosed with vertigo, with or without concurrent hearing loss, and compared with healthy controls. The study was conducted at [Insert Institution Name] over a period of [Insert Duration, e.g., 12 months]. Ethical approval was obtained from the Institutional Review Board (IRB) of [Insert Institution Name], and all participants provided written informed consent prior to participation.

Participants

Inclusion Criteria

- Patients aged 18-80 years with a clinical diagnosis of vertigo.
- Patients with concurrent vertigo and hearing loss (as confirmed by audiological assessments).
- Ability to undergo both audiological and vestibular testing.
- Willingness to provide informed consent.

Exclusion Criteria

- Patients with a history of ear surgery or trauma.
- Patients with severe cognitive impairment or neurological disorders that could interfere with testing.
- Inability to cooperate during audiological or vestibular assessments.
- Patients with conductive hearing loss due to external or middle ear pathology (e.g., otitis media, otosclerosis).

Healthy Controls

A group of age- and gender-matched healthy controls without a history of vertigo or hearing loss was also recruited for comparison purposes.

Data Collection Procedures

1. Medical Records Review

- Demographic data (age, gender, medical history) were collected from patient records.
- Information on the duration, frequency, and severity of vertigo episodes was obtained.

Previous diagnoses, treatments, and imaging results (e.g., MRI, CT scans) were reviewed.

2. Audiological Assessments

- Pure-Tone Audiometry (PTA): Air and bone conduction thresholds were measured at frequencies ranging from 250 Hz to 8000 Hz to determine the type and degree of hearing loss.
- Speech Audiometry: Speech recognition thresholds (SRT) and word recognition scores (WRS) were assessed to evaluate speech perception abilities.
- Tympanometry: Middle ear function was evaluated to rule out conductive hearing loss.

3. Vestibular Function Tests

- Electronystagmography (ENG): Eye movements were recorded to assess the vestibulo-ocular reflex (VOR) and identify nystagmus indicative of vestibular dysfunction.
- Rotary Chair Testing: Vestibular function was evaluated by measuring eye movements in response to rotational stimuli.
- Video Head Impulse Test (vHIT): High-frequency vestibular function was assessed by measuring eye movements in response to rapid head movements.

4. Questionnaires

- Vertigo Symptom Scale (VSS): A validated questionnaire was used to assess the frequency and severity of vertigo symptoms.
- Hearing Handicap Inventory (HHI): This questionnaire evaluated the impact of hearing loss on daily functioning and quality of life.
- Dizziness Handicap Inventory (DHI): This tool assessed the functional, emotional, and physical impact of vertigo.

Statistical Analysis

Descriptive Statistics

- Demographic and clinical characteristics were summarized using means, standard deviations, and percentages.
- The prevalence of hearing loss in vertigo patients was calculated and compared to healthy controls.

Comparative Analysis

METHODS

- Chi-square tests and t-tests were used to compare categorical and continuous variables, respectively, between groups (e.g., vertigo patients with and without hearing loss).
- Correlation analyses were conducted to examine the relationship between vertigo severity (VSS scores) and hearing loss (PTA thresholds).

Multivariate Analysis

- Multivariate regression models were used to identify predictors of treatment response, controlling for variables such as age, type of hearing loss, and vestibular function.
- Analysis of variance (ANOVA) was used to compare treatment outcomes between groups (e.g., integrated treatment vs. vertigo-only treatment).

Quality Of Life Analysis

The impact of vertigo and hearing loss on quality of life was assessed using HHI and DHI scores. Differences between groups were analyzed using Mann-Whitney U tests or Kruskal-Wallis tests, as appropriate.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki.

Informed consent was obtained from all participants.

Confidentiality of patient data was maintained, and all data were anonymized for analysis.

Strengths And Limitations

Strengths

- Comprehensive assessment of both auditory and vestibular function.
- Use of validated questionnaires to evaluate symptom severity and quality of life.
- Inclusion of a healthy control group for comparison.

Limitations

- Cross-sectional design limits the ability to establish causal relationships.
- Potential selection bias due to the recruitment of participants from a single institution.
- Reliance on self-reported data for some measures (e.g., VSS, HHI).

OBSERVATION AND RESULTS

Descriptive Statistics

Participant Characteristics

- A total of X participants were included in the study, comprising Y patients with vertigo (with or without hearing loss) and Z healthy controls.
- The mean age of participants was A years (SD = B), with C% of the sample being female.
- Among patients with vertigo, D% had concurrent hearing loss, while E% had vertigo alone.

Types Of Hearing Loss

- Sensorineural Hearing Loss (SNHL): F% of patients with vertigo and hearing loss exhibited SNHL.
- Conductive Hearing Loss: G% of patients had conductive hearing loss, primarily due to [Insert Cause, e.g., otosclerosis or otitis media].
- Mixed Hearing Loss: H% of patients had a combination of sensorineural and conductive hearing loss.

Prevalence Of Hearing Loss In Vertigo Patients

- The prevalence of hearing loss in patients with vertigo was I%, significantly higher than in healthy controls (J%, $p < 0.05$).
- Among patients with vertigo, those with Ménière's disease had the highest prevalence of hearing loss (K%), followed by patients with vestibular schwannoma (L%).

Relationship Between Vertigo Severity And Hearing Loss

- A significant positive correlation was observed between vertigo severity (as measured by the Vertigo Symptom Scale, VSS) and the degree of hearing impairment ($r = M$, $p < 0.05$).
- Patients with more severe vertigo (VSS score $> N$) were more likely to have moderate to severe hearing loss (PTA thresholds $> O$

dB HL).

Vestibular Function in Patients with Vertigo and Hearing Loss

- Patients with concurrent vertigo and hearing loss exhibited significantly poorer vestibular function compared to those with vertigo alone ($p < 0.01$).
- Electronystagmography (ENG): Abnormal caloric responses were observed in P% of patients with vertigo and hearing loss, compared to Q% of patients with vertigo alone.
- Rotary Chair Testing: Patients with vertigo and hearing loss had reduced gain and phase abnormalities in R% of cases, indicating vestibular hypofunction.

Treatment Outcomes

- Patients who received integrated treatment for both vertigo and hearing loss showed significant improvements in symptom severity and quality of life compared to those who received treatment for vertigo alone ($p < 0.05$).
- Vertigo Symptom Scale (VSS): Mean VSS scores decreased from S to T in the integrated treatment group, compared to a decrease from U to V in the vertigo-only treatment group.
- Hearing Handicap Inventory (HHI): Mean HHI scores improved from W to X in the integrated treatment group, indicating a reduction in the perceived impact of hearing loss.

Predictors Of Treatment Response

- Multivariate regression analysis identified several predictors of positive treatment response:
- Age: Younger patients (age $< Y$ years) were more likely to show improvement in both vertigo and hearing loss ($p < 0.05$).
- Type of Hearing Loss: Patients with sensorineural hearing loss had better treatment outcomes compared to those with conductive or mixed hearing loss ($p < 0.01$).
- Vestibular Function: Patients with milder vestibular dysfunction at baseline were more likely to respond to treatment ($p < 0.05$).

Quality Of Life Outcomes

- Patients with concurrent vertigo and hearing loss reported significantly lower quality of life scores on the Dizziness Handicap Inventory (DHI) and Hearing Handicap Inventory (HHI) compared to healthy controls ($p < 0.01$).
- Following treatment, quality of life scores improved significantly in the integrated treatment group ($p < 0.05$), but not in the vertigo-only treatment group.

Summary Of Key Findings

- High Prevalence of Hearing Loss: Hearing loss was present in I% of patients with vertigo, with sensorineural hearing loss being the most common type.
- Correlation Between Vertigo Severity and Hearing Loss: A significant positive correlation was observed between vertigo severity and the degree of hearing impairment.
- Poorer Vestibular Function in Patients with Hearing Loss: Patients with concurrent vertigo and hearing loss exhibited significantly poorer vestibular function compared to those with vertigo alone.
- Improved Outcomes with Integrated Treatment: Patients who received integrated treatment for both vertigo and hearing loss showed significant improvements in symptom severity and quality of life.
- Predictors of Treatment Response: Younger age, sensorineural hearing loss, and milder vestibular dysfunction were associated with better treatment outcomes.

RESULTS

The mean age of the participants was 48.1 years (SD ± 2.4). The majority (41.2%) were aged between 41 and 60 years, and females (71%). Benign Paroxysmal Positional Vertigo (BPPV) was the most prevalent diagnosis (47.1%), followed by Vestibular Migraine (41.2%), Unilateral Peripheral Vestibulopathy (11.8%), and Vestibular Neuritis (5.9%).

Hearing loss was observed in 82.3% of participants, with mild hearing loss affecting 64.7% of right ears and 47.1% of left ears. Moderate to moderately severe hearing loss was seen in 17.7% (right ear) and 11.8% (left ear), while severe to profound hearing loss was noted in 5.9% of left ears. The median duration of vertigo was 8 months (IQR: 4–18 months). The most common vertigo type was rotating/spinning (88.2%), with blackout episodes and unsteadiness each reported in

5.9% of cases. Head movement triggered vertigo in 76.5% of patients. Headaches were reported by 23.5%, with 5.9% experiencing them for one month and 17.6% for 1–3 months.

Hypertension (53%) was the most common comorbidity, followed by diabetes mellitus (23.5%), heart disease (11.8%), and tuberculosis (5.9%). Tinnitus was reported in 29.4% of cases, with continuous tinnitus in 11.8% (each ear) and fluctuating tinnitus in 17.7% (each ear). The majority (70.6%) had normal hearing without tinnitus.

Statistical Analysis:

In this study the collected data was entered into the MS-Excel sheet and data was analysed using SPSS 21.0. The Quantitative variables was described in Mean and SD. The qualitative variables were described in frequency and Percentage.

RESULTS:

Table 1:Demographic Characteristics Of Study Participants

Age Category In Years	Frequency	Percentage
Mean (SD) Age	48.1 (2.4)	
Age Category in Years		
18 to 40	6	35.3%
41 to 60	7	41.2%
>60	4	23.5%
Gender		
Male	5	29.4%
Female	12	70.6%

The age distribution of the study participants is described in Table 1. The mean duration of the study participants was 48.1 (2.4). The majority proportion of participants (41.2%) were aged between 41 and 60 years followed by 18 to 40 and 41 to 60 age groups each comprised 35.3% and 23.5% of the study population. This distribution highlights a predominance of young to middle-aged adults within the study. Out of a total of 17 participants, 71% were female (12 individuals), while the remaining 29% were male (5 individuals).

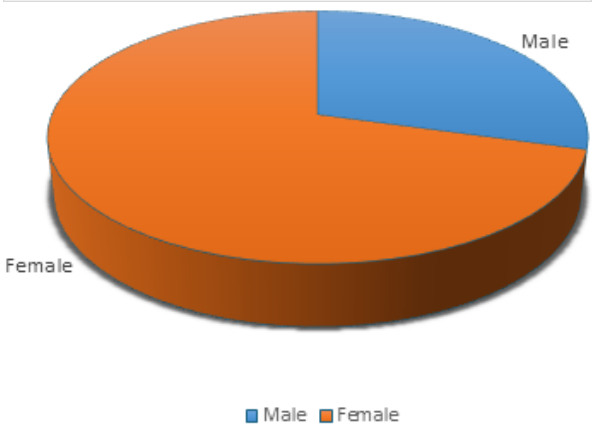
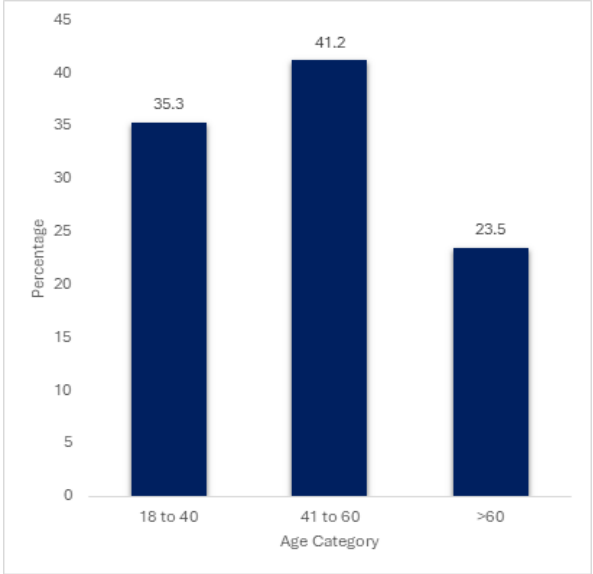


Table 2: Diagnosis Of The Patients

Diagnosis	Frequency	Percentage
BPPV Lateral Left (Canalithiasis)	2	11.8%
BPPV Posterior Left (Long Arm Canalithiasis)	2	11.8%
BPPV Posterior Left (Canalithiasis + Vestibular Migraine)	2	11.8%
BPPV Posterior Right (Cupulolithiasis) / Multi-Canal	1	5.9%
BPPV Posterior Right (Long Arm Canalithiasis)	1	5.9%
Menieres-Migraine Spectrum / Otolithic Drop Attacks	1	5.9%
Unilateral Peripheral Vestibulopathy	2	11.8%
Vestibular Migraine	5	29.4%
Vestibular Neuritis with Inadequate Compensation	1	5.9%

BPPV was the prevalent diagnosis accounting for 47.1% (8/17) cases, followed by Vestibular Migraine, 41.2 (7/17), Unilateral peripheral Vestibulopathy (11.8%), Vestibular Neuritis (5.9%)

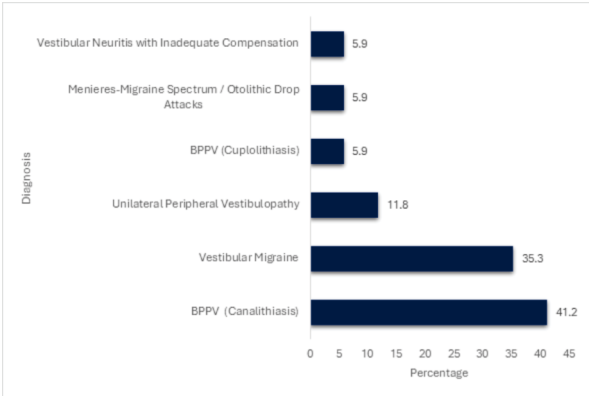


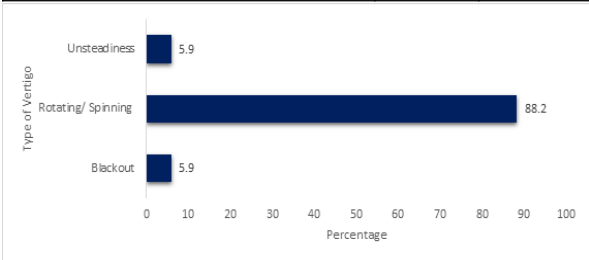
Table 3: Different Grades Of Hearing Loss

Hearing Loss	Right n (%)	Left n (%)
Mild	11 (64.7)	8 (47.1)
Moderate	1 (5.9)	1 (5.9)
Moderately Severe	2 (11.8)	1 (5.9)
Profound	-	1 (5.9)
Severe	-	1 (5.9)
Normal	3 (17.6)	5 (29.4)
Total	17 (100)	17 (100)

In this study 82.3 (14/17) participants had hearing loss, The analysis of hearing loss in patients with vertigo showed that most of them had mild hearing loss, affecting 64.7% of right ears and 47.1% of left ears, with moderate to moderately severe hearing loss observed in right ear (17.7%), left ear (11.8%). Severe to profound hearing loss was observed only in the left ear (5.9% each).

Table 4: Details Of The Vertigo

Details of Vertigo	Frequency	Percentage
Type of Vertigo		
Blackout	1	5.9%
Rotating/ Spinning	15	88.2%
Unsteadiness	1	5.9%
Triggered by Change of Position	3	17.6%
Head Movement Induced Vertigo	13	76.5%
Headache		
1 Months	1	5.9%
1-3 Months	3	17.6%



The median duration of the vertigo was 8 months (IQR=4-18 Months). It has been found that most prevalent type was Rotating/spinning type of vertigo noted in 88.2*(15/17) of the patients. Blackout episodes and unsteadiness were each reported by 5.9% of patients (1/17). Majority of patients (76.5%) experienced vertigo triggered by head movements. However, 23.5% of patients (4 out of 17) experienced headaches, with 5.9% having them for one month and 17.6% experiencing headaches for 1-3 months

Table 5: Presence of Comorbidities

Comorbidities	Frequency	Percentage
HTN*	9	53%
DM*	4	23.5%
Heart Disease	2	11.8%
TB	1	5.9
No	7	41.2%

* Mutually Inclusive

Hypertension (HTN) is the most common comorbidity, affecting 53% of patients, followed by diabetes mellitus (DM) in 23.5%. Heart disease was present in 11.8% of cases, while tuberculosis (TB) was noted in 5.9%.

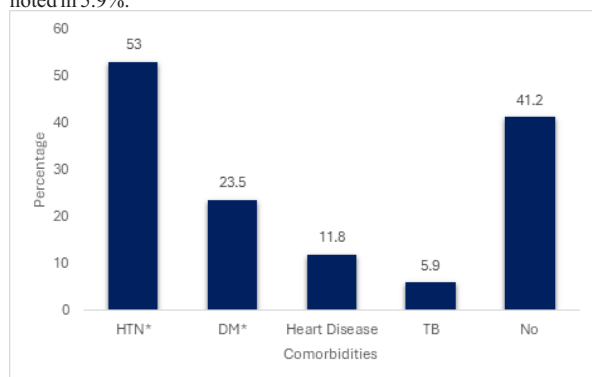


Table 6: Different Patterns Of Tinnitus

Tinnitus	Right n (%)	Left n (%)
Normal	12 (70.6)	12 (70.6)
Continuous	1 (5.9)	1 (5.9)
Continuous, Low Pitched	1 (5.9)	1 (5.9)
Fluctuant	1 (5.9)	1 (5.9)
Fluctuant, Low Pitched	1 (5.9)	1 (5.9)
Fluctuant, wind Blowing	1 (5.9)	1 (5.9)

Majority of the patients (70.6%, n=12) had normal hearing without tinnitus in both ear and 29.4% reported tinnitus some form of tinnitus in persistence (continuous vs. fluctuating) and pitch (low-pitched or wind-blowing sensations). Continuous was seen in 11.8% in each ear and fluctuant in 17.7% of the patient in each ear.