Original Article

# A Retrospective Study on Tinnitus Prevalence and Disease Associations in the Hospital-Based Population

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## Abstract

**Background:** Tinnitus is the perception of sound, which is not generated by external stimulus. Due to its clinical heterogeneity, lack of objective measurements and accompanying symptoms, a gold standard treatment, i.e., effective for every patient has not been established yet. The aim of the present study was to assess the prevalence and characteristics of tinnitus, disease, and lifestyle factors associated with tinnitus. **Materials and Methods:** Data were obtained from a total of 224 patients (mean age 46.21 ± 12.65), 141 men and 83 women, who attended the audiology department between 2015 and 2021. **Results:** We found that the tinnitus pitch perception (PP) of males was significantly higher than females ($P < 0.001$). In addition, we observed a significant positive correlation between tinnitus PP and tinnitus loudness perception ($P < 0,005$). 12.1% (27 patients) of the individuals included in the study had metabolic disorders (Vitamin D deficiency, diabetes, and cholesterol). Fifty-four percent (121 patients) of the individuals included in the study had normal hearing. **Conclusions:** Metabolic and cardiovascular diseases should be taken into account for tinnitus anamnesis. The amount of tinnitus patients with normal hearing is also notable.

**Keywords:** Cardiovascular diseases, lifestyle factors, metabolic disorders, tinnitus

## Introduction

Tinnitus is defined as the individual's perception of "phantom" sound or noise despite the absence of any external acoustic stimulus.[1] It affects approximately 30%–35% of the general population and 15% seeks treatment. It can be perceived unilaterally or bilaterally and can be intermittent or constant.[2] Seydel *et al*. found that gender differences regarding tinnitus-related distress in patients with chronic tinnitus; however, these differences depended on age and in part on the duration of tinnitus.[3]

Risk factors associated with tinnitus include intense noise exposure,[4] ototoxic drug use,[5] head-and-neck injuries,[6] and severe hearing impairment.[7] Other risk factors are metabolic and cardiovascular diseases, presbycusis, middle ear disease, Meniere's disease, vestibular schwannoma, trauma, and systemic illness.[2,8,9] The level of tinnitus distress appears to be associated with comorbid anxiety, comorbid depression, personality type, psychosocial situation, and the loudness of the tinnitus.[10]

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The lack of objective measurements, heterogeneous presentation, and the variability in response to tinnitus perception make investigation of the pathophysiology underlying tinnitus particularly challenging.[11] The aim of the present study was to assess the characteristics of tinnitus, and the patient's diseases and lifestyle factors.

## Materials and Methods

Subjective tinnitus perception of the patients and the factors thought to be related with tinnitus was evaluated. This study was designed as an analytical cross-sectional retrospective study. Data were collected from 83 female and 141 male tinnitus patients tinnitus patients who attended the Istanbul Medipol University Hospital Audiology Department between 2020 and 2021. The patients were between 20 and

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80 years of age, with an average of 46.21 years standard deviation (SD = 12.65). All described procedures were conducted following the Declaration of Helsinki. All the patient's data were obtained with "Tinnitus Assessment Form" by clinicians. This form contains patient demographic information, history, tinnitus mapping, and Visual Analogue Scales. Within the scope of the study, data on the medical information, tinnitus characteristics, and psychological well-being of the patients who attended the clinic were collected. Patients with a lack of data were excluded from the study.

### Procedure

First, anamnesis of the patients who attended the clinic was taken. The main assessment criteria are given in Table 1. Hearing and tinnitus evaluations of the patients were performed with pure tone audiometry (Interacoustics AC40 and TelephonicsTDH39). Tinnitus examination included the determination of pitch perception (PP) and loudness perception (LP). Patients were asked to match the sound that resembled their tinnitus. The loudness was interpreted as dB HL, at which tinnitus was defined by the patient. Minimum masking level (MML) and residual inhibition (RI) were evaluated for the patients whose tinnitus pitch and loudness were determined. MML was determined as the threshold at which tinnitus perception disappeared. RI was evaluated after presenting sound for 1 min at 10 dB above MML. Finally, the patients were assessed with three main disturbance areas. These main disturbance areas are related to; (a) sleeping disorders, (b) hearing difficulties (HD), and (c) discomfort levels.

### Statistical analysis

Statistical Package for the Social Sciences (SPSS) version 20 (The Statistical Package for the Social Sciences version 20 (SPSS inc. Chicago, IL, USA)) statistical package program was used for data analysis. The normal distribution was evaluated with the Kolmogorov–Smirnov test. Since it was determined that the data did not show normal distribution, analyzes were performed with nonparametric test methods. In correlation analyses, Spearman correlation analysis was used. Mann–Whitney *U*-test was used in pairwise comparison analyses. The level of significance was taken as 0.05.

## Results

This study was conducted on the tinnitus patients were between 20 and 80 years of age, with an average of 46.21 years (SD = 12.65). Mean and SD values of variables are shown in Table 2.

The total number of male and female patients was 141 (62.9%) and 83 (37.1%), respectively. The profile of patients with tinnitus is shown in Table 3.

The PP was statistically analyzed across gender. It was founded that the tinnitus frequency of males was statistically significant higher than that females ($P < 0.001$). The obtained results are shown in Table 4.

**Table 1: Anamnesis criterias**

| |
|---|
| Age |
| Gender |
| Disease (e.g., diabetes) |
| Complaint accompanying tinnitus (e.g., vertigo) |
| Noise exposure |
| Onset time |
| Loudness change |
| Localization |

**Table 2: Mean and standard deviation values of variables**

| Variable | Mean±SD |
|---|---|
| Pitch perception (Hz) | 5088.40±3243.90 |
| Loudness perception (dB) | 52.33±19.58 |
| MML (dB) | 54.69±21.58 |
| Tinnitus-sleep disorders | 3.68±3.29 (range 1-10) |
| Tinnitus-discomfort level | 5.22±2.96 (range 1-10) |
| Hearing difficulties | 2.90±3.09 (range 1-10) |

MML: Minimum masking level, SD: Standard deviation

The correlation between tinnitus characteristics and psychometric parameters was analyzed. It was founded that positive correlation between age and LP and MML ($P < 0.005$), duration of tinnitus and HD ($P < 0.005$), also LP and PP, tinnitus-sleep disorders (TSD), HD and tinnitus discomfort level (TDL) ($P < 0.005$). The obtained findings are shown in Table 5.

## Discussion

In the present study, we assessed diseases and lifestyle factors associated with tinnitus. The analyzed population includes 224 adult participants who reported tinnitus perception. First, we evaluated the association between PP and tinnitus LP across gender. Although we are expecting higher TLP in male patients because of the higher risk for noise-induced hearing loss, we did not find any difference across gender. Furthermore, we found that males reported higher Tinnitus Pitch Perception (TPP) than females [Table 4]. Our results confirmed that Niemann *et al*.,[12] however, Seydel *et al*. did not find a significant difference between male and female patients.[3]

Despite the hearing loss is a common risk factor for tinnitus; individuals with normal hearing may also experience tinnitus.[13,14] Although mostly associated with cochlear dysfunction, 20%–30% of patients have normal hearing.[15] Savastano suggested that the relationship between hearing loss and tinnitus is extremely lower than that referred to in the literature.[14] Laskar *et al*. showed that 27.9% of patients with tinnitus had normal hearing.[2] In our study, 54% (121 patients) of the individuals included in the study had normal hearing. This rate is above our expectations and our basic approach regarding the possible cause: most tinnitus patients with hearing loss are referred to hearing aids by the centers they consult, but the efficiency of tinnitus

**Table 3: Profile of patients with tinnitus**

| Variables | *n* (%) |
|---|---|
| Gender | |
| Male | 141 (62.9) |
| Female | 83 (37.1) |
| Disease | |
| Thyroid | 9 (4) |
| Anemia | 7 (3.1) |
| Psychiatric | 10 (4.5) |
| Pain | 2 (0.9) |
| Metabolic | 27 (12.1) |
| Cardiological | 29 (12.9) |
| RI | |
| Positive | 148 (66.1) |
| Negative | 73 (32.6) |
| Partial | 3 (1.3) |
| Complaint accompanying tinnitus | |
| Hearing loss | 52 (23.2) |
| Dizziness | 45 (20.1) |
| Headache | 6 (2.7) |
| Noise exposure | |
| Yes | 52 (23.2) |
| No | 172 (76.8) |
| Side of tinnitus | |
| Bilateral | 40 (17.85) |
| Right | 79 (35.26) |
| Left | 105 (46.89) |
| Duration of tinnitus (months) | |
| 0-6 | 75 (33.5) |
| 6-12 | 34 (15.3) |
| 12-60 | 68 (30.4) |
| 60-120 | 34 (15.1) |
| 120-240 | 12 (5.3) |
| 240+ | 1 (0.4) |
| Continuity | |
| Persistent | 192 (85.7) |
| Intermittent | 32 (14.2) |

RI: Residual inhibition

**Table 4: Comparison of pitch perception across gender**

| Gender | PP (mean) | |
|---|---|---|
| | Hz | *P* |
| Female (*n*=78) | 4015 | 0.000** |
| Male (*n*=137) | 5699 | |

PP: Pitch perception, **p<0.01

patients with normal hearing from various treatment/therapy methods is limited.

Metabolic circumstances may accept as a predispositional factor for tinnitus perception. Although it is known that there is a relationship between Vitamin D deficiency and ear diseases, the data on the relationship between Vitamin D deficiency and tinnitus are not sufficient.[16] Nowaczewska *et al*. found that a significant correlation between Vitamin D level and tinnitus according to THI and Visual Analogue Scale. Similarly, Abdelmawgoud Elsayed found a relationship between Vitamin D and tinnitus.[17] However, the mechanism between Vitamin D and tinnitus has not been fully elucidated.[16] Recently, Spankovich *et al*. found a relationship between diabetes and tinnitus.[18] Although diabetes may be associated with an increased risk of tinnitus there is a lack of data regarding this subject.[19] Hyperlipidemia can affect the cochlear metabolism, leading to hearing problems and tinnitus.[20] Avcı showed that total cholesterol, triglyceride, and low-density and high-density lipoprotein levels were significantly higher in tinnitus patients.[20] In our study, 12.1% (27 patients) of the individuals included in the study had metabolic disorders (Vitamin D deficiency, diabetes, and cholesterol). Although our results can be interpreted as relationship between tinnitus and metabolic disorders (Vitamin D deficiency, diabetes, and hyperlipidemia) more comprehensive studies are necessary to clarify the relationship.

There is evidence of an association between tinnitus and hypertension, but there is a lack of more comprehensive studies.[8,21-23] Recently, Umashankar and Prabhu concluded that hypertension affects the blood flow to the inner ear causing damage to the hair cells resulting in hearing loss, tinnitus, and vertigo.[23] On the other hand, Patel *et al*. showed that tinnitus was associated with hypertension in younger age groups of 20–39 years, but not in age groups older than 40 years.[24] In our study, 12.9% (29 patients) of the individuals included in the study had hypertension. Our findings are consistent with most studies in the literature,[8,21-24] but more comprehensive studies are required to elucidate this relationship.

We evaluated the relationship between age and psychometric parameters. There were significant positive correlations between age and TLP and MML [Table 5]. We thought that these findings were caused by age-related hearing loss. In their study, Al-Swiahb and Park found that older patients have reported higher TLP than younger, similar to our findings.[10] On the other hand, Pinto *et al*. did not find a significant relationship between age and TLP.[25] No significant correlation was found in TPP, TSD, HD, and TDL across age [Table 5].

Although Tyler and Baker found that slightly negative correlation between HD and duration of tinnitus,[26] we found a slightly positive correlation between HD and duration of tinnitus [Table 5]. Our findings do not match with the results of Tyler and Baker.[26] We think that the extension of the hearing loss may cause changes in the perception of tinnitus depending on neuroplastic changes as well. It could be thought that the continuation of tinnitus perceptions of individuals for a long time causes a cognitive load. Although we are expecting a correlation between the duration of tinnitus and TDL and TSD, no significant correlation was found [Table 5].

We think that there is a slightly positive correlation between TPP and TLP since hearing loss is more common, especially at high frequencies [Table 5]. However, we could not find any study related to these findings in the literature. No

**Table 5: Correlation analyses of tinnitus characteristics and psychometric parameters**

| | LP | PP | Tinnitus sleep disorders | Hearing difficulties | Tinnitus discomfort level | MML |
|---|---|---|---|---|---|---|
| Age | | | | | | |
| *r* | 0.216 | 0.017 | 0.033 | 0.085 | −0.105 | 0.215 |
| *P* | 0.001** | 0.801 | 0.634 | 0.224 | 0.129 | 0.002** |
| Duration of tinnitus | | | | | | |
| *r* | 0.102 | 0.068 | 0.047 | 0.146 | −0.025 | 0.076 |
| *P* | 0.132 | 0.323 | 0.503 | 0.035* | 0.719 | 0.281 |
| PP | | | | | | |
| *r* | 0.164 | | 0.001 | −0.036 | 0.017 | 0.027 |
| *P* | 0.017* | - | 0.992 | 0.612 | 0.810 | 0.705 |
| LP | | | | | | |
| *r* | | 0.164 | 0.409 | 0.057 | 0.382 | 0.436 |
| *P* | - | 0.017* | 0.000** | 0.414 | 0.018* | 0.003** |

PP: Pitch perception, LP: Loudness perception, MML: Minimum masking level, *p<0.05, **p<0.01

significant correlation was found TPP and TSD, HL, TDL, and MML [Table 5]. These findings were similar to Shekhawat *et al*.'s study.[27] We found a positive correlation between TLP and TSD, TDL and MML as we expected [Table 5]. There are different findings on this subject in the literature. In their study, Nascimento *et al*. did not find relationship between TLP and TSD and TDL.[28] However, Landgrebe *et al*. found a slightly positive correlation.[29]

## Conclusions

We thought that the continuation of tinnitus perceptions of individuals for a long time causes a cognitive load. Tinnitus may affect the all age groups but some factors such as metabolic and cardiovascular diseases should be taken into account for a tinnitus evaluation. Although hearing loss is known as one of the important factors for tinnitus, the amount of tinnitus patients with normal hearing is also notable. The treatment process of tinnitus patients should include comprehensive assessment methods for optimum outcomes.

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### Conflicts of interest

There are no conflicts of interest.

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