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The relationship between tinnitus characteristics, stress and depression in patients with subjective tinnitus

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ABSTRACT

Background: Tinnitus is a perception of a noise in the ears. Individuals with tinnitus symptoms may experience disrupt daily life activities and mental health issues such as stress and depression.

Objectives: This study aimed to examine the relationship between the tinnitus symptoms and mental health conditions – stress and depression – in individuals with subjective tinnitus.

Materials and methods: This was an analytical cross-sectional study, involved 139 participants with subjective tinnitus aged between 18 and 70 years. All participants underwent clinical hearing tests. The tinnitus severity level was assessed by the Tinnitus Handicap Inventory in Thai version (THI), while the Stress Test 5 (ST-5) and the nine-question depression screening test (9Q) were used to assess stress and depression, respectively.

Results: After adjusting for tinnitus-related variables, the overall THI scores showed significantly positively associated with both the ST-5 and 9Q scores. Additionally, gender was also significantly positively associated with the 9Q scores. In contrast, other tinnitus-related factors including age, affected ear, tinnitus pattern and duration and average hearing thresholds in the affected ear, showed no statistically significant correlations with the ST-5 and 9Q scores.

Conclusion: This study highlights a significant association between the THI scores and both ST-5 and 9Q, indicating that tinnitus severity is closely linked to the development of stress and depression. Therefore, it is essential to monitor and manage psychological distress in patients with tinnitus.

Introduction

Tinnitus is recognized as a condition in which individuals perceive sound that is not generated by an external source.[1] The global incidence of tinnitus ranges from 5.10 to 42.70%, with its occurrence increasing in association with noise exposure and advancing age.[2] The pathophysiological mechanisms of tinnitus may result from dysfunction in the peripheral or central auditory systems or from somatosensory dysfunction.[3,4] Tinnitus can occur in individuals regardless of their hearing condition, with prevalence rates ranging from 85 to 96%.[4] Furthermore, tinnitus can significantly impact the daily lives of patients, with approximately 20% experiencing severe effects that lead to mental health issues.[2] Studies show that 31.29 to 65.00% of individuals with tinnitus experience stress,[5,6] while 48.80 to 74.00% suffer from depression.[7–9]

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The clinical diagnostic approach includes taking a case history, conducting audiology assessments, evaluating the severity of tinnitus, and applying management strategies that vary according to the severity of symptoms in each patient. According to the internal statistical data of Nopparat Rajathanee Hospital, approximately 80% of patients visiting the outpatient clinic for hearing tests report tinnitus. Furthermore, 25-30% of these patients return with recurring tinnitus symptoms.[10] Some patients might experience or develop anxiety related to the tinnitus condition, which negatively affects their daily lives. Recognizing the importance of mental health for tinnitus patients, alongside audiological assessments, individuals should be screened and monitored for their mental health status. This study utilized: the Tinnitus Handicap Inventory (THI) – a 25 item self-administered questionnaire to assess the severity of tinnitus in Thai version,[11] Stress Test 5 (ST-5) – a five question to assess current stress level[12] and the nine-question depression screening test (9Q) – a widely used self-administered questionnaire to assess depression.[13] Therefore, this study aimed to examine the relationship between tinnitus symptoms and mental health status – stress and depression – in patients with subjective tinnitus.

Materials and methods

Participants

This cross-sectional analytical study included 139 patients aged 18-70 years with subjective tinnitus who received care at the Department of Otorhinolaryngology, Nopparat Rajathanee Hospital. Inclusion criteria were subjective tinnitus in at least one ear, age 18-70 years, and adequate communication skills, including the ability to read and write in Thai. Exclusion criteria were: conductive or mixed hearing loss, retrocochlear pathology, diagnosed psychiatric disorders, or inability to cooperate with hearing tests or complete all three questionnaires. Written informed consent was obtained from all participants prior to enrollment.

Ethics committee

This study received approval from the Research and Ethics Committee of Nopparat Rajathanee Hospital on July 3, 2024 (Certificate number: 41/2567).

Examination and evaluation

Audiological assessments included otoscopy to examine the ear canal and tympanic membrane, followed by pure tone audiometry to measure air conduction (250-8,000 Hz) and bone conduction (500-4,000 Hz) thresholds. Participants completed the Thai versions of the THI, ST-5, and 9Q questionnaires, which were self-administered with clarification available if needed.

The THI evaluates the severity of tinnitus impact on daily life, with total scores ranging from 0 to 100, classified into five categories: slight (0-16), mild (18-36), moderate (38-56), severe (58-76), and catastrophic (78-100).[11] The ST-5 assesses the level of stress, where higher total scores indicate greater stress severity, categorized as low (0-4), moderate (5-9), high (10-14), and severe stress (15-21).[12] The 9Q screens for depressive symptoms, with total scores interpreted as minimal (0-6), mild (7-12), moderate (13-18), and severe depression (19 or above).[13] The entire process was completed within the same day, with no follow-up required.

Statistical analysis

Descriptive statistics, including frequency counts, percentages, means, and standard deviations, were used to summarize characteristics data, hearing thresholds, THI scores, ST-5 scores, and 9Q scores. To examine the relationships between tinnitus symptoms, stress, and depression three main models were performed separately using simple and multiple linear regression applied to investigate the crude odd ratios for a single independent variable, while multiple linear regression was used to adjust for potential confounders, including sex, age, tinnitus ear, pattern of tinnitus, duration of tinnitus, average hearing threshold and THI scores.

Results

Among 139 tinnitus patients (62 males, 77 females, mean age 50.37 years, and SD±13.14 years) found that the left ear exhibited tinnitus more frequently than the right ear. Most participants experienced tinnitus for a duration of 0-3 months, accounting for 64.03% (89 cases). The average hearing thresholds are 30.99 and 33.78 dB HL for the frequency ranges of 500-2,000 Hz and 500-4,000 Hz, respectively, indicating mild hearing loss. The overall mean THI-score was 44.12 (SD=26.38), classified as moderate tinnitus severity level. Meanwhile, the mean ST-5 score was 4.57 (SD=3.71), indicating a moderate stress level, and the mean 9Q score was 5.39 (SD=4.90), suggesting no to very mild depression (Table 1).

Table 1. Characteristics of tinnitus patients (N=139).

Characteristics (N=139)	N (%)
Sex	
Male	62 (44.60%)
Female	77 (55.40%)
Age (years), mean±SD	50.37±13.14
Tinnitus ear	
Right ear	68 (48.92%)
Left ear	71 (51.08%)
Pattern of tinnitus	
Intermittent tinnitus	61 (43.88%)
Continuous tinnitus	78 (56.12%)
Duration of tinnitus (days), mean±SD	273.31±493.54
0-3 months	89 (64.03%)
>3-6 months	5 (3.60%)
>6-12 months	20 (14.39%)
>12 months	25 (17.99%)
Average hearing threshold (dB HL), mean±SD	
Frequency 500-2,000 Hz	30.99±22.28
Frequency 500-4,000 Hz	33.78±22.20
THI score, mean±SD	
Function subscale	19.01±12.79
Emotion subscale	13.64±10.88
Catastrophic subscale	11.47±5.01
Overall THI score	44.12±26.38
ST-5 score, mean±SD	4.57±3.71
9Q score, mean±SD	5.39±4.90

Simple linear regression revealed that individuals with continuous tinnitus reported significantly higher stress scores than those with intermittent tinnitus (ß=1.334, 95% CI: 0.096-2.572). THI scores were also positively associated with stress, with each 1-point increase corresponding to a 0.095-point rise in stress scores (ß=0.095, 95% CI: 0.078-0.113). After adjusting for tinnitus-related variables, the association between continuous tinnitus and stress was attenuated and no longer significant (ß=0.308, 95% CI: -0.685-1.301), while the THI–stress relationship remained significant and stable (ß=0.094, 95% CI: 0.075-0.113). Other factors—including age, sex, affected ear, tinnitus pattern and duration, and average hearing thresholds—were not significantly associated with stress scores (Table 2).

The unadjusted analysis showed a significant positive association between tinnitus severity and depression, with each 1-point increase in THI score linked to a 0.128-point rise in depression score (ß=0.128, 95% CI: 0.106-0.151). This association remained unchanged after adjusting for tinnitus-related variables (ß=0.128, 95% CI: 0.104-0.152). Female gender was also significantly associated with higher depression scores in both models—2.070 points higher than males in the unadjusted model (ß=2.070, 95% CI: 0.448-3.692), decreasing to 1.312 points after adjustment (ß=1.312, 95% CI: 0.063-2.574). Other factors, including age, affected ear, tinnitus pattern and duration, and average hearing thresholds, showed no significant association with depression scores (Table 3).

Table 2. Association between tinnitus characteristics and stress scores (ST-5).

Variable	Unadjusted results		Adjusted results	
	ß	95% CI	ß	95% CI
Age	-0.024	-0.071-0.024	-0.025	-0.062-0.012
Sex				
Male	Reference		Reference	
Female	0.910	-0.337-2.156	0.245	-0.745-1.236
Tinnitus ear				
Right ear	Reference		Reference	
Left ear	0.278	-0.970-1.526	-0.092	-1.062-0.877
Pattern of tinnitus				
Intermittent tinnitus	Reference		Reference	
Continuous tinnitus	1.334*	0.096-2.572	0.308	-0.685-1.301
Duration of tinnitus	-0.001	-0.002-0.001	0.000	-0.001-0.001
Average hearing threshold at frequency 500-2,000 Hz	0.012	-0.016-0.040	0.017	-0.100-0.135
Average hearing threshold at frequency 500-4,000 Hz	0.007	-0.021-0.035	-0.022	-0.141-0.096
THI scores	0.095*	0.078-0.113	0.094*	0.075-0.113

***Note**: *p<0.05.*

Table 3. Association between tinnitus characteristics and depression scores (9Q).

Variable	Unadjusted results		Adjusted results	
	ß	95% CI	ß	95% CI
Age	-0.039	-0.101-0.024	-0.046	-0.093-0.001
Sex				
Male	Reference		Reference	
Female	2.070*	0.448-3.692	1.312*	0.063-2.574
Tinnitus ear				
Right ear	Reference		Reference	
Left ear	1.048	-0.592-2.689	0.437	-0.792-1.666
Pattern of tinnitus				
Intermittent tinnitus	Reference		Reference	
Continuous tinnitus	1.423	-0.222-3.067	-0.106	-1.365-1.153
Duration of tinnitus	-0.001	-0.002-0.001	0.001	-0.001-0.002
Average hearing threshold at frequency 500-2,000 Hz	0.022	-0.015-0.059	-0.056	-0.205-0.093
Average hearing threshold at frequency 500-4,000 Hz	0.018	-0.019-0.055	0.061	-0.089-0.211
THI scores	0.128*	0.106-0.151	0.128*	0.104-0.152

***Note**: *p<0.05.*

Discussion

Relationship between tinnitus characteristics and stress

Simple linear regression analysis revealed that individuals with continuous tinnitus reported stress scores that were 1.334 points higher than those with intermittent tinnitus. However, this study did not observe a relationship between the characteristics of tinnitus and stress scores after adjusting for potential confounders. This is consistent with previous study investigating the relationship between the characteristics of tinnitus and problems, which indicated that stress was presented in both intermittent and continuous tinnitus meaning that tinnitus status was not significantly associated with stress.[14] Another study measuring cortisol to assess HPA axis reactivity found that individuals with tinnitus exhibited a blunted cortisol response, similar to other stress-related conditions, suggesting a link between tinnitus and stress.[15] Unfortunately, this study did not classify tinnitus status. As there is limited study on the relationship between tinnitus, and with limited research on its relationship with stress, further studies are needed for stronger evidence. Additionally, THI scores showed a significant positive correlation with stress, indicating that greater tinnitus severity is associated with higher stress levels. These findings support earlier studies linking tinnitus severity to stress. Assessing both tinnitus severity and mental health is crucial to mitigate its impact on quality of life. This association persists across different stress measurement tools.[16,17]

Other variables, including sex, age, tinnitus ear, duration of tinnitus, and average hearing thresholds in the affected ear, showed no statistically significant correlation with ST-5 scores. Although some previous studies have reported results consistent with these findings, others have demonstrated contradictory outcomes, highlighting the complexity and variability of factors associated with stress in tinnitus patients. Jae Hee Lee *et al*.[16] reported that neither tinnitus loudness nor frequency was significantly associated with tinnitus-related distress. However, younger patients showed significantly higher levels of stress and anxiety, indicating that reduced tolerance to tinnitus may exacerbate psychological distress in this group. Furthermore, Murtaza *et al*.[17] found no significant link between stress and tinnitus duration, type, or perception, but did observe a correlation with the affected ear, suggesting lateralization may influence stress responses. Discrepancies between their findings and those of the present study may stem from differences in psychological assessment tools and statistical methods employed. Moreover, several studies have demonstrated that hearing loss contributes to increased stress, with greater impairment linked to higher stress levels in individuals with tinnitus.[18-21]

Relationship between tinnitus characteristics and depression

In the present study, THI scores were found to be significantly associated with depression scores (9Q), indicating that greater tinnitus severity is correlated with higher prevalence and intensity of depressive symptoms. Several previous studies have demonstrated a consistent positive association between tinnitus severity, measured by THI scores, and depressive symptoms, despite using different depression assessment tools.[22-27] These consistent findings across various tools reinforce the robust link between tinnitus severity and depression.

Previous studies have linked tinnitus to mental health disorders, particularly through the limbic system, which regulates emotion and behavior. Functional imaging shows limbic activation in both tinnitus and anxiety, suggesting neurobiological overlap with auditory processing.[28] Additionally, elevated cortisol levels—common in anxiety and depression—are often found in tinnitus patients, possibly due to inner ear glucocorticoid receptors. This supports a feedback loop where cortisol exacerbates tinnitus symptoms.[29]

Besides gender was another demographic factor that significantly associated with depression. Females were more likely to experience depression compared to males, which may reflect gender-specific differences in neural processing. Recent investigations have highlighted the roles of estrogen and progesterone in cochlear function. Estrogen and progesterone modulate cochlear function and neural signaling, influencing excitatory–inhibitory balance in the auditory pathway. These hormonal effects may contribute to tinnitus onset and severity.[30] However, it is worth nothing that the relationship between gender and depression is controversial. Some studies found that tinnitus severity is closely associated with depressive symptoms, with a stronger link observed in males. These findings underscore the need to explore how gender influences the link between tinnitus severity and depression.[31,32]

Other variables—including age, tinnitus ear, duration of tinnitus, and average hearing thresholds in the affected ear—were not significantly associated with 9Q scores. This finding is consistent with previous researches [7,26] reported no statistically significant association between depressive symptoms and tinnitus-related characteristics. One previous study found that while the affected ear of tinnitus was significantly associated with depression, there was no significant correlation between depression and the duration and type of tinnitus.[17] However, several other studies have demonstrated significant associations between tinnitus characteristics and depression. For example, Zhang *et al*. reported that higher pure-tone average thresholds were significantly correlated with the depression scale, linking hearing loss to increased

depression severity.[8] In addition, Prolonged tinnitus has been consistently associated with an elevated risk of depression, indicating that its chronic nature may substantially contribute to psychological distress.[33,34]

Limitations

This study lacks analysis of other factors that may affect stress and depression, such as medical conditions, medication use, and socioeconomic status. Future studies should include these variables and use longitudinal designs to clarify the temporal and causal relationships between tinnitus and psychological distress.

Conclusion

This study investigated tinnitus-related factors influencing stress and depression. After adjusting for relevant covariates, the overall THI score was positively correlated with both ST-5 and 9Q scores, indicating that greater tinnitus severity is associated with higher stress and depression levels. These findings highlight the importance of assessing symptom severity and mental health in individuals with tinnitus to mitigate potential impacts on quality of life.

Ethical approval

This study was approved by the Research and Ethics Committee of Nopparat Rajathanee Hospital on July 3, 2024 (Certificate No. 41/2567). All participants provided written informed consent.

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None

Conflict of interest

The authors declared no potential conflicts of interest.

CRedit authorship contribution statement

Kittiphorn Luengrungrus: conceptualization, methodology, investigation, data curation, data dollection, formal analysis, writing – original draft; **Arnat Wannasri**: supervision, validation, writing – review and editing.

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