



A narrative review of mechanisms underlying tinnitus, depression, and anxiety

Nikolaos Stefanos Bastas¹, Elena Dragioti², Athanasios Basios¹, Ioanna Mega¹, Evangelos Kokkinis¹, Aikaterini D. Lianou³

¹ Department of Nursing, School of Health Sciences, University of Ioannina, Ioannina, Greece

² Research Laboratory Psychology of Patients, Families and Health Professionals, University of Ioannina, Ioannina, Greece

³ Department of Otorhinolaryngology, Primary National Health Network of Ioannina, Ioannina, Greece

Corresponding author: Aikaterini D. Lianou, Department of Otorhinolaryngology, Primary National Health Network of Ioannina, Paulou Mela 54, 45221, Ioannina, Greece; Email: lianouaikaterini1985@gmail.com; Tel.: +30 6932932765.

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Abstract

Tinnitus is a distressing condition that affects millions of people worldwide. Subjective tinnitus is characterized by the perception of sound without an external source. There are a few hypotheses, but exact causes and mechanisms remain unclear. Several studies have identified a strong correlation between tinnitus and psychological disorders, particularly depression. This review explores the relationship between tinnitus and disorders such as anxiety and depression. The aim was to examine the underlying mechanisms that contribute to this association.

Keywords

anxiety disorder, depressive disorder, mental health, tinnitus

Introduction

Tinnitus is an auditory and neurological symptom. The subjective type of tinnitus is characterized by the perception of sound in the absence of external stimuli, such as acoustic or electrical signals.^[1] It is not caused by muscle contractions, blood flow irregularities, or auditory hallucinations linked to mental illness.^[2,3] The term 'tinnitus' originates from the Latin word 'tinnire,' meaning 'ringing.'^[2] Epidemiological studies suggest that 15% to 20% of adults experience tinnitus, either temporarily or chronically.^[4] According to the World Health Organization, nearly 15% of the global population is affected.^[5] Prevalence rates range from 5% to 43% worldwide and 9% to 28% in Europe, with an increasing incidence in older individuals, particularly men.^[6] Tinnitus is classified as a symptom of the auditory system rather than an illness^[3] and often signals an underlying problem. It is most commonly associated with hearing loss caused by

various factors, such as noise-induced hearing loss, ototoxic medications, acoustic neuroma, autoimmune diseases, and head and neck injuries.^[7] It may also occur alongside other disorders, including otitis media, Meniere's disease, presbycusis, impacted cerumen, or otosclerosis.^[3] Furthermore, tinnitus has a link to neurological problems, prolonged exposure to loud noise (22%), specific drugs, head and neck injuries (17%), infections (10%), and circulatory system disorders.^[8-10] Moreover, it is increasingly recognized as a significant and sometimes predominant symptom in certain migraine sufferers, especially those with vestibular migraine or migraine with sensory hypersensitivity. While it is not yet universally accepted as a core migraine symptom, clinicians are encouraged to consider it in the context of migraine diagnosis and treatment.^[11] The intensity of tinnitus varies widely, ranging from infrequent sounds (such as ringing, hissing, humming, or a combination thereof) to persistent, intolerable noises that profoundly affect an indi-

vidual’s quality of life.^[12] The noise may be intermittent or continuous, and it can be perceived in one ear, both ears, or even internally within the head.^[4]

The etiology of tinnitus remains largely unidentified.^[13] Despite numerous proposals concerning the physiological basis of tinnitus, its pathophysiology is still not fully understood. All suggested pathogenetic pathways, however, are based on a spontaneous increase in nerve fiber activity.^[11] The wide range of tinnitus experiences is evident in its variability in sound, perception, frequency, loudness, and coexisting symptoms such as depression, anxiety, sleep disturbances, and physical issues. The severity and impact of tinnitus vary among individuals, ranging from chronic and debilitating to mild and negligible.^[14] Tinnitus is generally classified into objective, subjective, primary, or secondary types. Furthermore, the categorization of tinnitus may be classified as either acute or chronic.^[15] The most common classification is based on whether the tinnitus is perceptible to others, distinguishing it as either subjective or objective^[3] (Table 1).

Objective tinnitus

Objective tinnitus is an uncommon form of tinnitus typically resulting from vascular irregularities or myoclonus of the palatine muscles.^[16] It is pulsatile tinnitus that is perceptible to both patients and others.^[17] Its defining feature is that its existence can be perceived by others, either directly or through medical instruments, so it is termed “objective.”^[3]

Subjective tinnitus

Subjective tinnitus is the predominant form. It may arise from otologic, neurologic, metabolic, or psychological problems, although many cases remain idiopathic.^[18]

Chronic tinnitus

Chronic tinnitus is characterized by the persistence of tinnitus for over six months and is more prevalent in older

adults (12% post-60 years) compared to younger individuals (5% in the 20–30 age category). However, it can manifest at any age.^[19] Acute tinnitus may arise alongside several auditory or neurological conditions. Nevertheless, the determinants that facilitate its chronicity remain mostly unexplored.^[20] The effects of chronic tinnitus on individuals vary and include comorbidities such as sleep disturbances and attention difficulties.^[21]

Depression and anxiety

Mental issues, such as depression and anxiety^[23], might restrict an individual’s capacity to leave the domicile, so affecting their employment and social interactions^[7]. Primary features of depression are anhedonia, hopelessness, irritability, sleep and appetite disturbances, pervasive sorrow, diminished self-worth, and in extreme instances, suicidal ideation.^[7,23] Depression is linked to a pessimistic and depressive interpretation of failures in the patient’s life.^[24] The diagnosis indicates distinct and substantial alteration in mood.^[5] Anxiety is an ambiguous and distressing sensation of fear and apprehension, marked by tension or discomfort stemming from the anticipation of peril from either identifiable or unidentified sources.^[23] Individuals with anxiety disorders experience excessive or disproportionate concerns or fears.^[25]

This paper explore the correlation between tinnitus and occurrence of depression and anxiety.

Methods

This research project involved conducting a narrative review of articles from three online databases, namely PubMed, Google Scholar, and MEDLINE, over a six-month period. The focus was on exploring the connection between tinnitus and feelings of depression and anxiety. For the search, we used the following query terms: (tinnitus) AND [(depression) OR (anxiety)]. Our selection criteria included reviews, systematic reviews, meta-analyses and original research papers written in English and published within ten

Table 1. Tinnitus definitions^[22]

Type of tinnitus	Definition
Subjective tinnitus	The sound can be heard only by the affected individual.
Objective tinnitus	The sound can also be heard by the examiner (e.g. crepitus of temporomandibular joint, bruit or vascular malformation).
Pulsatile tinnitus	Tinnitus that is described as producing sound of regular pulsations. This may be subjective or objective.
Primary tinnitus	Tinnitus that is idiopathic and may or may not be associated with sensorineural hearing loss (SNHL). The SNHL should be symmetrical.
Secondary tinnitus	Tinnitus associated with a specific underlying cause (other than symmetrical SNHL).
Acute or recent onset tinnitus	Apparent for <6 months
Chronic tinnitus	Apparent for >6 months

years (2014 – 2024). The exclusion criteria we used were based on methodology, population, sample size, language, and publication date. So, we excluded non-primary studies, non-systematic reviews, non-peer-reviewed articles, non-human studies, and non-relevant populations. Studies with a sample size too small to provide reliable conclusions and studies with an unrepresentative sample with a lack of generalizability were excluded. Furthermore, non-English studies and studies outside the 2014–2024 time frame were excluded. Two researchers were involved in the screening process to ensure reliability and reduce the potential for bias. These researchers independently screened the titles, abstracts, and full texts of the studies according to the in-

clusion and exclusion criteria. There was an independent review process to reduce bias, particularly during the full-text screening phase, where one researcher was not influenced by other's initial judgment.

Results

Search results

Fig. 1 illustrates the process of selection of scientific articles. The first search yielded 357925 studies. After remov-

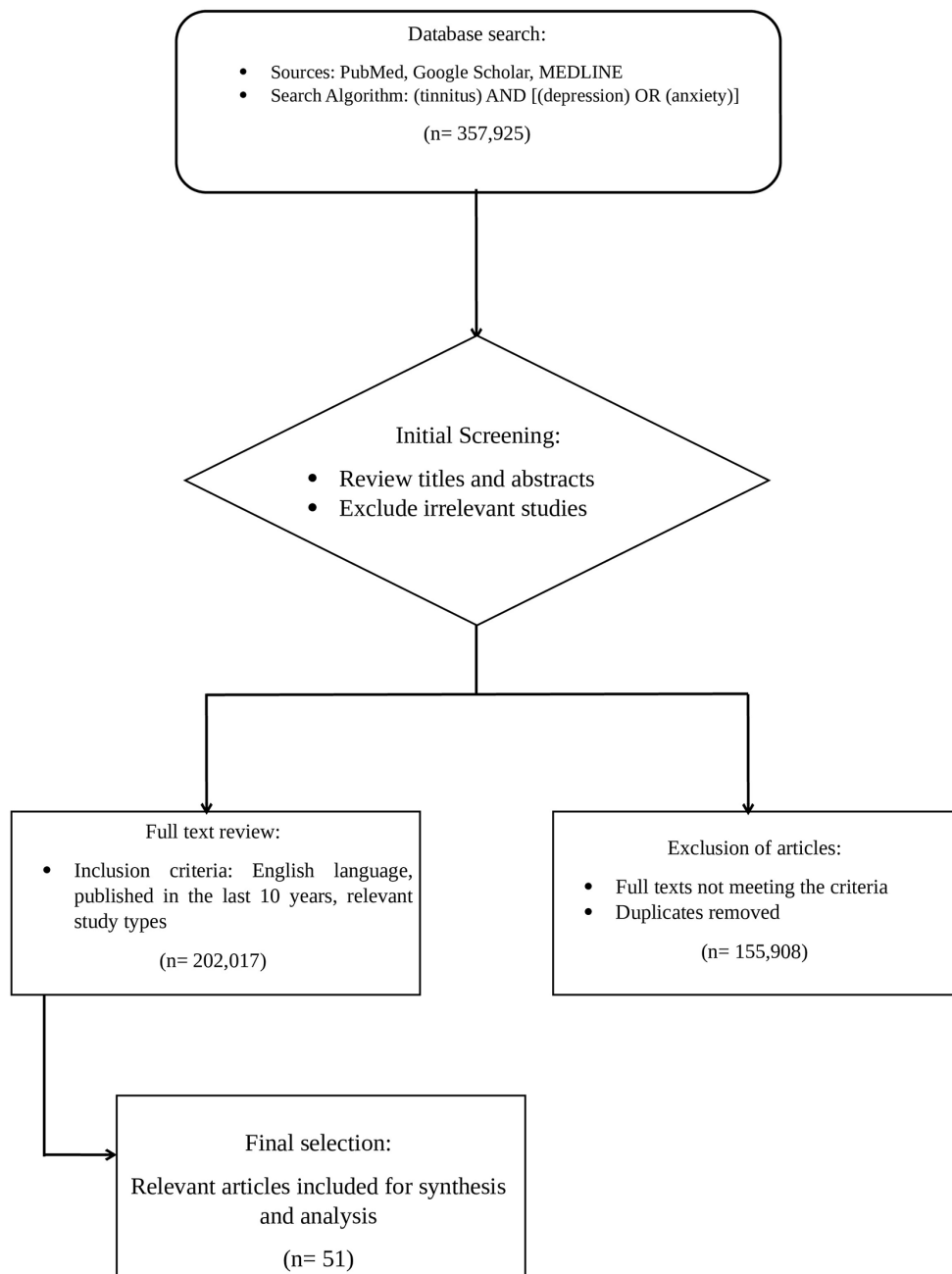


Figure 1. A flow chart illustrating the process of selection of scientific articles analyzed in the study.

ing duplicates, the remaining studies underwent screening, leading to the final inclusion of 51 studies.

Impact of tinnitus on quality of life and social functioning

Tinnitus can severely impact quality of life and social functioning, with increasing evidence showing a strong correlation between tinnitus and psychological distress or mental symptoms.^[26] Clinical studies suggest that individuals with tinnitus often experience difficulties in concentration.^[27] When left unmanaged, tinnitus may contribute to comorbidities, including depression and anxiety.^[15] There is a significant association between tinnitus and mental symptoms such as depressed mood and suicidal thoughts. Tinnitus affects 1%–3% of the general population to the extent that it impairs quality of life, disrupts sleep, affects work performance, and induces psychological distress.^[19] Recent population-based research has further confirmed the high prevalence of mental disorders among tinnitus patients, who show notably higher rates of comorbid anxiety, depression, and low self-esteem.^[28] A study found that higher levels of anxiety and depression were strongly correlated with tinnitus occurrence.^[29] Another study demonstrated that patients with tinnitus less than a year had a high level of disorders in daily life.^[30]

Anxiety and depression are not only debilitating but also increase morbidity and the risk of suicide in affected individuals.^[28] A large-scale population study (n=21.4 million respondents with tinnitus) examined the link between tinnitus and disorders such as depression and anxiety. The study found that 26.1% of individuals with tinnitus reported anxiety symptoms in the past year, compared to 9.2% of the control group. A similar trend was observed for depression: 25.6% of tinnitus patients reported depressive symptoms, while only 9.1% of controls did. Anxiety and other mental conditions may also contribute to structural brain changes seen in tinnitus patients.^[31] Moreover, individuals who perceived tinnitus as a “significant” or “extremely significant” issue were more likely to report anxiety and depression.^[32]

Correlation between tinnitus and depression

Depression is a common disorder among individuals with tinnitus.^[24] According to existing literature, the co-occurrence of tinnitus and depression can be as high as 30%^[33], with 30% to 60% of tinnitus patients experiencing depressive symptoms^[34]. The leading hypothesis explaining the connection between tinnitus and depression suggests that tinnitus acts as a trigger, leading to depression in individuals already predisposed to the condition.^[9] Multiple studies have explored this correlation. A study reported that 33% of tinnitus patients were diagnosed with depression and recommended routine depression screening for individuals with tinnitus.^[29] It has been additionally indicated that 20%

of tinnitus patients perceive their condition as a severe disruption to daily life, potentially leading to depression and, in extreme cases, suicidal ideation.^[5] Similarly, another study found that 90% of male tinnitus patients experienced depression, with 37.5% exhibiting mild to moderate symptoms and 52.5% suffering from severe to extreme symptoms. Among female patients, 80% reported depression, with 33.3% experiencing mild to moderate symptoms and 46.7% experiencing severe to extreme symptoms.^[35]

Depression in tinnitus patients may be linked to the challenges of adapting to chronic illness.^[5] Another study suggests a bidirectional relationship, where psychological distress amplifies tinnitus awareness and severity, creating a vicious cycle.^[9] Researchers found that comorbid depression was a stronger predictor of tinnitus severity than duration, pitch, locus of control, or perception of tinnitus as a disease.^[4] Another study suggested that tinnitus severity affects depression levels, while at the same time, the severity of depression influences tinnitus perception.^[33]

Correlation between tinnitus and anxiety

Several studies have investigated the relationship between tinnitus and anxiety.^[29] Recent research suggests that anxiety is highly prevalent in tinnitus patients, affecting up to 45% of all tinnitus patients and 50% of those undergoing psychological treatment.^[33] The reported prevalence of moderate to severe anxiety among tinnitus patients ranges from 28% to 45% in international literature. One study found that 26% of tinnitus patients reported anxiety symptoms in the previous year, while another study indicated that lifetime prevalence rates of anxiety disorders among tinnitus patients were 45%.^[24] Additionally, they found that 90% of male tinnitus patients experienced some level of anxiety, with 30% presenting mild to moderate symptoms and 60% suffering from severe to extremely severe anxiety. Similarly, 83% of female tinnitus patients reported anxiety, with 27% experiencing mild to moderate symptoms and 57% experiencing severe to extremely severe anxiety.^[35]

Discussion

Tinnitus constitutes a public health concern with considerable economic consequences. The burden of illness assessment is greater than for prostate cancer and HIV/AIDS in Europe.^[36] Tinnitus is a common condition, with an estimated 15%–20% of the adult population experiencing it, either momentarily or permanently.^[30] The prevalence of tinnitus in adults ranges from 10% to 15%, with 1% to 2% experiencing the severe form.^[17] Among individuals aged over 60, the prevalence rises to 33%.^[5] Epidemiological studies indicate that 7% of individuals with tinnitus necessitate medical intervention, 5% experience impairment due to the condition, and 1%–2% of the affected population regard it as a severe problem that significantly diminishes quality of life.^[30]

Some people with tinnitus manage to cope with the phantom perception, whereas others find it more challenging.^[37] The reasons some people acclimate to their tinnitus while others do not remain unclear.^[38] Tinnitus can affect health-related quality of life, with the majority of patients indicating a minor impact.^[10] Most tinnitus instances are temporary and reversible; nevertheless, 5%–15% of the general population suffers from chronic symptoms.^[26] Tinnitus, due to its incessantly heard sound, may disrupt daily activities, particularly for individuals with severe symptoms. Severe tinnitus can adversely affect focus, sleep, task execution, and social relationships.^[37] Annoyance is defined as an unpleasant mental state marked by annoyance and a departure from conscious thoughts, potentially eliciting responses such as anger and dissatisfaction.^[38]

Mental diseases, including anxiety, sadness, and post-traumatic stress disorder, have been linked to tinnitus.^[39] Tinnitus constitutes a considerable source of stress, with affected individuals exhibiting varied responses depending on their susceptibility to stress.^[40] The distressing features of tinnitus have led to its association with disorders such as anxiety and depression.^[41] It has long been established that individuals with tinnitus frequently exhibit symptoms of anxiety and depression.^[42] The problems associated with managing the discomfort of tinnitus exacerbate their misery and diminish quality of life.^[43] The discomfort associated with tinnitus appears to be linked to the patient's psychological condition rather than the hearing threshold or the psychoacoustic characteristics of tinnitus, although other researchers contend that increased loudness of tinnitus correlates with greater unpleasantness.^[38] The adverse consequences of tinnitus are sometimes amplified in tranquil environments, particularly during sleep.^[17]

Emerging research supports the hypothesis that serotonergic dysfunction may contribute to both tinnitus and affective disorders such as depression and anxiety, suggesting a shared neurobiological substrate. Serotonin plays a critical role in sensory gating within auditory pathways and in modulating emotional responses through limbic system interactions.^[44,45] When this regulation is disrupted, the brain may fail to filter out irrelevant auditory stimuli, contributing to the persistent perception of tinnitus. Concurrently, abnormalities in serotonin signaling are well-established in the pathophysiology of depression and anxiety.^[46] Population-based and clinical studies have consistently demonstrated strong comorbidity between tinnitus and mood disorders, reinforcing the concept of a common etiological mechanism.^[47,48] These findings not only enhance our understanding of tinnitus as more than a purely auditory phenomenon but also highlight potential therapeutic avenues targeting serotonergic systems.

Various therapies are employed to alleviate the discomfort associated with tinnitus.^[49] The efficacy of medications has not been conclusively established, but numerous trials are underway. In clinical practice, antidepressants are frequently administered for tinnitus treatment, but the outcomes are generally disappointing. Seven randomized con-

trolled studies and a Cochrane review have demonstrated no favorable outcomes; however, they may be beneficial in addressing any associated psychological distress.^[50]

The habituation procedure for tinnitus via sound treatment involves exposing the ears to a consistent and neutral sound to diminish sensitivities in tranquil settings. Sound generators, whether or not equipped with hearing amplification, can be utilized at low intensity to avert tinnitus and hence diminish its perception.^[50] Furthermore, hearing aids significantly diminish the experience of tinnitus by delivering constant auditory stimulation. Consequently, tinnitus progressively becomes less intrusive, auditory fatigue and stress diminish, leading to an enhancement in the patient's coping mechanisms.^[51]

This review contributes to our knowledge of the relationship between tinnitus and disorders such as anxiety and depression.

The current review has certain limitations, though. Reliance on data that has already been published may introduce biases from the studies, such as differences in population sampling. Moreover, the omission of grey literature and non-English publications may restrict the thoroughness of the results. The review focuses on the impact that tinnitus has on the daily life of people, while other biological and behavioral elements that contribute to the development of mental diseases are not considered.

Future research should focus on multicenter, longitudinal studies to establish causal relationships and evaluate the effectiveness of intervention strategies. Expanding investigations to include biological, behavioral, and neurophysiological factors would provide a more holistic understanding of the mechanisms linking tinnitus to depression and anxiety.

Conclusions

The etiology has been extensively studied. Common causes include noise-induced hearing loss, presbycusis, Meniere's disease, infections, and neurological conditions such as whiplash injury and acoustic neuroma. Despite ongoing research, the pathophysiology of tinnitus remains only partially understood. However, clinical studies have consistently demonstrated a high prevalence of depression and anxiety among tinnitus patients. For individuals struggling with tinnitus-related distress, seeking professional help is essential. While there is no cure for persistent tinnitus, various management strategies can help alleviate symptoms. Consulting an otorhinolaryngologist allows patients to explore treatment options tailored to their specific condition. Tinnitus management requires reducing the patient's focus on the condition, which can be achieved through therapeutic interventions, counseling, and coping strategies. When necessary, clinicians may also consider pharmacological treatments, such as antidepressants, or external aids like hearing devices, to help mitigate the psychological and auditory burden of tinnitus.

Ethical approval

Not applicable

Ethical statements

The authors declared that no clinical trials were used in the present study.

The authors declared that no experiments on humans or human tissues were performed for the present study.

The authors declared that no informed consent was obtained from the humans, donors or donors' representatives participating in the study.

The authors declared that no experiments on animals were performed for the present study.

The authors declared that no commercially available immortalized human and animal cell lines were used in the present study.

Conflict of interest

The authors have declared that no competing interests exist.

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Data availability

All data used are referenced or included in the article.

Author contributions

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