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## Depression in Patients with Tinnitus: A Literature Review

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### ABSTRACT

Tinnitus has been a worldwide complaint and refers to the bothersome auditory perception in the absence of external acoustic or electric stimulus. There is no consolidated criterion for tinnitus definition for the purpose of research. The most common definition of tinnitus demonstrates that tinnitus must exceed a 5-min duration. Tinnitus affecting 8 to 25.3% of the population of the United States and the world. Psychiatric disorders such as anxiety and depression are often comorbid in patients with chronic tinnitus, and these conditions can not only be troublesome and debilitating, they have been shown to increase morbidity and the risk of suicide among patients with tinnitus. This literature review aims to identify association between depression and tinnitus. The articles selected were all published within the past five years from PubMed. 7 articles were obtained and were included in the review. Based on the articles, hearing loss, noise, stress and depression have proven to be markers without differentiating between cause and effect. The etiology and pathogenesis of the interrelationships between psychological complaints or illnesses and tinnitus stress are not sufficiently understood despite intensive research efforts. In conclusion, the question of whether depression is the cause of the tinnitus or tinnitus is the cause of the depression, or whether there are other dependencies, remains unanswered.

### 1. Introduction

Tinnitus has been a worldwide complaint and refers to the bothersome auditory perception in the absence of an external acoustic or electric stimulus.<sup>1-6</sup> There is no consolidated criterion for tinnitus definition for the purpose of research. The most common definition of tinnitus demonstrates that tinnitus must exceed a 5-min duration.<sup>5</sup> The other tinnitus questions include “Do you have permanent tinnitus all the time?” or “Do you have recurrent tinnitus once a month or more?”.

Tinnitus is very common; a recent study conducted in the United States reported that tinnitus affects 9.6% of the adult population. Population based studies of other nations demonstrated similar prevalence estimates ranging from 4.6% to 30%.<sup>4</sup> Tinnitus can

manifest differently in regard to laterality, loudness, and type of sound. In turn, tinnitus can have varying impacts on the quality of life, from mild annoyance to moderate functional impairment and, in extreme cases, suicide.<sup>4</sup> Despite various international studies, it is hardly possible to give a clear indication of the prevalence of tinnitus, as the most varied of definitions of tinnitus (eg with regard to the minimum duration) are used. The prevalence figures fluctuate from 5 to 30%. The studies consistently point to an increase in the risk of tinnitus up to the age of about 65 years.<sup>3</sup>

Strictly speaking, tinnitus is a symptom of the auditory system rather than a disease. It can be the concomitant symptom of many diseases, such as otitis media, Meniere's disease, presbycusis, impacted cerumen, or otosclerosis. In some other cases, tinnitus

can be the first sign of other diseases, for instance, acoustic neuroma or sudden sensorineural hearing loss. Furthermore, some systematic diseases like arteriosclerosis, cervical spondylosis, and anemia can also cause tinnitus, and there is still some portion of tinnitus that is hardly attributed to some specific causes.<sup>5</sup>

Being different from the verbal auditory hallucination, the sound of tinnitus conveys no meaning, while the former always conveys intact content with clear sound. Tinnitus is clinically heterogeneous that the sound characteristics, the underlying pathophysiology, and the influence factors can vary. Tinnitus perception can be localized unilaterally or bilaterally in the ears or within the head. Buzzing in the brain is often called tinnitus cerebri, included in the range of tinnitus definition. Tinnitus can be constant or intermittent, and it may occur suddenly or develop slowly. The common described sounds of tinnitus are chirping, buzzing, ringing, hissing, or whistling sounds. In many cases, more than one sound but several mixed forms of noise or music-liked sounds are perceived. The sound heard as a form of tinnitus can sometimes be pulsatile, which synchronized with the heartbeat or peripheral pulses.<sup>5</sup>

The most common classification of tinnitus is subjective or objective tinnitus based on if it can be perceived by other people. Objective tinnitus is less common, often generated by biological activities in the body, for example, the sound produced by the blood turbulence of the middle ear, eustachian tube, and soft palate, pulse beats, and muscle contraction that

is transmitted to the ear. Others can also detect the presence of objective tinnitus directly or with the aid of medical devices. Subjective tinnitus is more common, refers to tinnitus that lacks corresponding sound source, and is currently thought to be caused by disorders of the auditory nervous system.<sup>5,7</sup>

For the choice of treatment approaches, the “Clinical Practice Guideline of Tinnitus” by American Academy of Otolaryngology—Head and Neck Surgery recommended that tinnitus should be classified as either primary or secondary. Primary tinnitus is idiopathic that may or may not be associated with sensorineural hearing loss (SNHL). Secondary tinnitus is associated with a specific underlying cause (other than SNHL) or an identifiable organic condition. The current cure for primary tinnitus is to provide symptomatic relief, while the management of secondary tinnitus is targeted firstly toward treatment of the specific underlying condition.<sup>5</sup>

In recent years, several large epidemiological population studies have also been evaluated to determine the extent to which an association with depression in the context of chronic tinnitus was recognizable. In almost all of these studies, hearing loss, noise, stress and depression have proven to be markers without differentiating between cause and effect (Table 1). It is undisputed that hearing loss significantly increases the risk of chronic tinnitus. Noise can, on the one hand, trigger a hearing loss and thus lead to increased exposure to tinnitus, but on the other hand it can also act as an independent stress factor of its own.<sup>3</sup>

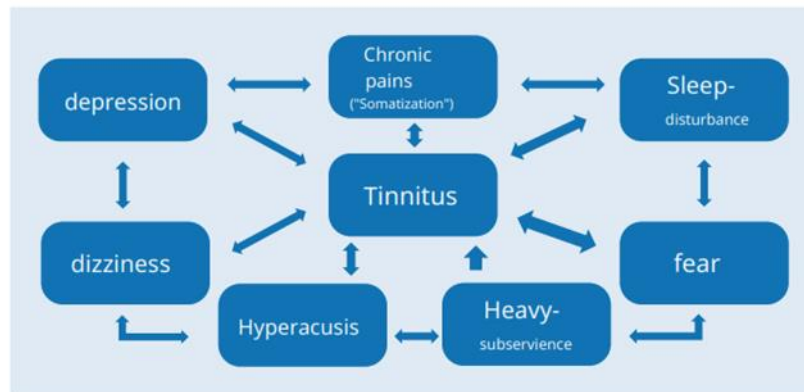


Figure 1. Clinical view of the interactions of the different stress factors.

Psychiatric disorders such as anxiety and depression are often comorbid in patients with chronic tinnitus, and these conditions can not only be

troublesome and debilitating, they have been shown to increase morbidity and the risk of suicide among patients with tinnitus.<sup>1</sup>

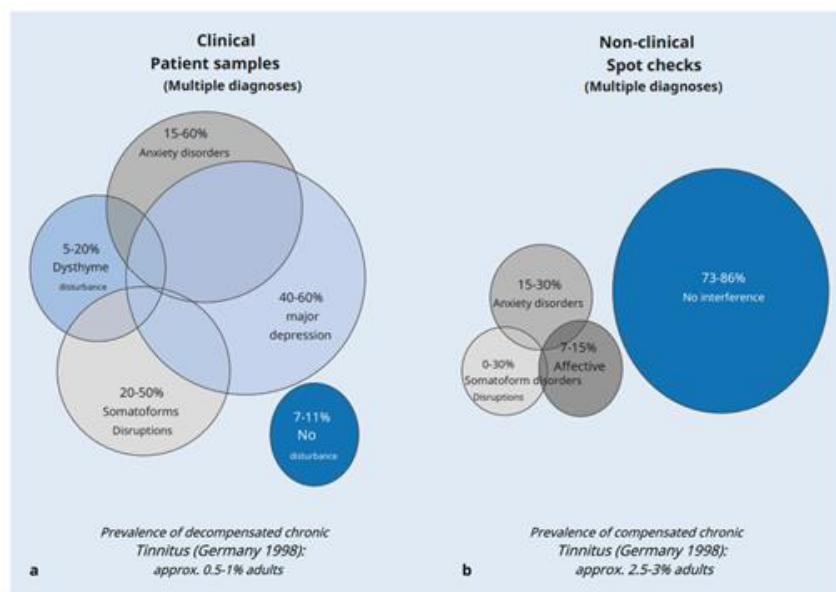


Figure 2. Mental comorbidity rates in people with decompensated (a) and compensated (b) tinnitus.

A number of studies demonstrated an association between tinnitus and a variety of psychological and psychiatric disorders, most commonly depression.<sup>4</sup> Previous work has shed considerable light on the relationships between tinnitus symptoms and mood disorders. Sullivan and colleagues reported a 78% lifetime and 60% current prevalence of major depression among patients with tinnitus, which were

rates substantially higher than the non-tinnitus control subjects (21% and 7%, respectively). Similarly, Belli and associates found that patients with chronic tinnitus had significantly higher Beck Anxiety Inventory and Beck Depression Inventory scores. Notably, anxiety and depression severity have been correlated with tinnitus severity, and tinnitus prevalence may even decrease within a cohort as

depression symptoms improve. Tinnitus is furthermore associated with sleep disorders, including insomnia, and can cause difficulty in initiating and maintaining sleep and lead to poor overall quality of sleep. These patients often suffer from greater distress and difficulty with concentration, irritability, and loss of control.<sup>1</sup> In contrast, Shargorodsky et al., in their study of the National Health and Nutrition Examination Survey data, failed to find a significant association between frequent tinnitus and major depression.

## **2. Methods**

PubMed were used as the searching engine in this study. The searching was conducted up to Aug 18, 2021 using the keywords "Tinnitus" and "Depression." Articles selected were all published within the past five years. Duplicate articles were excluded. From PubMed 7 results were obtained and were included in the review.

## **3. Discussion**

### **Interactions and connections**

The question of whether depression is the cause of the tinnitus or tinnitus is the cause of the depression, or whether there are other dependencies, remains unanswered.<sup>3</sup>

The etiology and pathogenesis of the interrelationships between psychological complaints or illnesses and tinnitus stress are not sufficiently understood despite intensive research efforts. The dysfunction of the serotonergic system associated with depression and anxiety may impair sensory processes in the limbic system and the primary auditory cortex. Then serotonergic vulnerability could be one of the factors that - similar to pain sensitivity - intensify the perception of tinnitus. Corresponding studies on the effectiveness of antidepressants influencing the serotonin balance show contradicting results on this hypothesis.<sup>3</sup>

The prevailing theory behind the relationship between tinnitus and depression is that tinnitus triggers depression in depression-prone individuals.

Another theory is that the relationship is bidirectional, with a cyclical process unfolding in which psychological processes contribute to worsening awareness and severity of tinnitus. Tinnitus is also a known side effect of a number of antidepressant agents.<sup>4</sup>

In 2007, during examinations using functional magnetic resonance imaging (fMRI), Struwe found that the same brain areas are activated for the emotional processing of tinnitus as in the context of a depression and concluded that tinnitus can be explained as a depression symptom even without an audiological component can.<sup>3</sup>

Working groups around Canlon and Langguth showed a comparable activation of the hypothalamus-pituitary-adrenal axis, an involvement of the dorsal cochlear core areas in depression and tinnitus attention and emotional processing via the locus caeruleus, formatio reticularis and the raphe core areas in the limbic system.<sup>3</sup>

McKenna et al. published a psychological model in 2014 in which they postulated that the interpretation of tinnitus as threatening and the resulting changes in patient behavior play a central role in the development of the stress caused by tinnitus.

### **Clinical studies on interactions**

There are certainly no monocausal relationships between tinnitus and psychological complaints. The following features interact with each other, so that the respective relationships can often only be understood with a more detailed behavioral analysis. Possible influences in the development and According to Goebel (2010) being: Depression and resignation; Somatization disorder; Fear; Personality variables; Coping ability; Control conviction; Self-awareness and physical observation; social support and caregiver recruitment; Attitude to tinnitus; Functionalization; external help search; negative counseling by doctors and aggravating media reports; dysfunctional thoughts; unclear tinnitus etiology.<sup>3</sup>

Geocze et al. In 2013, in a review in 18 of 20 studies considered, investigated a connection between

mental illness and tinnitus. There were very different interpretations of the possible connections.

In the overview of the included 18 studies on the connection between tinnitus and depression, however, the differences also become clear, which make it largely impossible to compare the results. Most studies take into account, in some cases, outpatient or inpatient treatment, who primarily suffered from either tinnitus or depression. The number of patients included varies between 19 (Sullivan et al.) and 1275 (in the study by Hiller et al.). With regard to the severity and burden of tinnitus and depression, 25 different question inventories are used, only 2 authors (Ooms et al., Figueiredo et al.) use the same test methods (Beck Depression Inventory [BDI]; Tinnitus Handicap Inventory [THI]). It is therefore not surprising that the reported results are very inconsistent: some authors suspect that depression is a possible risk factor for the later development of stressful tinnitus, possibly in the sense of somatization. Others see the occurrence of depression as a result of insufficient adaptation to the symptom of tinnitus or as a possible consequence of a particularly stressful course.<sup>3</sup>

The largest number of participants (n = 1275) shows the study by Hiller et al. 1997, in which in a multi-center study (n= 12) under the aegis of the WHO, patients in outpatient care in 11 countries were asked about the prevalence of tinnitus and psychological distress. 140 (11%) of the examined patients reported tinnitus, of which 45 (3.5% of the total sample) had symptoms of depression. The coincidence of tinnitus with somatoform complaints, depression and anxiety was increased. Hiller et al. put 3 presumed connections up for discussion: (1) an increased comorbidity of two independent symptoms, (2) Tinnitus as a somatic symptom depression or (3) both symptoms are through one causes increased neural activation and anxiety.

In a 2014 study of Egyptian tinnitus patients, Gomaa only a correlation of depression with duration, but not with the burden of the tinnitus. In contrast, Belli et al. in 90 outpatient tinnitus sufferers in

Anatolia an approximately 5 times higher burden for depression, anxiety and somatoform disorders than in 90 people in the control group. Weber et al. found a clear correlation between tinnitus exposure and the severity of the depression in 2008.

Both Belli and Weber use the BDI score for grading the severity of depression in their studies. Hebert et al. also described in 2012 a direct and sustained dependence of tinnitus stress on the degree of depression. In their study they used a subscale of the Hopkins Symptom Checklist, which is based on the Hamilton Depression Subscale (HAM-D6). As a result, the authors described that deafness was a more weighty predictor of tinnitus than depression. In a review in 2003, Arlinger came to the conclusion: Various studies have shown that unbalanced hearing loss worsens the quality of life, leads to isolation, restricts social activities and causes a feeling of exclusion, which leads to an increasing prevalence of depression symptoms.<sup>3</sup>

#### 4. Conclusion

A substantial proportion of patients with tinnitus have depression, and it is recommended that all who treat tinnitus should screen and treat their patients for depression, if present. The question of whether depression is the cause of the tinnitus or tinnitus is the cause of the depression, or whether there are other dependencies, remains unanswered.

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