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Relationships Between Tinnitus and the Prevalence of Anxiety and Depression

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Objectives/Hypothesis: Quantify the relationships between tinnitus, and anxiety and depression among adults.

Study Design: Cross-sectional analysis of a national health survey.

Methods: Adult respondents in the 2007 Integrated Health Interview Series tinnitus module were analyzed. Data for tinnitus symptoms and severity and reported anxiety and depression symptoms were extracted. Associations between tinnitus problems and anxiety, depression, lost workdays, days of alcohol consumption, and mean hours of sleep were assessed.

Results: Among 21.4 ± 0.69 million adult tinnitus sufferers, 26.1% reported problems with anxiety in the preceding 12 months, whereas only 9.2% of those without tinnitus reported an anxiety problem ($P < .001$). Similarly, 25.6% of respondents with tinnitus reported problems with depression, whereas only 9.1% of those without tinnitus reported depression symptoms ($P < .001$). Those reporting tinnitus symptoms as a “big” or “very big” problem were more likely to concurrently report anxiety (odds ratio [OR]: 5.7; 95% CI: 4.0-8.1; $P < .001$) and depression (OR: 4.8; 95% CI: 3.5-6.7; $P < .001$) symptoms. Tinnitus sufferers reported significantly fewer mean hours of sleep per night (7.00 vs. 7.21; $P < .001$) and greater mean days of work missed (6.94 vs. 3.79, $P < .001$) compared to those who did not report tinnitus. Mean days of alcohol consumption between the two groups were not significantly different.

Conclusions: Tinnitus symptoms are closely associated with anxiety, depression, shorter sleep duration, and greater workdays missed. These comorbidities and sequelae should be recognized and addressed to optimally manage patients with chronic and bothersome tinnitus.

Key Words: Tinnitus, depression, anxiety, sleep, work, productivity, substance abuse.

Level of Evidence: 4

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INTRODUCTION

Tinnitus is the perception of sound in the absence of an external auditory stimulus, affecting 8% to 25.3% of the population of the United States and the world.¹⁻⁷ Psychiatric disorders such as anxiety and depression are often comorbid in patients with chronic tinnitus,⁸⁻¹⁰ 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.¹¹

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 nontinnitus control subjects (21% and 7%, respectively).¹² Similarly, Belli and associates found that patients with chronic tinnitus had significantly higher Beck Anxiety Inventory and Beck Depression Inventory scores.¹³ Notably, anxiety and depression severity have been correlated with tinnitus severity,¹⁴ and tinnitus prevalence may even decrease within a cohort as depression symptoms improve.¹⁵ 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.¹⁶ These patients often suffer from greater distress and difficulty with concentration, irritability, and loss of control.¹⁷

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.⁶ Accordingly, we aimed to better evaluate the relationship of tinnitus symptoms with rates of mood disorders among adults by utilizing the tinnitus module from the 2007 National Health Interview Series. Additionally, we sought to further expand on the comorbidities associated with tinnitus by looking specifically at the relationship to sleep, work days missed, and alcohol abuse.

MATERIALS AND METHODS

Adult responses in the household-based 2007 National Health Interview Series (NHIS) were analyzed as aggregated in

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TABLE I.
Relationship of Tinnitus on the Rate of Self-Reported Anxiety and Depression Symptoms in the Past 12 Months.

With Tinnitus	Respondents	SE	%	Without Tinnitus	Respondents	SE	%
Had anxiety in past 12 months							
Yes	5,590,681	306,427	26.1	Yes	18,361,958	654,732	9.2
No	15,796,643	555,876	73.9	No	182,066,388	2,805,007	90.8
Had depression in past 12 months							
Yes	5,468,886	291,367	25.6	Yes	18,332,611	571,757	9.1
No	15,918,428	576,408	74.4	No	182,091,088	2,861,231	90.9

SE = standard error.

the Integrated Health Interview Series.¹⁸ The study protocol was deemed exempt from review by Partners Committee on Clinical Investigations as it analyzes deidentified data that are publicly available. We have previously used the NHIS data to analyze and describe the epidemiology of other otologic conditions in the United States.^{19,20} However, beginning in 2007, the NHIS began including a specific module that assessed multiple tinnitus-related variables.

Corresponding responses from the data were extracted for all adult patients (aged ≥ 18.0 years) and imported into SPSS version 22.0 (IBM, Armonk, NY) for analysis. The prevalence of self-reported tinnitus was determined along with the self-reported level of severity of the tinnitus problem ("no problem," "a small problem," "a moderate problem," "a big problem," "a very big problem"). In addition to the tinnitus variables, data were also extracted for frequent anxiety in the past 12 months, feeling frequently depressed in the past 12 months, hours slept per night, workdays missed, and mean days of alcohol consumption per year. The prevalence of anxiety and depression was compared between tinnitus sufferers and nonsufferers with the χ^2 test. Subgroup analyses were conducted for respondents reporting tinnitus as a big or very big problem for both anxiety and depression. Mean hours of sleep per night, mean number of workdays missed, and mean days of alcohol consumption were also compared between tinnitus sufferers and nonsufferers.

Sample weights and survey statistics were used to allow extrapolation from the raw sample size to representative statistics for the national population in the United States. Overall data are reported as the mean and its associated standard error (SE) of the national estimate. The SE reported here results from extrapolation to the larger national population per the weight directed by the survey data gathering process, performed to obtain the true estimates of reported data in the population. Statistical comparisons were conducted with χ^2 tests, with significance set at $P = .05$. It is important to note that this data analysis describes the relationships between tinnitus, anxiety, and depression but is unable to provide evidence on causality.

RESULTS

Among the 21.4 ± 3.4 million subjects who reported tinnitus within the past 12 months, 26.1% (5.59 ± 0.31 million adults) also had problems with anxiety in the same period. Comparatively, among those who did not report tinnitus in the past 12 months, only 9.2% (18.4 ± 0.65 million adults) reported an anxiety problem ($P < .001$) (Table I). Similarly, 25.6% (5.47 ± 0.29 million adults) of tinnitus sufferers reported problems with depression in the preceding 12 months, whereas only

9.1% (18.3 ± 0.57 million adults) of those without tinnitus reported depression symptoms ($P < .001$) (Table I).

In subgroup analysis, among those reporting tinnitus symptoms as a big or very big problem (1.54 ± 0.14 million), 40.4% (0.622 ± 0.084 million) had an anxiety problem in the preceding 12 months. In contrast, those without tinnitus or with tinnitus symptoms that are not a big problem (221.2 ± 3.4 million), only 10.6% (23.5 ± 0.75 million, odds ratio [OR]: 5.7; 95% confidence interval [CI]: 4.0-8.1; $P < .001$) self-reported anxiety symptoms (Table II). Correspondingly, 36.5% (0.563 ± 0.074 million) of those reporting tinnitus symptoms as a big or very big problem reported having symptoms of depression in the prior 12 months, whereas only 10.6% (23.5 ± 0.65 million, OR: 4.8; 95% CI: 3.5-6.7; $P < .001$) of those without tinnitus or reporting their tinnitus symptoms as not a big problem had depression symptoms (Table II).

Furthermore, those with tinnitus symptoms had fewer mean hours of sleep per night (7.00 vs. 7.21 hours, $P < .001$) and greater mean days of work missed (6.94 vs. 3.79 days, $P = .001$) compared to those who did not report tinnitus. Mean days of alcohol consumed in the last 12 months between the two groups were not significantly different (64.35 vs. 61.61, $P = .431$) (Table III).

DISCUSSION

Tinnitus is the perception of sound in the ear or head without an external source. Multiple components of the peripheral and central auditory system and brain have been implicated as potential contributors to the tinnitus percept. Recent population-based evidence has revealed close associations between mental illnesses and

TABLE II.
Relationship of Tinnitus Severity on Rates of Self-Reported Anxiety and Depression Symptoms in the Past 12 Months.

	Tinnitus Is Not a Big Problem, %	Tinnitus Is a Big/Very Big Problem, %	<i>P</i>	Odds Ratio
Had anxiety in past 12 months				
Yes	10.6	40.4	$< .001$	5.695
No	89.4	59.6		
Had depression in past 12 months				
Yes	10.6	36.5	$< .001$	4.85
No	89.4	63.5		

TABLE III.

Relationship of Tinnitus on Self-Reported Mean Hours of Sleep, Days of Alcohol Consumption, and Days of Missed Work in the Past 12 Months.

Tinnitus		SE	95% CI	P
Mean hours of sleep				
Yes	7.00	0.044	7.19–7.23	
No	7.21	0.012	6.91–7.08	<.001
Mean days of alcohol consumption in past 12 months				
Yes	64.35	1.101	59.44–63.77	
No	61.61	3.424	57.61–71.09	.431
Mean days of missed work in past 12 months				
Yes	6.94	157	3.48–4.10	
No	3.79	0.913	5.15–8.74	.001

CI = confidence interval; SE = standard error.

tinnitus, and significantly higher rates of comorbid anxiety, depression, and low self-esteem have been reported in tinnitus sufferers. Although there are a number of pathologic conditions that can result in intolerable tinnitus, such as Meniere's disease, vestibular schwannoma, and noise trauma, proposed neurophysiologic and psychoacoustic models of tinnitus suggest that the tinnitus perception is a common and nonpathologic condition that is typically habituated by the majority of people. For those reporting and seeking treatment of bothersome and intolerable tinnitus, however, it has been suggested that the tinnitus precept may produce an inappropriate activation of the limbic and sympathetic components of the autonomic nervous systems.²¹

The consequent hyperactive state can be concomitant with and can contribute to anxiety, depression, and panic and sleep disorder symptoms. Belli and colleagues¹³ discovered that 26.7% of patients with tinnitus had at least one psychiatric diagnosis, whereas Marciano and colleagues found that 77% of tinnitus patients met criteria for a psychiatric disorder, in both *Diagnostic and Statistical Manual of Mental Disorders IV* Axis I and Axis II spectrums.²² Additionally, tinnitus-associated dysfunctional cognition, including catastrophic thinking and avoidance cognitions, is strongly correlated with measures of tinnitus distress, depression, and anxiety.¹⁷

The elevated prevalence of depression among tinnitus subjects has been reported to be as high as 60% to 80%,^{12,23} whereas nearly 50% with generalized anxiety disorders can have tinnitus symptoms.⁶ Geocze et al. showed in a systematic review that a total of 18 studies between 1982 and 2011 found a positive correlation between tinnitus and depression.²⁴ The authors postulate that there may be at least three potential relationships between depression and tinnitus: depression affecting tinnitus, tinnitus predisposing to depression, and tinnitus appearing as a comorbidity in patients with depression. A majority of the studies reviewed found that depression either predisposes to tinnitus or occurs as a consequence of tinnitus. In the current study, we report substantial comorbidity of tinnitus and mood disorders. We found that when compared to those without

tinnitus, there is a significantly higher prevalence of depression (25.6% vs. 9.1%) and anxiety (26.1% vs. 9.2%) among survey respondents who reported tinnitus over the last 12 months. Our data moreover revealed that those reporting tinnitus symptoms as a big or a very big problem were four to six times more likely to have symptoms of anxiety or depression in the prior 12 months when compared to those without tinnitus or in whom tinnitus was not a big problem. Although we are unable to remark on causative relationships between tinnitus and psychiatric illnesses, our data add to the growing body of literature that strongly correlates intolerable tinnitus symptoms with comorbid anxiety and depression, supporting the role of psychiatric and psychologic forms of treatment, such as cognitive-behavioral therapy, which can notionally address both tinnitus intolerance and underlying mood disorders.

Sleep disturbance and annoyance are among the more frequently reported problems facing individuals with chronic tinnitus,^{25,26} and increased sleep disturbance has also been shown to closely correlate with increased tinnitus severity,²⁷ providing support for the hyperactive limbic and sympathetic system model for tinnitus intolerance. Similar to prior work correlating tinnitus symptoms with sleep disorders as measured by the Tinnitus Reaction Questionnaire and Insomnia Severity Index,²⁸ we found that tinnitus sufferers reported significantly fewer mean hours of sleep per night. Those with tinnitus symptoms had fewer mean hours of sleep per night (7.00 vs. 7.21 hours, $P < .001$), which equals over 80 minutes of sleep per week, or nearly equivalent to a whole night of sleep lost per month. Previous studies have shown that patients with tinnitus have statistically significant changes in sleep stages, including an increase in stage 1 and 2 sleep time, and reductions in stage 3, 4, and rapid eye movement sleep time.²⁹ However, this is the first study incorporating a large sample that shows an actual reduction in total duration of sleep in tinnitus sufferers. Of note, elderly subjects with tinnitus, in particular, suffer from greater sleep disturbance, including poor sleep and frequency awakening, compared to younger adults.²⁷ Accordingly, treatment and evaluation of insomnia, and administration of methods to modulate the limbic and sympathetic system reaction to tinnitus (e.g., cognitive-behavioral therapy), particularly in the more vulnerable populations, could provide tinnitus patients substantial benefit to their sleep quality and quantity.

The data show strong a strong and significant relationship between tinnitus symptoms and work days missed (Table III). Those with tinnitus miss approximately 1.8 times more work (6.94 vs. 3.79 days, $P = .001$) compared to those who do not suffer from tinnitus. Review of literature indicates that this is the first study to quantify the number of workdays that are lost in patients suffering with tinnitus in the United States. To further analyze these effects, the lost wages method, which is one of the most common methods to measure productivity loss,³⁰ was used to calculate the financial consequences of absenteeism caused by tinnitus. The number of extra work days missed were multiplied by a median multiplier of 1.28³¹ and the 2007 employer costs

for employee compensation of \$28.11 per hour, for a standard 8-hour work day.³² This calculation yields a loss of \$907 per tinnitus sufferer, with a total economic loss of \$19.4 billion dollars per year to the workforce of the United States. As evidenced here, the cost burden to the economy in lost wages and productivity from tinnitus is extravagant. Given the psychosocial and sleep disturbance issues related to tinnitus, it is understandable that these patients experience profound sequelae in different aspects of their lives, including their work and its related performance.

The data in this study are derived from a national database that samples the diverse population of the United States, from all 50 states and the District of Columbia. Given that the Centers for Disease Control and Prevention focuses on black, Hispanic, and Asian persons during the survey to allow for a precise estimation of health characteristics in these growing minority groups, the data reflect a true sampling of the country's population. The large, diverse sampling allows clear identification of relationships between tinnitus symptoms and their close association with anxiety, depression, shorter sleep duration, and greater workdays missed, along with its financial ramifications, which has previously not been reported in the literature. Additionally, the data are gathered by trained interviewers with standardized questions, thus the reliability of its responses is credible as they are collected through an assured process. However, given that the questions are retrospective in nature, the potential for recall bias from the respondents is a real possibility. Additionally, because the respondents provide subjective feedback regarding the severity of their symptoms, the ability of the dataset to objectively quantify the severity of anxiety, depression, and sleep disturbance is limited. Finally, the retrospective and deidentified nature of the study unfortunately prevents subgroup analysis. Future studies with different datasets can be directed toward evaluating such intricacies, including but not limited to gender and racial differences in the cohort.

CONCLUSION

Through this large population-based study, we demonstrate a strong association among tinnitus, depression, and anxiety. This association also bears a strong relationship between the severity of tinnitus and the likelihood of anxiety and/or depression. Additionally, we report reduced duration of sleep and increased days of work missed among individuals with tinnitus symptoms, with tinnitus sufferers sleeping less and missing significantly more work than nonsufferers. Such comorbidities and sequelae should be recognized and appropriately addressed to effectively manage patients with chronic and bothersome tinnitus.

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