

Tinnitus and suicide: An unresolved relation

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Abstract

Tinnitus is an auditory phantom sensation which can be a devastating condition for the affected person causing annoyance and discomfort. It may be associated with psychiatric conditions. Patients with highly annoying tinnitus and different comorbidities may have a higher risk of expressing suicidal behaviour and ideation. We aimed to review available reports on the prevalence of suicide and suicidal behaviour with tinnitus patients in order to collate current concepts and to identify possible alarming signs and risk factors. A comprehensive search for appropriate studies listed in PubMed, Ovid and Cochrane databases was conducted using appropriate keyword combinations. We identified 22 publications including original articles, case reports and reviews of which 10 fit our stringent search criteria. Most importantly, from the present studies it appears not feasible to univocally conclude on the co-occurrence of tinnitus and suicide. This is due to methodological differences in these approaches, complex interrelations between tinnitus and other psychiatric comorbidities and con-

founding factors such as the inclusion of patients suffering from post-traumatic stress disorder. More concerted actions involving different medical disciplines are needed to reflect the ethiological heterogeneity of tinnitus and suicide or suicidal behaviour to test for a relationship.

Introduction

Tinnitus is the perception of a phantom sound in the absence of a physical correlate and occurs with an estimated prevalence of 5.1¹ to 42.7%² in the general population. Subjective loudness, quality and awareness can vary significantly, which results in different degrees of suffering ranging from slight annoyance to severe distress. In 20% of the cases and thus more often than in control individuals, tinnitus causes distress that manifests in annoyance, anxiety, depression, concentration problems and sleep disturbances.^{3,4} As a consequence, tinnitus patients often become socially isolated and even lose their abilities to pursue regular work. In clinic, a number of self-reporting questionnaires are used in an attempt to grade tinnitus complaints such as the Tinnitus Handicap Inventory⁵ and Visual Analogue Scale (VAS). Patients with highly annoying tinnitus and comorbidity may be at a higher risk of expressing suicidal behaviour. However, this relation is debatable. Suicide or suicidal behaviour has a lot of different kinds of reasons behind it; related to mental and physical health and also social reasons. It is difficult to pinpoint one reason for this kind of attempt or ideation.^{6,7}

Here, we present a systematic literature review on current reports available from public databases, and critically discuss why current results are seemingly divergent and how this issue should be addressed in the future.

Methods of research

A comprehensive systematic literature search was performed in PubMed, Ovid, and Cochrane databases using the following search terms: ('tinnitus' [MeSH Terms] OR 'tinnitus' [All Fields]) AND (('depressive disorder' [MeSH Terms] OR ('depressive' [All Fields] AND 'disorder' [All Fields]) OR 'depressive disorder' [All Fields] OR 'depression' [All Fields] OR 'depression' [MeSH Terms]) AND ('suicide' [MeSH Terms] OR 'suicide' [All Fields])).

Results

Search results

We identified a total of 22 reports that conformed to our search terms in three public databases, *i.e.* PubMed, Ovid, and Cochrane

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(for details please refer to *Methods of research*). The abstracts of all reports were evaluated carefully leaving 10 reports eligible for further analysis based on predefined inclusion criteria⁶⁻¹⁵ (Table 1). Generally, we identified three types of publications: i) prevalence studies that differed considerably in size, methodological approach and geographic origin; ii) case reports; iii) review articles.

Prevalence studies

Among the 10 reports on tinnitus and suicide, we identified five prevalence studies. In 2014, Vogel *et al.*⁸ conducted a survey among 943 students in Dutch inner-city senior-secondary vocational schools with the primary aim to study music-related hearing impairments including tinnitus. The students completed questionnaires about their sociodemographic background, music listening behaviours and health. Indeed, 10% of the students experienced

permanent hearing-related symptoms (tinnitus, muffled sounds, distortion, hyperacusis or hearing loss). At least one query aimed at evaluating the mental health status by stating: *I often or very often seriously thought to end my life during the past 12 months (yes/no)*. Students affected by hearing impairments reported two-time more often symptoms of depression, thoughts about suicide and adverse self-assessed general and mental health. Although this study falls short in validating an intimate relationship between tinnitus and suicide, it does support the notion that hearing impairments and mental health are interrelated pathologies.

To validate a relationship between suicidal behaviour and tinnitus (suicidal thoughts as well as unsuccessful suicide attempts), Seo *et al.*⁹ conducted one of the first large-scale surveys on this issue. The authors examined data from 17,446 South Koreans in the Korean National Health and Nutrition Examination Survey

Table 1. Original studies, case reports and reviews reporting on tinnitus and suicide.

Authors	Design	Participants	Methodology	Key findings
Lewis <i>et al.</i> , 1994 ⁷	Case reports	28 cases world-wide	Evaluation of a 20-item tinnitus and suicide questionnaire	Suicide risk factors: male gender, low social economic status, social isolation, bereavement and depression
Frankenburg and Hegarty, 1994 ⁶	Case reports	2 cases in Massachusetts, US	-	Patients with history of significant psychiatric diseases
Jacobson and McCaslin, 2001 ¹³	Literature review	-	Evaluation of 4 reports from electronic databases	No evidence of causal relationship between tinnitus and suicide
Turner <i>et al.</i> , 2007 ¹⁴	Literature review	-	Evaluation of 13 reports from electronic databases	Risk factors for suicide in deaf people differed systematically from those in the general population
Pridmore <i>et al.</i> , 2012 ¹⁵	Literature review	4 cases in newspapers and internet over a period of 10 years	Examining the public domains (newspapers and the Web)	No arguments for or against a causal relationship between tinnitus and suicide
Vogel <i>et al.</i> , 2014 ⁸	Prevalence study	943 students in Dutch inner-city senior-secondary vocational schools	Analysis of self-reporting questionnaires, Key question: <i>I often or very often seriously thought to end my life during the past 12 months (yes/no)</i>	10% permanent hearing-related symptoms, two times more often symptoms of depression and thoughts about suicide
Seo <i>et al.</i> , 2016 ⁹	Prevalence study	17,446 responders, the KNHANES 2010-2012	Analysis of questionnaires Key question: <i>In the last 12 months, did you think about committing suicide?</i> If the subject answered yes, s/he was asked about the suicide attempt(s)	20.9% of tinnitus patients reported suicidal ideation and 1.2% suicide attempts; tinnitus is associated with an increased risk for depressed mood; tinnitus is related to suicidal ideation and attempts
Han <i>et al.</i> , 2018 ¹⁰	Prevalence study	28,930 responders, the KNHANES 2008-2012	Analysis of self-reporting questionnaires. Key question: <i>Within the past year, have you ever seriously considered attempting suicide?</i>	20.9% with tinnitus, in tinnitus patients 18.8% depression and 21.6% suicidal ideation, compared to non-tinnitus 12.3% and 13.1%; tinnitus and its severity are significantly associated with depressive mood and suicidal ideation
Aazh and Moore, 2018 ¹¹	Prevalence study	150 patients, National Health Service in the United Kingdom (12-month period)	Analysis of PHQ-9	13% suicidal or self-harm ideations small statistically significance between suicidal and self-harm ideations and tinnitus handicap, hyperacusis handicap, insomnia, and scores on the VAS
Martz <i>et al.</i> , 2018 ¹²	Prevalence study	769,934 veterans who accessed the Veterans Administration health care system from 2002-2011	Analysis of ICD-9-CM and ICD-10 codes.	15% with tinnitus, of these 21% depression, 8% anxiety, 17% depression and anxiety; 54% tinnitus without depression or anxiety; suicide rate was lower among veterans with tinnitus than veterans without tinnitus

KNHANES, Korea National Health and Nutrition Examination Surveys; PHQ-9, Patient Health Questionnaire, item 9; VAS, visual analogue scale; ICD-9-CM, International Classification of Diseases 9th Revision Clinical Modification.

(KNHANES) between 2010 and 2012. The presence of tinnitus was judged by the question: *Have you ever heard a noise (humming, hissing, ringing, humming, humming, machine noise) in your ear in the past year? (yes/no)*. If answered with *yes*, the authors graded tinnitus severity by the question: *How severe is this noise in your daily life? (not annoying/annoying; irritating; severely annoying and causes sleep problems)*. Finally, suicidal thoughts were included by the question: *In the last 12 months, did you think about committing suicide? (yes/no)*. If a person confirmed suicidal thoughts, a follow-up question asked for actual suicide attempts. Interestingly, 20.9% of tinnitus patients reported having suicidal thoughts, compared to 12.2% in the cohort without tinnitus and 1.2% of tinnitus patients admitted to have undertaken suicide attempts compared with 0.6% in the cohort without tinnitus. Thus, this study gave first concrete evidence for a relation between tinnitus suicidal thoughts but failed, due to its design, to validate a relation between tinnitus and suicide.

Using data from the same survey, the fourth and fifth KNHANES conducted from 2008 to 2012, and using very similar questions, Han *et al.*¹⁰ searched for the presence and severity of tinnitus, depressive mood, suicidal ideation, perceived usual stress level, and socioeconomic and health-related variables in 28,930 adults (aged ≥ 19 years). In confirmation of the study by Seo *et al.*,⁹ tinnitus and its severity associated significantly with the presence of depressive mood and suicidal ideation. Furthermore, the study revealed that tinnitus, depressive mood and suicidal ideation share common socioeconomic and health-related risk factors. To specifically grade the seriousness of the suicidal ideation, Han *et al.*¹⁰ asked in addition: *Within the past year, have you ever seriously considered attempting suicide? (yes/no)*. The conclusion of this study was that tinnitus contributes very likely to the development of depressive symptoms and suicidal ideation. Interestingly, tinnitus and suicide ideation share certain risk factors and stress levels.

Aazh *et al.*¹¹ conducted a prevalence study in audiology outpatients with tinnitus and hyperacusis to assess the prevalence of and factors related to suicidal and self-harm ideations. There were 150 out of 402 patients who answered the Patient Health Questionnaire, item 9, and of these, 13% indicated that they had suicidal or self-harm ideations in the past 2 weeks. Statistical significance was found for correlations between suicidal and self-harm ideations and tinnitus handicap, hyperacusis handicap, insomnia, and VAS scores. Interestingly, suicidal and self-harm ideations decreased with increasing age. A mathematical regression model revealed that abnormal depression scores increase the chance for suicidal and self-harm ideations (factor 6.2). It was concluded that audiologists should be aware of these comorbidities and eventually offer help.

A different approach was used by Martz *et al.*¹² In a large study on 769,934 veterans seeking medical aid between January 2002 and December 2011, tinnitus was diagnosed in 15% ($n=116,358$). Of these veterans diagnosed with tinnitus, 21% revealed symptoms of depression, 8% anxiety and 17% a combination of both. Hearing loss was co-occurring in 41.9%. The most surprising finding was that suicide rate among veterans with tinnitus was lower than veterans without tinnitus. Also, the presence of other mental-health comorbidities did not increase the risk of suicide.

Case reports

We identified two publications describing individual cases of tinnitus patients and suicide and categorized them as *quasi* case reports. One of the first analyses on this issue was conducted by Lewis *et al.* in 1994.⁷ The authors evaluated a 20-part tinnitus suicide questionnaire obtained from audiological clinics worldwide. Twenty-eight cases of committed suicide were identified among

individuals with known tinnitus complaints. The authors pointed out that the onset of tinnitus represents a significant event in life and determined certain risk factors that increase the risk for suicide amongst tinnitus patients, which are male gender, low social economic status, social isolation, bereavement and depression. The study remained descriptive, however, and thus did not allow clear-cut conclusions.

Frankenburg and Hegarty⁶ published another report 1994 on two patients suffering from tinnitus and with documented suicide attempts. The patients had histories of significant psychiatric comorbidities including depression and paranoid disorder. It was concluded that a relation between tinnitus, delusional ideation, suicidal attempts and depression is possible. But as said for Lewis *et al.*,⁷ a robust conclusion cannot be made due to the descriptive nature of the study and the low number of cases.

Review articles

In 2001, Jacobson and McCaslin¹³ published a literature review on tinnitus and suicide published between 1966-2001. Out of 12 articles identified from their literature search, eight articles were excluded because tinnitus was triggered by self-poisoning. The sample size in all remaining four articles was small. Interestingly, two articles discussed in this review did not appear using our more stringent criteria. Irrespective of the small numbers of publications at the time, the authors claim that a predictive relationship between tinnitus and suicide cannot be concluded. This has been debated later.¹⁶ Instead, the authors suggest that not tinnitus *per se* provokes suicide but a combination of psychiatric comorbidities increase the suffering from tinnitus thereby triggering the fatal decision.

Turner *et al.*¹⁴ conducted a literature review on suicide in deaf populations and identified 13 related reports. Little evidence was found to suggest that risk factors for suicide in deaf people differ systematically from those in the general population. However, just as seen for tinnitus, a higher level of depression and perceived risk for suicide was found among deaf individuals compared to control groups. Interestingly, Turner *et al.*¹⁴ discuss in detail a number of articles on tinnitus and suicide without offering a conclusive answer on a possible interrelation.

Unlike the previous studies, Pridmore *et al.*¹⁵ investigated a possible link between suicide and tinnitus by searching in newspapers and the Internet for *stories* over the past decade. They present four cases in which tinnitus appeared to precede suicide. The researchers acknowledged that, due to the nature of the data presented in their article, the results are anecdotal and thus cannot provide reliable arguments in favour or against a causal relationship between tinnitus and suicide. Nevertheless, it was suggested that health professionals should be compassionate to those who are disturbed by their tinnitus and should ensure that those who are significantly concerned about their tinnitus are referred to mental health providers.

Discussion and Conclusions

In this study, we aimed to evaluate if, and eventually how, tinnitus may trigger suicidal ideation, suicidal attempts and completed suicides. We defined stringent search terms and explored three public databases, *i.e.* PubMed, Ovid and Cochrane.

Apparently, all attempts to enlighten this issue are hampered by the fact that suicidal ideation and behaviour have multiple causes. We identified ten articles of which five describe prevalence studies, two discuss case reports and three reviewed the field. By

definition, the case reports^{6,7} were anecdotal and described individual circumstances without revealing the underlying mechanism. Previous reviews as well did not come to a definite conclusion. It has been discussed that a causal relationship between tinnitus and suicide is likely but not ultimately proven.¹³ From our point of view, the very few prevalence studies⁸⁻¹² are of utmost importance albeit suffering from a variety of limitations. One limitation is that tinnitus is rarely a singular event. It may occur on top of or in combination with other pathologies or may trigger the development of psychiatric comorbidities such as anxiety and depression. Both, post-traumatic stress disorder and depression alone have been described to trigger suicidal behaviour.¹² Another limitation is owed to the fact that current questionnaires can only address suicidal ideation or unsuccessful suicide attempts. Indeed, four out of five prevalence studies concluded that tinnitus triggers suicidal ideation to different degrees.⁸⁻¹¹ Interestingly, these studies relied on self-reporting questionnaires. Thus, the interviewer asked for ideation and related it to tinnitus. One study on veterans, however, was based on retrospective ICD-9-CM/ICD-10 analysis.¹² The unexpected finding was that suicide rate among tinnitus patients was lower than in controls. Clearly, a distinguished feature of this study is that it addresses successful suicides and not attempts or ideations. Therefore, all self-reporting questionnaires may result in too negative answers and thus overinterpret a possible relation.

We were able to show that patients suffering from tinnitus show attenuation of positive valence in ratings of affective sounds,¹⁷ which is very similar to responses seen in patients suffering from depression. Moreover, in patients suffering from tinnitus and depression blunted stress hormone response levels, such as cortisol, have been described.¹⁸ Diminished cortisol responses are indicative for the presence of severe forms of endogenous depression and are thought to be a negative predictor of subjective stress and tinnitus intensity.¹⁹ To better understand the relationship between stress responses in tinnitus and/or depression, more studies are needed that specifically address the sequence of events and its consequences. In other words, is a blunted stress response a prerequisite for the development of tinnitus and/or depression, or is the presence of tinnitus and/or depression the reason for the diminished response. Also, if tinnitus and possibly psychiatric comorbidities alter hormonal stress responses similarly, is the effect additive and thus suicide more likely if tinnitus is accompanied by comorbidities or is only the degree of stress response attenuation relevant to which all signalling cascades individually converge.

Taken together, from the above-mentioned literature we cannot univocally conclude if tinnitus and suicidal ideation are interrelated entities. There is good evidence, that severe forms of depression and tinnitus show altered stress responses such as lowered cortisol levels. Further studies are needed to validate this notion.

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