

Review articles

Tinnitus and its relationship with anxiety and depression in the elderly: a systematic review

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ABSTRACT

Objective: to verify, in the literature, a probable association of tinnitus with anxiety and depression in the elderly.

Methods: a systematic review (through a search in the indexed databases - Lilacs, Scielo, Pubmed, Science Direct, The Cochrane Library) of studies published between 2013 and 2018, in Portuguese and in English, involving adults and/or elderly (18 years and older). The descriptors used were: “tinnitus”, “depression”, “anxiety”, “adult”, “elderly”, interspersed by the Boolean operator AND.

Results: 11 studies were selected, from which, 5 compared adults to elderly and only 2 evaluated such relationship in the elderly alone. Studies suggest that, as age increases, tinnitus severity and psychological symptoms also increase, affecting both men and women.

Conclusion: few studies compared the relationship between the variables among the elderly. A probable association between the variables for both genders has been found, suggesting that the advancing age contributes to the increase of tinnitus severity and its psychological symptoms, affecting the quality of life of these individuals. Further studies are suggested to confirm the association between tinnitus, anxiety and depression in the elderly. Multi-professional work is important for the evaluation and treatment of these people.

Keywords: Tinnitus; Anxiety; Depression; Adult; Aged

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INTRODUCTION

Tinnitus is a common symptom that may become debilitating. It can be described as the conscious perception of a sensation in the absence of an external stimulus¹. This sensation is often related to the sounds of sizzle, rain, whistle or waterfall and may be distinct from person to person, being either continuous or intermittent².

In the adult population in general, the prevalence of tinnitus is estimated to be between 10-15%^{3,4}. This prevalence increases to 33-51% among individuals over 60 years of age⁴⁻⁷, and this age group is the most affected by tinnitus. Brazilian studies agree with the prevalence presented in studies conducted in other countries⁴⁻⁸. This symptom, present in about 25 million Brazilians, affects the auditory pathways and may have several causes, such as primarily otologic diseases, or diseases that affect the ear secondarily, such as metabolic, cardiovascular, neurological, pharmacological, dental and psychiatric disorders⁸.

Mental disorders are characterized as a group of diseases with a high degree of overload, among them, depression and anxiety. Depression, of insidious origin, is characterized by loss of interest and pleasure in everything, by the feeling of sadness and low self-esteem, possibly leading, in the more severe cases, to suicide⁹. Anxiety, in its turn, is a vague and unpleasant feeling of fear and apprehension, characterized by tension or discomfort derived from anticipating danger coming from either a known or unknown source. Anxiety and fear become recognized as pathological when they are exaggerated, disproportionate to the stimulus, or qualitatively different from what is observed as normal in that age group, thus interfering with the quality of life, emotional comfort or daily performance of the individual¹⁰.

Individuals with chronic tinnitus and nuisance often have associated psychological disorders, such as difficulty to concentrate and sleep, stress, irritability, anxiety and depression¹¹. The prevalence of people who are troubled by tinnitus is 64%, and in 18% of these patients, they report that tinnitus interferes with daily activities⁴. Authors indicate that there is a high degree of correlation between severe tinnitus and symptoms of depression and anxiety, but the results are not homogeneous^{5,10,11}.

Recent systematic reviews¹²⁻¹⁴ have addressed the theme in a broad way, presenting this probable association in general, but they do not identify the results by age group. As previously shown, the

highest prevalence of tinnitus is centered in the elderly population, and thus, considering the changes resulting from the aging process, a careful investigation directed to this population is made necessary. Thus, the main objective of this study was to systematically review in literature the likely association of tinnitus with anxiety and depression in the elderly and to identify differences from adult to elderly populations, if any is found.

METHODS

As a research strategy, it has been decided to carry out a review in literature on a probable association of tinnitus with anxiety and depression in the elderly. The work design was based on the national¹⁵ and international recommendations¹⁶ for the development of systematic reviews. The following guiding questions were elaborated in the first stage of the study: Is there a probable association of tinnitus with anxiety and depression in the elderly? Are there differences in the studies that approach adults and the elderly in relation to those that approach only the elderly as it refers to the results of the research?

In order to select the studies, a bibliographical survey of texts published in the period from 2013 to 2018 in electronic databases *Lilacs*, *SciELO*, *Pubmed*, *Science Direct* and *The Cochrane Library* was carried out. Based on the guiding question, the descriptors for the search were defined according to Decs - Descriptors in Health Sciences - and *Mesh Terms*, namely: “zumbido” (tinnitus), “depressão” (depression), “ansiedade” (anxiety), “adulto” (adult), “idoso” (elderly), interspersed by the Boolean operator “AND”. The combination of the words used for the search was as follows: buzz AND depression; tinnitus AND anxiety; tinnitus AND depression AND adult; tinnitus AND depression AND elderly; tinnitus AND anxiety AND adult; tinnitus AND anxiety AND elderly. These combinations were used both in Portuguese and In English.

The inclusion criteria were: being an original research article; being complete work and fully available; having been published within the last five years in Portuguese or in English; including adults (age equal to or older than 18 years) and/or elderly (age equal to or older than 60), i.e., including both adults and elderly or only the elderly. The exclusion criteria were defined as: articles not related to the objective; duplicate work in databases; works that dealt with a specific population (Meniere’s disease, deafness, malignant neoplasia, hyperacusis, war veterans, temporo-mandibular joint diseases, among others); language other than those

of the inclusion criteria; articles expressing experts' opinions, letters to the editor and case reports, as well as articles that, after thoroughly reading the text, did not answer the guiding question.

The process of analyzing the articles was done in three stages. The first constituted in reading the titles and abstracts and selecting them according to the inclusion criteria. The second stage occurred with the thorough reading of the articles, in search of the answer to the guiding question. And the third step was performed through the critical analysis of selected articles. For this purpose, the NIH Quality Assessment Tool for Observational Cohort and Cross-sectional studies¹⁷ was used for cohort and cross-sectional studies. Those classified as "good" and "fair" were included in the study. The selection of the works was done by two independent evaluators (P.C.D.G and D.S.A.C), and in case of conflict between them, a third evaluator was called (L.L.M.M) to settle the issue by consensus between them.

For this end, an instrument developed by the authors was used to extract data (I.C.G., P.C.D.G; V. M. M.) and to identify the works eligible for the study. This instrument included data such as: authors, study type,

sample characterization, tinnitus evaluation, depression or anxiety assessment, objective and main results

LITERATURE REVIEW

The search found 354 matches. Studies not related to the objective were excluded ($n = 218$), as well as duplicates ($n = 93$), studies that did not include the elderly in its sample ($n = 19$), those dealing with a specific population as described in the methods ($n = 8$) and those that were in the language restriction category ($n = 5$). After thoroughly reading the articles, 11 studies were selected for this review. The identification and characteristics of the included studies are presented in Figure 1. The instruments used for evaluation of both tinnitus and depression and anxiety varied according to the authors' objective and are shown in the same figure.

The findings of this study should be interpreted with caution, as there are some limitations such as the restriction of foreign language, since four articles published in German and one in Chinese were excluded because only their abstracts were presented in English. In addition, few studies had been found that evaluated the theme in the elderly population.

Author and year	Type of study	Sample	Assessment instruments*	Objective	Main results
Bhatt et al. (2016) ¹⁸	Cross-sectional	21,467,314 adult participants aged 18 or over.	National health research questionnaire	Quantify the relationship between tinnitus, anxiety and depression in adults.	There is a strong association between tinnitus, depression and anxiety. This association is also strongly related to the severity of tinnitus and the probability of anxiety and/or depression.
Trevis et al. (2016) ¹⁹	Cross-sectional	81 participants with chronic tinnitus; age ranging from 18 to 82 years, averaging 44.6 ± 16.2 years.	Tinnitus Case Sample History Questionnaire; THI; STRAIT; BDI.	Identify the psychological mediators of the vicious cycle proposed for the maintaining of the perception of chronic tinnitus.	Depressive symptoms act directly in maintaining the perception of tinnitus and explain the relationship between tinnitus and anxiety.
Weidt et al. (2016) ²⁰	Cross-sectional	208 participants with tinnitus; age ranging from 18 to 87 years, averaging 46.8 ± 14 years.	THI; HRQoL; BDI.	Evaluate the associations between tinnitus, quality of life, depressive symptoms, subjective noise intensity of tinnitus and audiometric characteristics.	Depressive symptoms were significantly greater in patients with tinnitus, as compared to the general population; severity of tinnitus was positively associated with the depressive symptoms. Quality of life was significantly lower in patients with tinnitus, when compared to healthy control groups.
Wallhäuser-Franke et al. (2017) ²¹	Cross-sectional	57 participants with acute tinnitus; age between 21 and 79 years, averaging 41.4 ± 15.6 years.	Mini-TQ12; PHQ9; GAD-7.	Assessed the transition from acute to chronic tinnitus, as well as variables such as anxiety and depression.	Scores for the assessment of depression and anxiety in patients with acute tinnitus were similar to those found in patients with chronic tinnitus; higher levels of depression around the onset of tinnitus resulted in the distinction between problematic and non-problematic tinnitus and the scores remained high while the research lasted.

Author and year	Type of study	Sample	Assessment instruments*	Objective	Main results
Kim et al. (2015) ²²	Cross-sectional	19,290 participants; age ranging from 20 to 98 years; averaging 45.49±0.21 years.	National health research questionnaire	Analyze the prevalence and the risk factors associated with tinnitus such as depression, among others.	Higher prevalence of tinnitus over the age of 60 (25%), increasing with age (85 years = 36%); positive association of the history of depression with tinnitus (OR = 2.02).
Strumilla et al. (2017) ²³	Cross-sectional	212 participants, age averaging 48.33±14.02 years, divided into 4 age groups.	HADS-D; HADS-A; THI and VAS	Investigate whether the severity of tinnitus may be predicted by the magnitude of the depressive and anxiety symptoms and the patients' profile.	Severity of tinnitus may be predicted by depressive and anxiety symptoms, of which anxiety is the most important. Difference found in the age group of 50 to 69 years; women had significantly higher scores in all scales.
Xu et al. (2016) ²⁴	Cross-sectional	543 participants with subjective tinnitus, age group from 11 to 80 years, averaging 44.81 ± 14.86 years.	THI; SAS; SDS.	Investigate the relationship between the quality of sleep and psychiatric disorders, including anxiety and depression in patients with subjective tinnitus.	The severity of tinnitus and the impairment of sleep seem to be the main risk factors of tinnitus accompanied by depression symptoms (p < 0.05). No significant correlation has been found between depression symptoms and age.
Al-Rawashdeh et al. (2018) ²⁵	Cross-sectional	1,328 participants aged from 18 to 86 years; divided by age in four groups.	Self-rating questionnaire on tinnitus; PHQ-9; GAD-7;	Evaluated different ENT complaints and their relationship with psychological symptoms.	The age group from 30 to 50 years differed from the other ones regarding scores for depression and anxiety, as compared to the general group. This relationship remained in the only-tinnitus group; tinnitus was a predictor of depression, though not of anxiety.
Park et al. (2016) ²⁶	Co-hort	140 adults with tinnitus divided in two groups: young (20-45 years) and elderly (65 years or over).	THI and BDI.	Explore the differences in various characteristics related to tinnitus and psychological aspects.	There was no difference for age, gender and score for depression between the young and the elderly groups; severity of tinnitus and depressive symptoms have not differed between the groups.
Michikawa et al. (2013) ²⁷	Prospective Co-hort	535 elderly ≥ 65 years of age; divided into 3 age groups without baseline depressive symptoms.	Question-naire; GDS-15.	Clarify whether tinnitus precedes the development of depressive symptoms in an elderly population.	After 2.5 years of follow-up, men with tinnitus revealed a significant increase in the risk of developing depressive symptoms (RR = 2.07). Aging doesn't seem to have an impact on the results.
Loprinzi et al. (2013) ²⁸	Cross-sectional	696 elderly; age group: 70 to 85 years.	National health research question-naire; PHQ-9.	Verify the association between tinnitus and depression in the elderly.	There was a significant association between depression and tinnitus, which suggests that those that perceived their tinnitus as a moderate problem had greater probability of being depressed, as compared to those who considered it to be small or absent.

*THI (Tinnitus Handicap Inventory); STRAIT (State-Trait Anxiety Inventory-1); BDI (Inventory Beck Depression); HRQoL (Questionnaire health-related quality of life); HADS-D (Hospital Anxiety and Depression Scale); HADS-A (Hospital Anxiety and Depression Scale (HADS) ; VAS (Visual Analogue Escal); Mini-TQ12 (Tinnitus Questionnaire); PHQ9 (Patient Health Questionnaire-9); GAD-7 (Generalized Anxiety Disorder 7-item); SAS (Self-rating Anxiety Scale); SDS (Self-rating Depression Scale); GDS-15 (Geriatric Depression Scale-15 item).

Figure 1. Characteristics of the studies included.

For the evaluation of tinnitus, depression and anxiety, the most frequently mentioned instruments were, respectively: the *Tinnitus Handicap Inventory* (THI)^{19,20,23,24,26}; the *Beck Depression Inventory* (BDI)^{18,19,26}; the *Patient Health Questionnaire-9* (PHQ9)^{21,25,28}; and the *Generalized Anxiety Disorder 7-item* (GAD-7)^{21,25}.

Of the 11 selected studies, 4 included elderly in their sample but not only them¹⁸⁻²¹. Some of these studies were carried out with Brazilian samples, which may be why the papers presented the variables only in the general group; 5 articles reported their data comparing adults and the elderly²²⁻²⁶; and finally, only 2 studies^{27,28} evaluated the relationship between variables only in the elderly population.

Regarding the type of tinnitus, 8 papers did not specify the type of tinnitus evaluated^{18,20,22,23,25-28}. Participants answered questions such as “Do you have tinnitus?”; “Have you heard buzzing, humming, roaring or whistling sounds without an external acoustic source in the last year?”; “What about in the last three months?”. If so, the participant was taken into account for the study; 1 study assessed chronic tinnitus¹⁹, 1 study reported acute tinnitus²¹ and 1 reported subjective tinnitus²⁴.

Of those that included the elderly in their general sample, a study with the American population¹⁸ aiming at quantifying the relationship between tinnitus, anxiety and depression evaluated about 21 million adults over 18 years of age who reported tinnitus in the previous 12 months. There was a significantly higher prevalence of depression (25.6%) and anxiety (26.1%) among participants reporting tinnitus ($p < 0.001$). In addition, the data revealed that those who reported tinnitus symptoms as a “big problem,” or a “very big problem,” were 4 to 6 times more likely to have anxiety symptoms (odds ratio = 5.69, $p < 0.001$), or depression (OR: 4.85; $p < 0.001$) when compared to those without tinnitus or to those for whom tinnitus “was not a big problem.” However, the authors did not report whether there was a difference by age group.

Another study²⁰ evaluating 208 patients with tinnitus assessed the associations between tinnitus, tinnitus severity, quality of life and depressive symptoms. The findings showed that patients with lower scores for tinnitus severity also reported lower scores on the depression scale ($p < 0.001$). Quality of life was significantly lower and depressive symptoms significantly higher in relation to the general population; the severity of tinnitus (measured by THI sum score)

was associated with poorer quality of life and more depressive symptoms ($p < 0.001$). Thus, severity of tinnitus was significantly associated with depressive symptoms and poorer quality of life.

When investigating 57 patients with acute tinnitus and their chronification process, with a follow-up period of one year, evaluating the participants at four different moments, a study²¹ found that 90% of the participants developed chronic tinnitus. At the beginning of the study, they were allocated in two groups: “low level of depression” and “higher levels of depression”. The results demonstrated that a high level of depression around the onset of tinnitus generated a distinction between problematic and non-problematic tinnitus at the end of follow-up ($p < 0.05$). Tinnitus symptoms were lower and significantly reduced during the time of the study in the “low depression” group, while the scores remained unchanged for the “higher depression” group ($p < 0.05$). As it can be noticed, since the onset of tinnitus there had already been mediation of the psychological symptoms that directly impacted its perception and severity.

In a study¹⁹ with 81 participants aiming at investigating the performance of psychological mediators intended for the perception of chronic tinnitus, there has been found a moderate to large effect size for positive association between anxiety and tinnitus by which anxiety predicts tinnitus and tinnitus predicts anxiety, generating a vicious cycle ($r_s = 0.43$, $p < 0.001$). When depression symptoms were included in the regression models, the vicious cycle was no longer present, meaning that depression fully explains the relationship between tinnitus and anxiety ($b = 0.79$, $p < 0.001$).

Regarding studies comparing adults and elderly, interesting findings should be mentioned. A population-based Korean study²² interviewed 19,290 participants, of which 4,234 (20.7%) reported tinnitus in the previous 12 months. Participants were divided by age group differing 5 years one from the other. The prevalence of tinnitus increased with age; it was around 20% for individuals under 50 years of age, while the highest prevalence was found in the 85-year-old age group (36%). Aging (every 10 years) increased the odds ratio (OR) of annoying tinnitus by 1.17 times. The female gender was significantly associated with tinnitus (OR = 1.32). The history of depression was positively associated with tinnitus after logistic regression (OR = 2.02). Thus, the authors report that tinnitus may precede depression. Along with that, the rate of tinnitus described as uncomfortable among subjects was

30.9%. This proportion increased with age and the rate was >40% for individuals over 60 years of age. The authors report that adaptation plays a major role in the discomfort caused by tinnitus. It is possible that older individuals have more difficulty adapting to tinnitus and this difficulty is influenced by psychological factors.

Contrasting with the previous findings, a study²³ with 212 participants divided into four age groups investigated whether the severity of tinnitus predicts the magnitude of depressive and anxiety symptoms and the patient's profile. Women scored significantly higher on the VAS, THI, HAD-D, and HAD-A scales ($p < 0.01$). As for anxiety, it was found to be a strong predictor of tinnitus severity and differences between the genders could be at least partially based on this, since the largest difference was found in the age group of 30 to 49 years, when women seek to balance professional and family life. Post hoc age analyses demonstrated differences in THI scores between the 50-to-69-year group and the >70-year group ($p = 0.01$); and in the <29 years and 50-to-69-year groups ($p = 0.03$). The 50-to-69-year group differed significantly from the <29 and 30-to-49-year groups in the VAS score ($p < 0.01$). Significant differences were also found in the scores of the depression scale used (HAD-D) between the <29 and 30-to-49-year groups ($p = 0.09$); as well as between <29 and 50-to-69-year groups ($p = 0.02$). The authors point to a directly proportional increase between the values of the scales and the increase of the age range (HAD-D up to 50-69 years = 6.90), however, after 70 years old there was a considerable decrease (HAD-D 70+ = 3.91). The authors report that the elderly may become accustomed to their condition and this would contribute to a lesser impact on the perception of tinnitus.

Xu et al.²⁴, after evaluating 543 participants with tinnitus and the relationship between quality of sleep and psychiatric disorders, including anxiety and depression, found that 12.9% of the participants had symptoms of anxiety, 18.0% presented depression, 8.66% had anxiety and depression, 4.23% showed only anxiety, 9.39% showed only depression. The logistic regression analysis revealed that acute tinnitus (< 3 months), younger age group, hearing loss, sleep impairment and tinnitus severity were the main risk factors for tinnitus with anxiety symptoms ($p < 0.05$). The severity of tinnitus assessed by THI is strongly related to the scores of the anxiety and depression scales, regardless of age ($p < 0.001$). There was no correlation between anxiety symptoms and gender.

Severity of tinnitus and sleep impairment seem to be the major risk factors for tinnitus accompanied by depression symptoms ($p < 0.05$). No significant correlation was found between depression symptoms, gender and age. The study suggested that young people are more likely to develop anxiety symptoms because they tend to be more easily surprised by the sudden onset of tinnitus, leading to anxiety.

However, the authors²⁶ compared the characteristics related to tinnitus and psychological aspects of 140 adults divided into two groups: younger adults (ages between 20 and 45 years) and the elderly (65 years or older). There was no statistical difference between the scores on the depression scale, being that the proportion of low depression was similar in the groups (53% and 55%, respectively). There was also no difference for THI categories. These results indicate that depressive symptoms are associated with tinnitus in adults of all ages.

Another study²⁵ that evaluated the impact of anxiety and depression on 1,328 subjects with different ENT complaints, but analyzing tinnitus separately, divided the sample into four groups according to their age: <30, 30 to 50, 51 to 70 and >70 years. In the general group, the post-hoc analysis showed a difference in the score for the depression scale in the age group of 30 to 50 years as superior to the <30-, 51-to-70- and >70-year groups ($p = 0.029$, $p = 0.001$ and $p = 0.007$, respectively). Likewise, a difference was found for the scores of the anxiety scale for the age group of 30 to 50 years, which was higher than the <30-, 51-to-70- and >70-year groups ($p < 0.005$, $p < 0.005$, $p = 0.001$, respectively). In the specific tinnitus group this relationship was maintained and the scores on the depression scale were statistically significant ($p = 0.002$). In addition, higher scores on the anxiety scale were statistically significant in the tinnitus group ($p = 0.019$). Tinnitus was demonstrated as a significant predictor of depression (OR = 2.71), as well as a predictor of severe depression (OR = 3.67). As for anxiety, tinnitus was not a predictor. Thus, in this study, the age range of 30 to 50 years differed significantly from the others.

As previously mentioned, only two studies evaluated the relationship between the highlighted variables in an elderly population. A prospective cohort study²⁷ evaluating 535 elderly people 65 years of age and older, without baseline depression, sought to clarify whether tinnitus precedes the development of depressive symptoms in an elderly population. During the 2.5-year

follow-up period in the cumulative period, the incidence of depressive symptoms was 20.5% among men with tinnitus, and 9.5% among those without tinnitus. Men with tinnitus had a statistically significant increase in the risk of depressive symptoms (RR = 2.07, 95% CI = 1.01-4.25), which persisted after adjustments. On the other hand, no association between tinnitus and depressive symptoms was observed in women. The authors suggest that persistent (chronic) tinnitus is more common in men because of hearing impairment caused by occupational noise exposure which can lead to depressive symptoms.

Authors²⁸ evaluated 696 elderly aged from 70 to 85 years to verify the association between tinnitus and depression in the elderly. The results demonstrated positive association between depression and tinnitus in those individuals who reported tinnitus at least as a moderate problem. This suggests that those who perceived tinnitus as a moderate problem were more likely to be depressed than those who perceived it as a small problem or as no problem at all (beta coefficient: 1.28, 95% CI: 0.26-2.29, $p < 0.01$).

In conclusion, the studies indicated a probable association between the variables taken into consideration. There has been shown a tendency that, as age increases, so do the scores. Regarding this, two studies found that the adult age group around 50 years old differed from the others; one study found difference for the elderly group; and one study did not find differences between the age groups. This, therefore, makes evident the lack of literature on these issues when related to the elderly population.

It was, thus, evidenced that the relationship between the variables is extremely complex, highly dependent on the ability of each individual to deal with adversities, and affects men and women of all ages. Health professionals should always be attentive to the psychological symptoms of their patients, once it's important to track these disorders. Authors²⁹ suggest the importance of a multiprofessional effort to establish the treatment procedure for patients with tinnitus. Psychological and psychiatric evaluation is recommended in patients who present a Tinnitus Handicap Inventory (THI) score above 36 in order to improve their quality of life.

Such increase in changes as the person ages, as it has been observed in the studies, especially as those that approached only the elderly population are compared to those that approached both the elderly and the adult population, supports the need for new studies. This is mainly due to the fact that this

population constitutes a risk group for both tinnitus and the psychological changes that may arise as a result of it.

CONCLUSION

This study has made possible to notice a lack of studies when taking into account the association of tinnitus with anxiety and depression in the elderly. It has also allowed carrying out a comparison that showed the increase of these changes as age increases. A probable association of tinnitus with anxiety and depression in adults and the elderly, for both genders, has been found, as well as the contribution of aging to the severity of tinnitus and related psychological symptoms, affecting the quality of life of these people.

Further studies are necessary to confirm the actual association between tinnitus, anxiety and depression in the elderly, with the purpose of assisting future interventions, which would both promote mental health and prevent these aspects related to tinnitus. Consideration should also be given to the development of public policies focused on anxiety and depression as risk factors for tinnitus as well as for other symptoms that affect the quality of life of the elderly.

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