SYSTEMATIC REVIEW

RELATIONSHIP BETWEEN HYPERACUSIS, TINNITUS AND EMOTIONAL DISORDERS: A SYSTEMATIC REVIEW.

RELACIÓN ENTRE HIPERACUSIA, TINNITUS Y LOS TRASTORNOS EMOCIONALES: UNA REVISIÓN SISTEMÁTICA.

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Received: February 15, 2024. **Accepted:** March 15, 2024

Abstract:

Objective: to determine the relationship between hyperacusis, tinnitus, and emotional disorders, given that, although auditory discomfort due to excessive sensitivity to noise or sound stimuli and tinnitus are common, they diminish the quality of life of human beings in their different facets of life. **Materials and methods:** Considering the stated objective, a qualitative descriptive research approach was conducted through a systematic review guided by the PRISMA methodological guide, with the PICO tool, adapted to the PIO tool. **Results:** fifty articles were taken, of which eighteen were part of experimental studies in humans, mostly from 1994, 1995, 2002, and 2003, in European countries, due to the scarce research on the subject in Latin America. **Analysis:** Hyperacusis and tinnitus do have an existing relationship, because of their connection with shared neuronal structures and because of the neurotransmitters in common for the regulation of emotions and hyperacusis and tinnitus. **Conclusions:** According to the literature review, the existing relationship between hyperacusis, tinnitus, and disorders is evidenced.

Key words: Tinnitus, hyperacusis, depression, stress, and anxiety.

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How to cite this article: Jaimes-Socha Vanessa, Merchán-Mantilla Karen. Relación entre hiperacusia, tinnitus y los trastornos emocionales: una revisión sistemática. Revista Ciencias Básicas En Salud, 2(1): 96-113. marzo 2024, ISSN 2981-5800.

RESUMEN

Objetivo: determinar la relación entre hiperacusia, tinnitus y los trastornos emocionales, dado que, aunque las molestias auditivas por excesiva sensibilidad al ruido o estímulos sonoros y el tinnitus son comunes, disminuyen la calidad de vida del ser humano en sus diferentes facetas de vida. **Materiales y métodos:** Teniendo en cuenta el objetivo planteado, se realiza un planteamiento de la investigación descriptivo cualitativo, a través de una revisión sistemática orientada por la guía metodológica PRISMA, con la herramienta PICO, adaptada a la herramienta PIO. **Resultados:** Se tomaron 50 artículos de los cuales 18 hacían parte de estudios experimentales en humanos, en su mayoría de la fecha de 1994, 1995, 2002, 2003, en países europeos, debido a la escasa investigación acerca del tema en Latinoamérica. **Discusión:** La hiperacusia, el tinnitus si tienen una relación existente, por su conexión con estructuras neuronales compartidas y por los neurotransmisores en común para la regulación de las emociones y la hiperacusia y tinnitus, de acuerdo con la revisión de la literatura, se evidencia la relación existente entre la hiperacusia, tinnitus y los trastornos emocionales.

Palabras clave: Tinnitus, hiperacusia, depresión, estrés y ansiedad.

INTRODUCTION:

The ear is responsible for enabling everyday activities and human interaction in society, as it handles functions like balance and hearing. With normal hearing, it is possible to perceive environmental sounds accurately and interact in society more easily, as hearing plays a crucial role in language development. Hyperacusis does not mean hearing more than others; rather, it is defined as a hearing disorder where there is a reduced tolerance threshold for environmental sounds. This means the auditory threshold is at an unusual parameter(3), making everyday sounds extremely bothersome or even unbearable for someone with hyperacusis. Over time, since *Perlam in 1938*, various authors have defined the concept of "Hyperacusis" (6); in 2015, *The American Speech-Language-Hearing Association* described hyperacusis as an uncommon hearing disorder that can occur even in people with normal hearing, making some sounds seem unbearable or extremely loud, even when these sounds are comfortable for most people (7). *The British Association* stated: "It applies to

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people who experience everyday sounds as intrusively loud, uncomfortable, and sometimes painful." Similarly, the *American Academy of Audiology* (2019) refers to it as "the intolerance to certain everyday sounds that causes significant distress and impairment in social, occupational, recreational, and other daily activities." The causes of hyperacusis are not concretely established; however, a possible relationship to central structures such as the hippocampus, the limbic system, and the amygdala has been suggested. This can lead to post-traumatic stress disorder, traumatic brain injuries, fibromyalgia, migraines, depression, multiple sclerosis, benign intracranial hypertension, and some common conditions like autism spectrum disorder (23.9%) and Williams syndrome, with 95% of those with these syndromes showing hyperacusis. Neurovascular compression syndromes and facial paralysis can also increase the risk of hyperacusis.

The most reported symptoms include tinnitus, perceiving normal sounds as excessively loud, children's voices, the sound of household items, car horns, and other transportation noises. People with hyperacusis often feel trapped by noise, leading them to progressively abandon activities involving excessive sound. It is important to differentiate hyperacusis from recruitment. In hyperacusis, hearing loss may or may not be present, being more common in mild hearing loss; any sound can be bothersome to those with hearing loss, whereas in recruitment, there is a combination of hearing loss and increased sound perception time, with sounds being bothersome only at high volume levels (15,16).

Tinnitus is not considered a pathology; it is actually known as a symptom, though it is a common reason for medical consultation (2). To understand it, it is necessary to clarify that tinnitus is typically not caused by an external sound source. Various studies suggest that tinnitus involves a series of structural and functional changes in the brain (4). Tinnitus can be classified as pulsatile or non-pulsatile, cardio-synchronous or not, and can vary between tonal and non-tonal. Subjective tinnitus occurs in the absence of an identifiable sound source and is considered a phantom auditory perception because it is not recordable or

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controllable, Londero A (5). Common sounds reported include whistling, crickets, locomotives, crackling, and ringing. However, more complex sounds such as voices or music are also described in consultations. The prevalence of tinnitus is higher in men (26%) than in women (24%). Its pathophysiology is associated with an aberrant response to the contractile activity of outer hair cells, often linked to the use of ototoxic medications, which can cause anatomical and functional changes in these cells. Despite this, the etiology of tinnitus is variable and can be congenital, infectious, traumatic, tumoral, muscular, or psychiatric, including stress, anxiety, and emotional traumas.

When relating hyperacusis to "emotional disorders," high rates of stress, depression, and other emotional regulation issues are identified today. These conditions may seem irrelevant but actually threaten the physical integrity of human beings (10). It is crucial to understand the brain structures involved in emotional regulation, such as the brainstem, limbic system, and neocortex, which are interconnected with the auditory system and share neurotransmitters that play important roles not only in psychological performance but also in the development of auditory structures. Jastreboff, in his description of the neurophysiological model of tinnitus, explains that there is a relationship between the limbic and autonomic systems, indicating that these systems are activated when tinnitus is caused by negative reinforcement, strong emotions, and traumatic experiences.(13).

Therefore, the research question arises: *What is the relationship between hyperacusis, tinnitus, and emotional disorders in young adults, adults, and older adults?* The objective of this research is to identify the relationship between tinnitus and hyperacusis and emotional disorders. This will be developed through a systematic review to determine the neurophysiological and psychological components involved in the onset of tinnitus and hyperacusis and their relationship with emotional disorders, detailing the study variables as well as the most frequent signs and symptoms of these conditions.

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MATERIALS AND METHODS

This research is characterized as a descriptive qualitative study based on a systematization of data or literature related to the study of the variables *hyperacusis, tinnitus, and emotional disorders*. The collected information is linked to theoretical bases, as well as to the collection of literature in designs or represented in articles, narratives, and interviews. This extensive compilation of information facilitates the collection of important data to conduct the study among the study variables, aiming to carry out an exhaustive analysis that allows answering the research proposal outlined throughout the document.

The descriptive qualitative study allows a focus on the rigorous understanding and description of phenomena explored from the participants' perspective and in relation to the context. It seeks to study how individuals experience the situations around them, answering questions such as: what? how? where? of the events to be investigated.(1) The methodology to be implemented includes a systematic review, following the PRISMA guidelines (11,12). This guide enables authors to achieve this objective more easily. It is designed to address issues in the publication of systematic reviews. It has been primarily designed for systematic reviews of studies that assess the effects of health interventions, but it is also applicable to research in the health field (17).

In the documents found in the literature review, the PRISMA statement is highlighted, stipulating that it consists of 27 items, aiming for an orderly selection of articles for the corresponding systematic review, through 4 phases, considering a number of records identified, included, and excluded (18). (See table N°1)

The PICO research tool allows for the formulation of concrete research questions for different events in the clinical field. The goal of this tool is to identify a specific population, with a determined intervention. (See Table N°2) However, this systematic review omits the comparison point of the PICO methodology, thus reducing it to PIO. This tool is proposed as a strategy that identifies three important components: problem or patient (P), intervention to be analyzed (I), and outcomes (O) (9). *(See table N°2)*

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Currently, there is a wide range of tools that allow for the collection of diverse information, generating hypotheses throughout the research, which encourages critical thinking and relationships in this work. On the other hand, the reading conducted has been guided by the construction of this systematic review, aiming to clearly understand the information collection process (19).

The research process has relied on searching for information in primary databases such as Google Scholar, Science Direct, Scielo, Taylor & Francis, and Revista Areté Fonoaudiología, using literature in Spanish and other languages such as English and Russian. Key terms considered include Tinnitus, Hyperacusis, Depression, Stress, and Anxiety.

Table N° 2: PICO

P		I	C	O
Patient, Population or Problem.		Intervention.	Comparison.	Result.
Young adult, Adult, Elderly adult.		Hyperacusis and tinnitus.	Not applicable.	Relationship between hyperacusis, tinnitus, and emotional disorders.

Source: Merchán K.

Table N° 3: PIO

P: Patient, population of reference or problem of interest.	Establish the characteristics of a population or patient that may limit the collection of literature data.
I: Intervention to be analyzed.	It refers to the intervention from speech therapy that is to be investigated, whether it is preventive, diagnostic, or therapeutic.
O: Results	More specific deductions or conclusions from the investigation of the intervention.

Source: Merchán K.

Thanks to converting the PICO tool to PIO, inclusion and exclusion criteria are established, including documents extracted from theoretical bases, scientific articles from indexed journals, and systematic reviews. The bibliographic search spanned 31 years due to limited current information on the research question. The study included adults, young adults, and the elderly, excluding children, with studies reporting visible variables like hyperacusis, tinnitus, and their relation to emotional disorders. Excluded were articles on hypoacusis and other emotional disorders not previously mentioned.

Supporting the systematic review process, health science descriptors DeCS and MeSH were considered. These are crucial for indexing scientific articles and other clinical documents. MeSH, or Medical Subject Headings, provides terminology in multiple languages, ensuring a consistent and comprehensive means of information gathering. DeCS/MeSH forms part of the LILACS methodology and integrates with the BVS, comprising approximately 34,126 descriptors and 77 qualifiers: 30,194 from MeSH and 3,932 exclusively from DeCS. These descriptors include Science and Health, Homeopathy, Traditional Medicines, Complementary and Integrative Medicines, Health Surveillance, and Public Health. DeCS/MeSH used in this review are specified in (See Table No. 3)

Table N°3: Descriptors DeCs/MeSH.

DeCs	MeSH
Hyperacusis	hyperacusis.
Tinnitus.	tinnitus.
Depression	depression.
Anxiety	anxiety.
Stress	stress.

Source: Merchán K.

RESULTS

For presenting the results of the 50 articles supporting this review, relevant information such as author, country, years, study type, subjects, and characteristics was considered **(see Table No. 4)**. This information is detailed in the flow diagram for article selection, based on elements from the PRISMA systematic reviews and meta-analysis guidelines.

The analyzed articles were compiled from primary databases such as ScienceDirect, Scielo, PubMed, Taylor & Francis, and secondary sources including journals, documents, and search engines like Google Scholar. However, the descriptors used for efficient searching did not yield relevant results. The publication years included articles dating back to 1995, featuring experimental research on the relationship between hyperacusis, tinnitus, and emotional disorders. Recent literature on this topic is sparse, with older studies informing current research. Studies addressing the posed question primarily originate from various countries, highlighting low scientific productivity in Latin America compared to others.

Of the total information gathered, 18 articles were experimental studies in humans aged 18 to 79 years, typically referred from clinics due to hyperacusis and tinnitus. These studies also utilized

web applications for survey questionnaires as an initial filter to identify populations with these study variables. Additionally, 32 articles consisted of systematic reviews, narrative reviews, and theoretical bases focusing on describing the neurophysiological behavior and characteristics of tinnitus and hyperacusis.

Based on the findings from the analyzed research, a relationship between hyperacusis, tinnitus, and emotional disorders can be established. This relationship is attributed to the close association between brain structures involved in tinnitus and emotion regulation. Hyperacusis, on the other hand, correlates with emotions such as depression, stress, and anxiety, possibly due to their connection with neurotransmitters like serotonin (21).

(See results in diagram N°2)

Diagram N° 1. Phases PRISMA

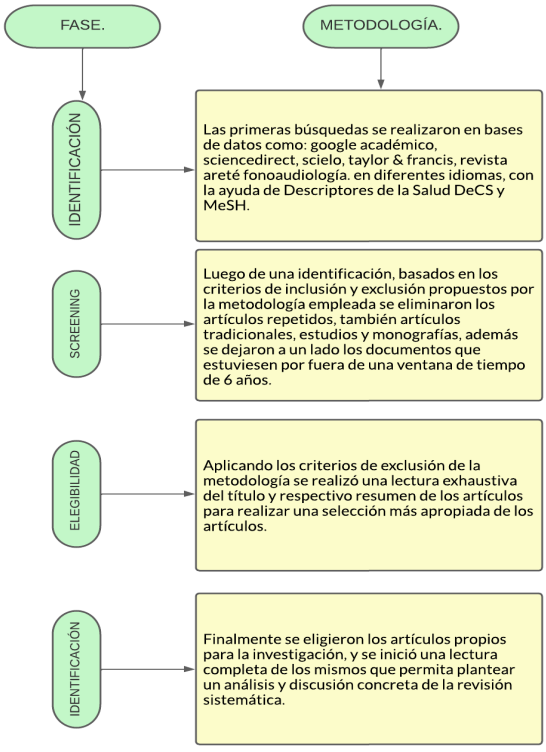
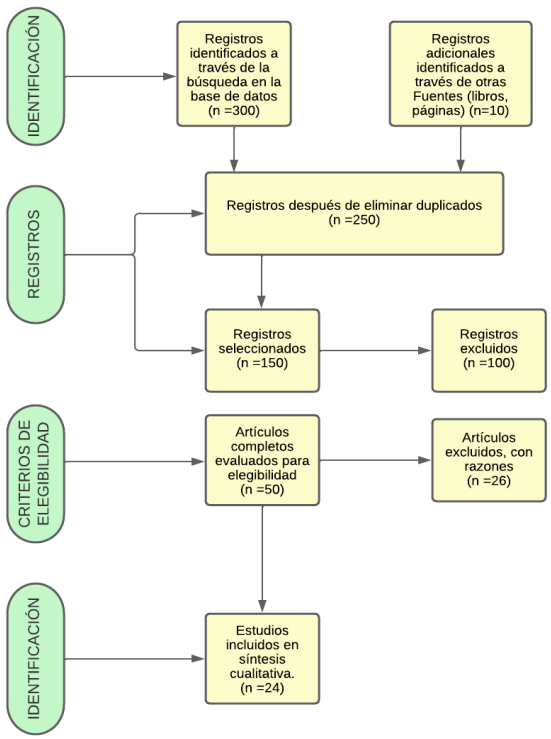


Diagram N°2 Results.



Source: Merchán K.

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DISCUSIONES

Hearing can be defined as the action of listening or hearing, enabling human beings to develop as social beings through their communicative abilities. Hearing is made possible by various psychophysiological processes, meaning that hearing is also a task of our brain. (22). However, there are different disorders that can affect our hearing, such as hyperacusis and tinnitus. Hyperacusis, defined as a reduced tolerance threshold to sounds, involves an inappropriate response to sounds that are not bothersome to others. The term "hyperacusis" is attributed to the work of Henry B. Perlman (1938), and it should not be confused with "phonophobia" or "misophonia" (23). Hyperacusis negatively impacts human life by limiting social abilities due to discomfort from noise, as well as persistent irritability and avoidance of certain activities. It involves abnormal activation of neurons in the auditory pathway and is often associated with physical causes such as acoustic trauma, exposure to loud sounds, head injury, sudden deafness, Williams syndrome, chronic ear infections, among others. Its most characteristic symptoms include ringing in the ears, pain, and a feeling of fullness in the ear.

Tinnitus or ringing in the ears is defined as the perception of sound in the ears or head without an external source. It is considered an abnormal bio-electrical, biomechanical, or biochemical activity in the central nervous system or inner ear (Herráiz and Hernández, 2001). Some individuals with sound sensitivity may perceive mild tinnitus that the brain ignores, while others with tinnitus may develop sound hypersensitivity due to the recurring perception of sound without an external source. According to Gerllcird Andersson in Sweden, based on internet surveys of 595 participants, between 40% and 59% of clinical tinnitus cases reported symptoms of hyperacusis, indicating that the prevalence of sound hypersensitivity in tinnitus patients could increase up to 86% (25).

Discussing the relationship between hyperacusis and tinnitus, it is important to clarify their connection with emotional disorders. *Langguth* and *Landgrebe* note that tinnitus is strongly associated with emotional stress, anxiety, and depression. Just as external noise can trigger tinnitus, mood disorders can act

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as stressors that exacerbate tinnitus symptoms (27). The brain regions involved are intricately interconnected, particularly the auditory and limbic systems, suggesting that tinnitus can affect emotions and cognitive functions. Individuals with tinnitus show activation of the medial dorsal thalamus, projecting neurons to the lateral amygdala, a structure heavily implicated in emotion regulation. This activation of extralemniscal pathways may explain the stress-related signs and symptoms in tinnitus patients (28).

Symptoms associated with tinnitus and its neural networks, as described by *Jonathan Wimmer, Rodrigo Donoso, Alexis Leiva, Hayo Breinbauer, and Paul Délano*, are linked to partial deafferentation of the inner ear, leading to changes in various nuclei within the brainstem and primary auditory cortex, as well as auditory association cortices. (29). These interactions occur bidirectionally at the brainstem level, where the auditory system interacts with the somatosensory system, and auditory cortices influence brain networks related to alertness, executive functions, emotions, and memory, Moreover, the literature review justifies this relationship through biochemical origins, implicating serotonin in conditions such as hyperacusis, migraine, and depression (30). Studies by *C. Herráiz, G. Plaza, and JM Aparicio* highlight the role of endorphins, which activate the excitatory function of glutamate, an auditory neurotransmitter. However, glutamate also plays roles in emotional, motor, sensory, and cognitive systems. Excessive glutamate excitation can lead to overactivation of limbic and autonomic nervous systems, triggering emotional reactions such as anxiety, fear, and depression in hyperacusia (31). In a study conducted by *Martin Benka Wallen, Dan Hasson, and Torres Theorell* involving 348 participants, questionnaires and audiologic tests revealed a correlation between emotional exhaustion reported by participants and tinnitus and hyperacusis detected in the audiologic exams. Psychological characteristics play a significant role, as individuals may develop tinnitus or hyperacusis due to the social and personal consequences, such as irritability, which can lead to emotional disorders like stress, anxiety,

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fear, or depression. Andersson and McKenna, acknowledging limited scientific evidence, proposed a diathesis-stress model, suggesting that vulnerable individuals might develop tinnitus at lower levels, whereas those more resilient to stress might experience higher tinnitus levels before seeking medical help. However, they noted that individuals seeking medical attention for tinnitus were more likely to have psychological issues than those who did not have tinnitus.

From this review, an experimental investigation by *Lewis, Stephens, and McKenna in 1994* reported that 24 tinnitus patients had committed suicide based on medical records from various clinics in the study. Initially studying 17 cases, they eventually analyzed a total of 28 cases, including 15 from the UK, 4 from the rest of Europe, 4 from North America, 4 from Australia, and 1 from Japan. The study used questionnaires to assess the emotional state and psychological circumstances of the deceased. Among the studied cases, two had schizophrenia, five had depression, two had anxiety disorders, and one had hysterical attacks. At the time of death, 18 were experiencing depressive episodes, with ten already diagnosed by psychiatrists and others by their general practitioners. Seven individuals were anxious, distressed, or desperate at the time of death, while only one person in the study showed no emotional disturbances or disorders. Family members noted that some individuals had auditory symptoms before developing psychological disorders, while others developed them after diagnosis. (32).

CONCLUSIONS

According to the literature review, there is clear evidence of the relationship between hyperacusis, tinnitus, and emotional disorders due to anatomical neural connections and the role of neurotransmitters that activate and inhibit activities such as hearing and emotions.

There is a high prevalence of depression symptoms in patients with tinnitus. Studies conducted by Luciana Geocze, Samantha Mucci, Denise Caluca, Mario

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Alfredo de Marco, and Norma de Oliveira in 2013 suggest possible associations between depression and tinnitus: depression affecting tinnitus, and tinnitus affecting or predisposing individuals to depression.

It is important to revisit experimental and descriptive research on these auditory disorders and their relationship with other diseases or disorders such as emotional disorders, as many explanations exist from studies conducted many years ago.

Having validated instruments for the Latin American context to investigate study variables within clinical settings is crucial, especially since recent studies primarily originate from European countries.

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How to cite this article: Jaimes-Socha Vanessa, Merchán-Mantilla Karen. Relación entre hiperacusia, tinnitus y los trastornos emocionales: una revisión sistemática. Revista Ciencias Básicas En Salud, 2(1): 96-113. marzo 2024, ISSN 2981-5800.

Autor/Año	País	Tipo de estudio	Sujetos	Especie/características
1. Patricia Oyarzún Et Al. (2021).	Talca, Chile.	Descriptive.	Not applicable.	Not applicable.
2. Jonathan Wimmer del S. Et Al.(2018)	Santiago de Chile.	Descriptive.	Not applicable.	Not applicable.
3. Silvia Sogamoso Et Al.(2014)	Bogotá, Colombia.	Cross-sectional study.	Humans.	77 individuals, 50.6% were women and 49.4% were men, aged between 31 to 79 years, taken from the Tinnitus Clinic program at Hospital de San José.
4. Saida Melisa Carmona Cortés. (2019)	Colombia.	Descriptive.	Not applicable.	Not applicable.
5. Isabela Jaramillo-Rivera, Et Al. (2022)	Colombia.	Descriptive.	Not applicable.	Not applicable.
6. Susana Domínguez; Et Al.(2009)	Argentina.	Descriptive.	Humans.	Patients undergoing a study protocol, consisting of demographic data, otolaryngological and general medical history, personal background assessment, and comprehensive physical examination of the ENT area.
7. Carlos Calvo,Et Al.(2017)	Colombia.	Descriptive.	Not applicable.	Not applicable.
8. Dr. Carlos Curet, Dr. Darío Roitman. (2016)	Argentina.	Descriptive.	Not applicable.	Not applicable.
9. C. Herráiz, G. Plaza, JM Aparicio. (2013)	Madrid.	Descriptive.	Not applicable.	Not applicable.
10. Gerhard Andersson, et al. (2009)	Suecia.	Experimental.	Humans.	A postal survey was conducted with a random sample (59.7%) and online (51.9%). The data collection method did not lead to substantial differences.
11. Maria Jimena Merchan Velasquez, Et Al.(2019)	Bogotá.	Descriptive.	Not applicable.	Not applicable.
12. Daila Urnau, Tania Maria Tochetto. (2011)	Brasil.	Experimental.	Humans.	In this cross-sectional study, 25 individuals with normal hearing were studied.
13. Darío Roitman. (2018)	Buenos Aires, Argentina,	Experimental.	Humans.	The private tinnitus center has a website where patients are surveyed and polled, with 66% being male and 44% female, receiving questions from ages 9 to 88.
14. Juan Ramirez, José Prieto. (2023)	Bogotá, Colombia.	Descriptive.	Not applicable.	Not applicable.
15. Jing Ren, Tao Xu, Tao Xiang, Jun-mei. 2021	Luzhou, China.	Experimental.	Humans.	A total of 34,796 subjects were studied, including the general population (28,425 subjects), a special population (2,746 subjects), and patients with concomitant diseases (5,093 subjects).

16. Natashya H Rent, Kiran Bhojwani. 2013	India.	Experimental.	Humans.	Seventy-eight people participated in the study, including 39 men and 39 women, ranging in age from 18 to 82 years.
17. Maira Santos Goncalves, Tania Maria Tochetto. 2005	Brasil.	Descriptive.	Not applicable.	Not applicable.
18. Dr. Alejandro Peña.	Talca, Chile.	Descriptive.	Not applicable.	Not applicable.
19. Silvia Sogamoso García, Juan Carlos Izquierdo. (2014)	Bogotá, Colombia.	Cross-sectional study.	Humans.	Seventy-seven individuals participated, with 50.6% being women and 49.4% being men, ranging in age from 31 to 79 years, selected from the Tinnitus Clinic program at San José Hospital.
20. David Baguley, Don McFerran, Deborah Hall. (2018)	Reino Unido.	Descriptive.	Not applicable.	Not applicable.
21. C. Herráiz, G. Plaza, JM Aparicio. (2013)	Madrid.	Descriptive.	Not applicable.	Not applicable.
22. J.E. LEWIS, S.D.G. STEPHENS, L. M cKENNA. (1994)	Londres, Reino Unido.	Experimental.	Humans.	Reports were received from 17 doctors, providing information on 24 tinnitus patients who had committed suicide. Combining these with other patients, a total of 28 cases were included in the series: 15 from the United Kingdom, 4 from the rest of Europe, 4 from North America, 4 from Australia, and 1 from Japan.
23. Jaramillo Rivera, Isabela Vásquez, Stefany Palacio. (2023)	Medellín.	Descriptive.	Not applicable.	Not applicable.
24. Dr. Cesar Augusto Burneo.	Ecuador.	Descriptive.	Not applicable.	Not applicable.
25. David Baguley, Don McFerran. 2013.	Reino Unido.	Descriptive.	Not applicable.	Not applicable.
26. Brian Morales, Et Al. (2020)	Chile.	Experimental.	Humans.	Patients over 18 years old diagnosed with tinnitus between 2015 and 2017 were included in the study.
27. Lopez Ibor. (2007).	Madrid.	Descriptive.	Not applicable.	Not applicable.
28. Jesús Sanz. (1994)	Madrid.	Descriptive.	Not applicable.	Not applicable.
29. A.G. Karayani, J.M. Karayani. (2014)	UDC.	Descriptive.	Not applicable.	Not applicable.
30. Karamzina Lyudmila Antonovna. (2008)	Namsu, Ucrania.	Experimental.	Humans.	The study group consisted of 80 patients of both sexes, all of working age, with varying levels of hearing.
31. C. Herráiz, G. Plaza, J. M. Aparicio. (2006)	Madrid	Descriptive.	Not applicable.	Not applicable.

32. Gerllcird Andersson, et al. (2002).	Uppsala, Suecia	Experimental.	Humans	Two data collection methods were used: the first was a postal survey to a random sample, which received responses from 589 people; the second was conducted online, with 595 self-selected individuals responding to a participant call via an advertisement on a website.
33. Carlos Herraiz, José Aparicio. (2007)	Madrid, España.	Descriptive.	Not applicable.	Not applicable.
34. Hashir Aazh, Brian C. (2017)	Reino Unido.	Experimental.	Humans.	To patients who attended the specialized clinic for tinnitus and hyperacusis therapy between March 15, 2015, and March 15, 2016.
35. Martin Benka Wallen, Dan Hasson, Torres Theorell. (2012)	Estocolmo, Suecia.	Experimental.	Humans.	The participants were recruited from SLOSH, selected based on the level of emotional exhaustion.
36. Linda Juris, et al. (2013).	Estocolmo, Suecia.	Experimental	Humans.	Patients referred to the clinic, characterized by hyperacusis, aged between 18 and 65 years old.
37. David M, Baguley MSc MBA. (2003)	Reino Unido.	Descriptive.	Not applicable.	Not applicable.
38. Carlos Herráiz e Isabel Diges. (2011)	Madrid, España.	Descriptive.	Not applicable.	Not applicable.
39. Josephine Matrimonio, Et Al.(1995)	Reino Unido.	Descriptive.	Not applicable.	Not applicable.
40. Silvia Sogamoso García, Juan Carlos Izquierdo. (2014)	Colombia.	Experimental.	Humans.	A convenience non-random sampling was conducted, consisting of 77 individuals.
41. Alan H. Et Al. (2002)	Australia.	Experimental.	Humans.	An observer correlated the rhythm of pulsations, which can be heard during auscultation, with the cardiac cycle. Various causes of pulsatile tinnitus were considered, and interviews such as medical history, physical examination, and neuroradiological assessment were also conducted.
42. Robert A. Levine, Yahav Oron. (2015)	Israel.	Descriptive.	Not applicable.	Not applicable.
43. Yosuke Ariizumi, Akio Hatanaka. (2009)	Toky, Japon.	Experimental	Humans.	The subjects were 270 patients (151 males and 119 females; median age 62 years) with intractable tinnitus who visited this institute between 2004 and December 2008.
44. David Ibarra, Francisco Tavira, Manuel Recuero.	Madrid,	Descriptive.	Not applicable.	Not applicable.
45. Jeffrey J, Nelson, MD.	Toledo, España.	Descriptive.	Not applicable.	Not applicable.

Kejian Chen, MD, PhD. (2004)				
46. Fan-Gang Zeng. (2012)	California.	Descriptive.	Not applicable.	Not applicable.
47. Maria Sol Leira Permuy. (2011)	Montevideo.	Descriptive.	Not applicable.	Not applicable.
48. J.E. LEWIS, Et Al.(1994)	Londres, Reino Unido.	Experimental.	Humans.	Reports were received from 17 doctors, providing information on 24 tinnitus patients who had committed suicide. Combining these with other patients, a total of 28 cases were included in the series: 15 from the United Kingdom, 4 from the rest of Europe, 4 from North America, 4 from Australia, and 1 from Japan.
49. Gerhard Andersson, Liria Ortiz.	Suecia	Descriptive.	Not applicable.	Not applicable.
50. Luciana Geocze, Sanmantha Mucci, Denise Caluca, Mario Alfredo de Marco, Norma de Oliveira. (2013).	Brasil.	Descriptive.	Not applicable.	Not applicable.

Fuente: Karen M.

Tabla N°5: Hallazgos sobre la relación entre hiperacusia, tinnitus y los trastornos emocionales.

Author.	**Findings.**
C. Herráiz, Et Al.	The role of serotonin, also implicated in other conditions related to hyperacusis (such as migraine and depression), may be crucial in this disorder. Other theories confirm the effect of endorphins, which activate the excitatory function of glutamate, the auditory neurotransmitter, thereby increasing its toxicity. Activation of the limbic and autonomic nervous systems leads to the emotional reaction seen in hyperacusis (anxiety, fear, and depression).
Carmona Cortés.	Tinnitus is strongly associated with emotional stress, anxiety, and depression (Langguth, 2011; Langguth & Landgrebe, 2011). Like external noise, internally generated tinnitus can cause emotional distress that results in mood disorders such as depression.
Silvia Sogamoso García, Et Al.	In a sample of 77 patients, 80.5% exhibited a higher frequency of anxiety and depression disorders, classified as severity grade 4. In severity grade 1, there were fewer patients with anxiety and depression. However, in the study, no patient with severity grade 5 had a normal HADS score.
Susana Domínguez, Et Al.	The limbic system and the nervous system are stimulated secondarily, thus justifying the psychoemotional reaction of hyperacusis (anxiety, fear, depression). In contrast, phonophobia shows normal neural auditory activity in the auditory pathway, with an abnormally intense reaction from the limbic and autonomic systems.
María Jimena Merchán	Studies have focused on the association between hyperacusis and tinnitus, with hyperacusis being present in a significant proportion of patients with tinnitus. It is

Velásquez, Et Al.	sometimes associated with other sensory sensitivities. Characteristics generally manifest as increased sound perception or responsiveness to sound, resulting in decreased tolerance. These responses can be modulated by emotional states and may be perceived as uncomfortably loud, unpleasant, frightening, or painful.
Jonathan Wimmer, Et Al.	Symptoms associated with tinnitus and associated neural networks. Partial deafferentation of the inner ear leads to changes in various nuclei at the brainstem level and in the primary auditory cortex and auditory association cortices. These interactions occur bidirectionally at the brainstem level, where the auditory system interacts with the somatosensory system, and the auditory cortices influence brain networks related to alertness, executive functions, emotions, and memory.
DR. Carlos Curet, Et Al.	The biochemical origin of tinnitus generation in response to stress is related to the excitatory effects of neurotransmitters like "dynorphin A" and "glutamate." Dynorphin A, an endogenous opioid belonging to the endorphin family, is naturally produced in the Central Nervous System. Unlike other endogenous opioids, dynorphin A does not alleviate pain but rather has an excitatory effect that can exacerbate chronic neuropathic pain. This effect is thought to involve its interaction with kappa opioid receptors and NMDA receptors.
Martin Benka Wallen Et Al.	The selection included 720 individuals, with 49 excluded for participating in a simultaneous study or not living in Stockholm. The final number of participants was 348, aged between 23 and 71 years. In the initial phase, an internet questionnaire was administered 1 to 3 days before their clinic visit for corresponding audiological evaluations. This phase aimed to establish the relationship between emotional exhaustion, tinnitus, and hyperacusis.
Linda Juris, Gerhard Et Al.	After audiologic, clinical, and psychiatric tests, it was found that the rate of anxiety disorders was significantly higher (more than half) among these patients. Eight patients among those studied were taking antidepressants.
David M, Baguley	Sahley and Nodar suggested that hyperacusis and tinnitus appear to intensify during periods of fatigue, anxiety, or stress. Their hypothesis is that during stress, endogenous dynorphins are released in the synaptic region beneath the inner hair cells. This release could potentiate the neurotransmitter glutamate, causing sounds to be perceived at excessive volumes.
Carlos Herráiz e Isabel Diges.	Hyperacusis is an abnormally low tolerance to sounds and may be associated with a defective gain control in the auditory pathways, leading to abnormal activation of emotional responses in the limbic and autonomic systems.
Josephine Matrimonio, Et Al.	Stephens (1970) reported on the correlation between sound intensity tolerance and anxiety. This article links serotonin deficiency with hyperacusis, suggesting that this neurotransmitter regulates sensory reception.
Jonathan Wimmer del S. Et Al.	Literature review: Based on an analysis of the literature review concerning brain network behavior, the authors concluded that patients with chronic non-pulsatile tinnitus often exhibit high neuropsychiatric comorbidity, including symptoms of anxiety and depression.
J.e. Lewis, s.d.g. Stephens, l. m Ckenna. (1994)	Seventeen doctors provided reports on 24 tinnitus patients who had committed suicide. Combined with other cases, a total of 28 cases were included in the series: 15 from the UK, 4 from the rest of Europe, 4 from North America, 4 from Australia, and 1 from Japan. Before the onset of tinnitus, two individuals had schizophrenia, five had depression, two had anxiety disorders, and one had hysterical attacks. At the time of death, 18 individuals were experiencing depressive episodes, with 10 diagnosed by psychiatrists and the remainder by their primary care physician or family. Seven individuals reported feeling anxious, distressed, or hopeless at the time of death, and only one person who did not report mental illness in the forms appeared without any emotional distress. This underscores a common link between emotional disorders and the tinnitus experienced by these patients.
Gerhard Andersson, Liria	Psychological characteristics influence how a person may react upon acquiring tinnitus (Stouffer and Tyler, 1992). Based on limited scientific evidence, Andersson and

Ortiz. (2002)	McKenna (1998) proposed a diathesis/stress model, suggesting that emotionally vulnerable individuals might develop tinnitus problems at lower levels, whereas those with higher stress tolerance might experience higher levels of tinnitus before seeking medical help. However, individuals seeking medical attention for tinnitus showed greater psychological problems compared to those without tinnitus.

Source: Karen M.