

Original Article

# Current Status and Trends in Research Relating to the Diagnosis and Treatment of Meniere's Disease: A Bibliometric Analysis

Yuhan Wu<sup>1,\*</sup>, Xiyu Quan<sup>1,\*</sup>, Yuanjia Hu<sup>2</sup>, Jia Song<sup>1</sup>, Chenghua Tian<sup>1</sup>

<sup>1</sup>Zhejiang Chinese Medical University School of Medical Technology and Information Engineering, Hangzhou, China

<sup>2</sup>Department of Voice Medicine, Zhongshan Hospital of Xiamen University, School of Medicine, Xiamen University School of Medicine, Xiamen, China

ORCID IDs of the authors: Y.W. 0009-0005-2181-9861, X.Q. 0009-0007-4521-3383, Y.H. 0009-0005-2276-1200, J.S. 0009-0009-9552-1688, C.T. 0009-0000-9980-9448.

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**BACKGROUND:** Meniere's disease (MD) is a challenging vestibular disorder causing vertigo and hearing loss, significantly impacting patients' quality of life.

**METHODS:** A bibliometric analysis of MD-related literature (up to September 2023) from Web of Science and PubMed was conducted, using R and VOSviewer to assess publication trends, key authors, institutions, and research topics.

**RESULTS:** The literature review through September 2023 identified 1337 publications showing steady growth (5.33% annually). These works involved 3130 authors across 198 journals, with 26% appearing in 3 leading journals: *Laryngoscope*, *Acta Oto-Laryngologica*, and *Otology & Neurotology*—the latter showing particularly rapid growth. The U.S. produced the most publications and collaborations, followed by the U.K. and Japan. Research primarily focused on diagnostic methods, treatments, and influencing factors.

**CONCLUSION:** Meniere's disease research is expanding, but etiology remains unclear. Emerging diagnostic tools like vestibular-evoked myogenic potentials, cochlear electrograms, and magnetic resonance imaging may improve MD differentiation. Treatment optimization remains crucial, with traditional Chinese medicine (TCM) emerging as a key research focus—though it requires larger clinical trials and standardized protocols. Genetic advances have linked MD risk to MITF and SOX10 genes, with further genetic discoveries representing a promising future direction.

**KEYWORDS:** Bibliometrics, diagnosis, hotspots, Meniere's disease, treatment, trends

## INTRODUCTION

Meniere's disease (MD) is a clinical syndrome characterized by episodes of vertigo, tinnitus, and hearing loss.<sup>1</sup> Over recent years, there has been a growing trend toward a younger age of onset for MD, and this disease has also been found to occur in children.<sup>2</sup> Furthermore, there is a gradual increase in the number of elderly patients with MD due to social and work-related stress and a widening of the age range for the onset of MD.<sup>3</sup> Meniere's disease typically manifests in 1 ear. However, as this condition progresses, approximately 41.5% of patients experience bilateral involvement, and the degree of hearing loss tends to worsen as the frequency of episodes increases. The duration of vertigo increases with the number of recurrences, especially when the interval is reduced. Meniere's disease creates a heavy psychological burden for patients, which can aggravate the condition, thus forming a vicious circle in addition to potential neuro-otological complications.

The specific etiology of MD remains unclear. Currently, it is believed that pathology in the labyrinth of the inner ear may be the root cause of recurrent vertigo, fluctuating hearing loss, tinnitus, and/or a sensation of fullness or pressure in the ear. However, endolymphatic fluid cannot fully explain the full range of clinical features in MD.<sup>4</sup> The development of validated and specific diagnostic criteria for MD is a very important endeavor since there are a number of disorders other than MD that can cause similar vertigo and auditory symptoms.

\*These authors contributed to the work equally and should be regarded as co-first authors.

Corresponding author: Chenghua Tian, e-mail: 20071044@zcmu.edu.cn

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Worryingly, the etiopathology of MD has been the focus of ongoing controversy. Meniere's disease remains poorly understood and challenging to treat, despite being identified over 150 years ago. Current treatments focus on managing symptoms like vertigo, tinnitus, and hearing loss rather than addressing the underlying cause. The lack of effective therapies and frequent misdiagnosis make MD a significant ongoing challenge in otolaryngology.

To assess the current status and trends in MD diagnosis and treatment, a bibliometric analysis of relevant research was conducted. The global distribution of publications, key authors, institutions, and journals, along with their connections was examined. By analyzing references and keywords, research hotspots and emerging trends were identified, highlighting strengths and gaps in the field. The goal was to provide a comprehensive reference for future studies on MD diagnosis and treatment.

## METHODS

This study did not involve human or animal subjects, and thus, no ethical approval nor informed consent was required.

### Data Sources and Search Strategies

In this study, 2 different databases were searched from 2 different disciplines to ensure comprehensive coverage of the existing literature. For the medical discipline, PubMed was screened, while for the general science discipline, the Web of Science Core Collection was screened. A search formula was constructed with reference to well-established programs<sup>5,6</sup> Annex 1 depicts the search formula and strategy used for the different databases, as well as the inclusion and exclusion criteria. The existing literature was searched up to September 20, 2023. The main research methodology and content are shown in Figure 1.

### Inclusion and Exclusion Criteria

As of September 2023, a total of 32 486 valid publications were retrieved from the 4 databases (4434 from PubMed and 28 062 from WoS). Two researchers independently screened and analyzed the retrieved literature based on predetermined inclusion and exclusion criteria. In case of discrepancies, a third researcher was involved to

provide a resolution. A total of 1337 documents were included in the final analysis; Figure 2 shows the specific screening process.

## Statistics and Analysis of Data

We extracted a range of information from each of the selected articles, including the title, abstract, author, author's affiliation, author's nationality, publication date, titles of published journals, and keywords. These data were analyzed using the Bibliometrix package in R;<sup>7</sup> statistical graphs were generated using the ggplot2 package in R,<sup>8</sup> (R Foundation; Vienna, The Republic of Austria) and co-citation and co-occurrence analyses were performed using VOSviewer v1.6.18,<sup>9</sup> (Leiden University; Leiden, Netherlands) developed by Nees Jan van Eck and Ludo Waltman of Leiden University in the Netherlands. Bibliometric networks were also constructed and visualized, including networks of high-frequency co-occurring keywords and the chronological order of publications for network visualization.

## RESULTS

### Analysis of Publication Trends and Citations

A total of 1337 eligible papers were retrieved from the WoS Core Collection and PubMed databases. A total of 3130 authors were identified in 198 different journals, with a combined citation record of 8138 citations for the retrieved articles. The average annual citation frequency was 105.68, and the average citation frequency per article was 6.09.

### Trend Analysis of the Annual Number of Publications

The annual distribution of the number of publications in the existing literature demonstrated that research interest in MD increased steadily from 1947 to the present day. In addition, there is a clear trend of growth in the number of articles published over the past 3 years. Over the past decade, the number of research publications relating to MD has increased consistently and peaked at almost double that of the preceding decade. As shown in Figures 3, of the 1337 articles that met the inclusion criteria, there was a clear upward trend between 1947 and 2023, with an average annual growth rate of 5.33%, peaking in 2021 and remaining at the same level in 2022 as in 2021. This finding indicates that the diagnosis and treatment of MD are receiving increasing levels of attention, with more individuals actively conducting research. These data indicate a growing research interest in this field.

### Analysis of the Journals Publishing Research Related to Meniere's Disease

According to Bradford's Law of Econometrics,<sup>10</sup> within a certain time period, all publications in a particular field can be divided into core, related, and peripheral zones based on their publication volume. Core journals published approximately 1/31 of the total number of publications. According to this, the journals accounting for 1/31 of the included literature in this study were the core journals, and the core journals were the top 5 journals in terms of publication volume after calculation. The articles published in these 5 journals accounted for 36.94% (494/1337) of all articles, as shown in Supplementary Table 1. In addition, by plotting the comparative trend of annual publications by core publications, as shown in Figure 4, it was found that the journal "Laryngoscope" was superior to all other journals in terms of growth rate and the number of publications. Furthermore, although "Otology & Neurotology" had an overall journal publication

## MAIN POINTS

- The number of research publications on Meniere's disease (MD) has steadily increased, peaking in 2021 with an average annual growth rate of 5.33%, led by contributions from the United States, United Kingdom, and Japan.
- Emerging diagnostic tools, including magnetic resonance imaging, vestibular-evoked myogenic potentials, and cochlear electrograms, show promise for precise differential diagnosis of MD.
- Traditional Chinese medicine, such as acupuncture, was first included in clinical guidelines but requires validation through large-scale trials and long-term follow-up.
- Genetic studies identified MITF and SOX10 genes as potential genetic risk factors, offering a molecular foundation for future precision diagnosis and treatment.
- Current therapies (e.g., endolymphatic sac surgery, intratympanic drug injections) need optimization, while psychological interventions and quality-of-life improvement are emerging priorities.

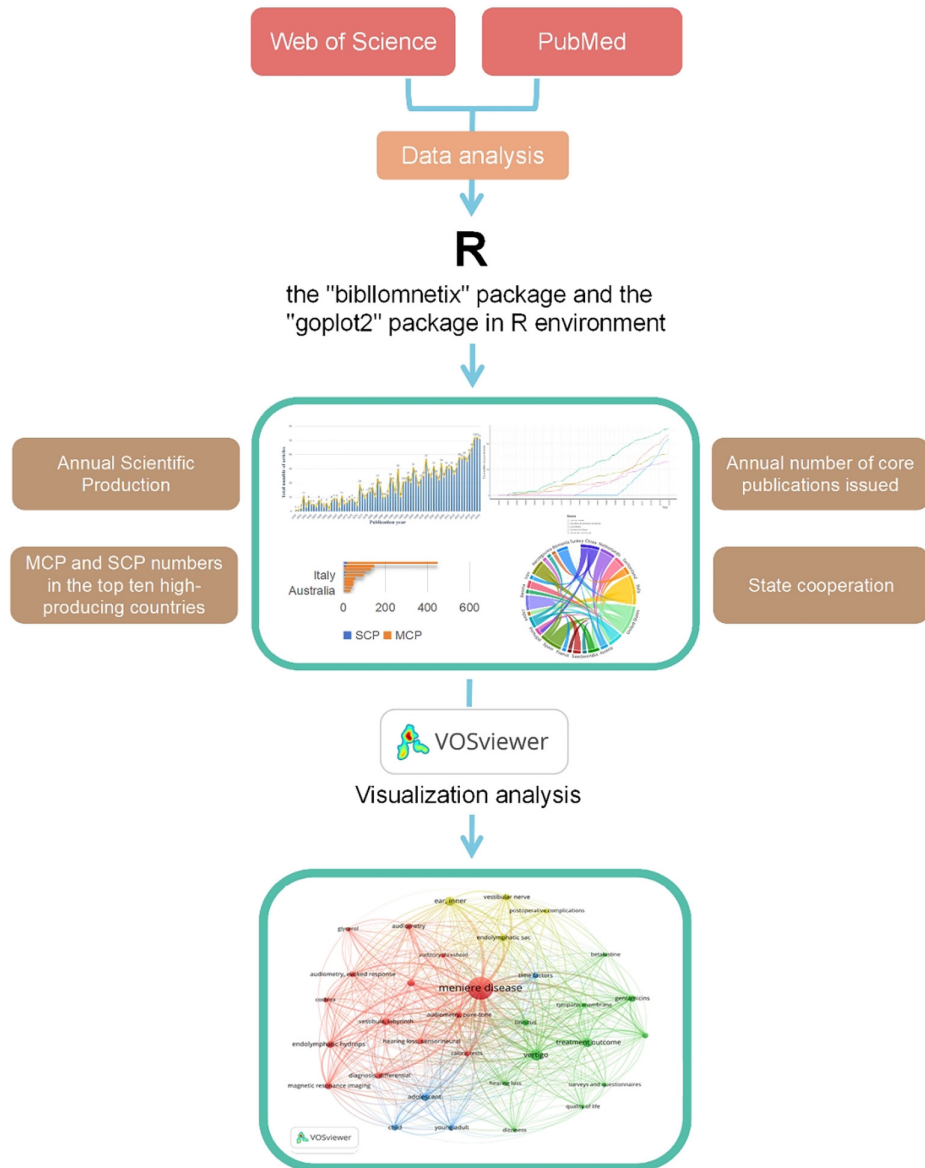


Figure 1. Main research methodology and study content.

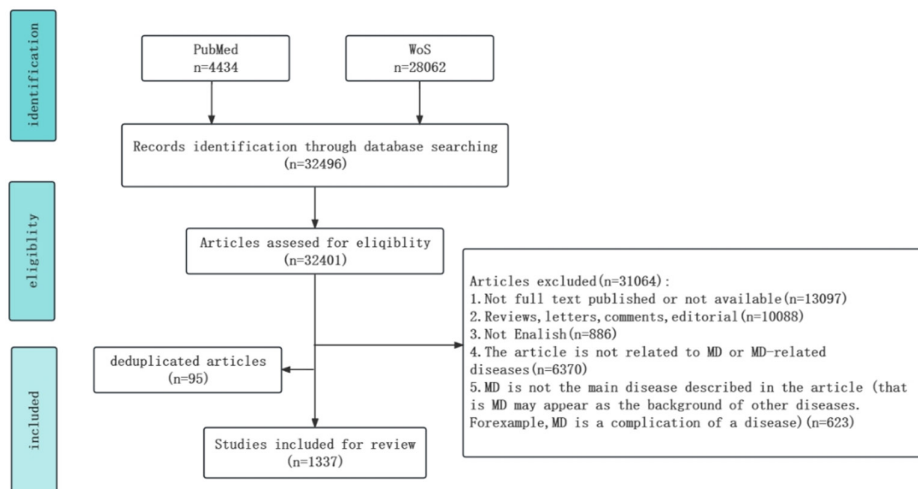
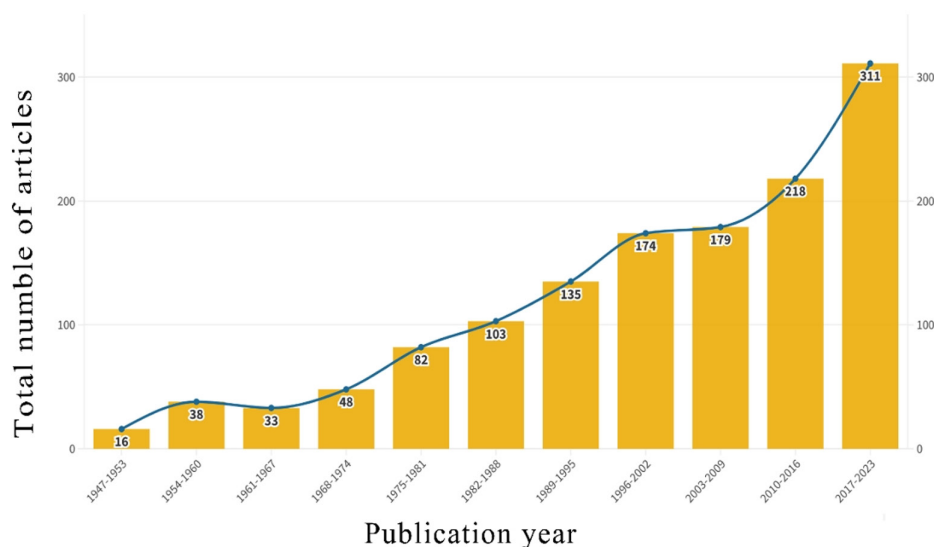


Figure 2. Flowchart showing the process used to screen existing.



**Figure 3.** Total number of articles published over time related to Meniere's disease.

time later than other journals, its growth rate far surpassed that of others, with a total number of publications approaching that of "Acta Oto-Laryngologica" by 2023.

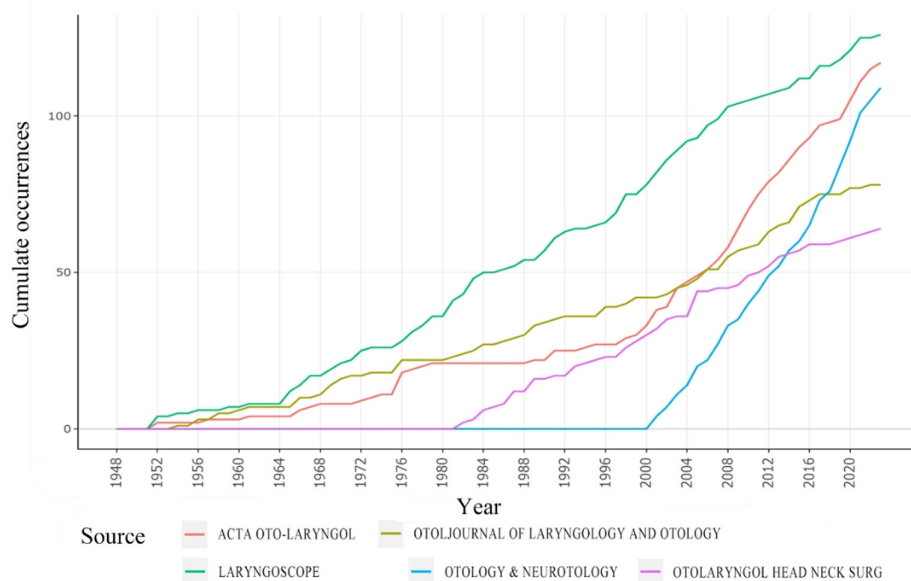
#### Analysis of Highly Cited Publications

(Supplementary Table 2) lists the publications in descending order in terms of the total number of citations. The top 10 most frequently cited articles were published between 1982 and 2020, and 2 articles were cited more than 370 times. The first of these articles was published in *Otolaryngology-Head and Neck Surgery* in 1995 and was entitled "Committee on Hearing and Equilibrium Guidelines for the Diagnosis and Evaluation of Therapy in Menière's Disease" (study type: guideline); these guidelines were prepared by the American Academy of Otolaryngology-Head and Neck Foundation, Inc. The second article was published in 2015 in the *Journal of Vestibular Research* and was entitled "Diagnostic Criteria for Menière's Disease" (study type: guideline). The first article describes the development of

specific guidelines by the American Board of Otolaryngology, Head and Neck Surgery and Balance (ABOTH) for the diagnosis and treatment of MD. These guidelines can be directly applied to the clinic and are relatively easy to use. The second article provides an introduction to the guidelines developed by audiological associations to help understand the clinical guidelines developed by these associations and to facilitate accurate clinical diagnosis and treatment.

#### Author Analysis

The analysis included a total of 3130 authors. According to Lotka's law,<sup>11</sup> authors with more than 0.749 times the square root of the number of papers published by the most prolific scientists are considered to be highly prolific authors. In this study, authors with greater than 4 publications were defined as highly productive authors; these authors accounted for 2.49% (78/3130) of all authors. The top 10 authors in terms of the number of publications were identified; these findings are shown in Supplementary Table 3.



**Figure 4.** Trend chart comparing the annual number of articles published by core journals.

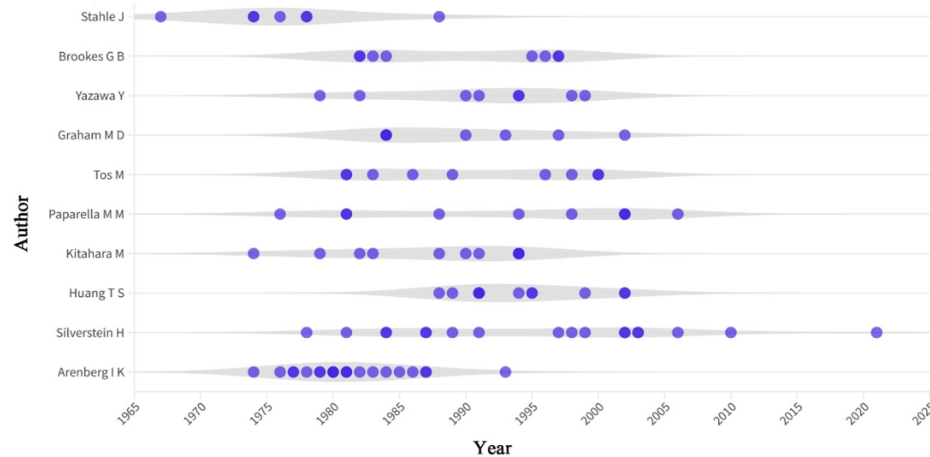


Figure 5. Analysis of the annual output by the most prolific authors.

#### Trend Analysis for Publications by Prolific Authors

Next, trend analysis of the annual publication output and yearly citation frequency for the top 10 authors based on their prolificacy were performed. Figure 5 depicts the trend in annual publications; the intensity of the purple dots indicates the volume of publications per year. Of the 10 most prolific authors, 9 began their research in the field of MD after 1974. The majority of publications by these authors were concentrated between 1974 and 2002, with a relatively lower publication output over recent years.

#### Analysis of Author Affiliations

The analysis involved 3130 authors from 43 countries and 1208 research institutions, as shown in Figure 6. The United States published the highest number of articles in this field (425), followed by the United Kingdom and Japan. With regard to articles involving international collaboration, the United States published the most

articles, followed by the United Kingdom and Italy. Figure 7 represents a visualization of national collaboration. Generally, in terms of the publication landscape in this field, the level of collaboration between countries appears to be relatively low, with each country operating in a relatively independent manner. This suggests a need for future efforts to strengthen collaboration between different countries.

Osaka University, Sydney University, and Massachusetts Eye and Ear Infirmary were the 3 most published institutions in the field, followed closely by the University of California and Harvard University. Osaka University primarily focused on research related to internal lymphatic decompression surgery, internal lymphatic sac drainage treatment, and various diagnostic methods for MD, especially those centered around inner ear lymphatic hydrops. Sydney University focused on a variety of therapeutic approaches, particularly cochlear

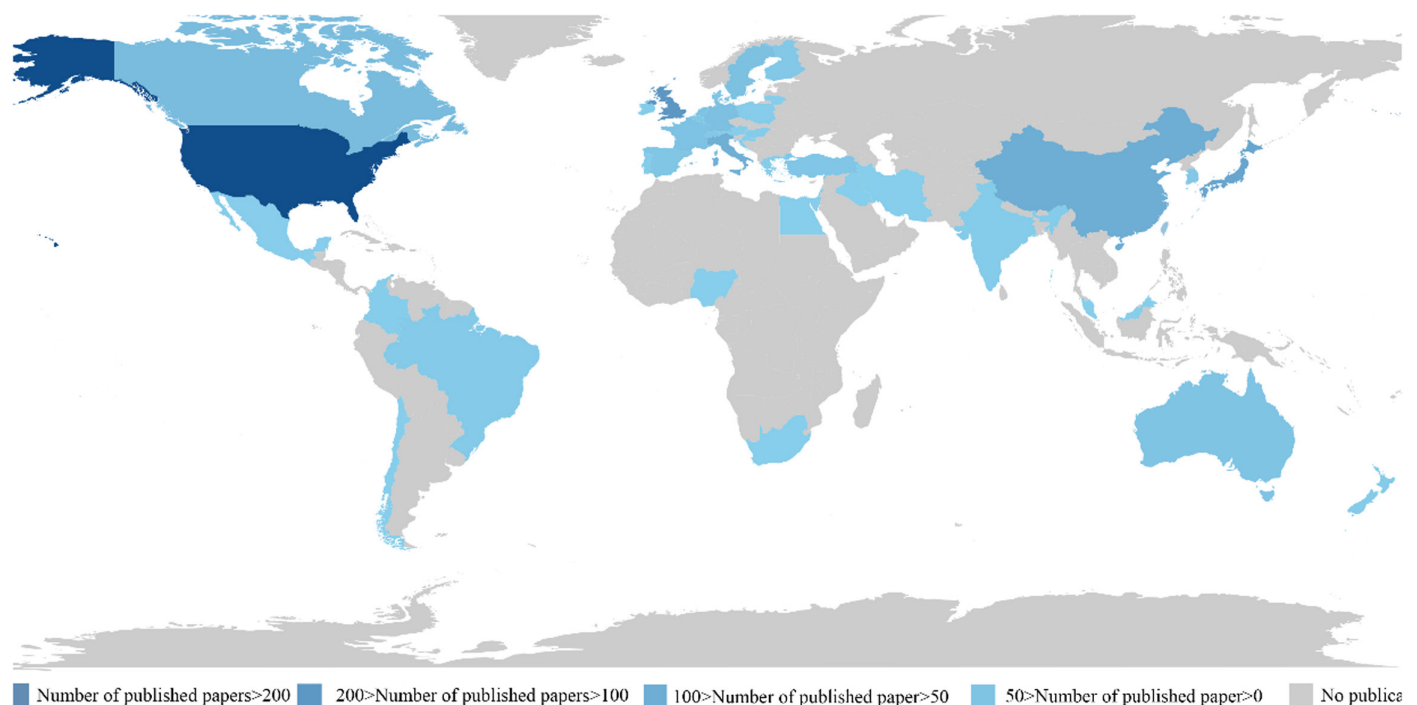
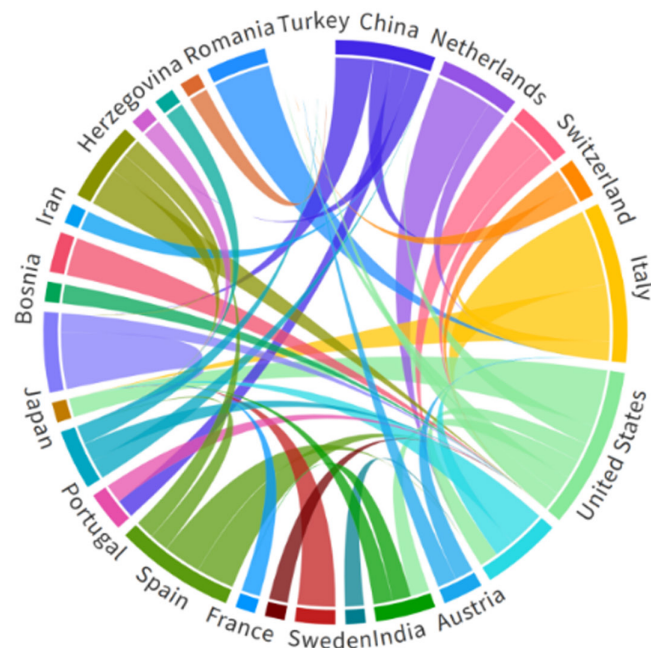


Figure 6. Visualization of the distribution of authors by country.





**Figure 7.** Collaboration between countries and volume of articles issued by the top 10 organizations.

implant research, and in 2022 reported potential nanotechnology approaches in the diagnosis and treatment of MD. Over recent years, Massachusetts Eye and Ear Infirmary has focused on the use of vestibular-evoked myogenic potentials in MD. Figure 7 visualizes the publication output for the top 10 institutions in various major rankings. Overall, the publication outputs from these institutions were relatively similar, with no institution standing out as particularly influential with respect to the others.

### Thematic Analysis of Communications

In this study, the themes of publications in the field were analyzed in 3 different ways: first, high-frequency keywords were extracted from the abstracts of the included literature. Relationships between high-frequency keywords were analyzed through a high-frequency keyword co-occurrence network to identify major research themes from the clustering results. Next, a thematic map was prepared, as proposed by Cobo et al<sup>12</sup> in 2011. Themes were clustered and mapped based on density and centrality so that current research hotspots could be identified. Finally, an analysis of the evolving trends of topics in the MD field was conducted over time. The 40 most frequently occurring theme words, including basic words (such as “human” and “male”) and research methods (such as “retrospective studies” and “follow-up studies”), were removed, as shown in Supplementary Table 4.

### VoSViewer Keyword Clustering

The abstracts of the included articles were subjected to word splitting, de-duplication, and lexical normalization using Python to acquire all keywords. A high-frequency keyword co-occurrence network was produced using VOSviewer, as shown in Figure 8; clustering divided all keywords into 3 main categories, with the red section representing MD symptoms, including “hearing loss” and “dizziness,” along with diagnostic and therapeutic methods such as “vertigo” and “gentamicin.” The yellow section focuses on factors influencing the diagnosis and treatment of MD, with related words such as “adolescent” and “time factors.” The green section predominantly



refers to hearing-related tests, including high-frequency words such as “audiometry threshold” and “audiometry pure-tone.” This analysis also included related basic words, such as “cochlea.” The blue section represents diagnostic tests for MD, including “magnetic resonance imaging” and “caloric tests.”

In Figure 8, the yellow section represents the highest frequency keywords utilized after 2010, and demonstrates that the main research interests over recent years include the use of magnetic resonance imaging and vestibular-evoked myogenic potentials in MD, the use of questionnaires in the diagnosis and treatment of MD, as well as the quality of life for patients with MD and geriatric MD.

### Thematic Map Analysis

In 2011, Cobo et al<sup>12</sup> proposed the thematic map method, which utilizes a quadrant in which a theme is located on a thematic map to analyze the research intensity and importance of the theme. “Very specialized/niche themes” are shown in the first quadrant and have experienced significant development, although their overall importance is relatively low. “Motor themes” are shown in the second quadrant and have experienced significant and essential development. Themes in the third quadrant, characterized by “merging or disappearing,” do not exhibit robust development and attract relatively low levels of attention. Finally, “basic themes” are shown in the fourth quadrant; while not well developed, these are crucial and typically represent foundational concepts.

By calculating the density and centrality of the already clustered covariance matrices, each of these 3 categories was visualized within two-dimensional coordinates, as shown in Figure 9. It was found that the first quadrant was dominated by words that differentiated patients, such as “female,” suggesting that research on gender differences in MD has developed well but is now being phased out. The second quadrant shows that endolymphatic fluid and diagnostic imaging are very important and well-researched topics that are

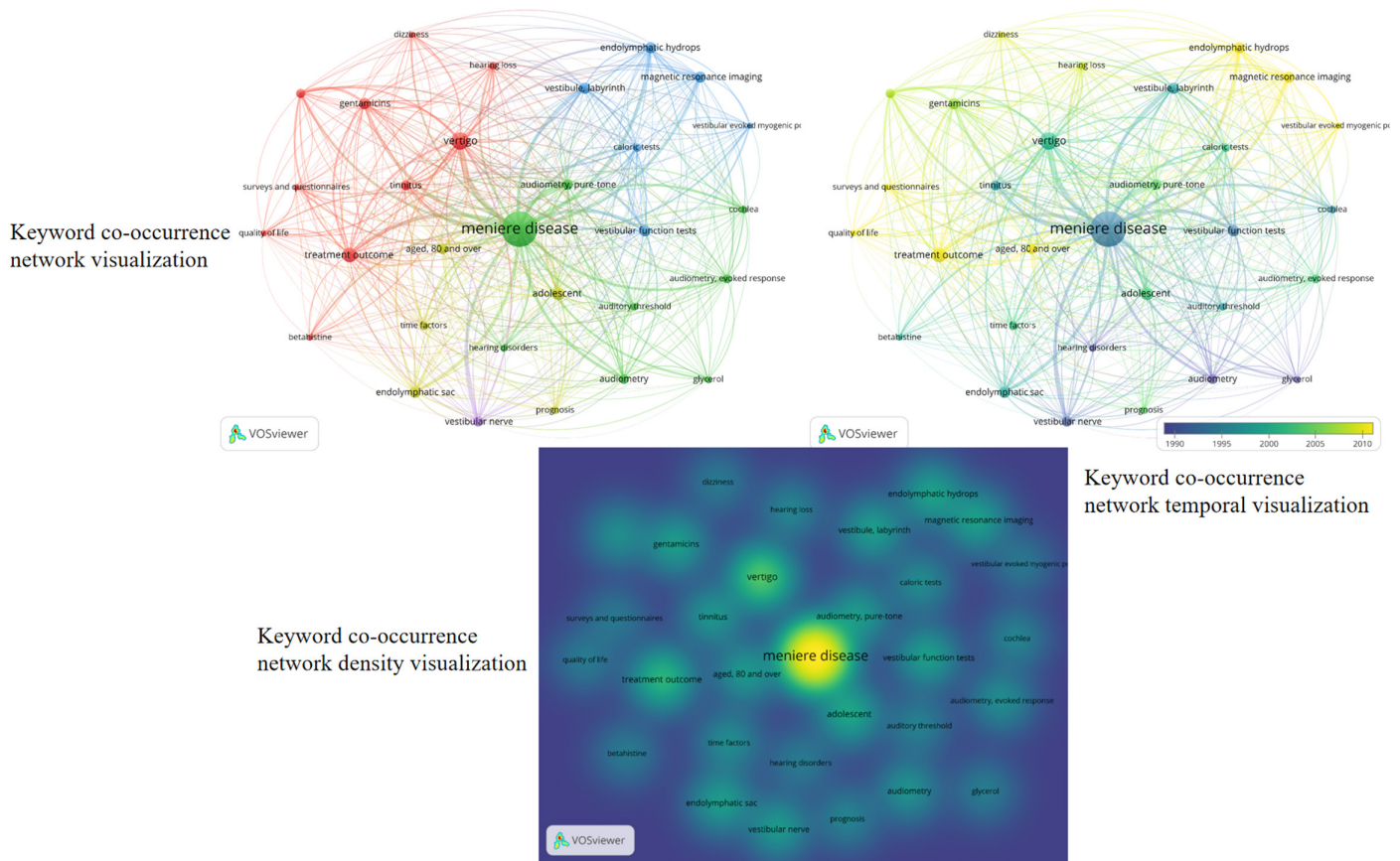


Figure 8. Keyword co-occurrence network visualization, temporal visualization, and density visualization.

currently being studied in the field; some of these topics also feature in the first quadrant, thus indicating good development. The third quadrant shows that ultrasound therapy for MD has not yet been developed, while the fourth quadrant is dominated by terms such as “administration” and “dosage”; these represent basic concepts in the diagnosis and treatment of MD.

#### Sankey Diagram Analysis

Time dimension analysis was used to analyze the evolution of research themes from 1947 to 2023 and to create a Sankey diagram, as shown in Figure 10. Both changing and unchanging themes were observed during this period. Between 1947 and 1983, researchers investigated the diagnosis and treatment of MD, concentrating on

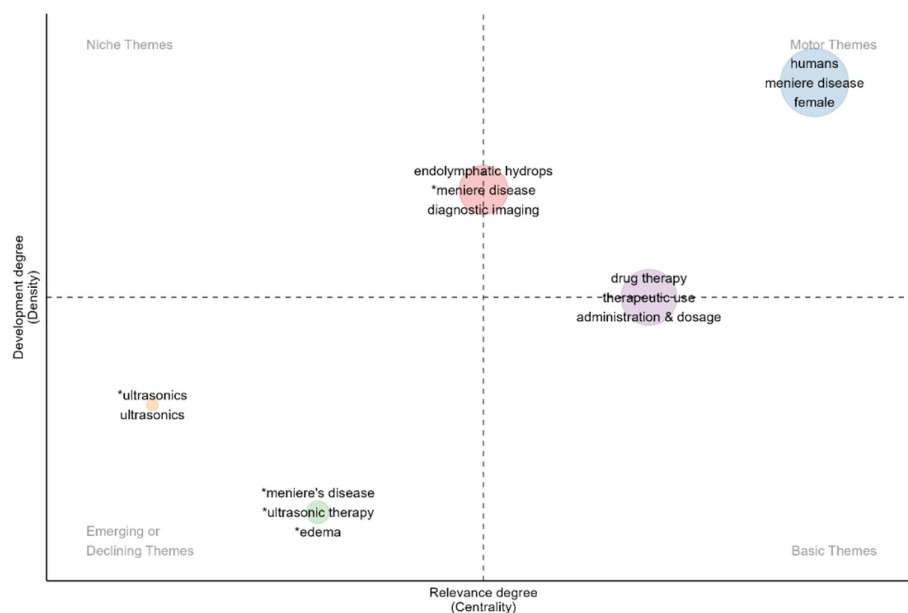
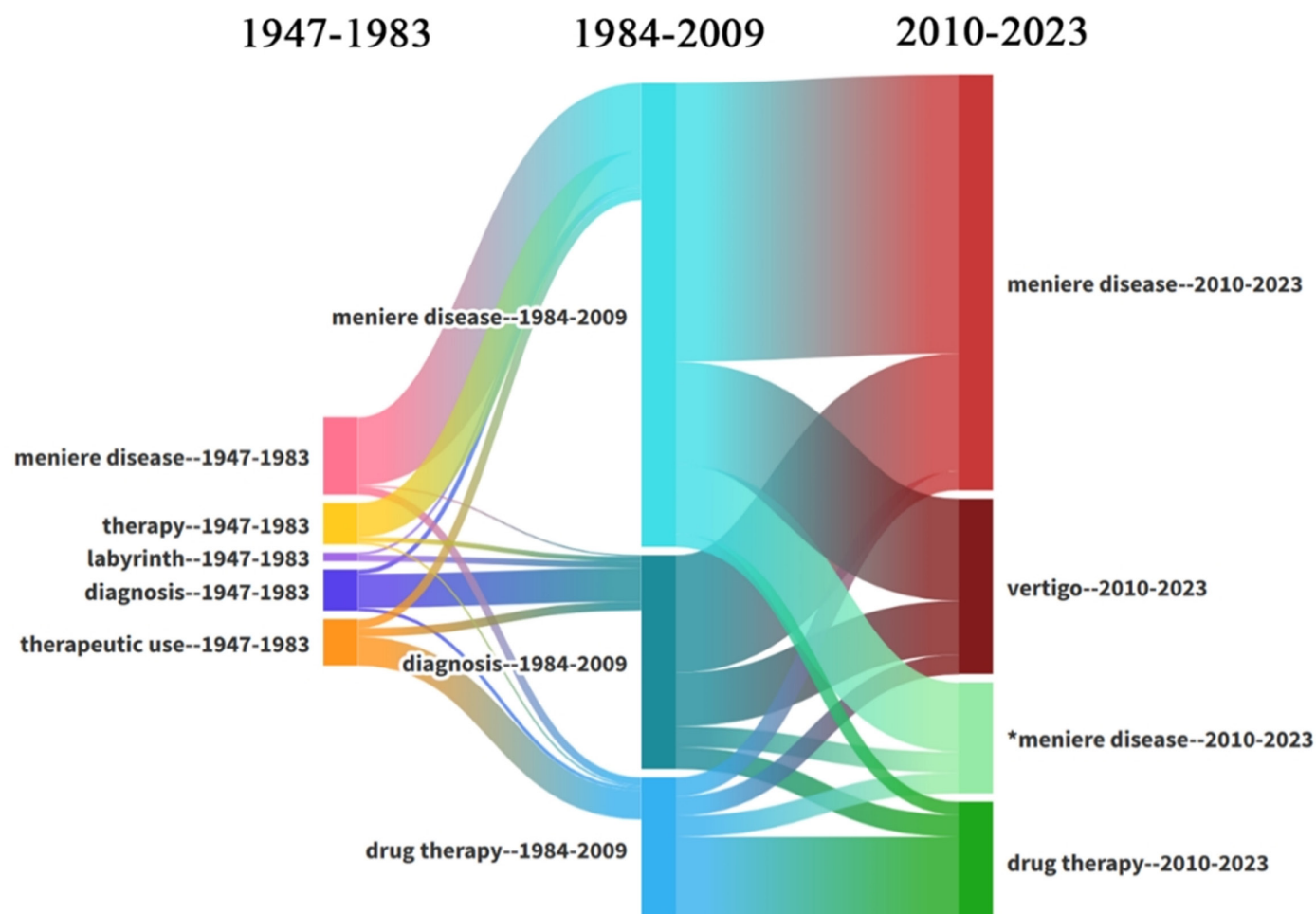


Figure 9. Thematic maps shown by domain.



**Figure 10.** Sankey diagram depicting trends in the evolution of Meniere's disease research themes.

basic concepts such as the vestibule of the inner ear. During this time, the concept of MD was introduced and widely publicized. Between 1984 and 2009, the diagnosis of MD was still being discussed by researchers, while treatment had gradually focused on medication, which remained a significant research hotspot between 2010 and 2023. There was also evidence of greater concern for the quality of life of patients; researchers also focused on the vertigo arising from MD, with the overall concept of MD remaining a major research hotspot as of 2022.

## DISCUSSION

### Analysis of the Status and Trends of Publications Relating to Meniere's Disease

The number of papers in the field of MD has steadily increased year by year, reflecting both MD-specific advancements and the overall expansion of otolaryngology research. The number of papers peaked in 2021; this could be attributed, to some extent, to the revision of the clinical practice guidelines for MD in 2020, which may have stimulated the interest of researchers in the diagnosis and treatment of MD. Current research has been published primarily in *Laryngoscope*, *Acta Oto-Laryngologica*, and *Otology & Neurotology*. These journals published a total of 352 articles (126, 117, and 109) as of September 2023; this represents 26.32% (352/1337) of the total number of articles published. However, the acceptance rates of articles in this field

by top medical journals have been poor, with no relevant papers published in the *New England Journal of Medicine* and *The Lancet*; a total of 6 (2 and 4) relevant papers were published in *The Journal of the American Medical Association* and *the British Medical Journal*, thus accounting for 0.45% (6/1337) of the total number of papers.

A total of 589 articles were published by authors from the United States and the United Kingdom, accounting for 44.05% (589/1337) of the total number of articles, followed by Japan, China, and Italy, with fewer contributions from authors in other countries. Osaka University, Sydney University, and Massachusetts Eye and Ear Infirmary represent the top 3 organizations in terms of the number of publications in this field.

### Analysis of Hotspots and Future Directions

After classifying the 1337 included articles by research topic, it was found that 332 articles were related to the diagnosis of MD, 990 articles were related to the treatment of MD, and 15 articles were related to both diagnosis and treatment.

In the literature related to diagnosis, the research focus of 49 articles related to diagnostic methods for MD, while 283 articles focused on diagnostic-related examinations for MD. In the literature related to treatment, the research focused on 669 articles related to treatment methods for MD, and 321 articles focused on the treatment outcomes



of MD. Therefore, the current research hotspot in this field centers around diagnostic-related tests and therapeutic methods for MD.

### Diagnostic Methods

Currently, there is no reliable method that can accurately diagnose MD. Diagnosis remains primarily symptom-based, supported by lab tests and imaging. The approaches described in the literature closely align with the 2020 Clinical Practice Guidelines for Meniere's Disease. Researchers have yet to identify a diagnostic method for MD that exhibits good levels of sensitivity and specificity.

### Diagnostic-Related Tests

In addition to conventional tests, MD is also commonly diagnosed by electrophysiological and imaging tests. Cochlear electrograms record electrical activity from the cochlea and primary cochlear nerve fibers following acoustic stimulation; a cochlear electrogram with a total potential/action potential ratio (SP:AP) > 0.4 is indicative of the presence of endolymphatic hydrops.<sup>13</sup> An elevated SP:AP ratio indicates higher reliability in terms of diagnosing chronic or severe MD. The sensitivity of this test depends on the severity and chronicity of the disease. Otoacoustic emission exhibited high sensitivity to slight changes in intracranial pressure in patients with MD.<sup>14</sup> The vestibular-evoked myogenic potential can be used to systematically evaluate the vestibular function of MD patients; however, the sensitivity and specificity of this test are low, leading to low usage in clinical practice.<sup>15</sup> The auditory brainstem response is also frequently used as a well-established electrophysiological test of the inner ear to aid in the diagnosis of MD. The glycerol test, which uses the change in pure-tone audiometry hearing thresholds as an indicator, supports the diagnosis of MD if the results are positive. Over recent years, advancements in high-resolution computed tomography and MRI (magnetic resonance imaging) technologies have allowed researchers to study the morphology and function of the affected areas more intuitively. These technologies also provided possibilities for the radiological diagnosis of MD.<sup>16</sup> WBT (wideband tympanometry test) may represent a useful and simple non-invasive diagnostic tool for MD, but still needs to be supported by further clinical studies.<sup>17</sup>

### Treatment Methods

The evolution of MD treatments has been difficult and tortuous, largely due to the ongoing difficulty in accurately diagnosing MD. The current primary goals of treatment are to initially reduce the frequency of episodes, prevent or minimize the severity and occurrence of vertigo, and maximally enhance the quality of life for patients. The first choice of treatment for MD is dietary modification (as recommended in the 2020 guidelines). However, Luxford et al<sup>18</sup> reported that only 3.2% of surveyed patients followed the recommended dietary guidelines after receiving nutritional counseling. During acute episodes of vertigo, central vestibular inhibitors are used for symptom control (as recommended in the 2020 guidelines). Drugs such as diuretics and betahistine may be considered in the remission phase, alongside intratympanic therapies like gentamicin or dexamethasone (as an optional approach in the 2020 guidelines). The hotspots of concern relating to medication correspond to the high-frequency keyword 'gentamicin' in this study. Traditional Chinese medicine (TCM) and acupuncture have been studied for MD, with the 2020 guidelines including acupuncture as a recommended option.<sup>19</sup> Vestibular rehabilitation (VR) is used for chronic imbalance symptoms,

though 5%-10% of patients remain refractory and may require surgery (as recommended in the 2020 guidelines). Endolymphatic sac decompression, semicircular canal occlusion,<sup>20</sup> and vestibular neurectomy are common surgical approaches. Zhang et al<sup>21</sup> reported a 98.7% vertigo control rate with semicircular canal occlusion. For profound hearing loss, hearing aids or cochlear implants can improve auditory and vestibular compensation (as recommended in the 2020 guidelines).<sup>22</sup> A pilot study in China suggested virtual reality VR may aid chronic imbalance, though it remains investigational and is not the 2020 guideline-recommended.<sup>23</sup> The vertigo and nausea caused by MD often cause a certain degree of psychological stress for patients. Consequently, psychological treatment is an indispensable aspect of treatment for MD patients. Over recent years, the use of internet-based therapies are increasingly recognized but require further study.<sup>24</sup>

### Treatment Results

Dietary therapy generally takes precedence in the treatment of MD. A healthy lifestyle leads to effective vertigo control in 50% of MD patients.<sup>25</sup> In addition, psychological factors have gained attention in MD management. Some patients unresponsive to pharmacological treatments improved after psychological therapy.<sup>26</sup> Appropriate psychological care can alleviate symptoms and enhance quality of life.<sup>27</sup> The long-term use of vestibular depressants can inhibit central compensation for vestibular function and can result in chronic imbalance symptoms over time. However, a 2016 controlled study found no difference in vertigo control between high-dose betahistine, low-dose, and placebo.<sup>28</sup> Intratympanic gentamicin has been confirmed as safe and effective,<sup>29</sup> while quinidine also demonstrated safety.<sup>30</sup> Naples et al<sup>31</sup> compared intratympanic streptomycin (90% vertigo control, recurrence at ~27 months) and dexamethasone (62% control, recurrence at ~5 months), suggesting streptomycin is more effective. Endolymphatic dacryocystectomy is the most commonly used conservative procedure in the clinic, and endolymphatic sac surgery combined with corticosteroids may stabilize hearing in bilateral MD for 2 years,<sup>32</sup> though its efficacy remains debated.<sup>33</sup> Internet-based questionnaires and surveys are increasingly used to complement drug therapy.<sup>24</sup> Advancements in genetic testing, such as mt-tRNA gene variation studies, could predict aminoglycoside susceptibility and reduce deafness risk, though clinical application remains preliminary.<sup>34</sup>

### Limitations of the Current Research and Suggestions for Future Development

Current research perspectives on the diagnosis and treatment of MD are relatively focused, and there is some similarity between the studies reported by different scholars. There has yet to be a major breakthrough in this field over recent years. Researchers should eliminate the limitations of existing diagnostic and treatment protocols, innovate diagnostic and therapeutic methods, propose new ideas, and summarize new conclusions, so as to provide more theoretical support for clinicians, identify diagnostic and therapeutic methods for patients with MD, and improve the quality-of-life of patients.

### Limitations of the Study

This study focuses on quantitative trends in MD research, which may not directly correlate with clinical impact or methodological rigor, and future studies should integrate quality assessments (e.g., evidence hierarchies) to complement bibliometric findings.

## CONCLUSION

This bibliometric study shows that research on the diagnosis and treatment of MD began in 1947; this was followed by a steady increase in the number of relevant studies in the published literature; the number of publications related to MD peaked in 2021. Research in MD is expected to maintain a certain growth trend, potentially. The United States has published most articles in the field of MD, followed by the United Kingdom and Japan. Most relevant articles were published in *Laryngoscope*, and the highest number of recent research advances over a 5-year period were published in the journals *Laryngoscope*, *Acta Oto-Laryngologica*, and *Otology & Neurotology*, although these journals have a fairly low impact factor.

Analysis showed that vestibular-evoked myogenic potentials, cochlear electrograms, MRI and other methods can provide new ideas for the diagnosis of MD and represent hot areas of research in MD. Various treatments for MD still need to be further optimized. Studies on the treatment of MD with traditional Chinese medicine are gradually emerging and are expected to become a research hotspot in the future. However, the development of these methods remains in the early stages, and the efficacy criteria used in the literature are mostly based on short-term symptomatic improvements, and lack objective evaluation criteria and medium- and long-term follow-up. With the advent of next-generation sequencing technologies and progression of the Human Genome Project, identifying the genetic mechanisms of MD has become increasingly possible. Several associated genes and variations have been identified, including MITF and SOX10, thus suggesting a genetic correlation with MD. However, these findings still need to be validated by clinical research. Further research could facilitate the precise diagnosis and treatment of MD.

In summary, this study systematically evaluated the current status, hotspots, and trends of diagnostic and therapeutic research in MD between 1947 and 2023 from a bibliometric perspective. These findings enhance the understanding the international research status of MD and provide suggestions for future research.

**Data Availability Statement:** The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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**Informed Consent:** N/A.

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## Supplementary Annex 1. Query strategy and results

Databases	Query	Results	Query time
PubMed	("Meniere Disease/diagnosis"[Majr] OR "Meniere Disease/diagnostic imaging"[Majr] OR "Meniere Disease/therapy"[Majr] ) OR (("meniere's disease" OR "meniere disease" OR MD OR meniere OR "Ménière's disease" OR Ménière OR "Ménière disease" ) AND TS=(cure OR treat* OR therap* OR repair OR diagnose OR diagnostic OR diagnosis))	4434	2023.9.20
Web of Science Core Collection	TS=("Meniere's disease" OR "meniere disease" OR MD OR meniere OR "Ménière's disease" OR Ménière OR "Ménière disease" ) AND TS=(cure OR treat* OR therap* OR repair OR diagnose OR diagnostic OR diagnosis)	28,062	2023.9.20

This table documents the search strategies and results from PubMed and Web of Science.

The following are the criteria for the nesting of data in the literature.

### Inclusion criteria

1. The article describes the treatment and/or diagnosis of MD (Ménière's disease).
2. The article is related to diagnostic methods, diagnostic tests, treatment approaches, or treatment outcomes for MD.

### Exclusion criteria

1. Not full text published or not available.
2. Reviews, letters, comments, editorial, conference abstracts.
3. Not English.
4. The article is not related to MD or MD-related diseases.
5. MD is not the main disease described in the article (that is MD may appear as the background of other diseases. For example, MD is a complication of a disease).

**Supplementary Table 1.** Core Publication Ranking, JCR Classification and Evaluation Indicators

Sources	Articles	JCR categories	2022 JIF	JCR partition
LARYNGOSCOPE	126	MEDICINE, RESEARCH & EXPERIMENTAL & OTORHINOLARYNGOLOGY	2.6	Q4
ACTA OTO-LARYNGOL	117	OTORHINOLARYNGOLOGY	1.4	Q4
OTOLOGY & NEUROTOLOGY	109	CLINICAL NEUROLOGY & OTORHINOLARYNGOLOGY	2.1	Q4/3
JOURNAL OF LARYNGOLOGY AND OTOLOGY	78	OTORHINOLARYNGOLOGY	1.7	Q3
OTOLARYNGOLOGY-HEAD AND NECK SURGERY	64	OTORHINOLARYNGOLOGY & SURGERY	3.4	Q1

Provides core journal data supporting the bibliometric analysis, including article counts, JCR classifications, impact factors (2022), and JCR partition.

**Supplementary Table 2.** Journal of highly cited publications, year, citations

Sources	Years	Title	Total Citations
Otolaryngol Head Neck Surg	1995	Committee on Hearing and Equilibrium guidelines for the diagnosis and evaluation of therapy in Menière's disease. American Academy of Otolaryngology-Head and Neck Foundation, Inc	401
J Vestib Res	2015	Diagnostic criteria for Menière's disease	377
S. ALBUAm J Otolaryngol	2016	Treatment of Meniere's disease with intratympanic dexamethazone plus high dosage of betahistine	172
AJNR Am J Neuroradiol	2014	Detection and grading of endolymphatic hydrops in Menière disease using MR imaging	72
Int J Audiol	2009	Improved sensitivity of electrocochleography in the diagnosis of Meniere's disease	70
Otolaryngol Head Neck Surg	2020	Clinical Practice Guideline: Ménière's Disease	68
Auris Nasus Larynx	1982	Endolymphatic-mastoid shunt operation: results of the 24 cases and revision surgery with the silastic sheet	60
Pharmacol Ther	2009	Role of coenzyme Q10 (CoQ10) in cardiac disease, hypertension and Meniere-like syndrome	53
Neuroradiology	2019	The value of four stage vestibular hydrops grading and asymmetric perilymphatic enhancement in the diagnosis of Menière's disease on MRI	51
Acta Otolaryngol	2014	Caloric stimulation and video-head impulse testing in Ménière's disease and vestibular migraine	47

Lists highly cited publications in Meniere's disease research, including publication years, titles, and citation counts.



**Supplementary Table 3.** Ranking of the top 10 authors in terms of publications

Rank by Articles	Author Name	Total Articles
1	Arenberg I K	23
2	Silverstein H	18
3	Huang T S	12
4	Kitahara M	11
5	Paparella M M	10
6	Tos M	9
7	Graham M D	8
8	Yazawa Y	8
9	Brookes G B	8
10	Stahle J	7

Ranks the top 10 authors by publication volume, identifying key contributors and their academic influence in Meniere's disease research.

**Supplementary Table 4.** Top 40 most frequently occurring theme words

Words	Occurrences
middle aged	695
audiometry	322
ear	270
treatment outcome	269
surgery	157
hearing loss	156
drug therapy	153
pure-tone	151
vestibule	109
diagnosis	106
inner surgery	103
gentamicins/administration & dosage	94
80 and over	93
adolescent	92
injections	91
vertigo	90
endolymphatic hydrops	81
time factors	81
severity of illness index	79
endolymphatic sac surgery	75
evoked response	75
vestibular function tests	74
tympanic membrane	70
young adult	67
caloric tests	66
magnetic resonance imaging	64
differential	59
vestibular nerve/*surgery	59
audiometry	49
injection	44
child	43
evoked potentials	43
surveys and questionnaires	42
intratympanic	40
vertigo/drug therapy	38
topical	37
electronystagmography	35
postoperative complications	35
drug administration schedule	33
prognosis	32

Compiles high-frequency thematic terms and their occurrence counts in Meniere's disease studies.