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Exploring Global Trends in Otorhinolaryngology Research Output

Mohammad Karim Saberi[1], Heidar Mokhtari[2*], Arezoo Farhadi[3], Ali Ouchi[4], Zahra Shamloo[5], Davoud Haseli[6]

1. Department of Medical Library and Information Sciences, School of Paramedicine, Hamadan University of Medical Sciences, Hamadan, Iran,
2. Department of Knowledge and Information Science, Payame Noor University, Tehran, Iran.
3. Medical Library and Information Sciences, Hamadan University of Medical Sciences, Hamadan, Iran.
4. Student Research Committee, School of Health Management and Information Sciences Branch, Iran University of Medical Sciences, Tehran, Iran.
5. Hearing Disorders Research Center, Loghman Hakim Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
6. Department of Knowledge and Information Science, Faculty of Psychology and Education, Kharazmi University, Tehran, Iran.

Article Info

Abstract

Background: As an interdisciplinary field, bibliometrics analyses research publications in scientific fields. As a developing medical field, otorhinolaryngology needs to be evaluated from a bibliometric perspective.

Aim: This evaluative bibliometric study aimed at analyzing and exploring global research trends in otorhinolaryngology from the beginning to year 2021.

Methods: All papers published in otorhinolaryngology field that indexed in Web of Science (WoS) from 1976-2021 were extracted for analysis by conducting a certain search strategy in advanced search section within category of otorhinolaryngology in the WoS. Data were analyzed by Excel and VOSviewer for measuring bibliometric indicators and depicting visualization maps.

Results: 217,027 papers were published during the studied time span. The papers increased from two items in the beginning in 1976 to 9,759 items in 2021. USA ranked first with publishing 75,742 papers, followed by Germany with 17,718 papers and England with 14,244 papers. League of European Research Universities (LERU) ranked first among research institutes with publishing 6,517 papers. In journals, *Laryngoscope* ranked first with publishing 17,891 papers, followed by *Otolaryngology-Head and Neck Surgery* with 14,340 papers and *Journal of Laryngology and Otology* with 11,219 papers. The majority of papers were in English (n=199,069; %91,725) and original articles (n=167,724; %77.28). After otorhinolaryngology as the first-ranked area with full coverage, surgery (n=37,586) and audiology speech language pathology (n=22,136) ranked second and third, respectively. 10 highly-occurred keywords were surgery (110), management (94), children (83), quality of life (81), squamous-cell carcinoma (78), cancer (75), head (73), radiotherapy (69), cochlear implant and noise (58) and experience (53), respectively. Co-citation clustering showed *Journal of the Acoustical Society of America*, *Laryngoscope*, *Otolaryngology–Head and Neck Surgery* and *Journal of Allergy and Clinical Immunology* as the top cited sources.

Conclusion: This study is the first to give a comprehensive bibliometric analysis and visualization of global research publication in otorhinolaryngology. It recognized important and influential papers, journals, authors, research institutions, countries and topic areas as well as main considerable keywords and subject clusters and cited sources.

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Introduction

Bibliometrics or scientometrics is an interdisciplinary field that tends to identify scientific trends and facilitate scientific interactions and decision-making (1) by mathematically analyzing scientific items and exploring their bibliometric features (2). As a retrospective study, it correlates scientific data and predicts future trends in research (3). Bibliometric indicators and scientific visualization techniques can integrate data on different scientific items in different aggregate levels for better understanding, interpreting and developing research. Bibliometric data depicts publication growth in scientific fields and measures authors, research institutes and countries' research influence (4). Due to development of information technologies, the scientific visualization has been developed as a complement to bibliometrics in which data can be interpreted easily in a macro level for detecting new patterns (5). Regarding the importance of bibliometric analyses in evaluating medical research, many bibliometric studies and scientific visualization analyses have been conducted in different medical fields and subfields (6-17). As one of main specialties in medicine with its own procedures and approaches (18) and about a half century tradition of formal publication, otorhinolaryngology needs to be evaluated comprehensively from a bibliometric perspective for its global research contribution. Some "limited" bibliometric studies considered the field from different perspectives (19-21). This study aimed to conduct a bibliometric analysis and visualization of this medical field for analyzing and exploring its global research trends from the beginning to year 2021.

Methods

This bibliometric analysis and visualization included all scientific publications in otorhinolaryngology field indexed in the Web of Science (WoS) during 1976-2021. On 12 July 2022, a search was done in advanced search section of WoS in the otorhinolaryngology category in the time span of 1976-2021 as follows:

WC=Otorhinolaryngology

Refined by: [excluding] PUBLICATION YEARS: (2022)

Timespan: All years. Indexes: Web of Science Core Collection

In the export section of WoS, retrieved records were extracted and saved as txt files. Excel as a statistical software package and VOSviewer as a scientific visualization software package were used for identifying, measuring and depicting needed indicators. Bibliometric indicators such as publication annual growth trend, most-cited papers, most-productive authors, most-active research institutes and countries and top publishing journals were identified and then, keyword clustering and co-citation network techniques were used for clustering highly-co-occurred keywords and clustering cited sources in the most-cited papers on the field.

Results

Annual growth trend in publication

Total publications indexed in WoS Core Collection were 217,027 papers during the studied time span. Figure 1 depicts the annual growth trend in publication. The papers increased from two items in the beginning in 1976 to 9,759 items in 2021. With ups and downs in the annual publication number, the growth coefficient (R^2 = .8851) showed a gradual increasing trend. The highest and lowest annual growth rates belonged to 2020 with 10,612 papers and 1977 without any paper.

Top ten highly-productive authors

Table 1 shows some bibliometric indicators of the top ten highly-productive authors. The first to third ranks belonged to Lenarz T. from

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Hannover Medical School, Germany (n=541), Sataloff RT (n=511) from Drexel University and Ferlito A. (N=495) from Int Head & Neck Sci Grp, respectively.

Table 1. Top ten highly-productive authors in otorhinolaryngology (n= 217,027 papers)

SCR[a]	Author's name	NP	% of total publication	Total citation	Mean citations per paper (R)	H-index (R)	Institution	Country
1st	Lenarz T	541	.249	7522	13.9 (5)	41 (3)	Hannover Medical School	Germany
2nd	Sataloff RT	511	.235	5,080	9.94 (9)	39 (4)	Drexel University	USA
3rd	Ferlito A	495	.228	11,929	24.1 (3)	53 (1)	Int Head & Neck Sci Grp	Italy
4th	Suzuki M	473	.218	5,481	11.59 (8)	32 (6)	Nagoya City University	Japan
5th	Nakashima T	401	.185	7,084	17.67 (4)	36 (5)	Natl Hosp Org	Japan
6th	Rinaldo A	393	.181	9,951	25.32 (1)	50 (2)	University of Udine	Italy
7th	Lee JH	373	.172	4,508	12.09 (7)	31 (7)	Ewha Womans University	South Korea
8th	Guntinas-lichius O	369	.170	3,557	9.64 (10)	30 (8)	Friedrich Schiller University of Jena	Germany
9th	Johnson JT	355	.164	8,878	25.01 (2)	50 (2)	UPMC Hillman Canc Ctr	USA
10th	Takahashi H	339	.156	4,521	13.34 (6)	32 (6)	Nagasaki University	Japan

SCR: standard competition ranking; a: Equal authors have the same ranking number, and then a gap is left in the ranking numbers; R: rank; NP: Number of Papers
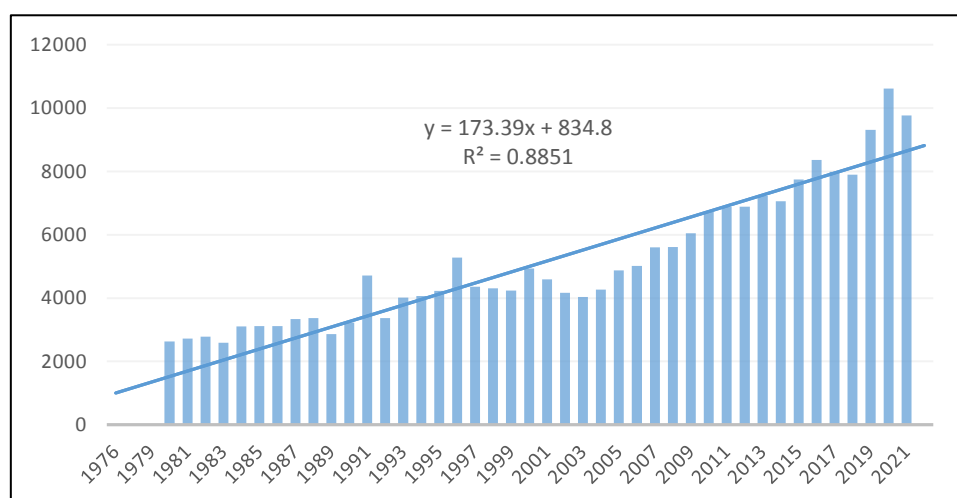

Figure 1. Annual growth trend in otorhinolaryngology publication (1976-2021)

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Top ten highly-cited papers

Table 2 shows some bibliographic features of the top ten highly-cited papers in the field. The first-ranked paper (n=2693) entitled as "European position paper on rhinosinusitis and nasal polyps 2012" by Fokkens, WJ et al. was published in *Rhinology* in 2012. A paper by House, JW et al. that was published in *Otolaryngology-Head and Neck Surgery* in 1985 and entitled as "Facial-Nerve grading system" ranked second (n=2,445). Seven top highly-cited papers were original articles.

Top ten highly-contributing countries

Of 178 contributing countries, the top ten ones and their contribution rates are shown in Figure 2. The USA ranked first with publishing 75,742 papers (about 35% of all publications), followed by Germany with 17,718 papers and England with 14,244 papers.

Top ten most-active research institutes

Figure 3 depicts the top ten most-active research institutes worldwide. League of European Research Universities (LERU) ranked first with publishing 6,517 papers.

The second and third ranks belonged to University of California System (n=5,537) and Harvard University (n=4,791), respectively.

Table 2. Top 10 highly-cited otorhinolaryngology papers

| Rank	Authors/(Year)	Title	Source title, Volume (Issue)	Cited by	Paper Type
1st	Fokkens, WJ. et al./ (2012)	European position paper on rhinosinusitis and nasal polyps 2012	Rhinology, 50 (NA)	2,693	Article
2nd	House, JW. et al. / (1985)	Facial-Nerve Grading System	Otolaryngology-Head and Neck Surgery, 93 (2)	2,445	Editorial Material
3rd	GLASBERG, BR / (1990)	Derivation of Auditory Filter Shapes from Notched-Noise Data	Hearing Research, 47 (1-2)	1,768	Article
4th	Rosenbek, JC et al. / (1996)	A penetration aspiration scale	Dysphagia, 11 (2)	1,444	Article
5th	Lechien, JR et al. / (2020)	Olfactory and gustatory dysfunctions as a clinical presentation of mild-to-moderate forms of the coronavirus disease (COVID-19): a multicenter European study	European Archives of Oto-Rhino-Laryngology, 277 (8)	1,280	Article
6th	Monsell, EM et al. / (1995)	Committee on Hearing and Equilibrium guidelines for the diagnosis and evaluation of therapy in Menière's disease	Otolaryngology–Head and Neck Surgery, 113 (3)	1,249	Editorial Material
7th	Jacobson, GP et al. / (1990)	The development of the Dizziness Handicap Inventory	Archives of Otorhinolaryngology-Head & Neck Surgery, 116 (4)	1,227	Article
8th	Hadad, G et al. / (2006)	A novel reconstructive technique after endoscopic expanded endonasal approaches: Vascular pedicle nasoseptal flap	Laryngoscope, 116 (10)	1,123	Article
9th	Luce, PA et al. / (1998)	Recognizing spoken words: The neighborhood activation model	Ear and Hearing, 19 (1)	1,112	Review
10th	Hummel, T. et al. / (2007)	Normative data for the "Sniffin' Sticks" including tests of odor identification, odor discrimination, and olfactory thresholds: an upgrade based on a group of more than 3,000 subjects	European Archives of Oto-Rhino-Laryngology, 264 (3)	1,050	Article
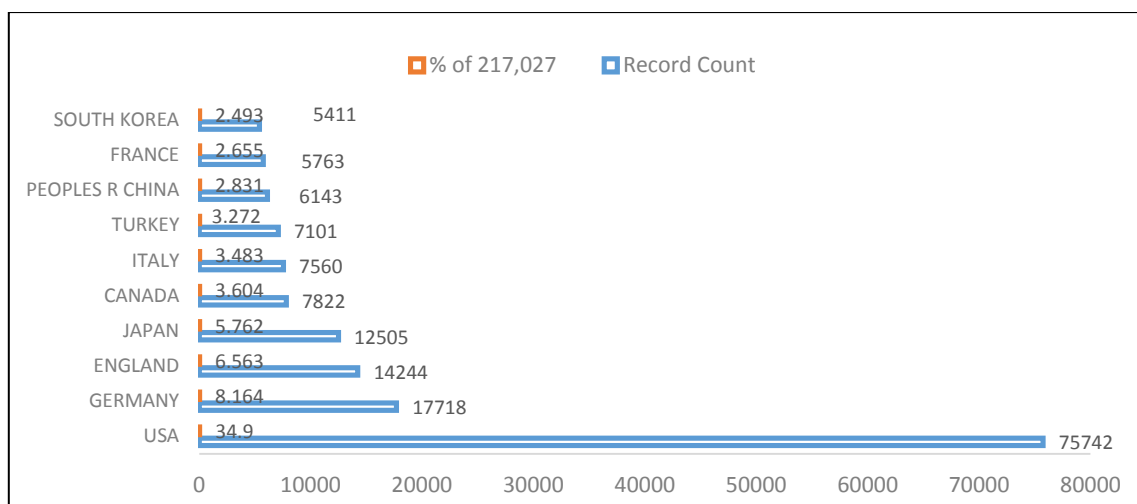
Figure 2. Top ten highly-productive countries in otorhinolaryngology publications
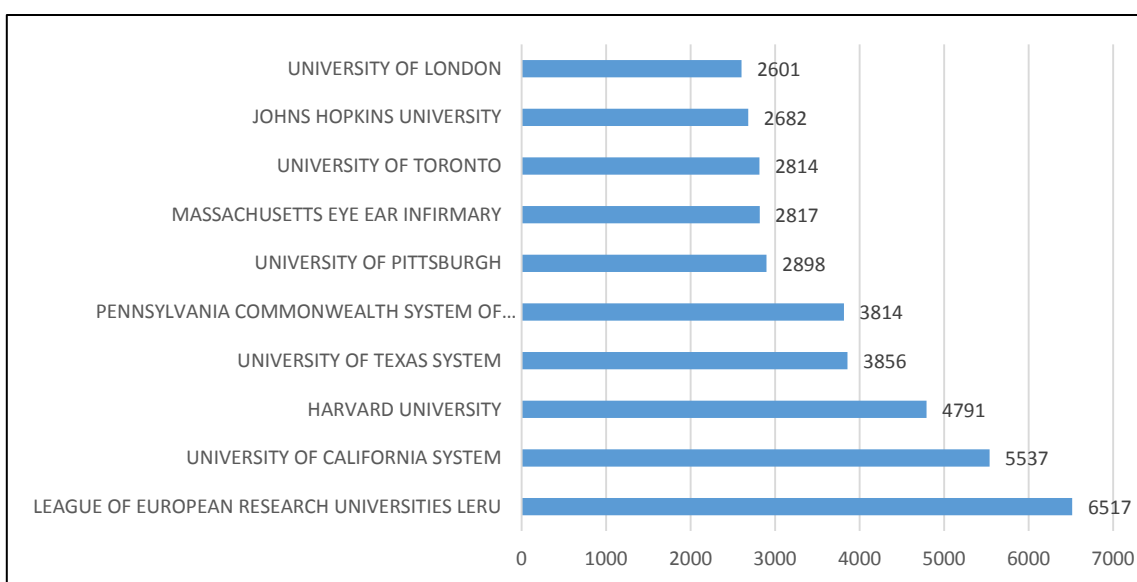

Figure 3. Top ten most-active research institutes in otorhinolaryngology

Top ten highly-publishing journals

Table 3 shows the top ten highly-publishing journals. *Laryngoscope* ranked first with publishing 17,891 papers (about 8.25% of all publications), followed by *Otolaryngology - Head and Neck Surgery* with 14,340 papers and *Journal of Laryngology and Otology* with 11,219 papers. Of these journals, *Otolaryngology - Head and Neck Surgery* had the highest IF (=3.497) in 2020.

Paper types and languages

Table 4 shows the top ten languages and types of published papers. The majority of papers were in English (n=199,069; %91,725), followed by Germany (n=14,980) and Spanish (n=1,534). The majority of papers were original articles (n=167,724; %77.28). Proceeding papers ranked second (n=24,109) and editorial material ranked third (n= 13,062).

Top ten highly-considered research areas

Figure 4 depicts the top ten highly-considered areas in the field. After otorhinolaryngology as the first-ranked area with full coverage, surgery (n=37,586; %17.32) and audiology speech language pathology (n=22,136; %10.19) ranked second and third, respectively.

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Table 3. Top ten highly-publishing journals on otorhinolaryngology

No.	Journal Title	IF$_{2020}$	Country	Number of papers	% of 217,027
1	Laryngoscope	3.325	United States	17891	8.244
2	Otolaryngology - Head and Neck Surgery	3.497	United Kingdom	14340	6.607
3	Journal of Laryngology and Otology	1.469	United Kingdom	11219	5.169
4	Acta Oto-Laryngologica	1.494	United Kingdom	10469	4.824
5	International Journal of Pediatric Otorhinolaryngology	1.675	Ireland	9395	4.329
6	European Archives of Oto-Rhino-Laryngology	2.503	Germany	8980	4.138
7	Archives of Otolaryngology - Head and Neck Surgery	2.327 (IF$_{2014}$)	United States	8288	3.819
8	Annals of Otology, Rhinology & Laryngology	1.547	United States	7912	3.646
9	head and neck-journal for the sciences and specialties of the head and neck	3.147	United States	7262	3.346
10	Hearing Research	3.208	Netherlands	7154	3.296

IF$_{2020}$: Impact Factor in 2020

Table 4. Frequency distribution of top ten languages and types of published papers in otorhinolaryngology

	Languages				Types		
Rank	Languages	Number of papers	% of 217,027	Rank	Document types	Number of papers	% of 217,027
1	English	199069	91.725	1	Articles	167724	77.283
2	German	14980	6.902	2	Proceedings Papers	24109	11.109
3	Spanish	1534	.707	3	Editorial Materials	13062	6.019
4	French	883	.407	4	Review Articles	9822	4.526
5	Turkish	259	.119	5	Letters	7954	3.665
6	Italian	163	.075	6	Meeting Abstracts	4392	2.024
7	Portuguese	148	.068	7	Notes	2202	1.015
8	Polish	7	.003	8	Book Chapters	1854	.854
9	Georgian	3	.001	9	Early Access	1346	.62
10	Welsh	2	.001	10	Corrections	1043	.481

Keyword co-occurrence map of top highly-cited papers

Out of 6,715 unique keywords used in 2000 highly-cited papers, 10 highly-occurred keywords were surgery (110), management (94), children (83), quality of life (81), squamous-cell carcinoma (78), cancer (75), head (73), radiotherapy (69), cochlear implant and noise (58) and experience (53), respectively. Keyword co-occurrence map with keywords occurred more than 30 times showed four subject clusters (Figure 5).

The first cluster (in red) included 16 keywords such as age, children, cochlea, cochlear implant, deafness, guinea-pig, hearing, hearing loss, inferior colliculus and inner-ear. The

second cluster (in green) had 13 keywords such as experience, management, outcomes, prevalence, and quality of life. The third cluster (in blue) included ten keywords, such as chemotherapy, head, head and neck cancer, neck cancer, radiation-therapy and radiotherapy. The fourth cluster (in yellow) had three keywords: deglutition, deglutition disorders and dysphagia.
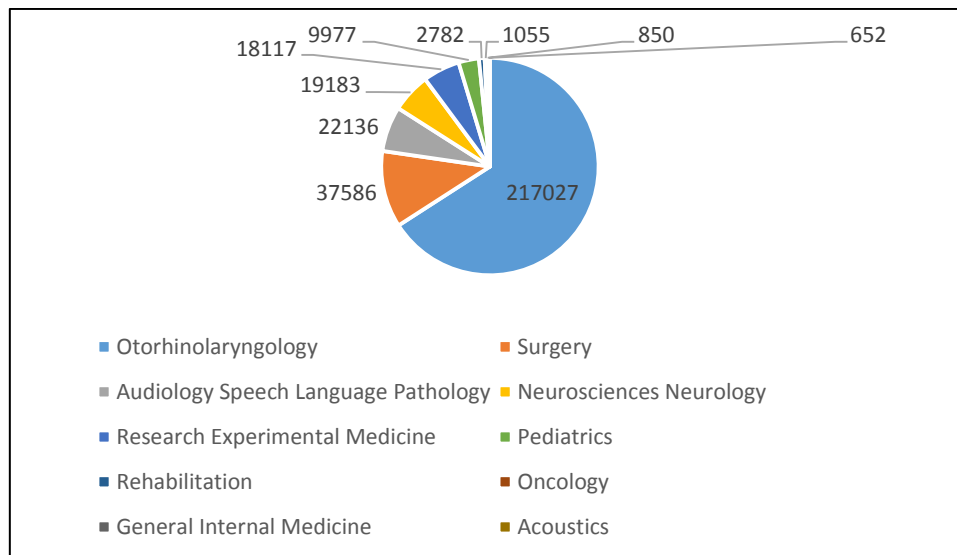

Figure 4. Top ten research areas in otorhinolaryngology field
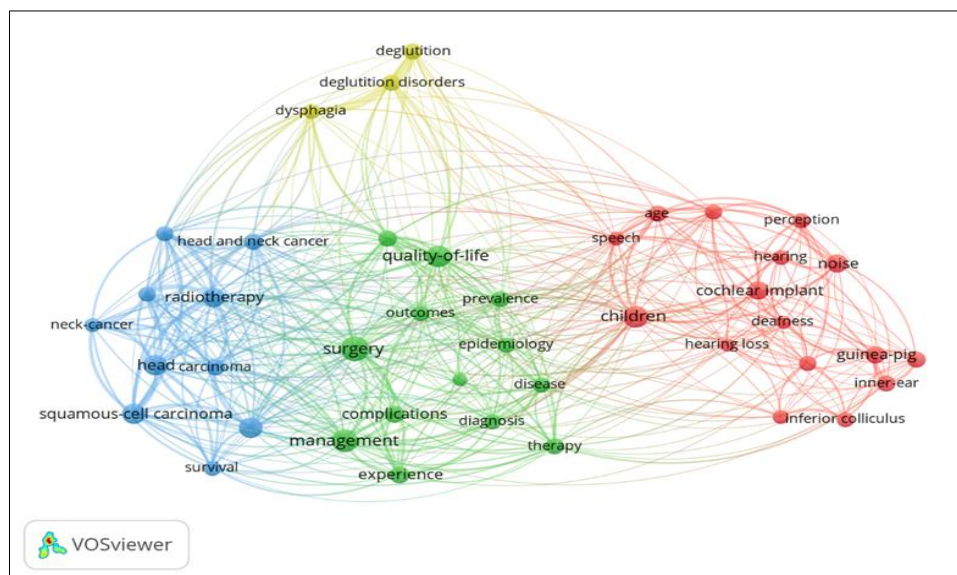

Figure 5. Keyword co-occurrence map of highly-cited papers in otorhinolaryngology

The time-based keyword co-occurrence map (Figure 6) illustrated that keywords included in light green and yellow regions have been common from 2004 onwards and are relatively newly-emerged. Ones in heavy-colored regions had been common before 2004. Main recently-used keywords were quality-of-life, outcomes, prevalence, neck-cancer, chronic rhinosinusitis, epidemiology, hearing loss and survival.
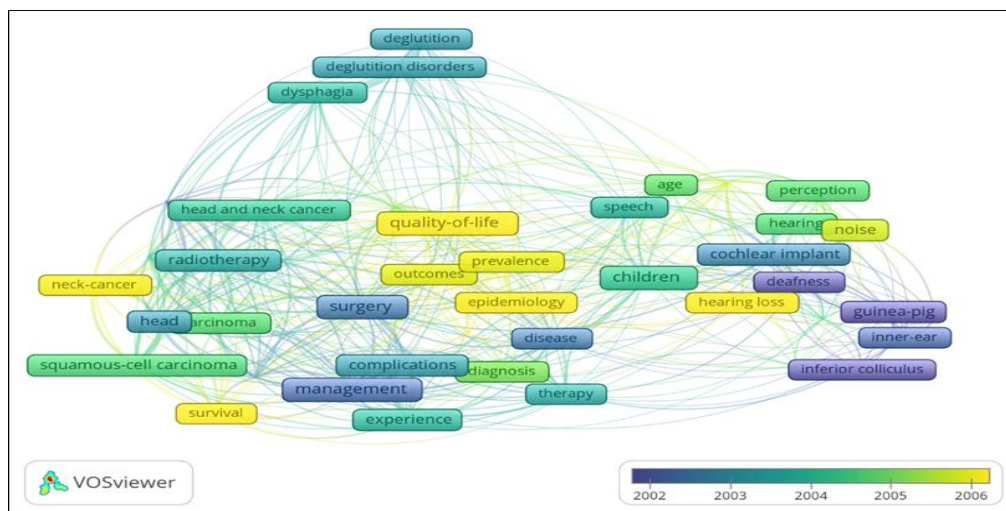
Figure 6. Time-based keyword co-occurrence map of highly-cited papers in otorhinolaryngology

Source co-citation map of highly-cited papers

9,965 sources were cited in 2000 highly-cited otorhinolaryngology papers. 871, 466, 227 and 121 sources were cited at least 10, 20, 50 and 100 times, respectively. With considering 100 as the threshold, the co-citation map was depicted for papers with at least 100 received citations (Figure 7). As can be seen, the papers published in *Laryngoscope* were cited in the highest rate. In the map, 121 main sources were presented in four clusters. The first and biggest cluster (in red) included 51 sources with the *Journal of the Acoustical Society of America* as the first ranked with 3,113 received citations. The second cluster (in green) with 43 sources included *the Laryngoscope* as the most influential source with receiving 4,809 citations. The third cluster (in blue) had 14 sources in which *Otolaryngology–Head and Neck Surgery* was the most influential with receiving 2,622 citations. The fourth cluster (in yellow) included 13 sources and *Journal of Allergy and Clinical Immunology* with 1,090 citations ranked first in the cluster. The most-cited sources were the *Laryngoscope* (4,809), *Journal of the Acoustical Society of America* (3,113), *Hearing Research* (3,072), *Otolaryngology–Head and Neck Surgery* (2,622), *Archives of Otolaryngology-Head & Neck Surgery* (2,447), *Annals of Otology, Rhinology & Laryngology (2309), Acta Oto-Laryngologica* (1911), *Ear and Hearing* (1189), *Journal of Allergy and Clinical Immunology* (1,090) and *Journal of Laryngology & Otology* (1,071), respectively.
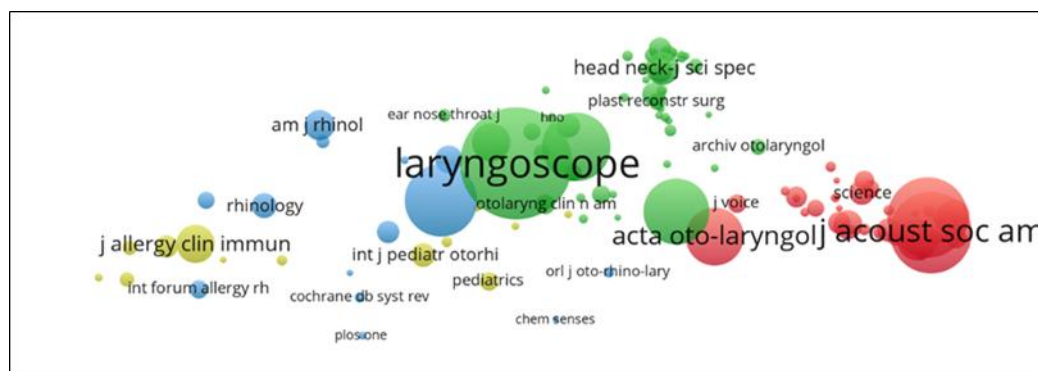

Figure 7. Co-citation map of cited sources used in highly-cited papers in otorhinolaryngology

Discussion

Publication growth rate is a symbol of scientific progression in a field, reflecting its ups and downs in publishing research output(22). Research on different aspects of otorhinolaryngology field is developing as its gradual annual growth trend shows. The field has found its way in research and development and succeeded in making helpful research output for solving its problems and developing its procedures. Its growth trend has been more visible during the recent decade.

Prolific authors can be astute scientists and they can be useful in rapid promotion of scientific discovery(23). Collaborating with them can be beneficial to researchers and increase the reach of their research. Most productive authors in otorhinolaryngology were from European countries. It seems that more contributions need to be made by researchers from other regions worldwide. African researchers had no contributions as highly-productive authors. Worldwide contribution is a suitable approach that can manifest worldwide problems and result in more focus on world's concerns in the field.

The bibliometric analysis of the highly-cited papers provides insights and research directions for medical researchers and healthcare practitioners in the future(24). The majority of highly-cited papers in otorhinolaryngology were original research articles that considered many newly-emerged and hot topics and innovative procedures in the field. These papers can reflect highly-focused issues and concerned problems for further research. Highly-productive countries in the field were some developed countries and the USA was the first-ranked country in this regard. Similar findings were reported in a previous study(19). Collaboration of other countries with these pioneering countries can potentially increase their contribution to the field and may be influential in developing theory and practice. This is true regarding top most-active research institutions as all were with American-European origin.

All of the top publishing journals as well as highly-cited journals in otorhinolaryngology are high prestigious known journals in the field with high influence as reflected in their IF rates. Some of these journals have been identified in another related study(21). Researchers' contribution to these influential journals can increase the visibility and reach of their research products.

As the majority of papers were original articles, it can be argued that some innovative approaches and concerned issues are under consideration in the otorhinolaryngology field. The fact of English being as a predominant language in papers reflects the research popularity and international-level consideration of the field.

Highly-considered areas of a field are ones that can be conceived as so-called general hot topics with a heavy research focus. These areas in otorhinolaryngology field cover some main topics ranging from surgery and audiology to oncology and pediatrics. Some of these focused-on areas have been identified in a citation analysis study (20).

Co-occurred keywords and their clustering show the interrelated topics and helpful in detecting different interests for co-authorship. Researchers in the otorhinolaryngology field can use them for finding possible co-authors for their research. Tim-based co-occurred keyword map illustrates newly-emerged topics in the field and can be helpful in finding and being informed on new research frontiers.

Clusters of co-cited sources provide a new way to study the specialty structure of science (25). The co-citation and clustering map of cited sources showed the domination of highly-impacted journals in making international collaboration in

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otorhinolaryngology. These cited sources are main role-players in the scientific development of the field.

Despite some limitations related to data extraction, selected indexing database and other natural constrains of bibliometric studies, this study is the first to give a relatively comprehensive bibliometric analysis and visualization of global research publication in otorhinolaryngology. It identified influential papers, journals, authors, research institutions, countries as well as highly-concerned keywords and subject clusters and main cited sources.

Conclusion

Being as a reference study for conducting similar bibliometric analyses and visualization, this study is beneficial to authors tracing agents for making collaboration and contributions and helpful for research policy-makers in otorhinolaryngology.

Acknowledgments

Not declared.

Conflicts of Interest

The authors declare no conflicts of interest.

Ethics

This study has been ethically approved by the Ethics Committee of Hamadan University of Medical Sciences with code number: IR.UMSHA.REC.1401.209.

Authors' ORCIDs

Heidar Mokhtari
https://orcid.org/0000-0002-2396-8634

Mohammad Karim Saberi,
https://orcid.org/0000-0002-2471-0408

Zahra Shamloo
https://orcid.org/0000-0003-1234-3070

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