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The top 100 most influential articles in allergic rhinitis from 1970 to 2018: A bibliometric analysis

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Abstract

Objective: This study aimed to identify the top 100 most influential articles in the field of allergic rhinitis (AR).

Methods: Web of Science was queried for 1970 to 2018. Articles were sorted in descending order of the citation count. All titles and abstracts were screened to identify the top 100 articles.

Results: The top 100 most influential articles in AR were identified. The earliest article was published in 1975, and the most recent in 2015. The most prolific decade was the 2000s, with 59 articles published. Twenty-nine journals contributed to the top 100 articles, with the *Journal of Allergy and Clinical Immunology* contributing most of the articles (n = 34). The top three countries of article origin were the United States (n = 34), followed by the United Kingdom and France (n = 14 each). The type of article covered clinical research (n = 68), reviews (n = 22), and basic research (n = 10). For the clinical research articles, there were 6 studies with level 1 evidence, 25 with level 2 evidence, 11 with level 3 evidence, and 26 with level 4 evidence.

Conclusions: This study identified the top 100 most influential articles in the area of AR. Recognition of important historical contributions to this field may guide future investigations into AR.

Keywords

Allergic rhinitis, bibliometric, citation analysis, immunity therapy, influential article, landmark study

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Introduction

Allergic rhinitis (AR) represents a global health problem for all age groups. To improve our understanding of AR and our ability to manage and control it effectively, a great number of articles have been published on the epidemiology, pathogenesis, diagnosis, and treatment of AR. However, it is difficult to identify the most influential articles among numerous publications.

Bibliometrics are statistical and quantitative analyses that are designed to analyze the academic impact and publication characteristics within a certain field.[1] Citation analysis is one method of bibliometric analysis that evaluates the influence and importance of an article by analyzing the citation count.[2,3] It is widely recognized in various disciplines, such as medicine,[4] respiratory medicine,[5] and neurosurgery.[6]

To the best of our knowledge, there has been no citation analysis performed in the field of AR. Therefore, we performed a citation analysis to identify the top 100 most influential articles on AR and analyzed their characteristics.

Methods

Search strategy

We used the advanced search "TI = ((allergi * rhiniti*) OR (pollen allerg*) OR (pollinos*) OR (hay fever) OR (hayfever))" in the Web of Science (WoS) core collection. The publication range was from January 1970 to August 2018 and the document types were original articles and reviews. Conference proceedings and Letters to the Editor were excluded. We also excluded some studies that did not involve AR, such as chronic idiopathic urticaria, chronic sinusitis, and grass sensitization. No language was restricted in this search. Two researchers (Q.-W.W. and R.Z.) reviewed and screened the titles and abstracts of the articles. The retrieved articles were ranked from the highest to the lowest based on the number of citations. Because no human subjects were enrolled, ethics approval was not required in this study.

Data extraction

After the articles were screened, we extracted the contents including the title of each article, the number of citations, the source of the journal, and the first author and their country. Next, based on the type of article, the publications were further divided into basic research, clinical research, and review article groups. Levels of evidence for clinical research articles were based on The Oxford 2011 Levels of Evidence.[7] The Levels of Evidence Table focuses on the issues of prevalence, diagnosis, prognosis, treatment and screening, and has been frequently used in bibliometric research. For example, a systematic review of randomized trials that is graded level 1 represents the highest level.

Statistical analysis

The data were analyzed using IBM SPSS 22.0 package (IBM Corp., Armonk, NY, USA). Descriptive statistics were quantified as counts or percentages of parameters. This study did not involve statistically significant differences.

Results

Our literature search yielded 14,270 articles between 1970 and 2018, which were further screened for the top 100 articles (Table 1).

Number of articles published

Among the top 100 articles, the oldest article was published in 1975 and the most recent was published in 2015 (Figure 1). Among these 100 articles, the most prolific

Table 1. List of the top 100 most influential articles on allergic rhinitis.

Rank	Title	Journal	Year	First Author	Institute	Citation	Class
1	Allergic rhinitis and its impact on asthma (ARIA) 2008 update (in collaboration with the World Health Organization, GA(2)LEN and AllerGen)	Allergy	2008	Bousquet J	Hospital Arnaud de Villeneuve	2130	review
2	Allergic rhinitis and its impact on asthma	Journal of Allergy and Clinical Immunology	2001	Bousquet J	Hospital Arnaud de Villeneuve	1624	review
3	Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines: 2010 Revision	Journal of Allergy and Clinical Immunology	2010	Brozek Jan L	McMaster University	684	review
4	Prevalence and rate of diagnosis of allergic rhinitis in Europe	European Respiratory Journal	2004	Bauchau V	UCB Pharma S.A.	499	4
5	Immunolocalization of cytokines in the nasal-mucosa of normal and perennial rhinitic subjects - the mast-cell as a source of IL-4, IL-5, and IL-6 in human allergic mucosal inflammation	Journal of Immunology	1993	Bradding P	Southampton University	470	technology
6	Sublingual immunotherapy for allergic rhinitis: systematic review and meta-analysis	Allergy	2005	Wilson DR	University Hospital Birmingham	459	1
7	Consensus statement on the treatment of allergic rhinitis	Allergy	2000	van Cauwenberge P	Ghent University Hospital	396	review
8	Allergic rhinitis: Definition, epidemiology, detection, and pathophysiology, diagnosis	Journal of Allergy and Clinical Immunology	2001	Skoner DR	University of Pitts-burgh School of Medicine	384	review

(continued)

Table 1. Continued.

Rank	Title	Journal	Year	First Author	Institute	Citation	Class
9	Immunotherapy with a ragweed-toll-like receptor 9 agonist vaccine for allergic rhinitis	New England Journal of Medicine	2006	Creticos Peter S	Johns Hopkins University School of Medicine	372	2
10	Intranasal corticosteroids versus oral H-1, receptor antagonists in allergic rhinitis: systematic review of randomised controlled trials	British Medical Journal	1998	Weiner JM	Monash University	365	1
11	Assessment of quality-of-life in patients with perennial allergic rhinitis with the French version of the SF-36 health-status questionnaire	Journal of Allergy and Clinical Immunology	1994	Bousquet J	Hospital Arnaud of Villeneuve	334	4
12	Optimal dose, efficacy, and safety of once-daily sublingual immuno-therapy with a 5-grass pollen tablet for seasonal allergic rhinitis	Journal of Allergy and Clinical Immunology	2007	Didie Alain	Larrey Hospital	333	2
13	Epidemiology of physician-diagnosed allergic rhinitis in childhood	Pediatrics	1994	Wright AL	The Steele Memorial Children's Research Center	305	4
14	Immediate and late airway response of allergic rhinitis patients to segmental antigen challenge - characterization of Eosinophil and mast-cell mediators	American Review of Respiratory Disease	1991	Sedgwick JB	University of Wisconsin	288	technology
15	The burden of allergic rhinitis	Allergy and Asthma Proceedings	2007	Nathan Robert A.	University of Colorado Health Sciences Center	287	review
16	Seasonal allergic rhinitis and antihistamine effects on children's learning	Annals of Allergy	1993	Vuurman EF	University of Limburg	267	4

(continued)

Table 1. Continued.

Rank	Title	Journal	Year	First Author	Institute	Citation	Class
17	Allergic Rhinitis and its Impact on Asthma (ARIA): Achievements in 10 years and future needs	Journal of Allergy and Clinical Immunology	2012	Bousquet J	Hospital Arnaud of Villeneuve	262	review
18	Drug-therapy - allergic rhinitis	New England Journal of Medicine	1991	Naclerio RM	Johns Hopkins University School of Medicine	252	review
19	Allergen injection immunotherapy for seasonal allergic rhinitis	Cochrane Database of Systematic Reviews	2007	Calderon MA	Royal Brompton Hospital	246	1
20	Obstructive apneas during sleep in patients with seasonal allergic rhinitis	American Review of Respiratory Disease	1982	McNicholas WT	Queen Elizabeth Hospital	245	3
21	Segmental bronchial provocation induces nasal inflammation in allergic rhinitis patients	American Journal of Respiratory and Critical Care Medicine	2000	Braunstahl GJ	Erasmus University Medical Center Rotterdam	244	3
22	Nasal mast cells in perennial allergic rhinitics exhibit increased expression of the Fc epsilon RI, CD40L, IL-4, and IL-13, and can induce IgE synthesis in B cells	Journal of Clinical Investigation	1997	Pawankar R	Juntendo University School of Medicine	244	technology
23	Inhibition of mediator release in allergic rhinitis by pretreatment with topical glucocorticosteroids	New England Journal of Medicine	1987	Pipkorn U	Johns Hopkins University School of Medicine	244	2

(continued)

Table 1. Continued.

Rank	Title	Journal	Year	First Author	Institute	Citation	Class
24	A survey of the burden of allergic rhinitis in Europe	Allergy	2007	Canonica GW	University of Genoa	238	4
25	Efficacy of sublingual immunotherapy in the treatment of allergic rhinitis in pediatric patients 3 to 18 years of age: a meta-analysis of randomized, placebo-controlled, double-blind trials	Annals of Allergy Asthma & Immunology	2006	Penagos Martin	University of Genoa	236	1
26	Local production of specific IgE antibodies in allergic-rhinitis patients with negative skin-tests	Lancet	1975	Huggins KG	Middlesex Hospital Medical School	231	3
27	Use of an anti-IgE humanized monoclonal antibody in ragweed-induced allergic rhinitis	Journal of Allergy and Clinical Immunology	1997	Casale TB	University of Iowa	229	3
28	Effect of omalizumab on symptoms of seasonal allergic rhinitis - A randomized controlled trial	Jama-Journal of the American Medical Association	2001	Casale TB	Creighton University	223	2
29	Recombinant humanized mAb-E25, an anti-IgE mAb, in birch pollen-induced seasonal allergic rhinitis	Journal of Allergy and Clinical Immunology	2000	Adelroth E	Umea University Hospital	219	2
30	Concomitant montelukast and loratadine as treatment for seasonal allergic rhinitis: A randomized, placebo-controlled clinical trial	Journal of Allergy and Clinical Immunology	2000	Meltzer EO	Allergy and Asthma Medical Group and Research Center (San Diego)	217	2
31	Burden of allergic rhinitis: Results from the Pediatric Allergies in America survey	Journal of Allergy and Clinical Immunology	2009	Meltzer EO	Allergy and Asthma Medical Group and Research Center (San Diego)	215	4

(continued)

Table 1. Continued.

Rank	Title	Journal	Year	First Author	Institute	Citation	Class
32	Efficacy of combination treatment with anti-IgE plus specific immunotherapy in polysensitized children and adolescents with seasonal allergic rhinitis	Journal of Allergy and Clinical Immunology	2002	Kuehr J	University Children's Hospital	209	2
33	Allergic rhinitis	Lancet	2011	Greiner Alexander N	Allergy and Asthma Medical Group and Research Center (San Diego)	207	technology
34	Omalizumab pretreatment decreases acute reactions after rush immunotherapy for ragweed-induced seasonal allergic rhinitis	Journal of Allergy and Clinical Immunology	2006	Casale TB	the Creighton University School of Medicine	205	2
35	A cost of illness study of allergic rhinitis in the United States	Journal of Allergy and Clinical Immunology	1997	Malone DC	University of Colorado Health Sciences Center	202	4
36	Airway hyperresponsiveness in allergic rhinitis - a risk factor for asthma	Chest	1987	Braman SS	Rhode Island Hospital and Brown University	201	4
37	Seasonal allergic rhinitis is associated with a detrimental effect on examination performance in United Kingdom teenagers: Case-control study	Journal of Allergy and Clinical Immunology	2007	Walker Samantha	University of Edinburgh	199	4

(continued)

Table 1. Continued.

Rank	Title	Journal	Year	First Author	Institute	Citation	Class
38	Immunohistology of the nasal-mucosa in seasonal allergic rhinitis - increases in activated eosinophils and epithelial mast-cells	Journal of Allergy and Clinical Immunology	1992	Bentley AM	Royal Brompton Hospital	198	technology
39	Quality of life in adults and children with allergic rhinitis	Journal of Allergy and Clinical Immunology	2001	Meltzer EO	The Allergy and Asthma Medical Group and Research Center	196	review
40	Allergic rhinitis and its impact on asthma update: Allergen immunotherapy	Journal of Allergy and Clinical Immunology	2007	Passalacqua Giovanni	University of Genoa	194	review
41	Absence of growth retardation in children with perennial allergic rhinitis after one year of treatment with mometasone furoate aqueous nasal spray	Pediatrics	2000	Schenkel EJ	Easton	185	2
42	Nasal congestion secondary to allergic rhinitis as a cause of sleep disturbance and daytime fatigue and the response to topical nasal corticosteroids	Journal of Allergy and Clinical Immunology	1998	Craig TJ	Penn State University	184	3
43	Severity and impairment of allergic rhinitis in patients consulting in primary care	Journal of Allergy and Clinical Immunology	2006	Bousquet J	Hospital Arnaud of Villeneuve	167	3
44	Montelukast for treating seasonal allergic rhinitis: a randomized, double-blind, placebo-controlled trial performed in the spring	Clinical and Experimental Allergy	2002	Philip G	Merck Research Laboratories	167	2

(continued)

Table 1. Continued.

Rank	Title	Journal	Year	First Author	Institute	Citation	Class
45	Low-dose sublingual therapy in patients with allergic rhinitis due to house dust mite	Clinical Allergy	1986	Scadding GK	Middlesex Hospital Medical School	163	3
46	Exhaled and nasal NO levels in allergic rhinitis: relation to sensitization, pollen season and bronchial hyperresponsiveness	European Respiratory Journal	1999	Henriksen AH	Norwegian University of Science and Technology	161	3
47	Epidemiological characterization of the intermittent and persistent types of allergic rhinitis	Allergy	2005	Bauchau V	UCB Pharma S.A	148	4
48	Economic impact and quality-of-life burden of allergic rhinitis	Current Medical Research and Opinion	2004	Schoenwetter WF	Park Nicollet Clinic	148	review
49	Economic impact of workplace productivity losses due to allergic rhinitis compared with select medical conditions in the United States from an employer perspective	Current Medical Research and Opinion	2006	Lamb Charles	PCA Occupational Medicine	146	4
50	Levocetirizine improves quality of life and reduces costs in long-term management of persistent allergic rhinitis	Journal of Allergy and Clinical Immunology	2004	Bachert C	Ghent university Hospital	146	2
51	Characteristics of intermittent and persistent allergic rhinitis: DREAMS study group	Clinical and Experimental Allergy	2005	Bousquet J	Hospital Arnaud of Villeneuve	142	4
52	Prevalence, classification and perception of allergic and nonallergic rhinitis in Belgium	Allergy	2006	Bachert C	Ghent University Hospital	141	4

(continued)

Table 1. Continued.

Rank	Title	Journal	Year	First Author	Institute	Citation	Class
53	The economic burden of allergic rhinitis - A critical evaluation of the literature	Pharmacoeconomics	2004	Reed	SD	Duke University Medical Center	140	review
54	Efficacy and tolerability of montelukast alone or in combination with loratadine in seasonal allergic rhinitis: a multicenter, randomized, double-blind, placebo-controlled trial performed in the fall	Annals of Allergy Asthma & Immunology	2002	Nayak AS	University of Illinois	138	2
55	Once daily intranasal fluticasone propionate (200 mu g) reduces nasal symptoms and inflammation but also attenuates the increase in bronchial responsiveness during the pollen season in allergic rhinitis	Journal of Allergy and Clinical Immunology	1996	Foresi A	Serbizio di Fisiopatologia Respiratoria	138	2
56	Leukotriene receptor antagonists for allergic rhinitis: A systematic review and meta-analysis	American Journal of Medicine	2004	Wilson AM	McMaster University	137	1
57	Intranasal corticosteroids versus topical H-1 receptor antagonists for the treatment of allergic rhinitis: a systematic review with meta-analysis	Annals of Allergy Asthma & Immunology	2002	Yanez A	Hospital Aerona útico Central	134	1
58	The expression of leukocyte-endothelial adhesion molecules is increased in perennial allergic rhinitis	American Journal of Respiratory Cell and Molecular Biology	1992	Montefort S	Southampton General Hospital	134	technology

(continued)

Table 1. Continued.

Rank	Title	Journal	Year	First Author	Institute	Citation	Class
59	Omalizumab, an anti-IgE antibody, in the treatment of adults and adolescents with perennial allergic rhinitis	Annals of Allergy Asthma & Immunology	2003	Chervinsky P	Northeast Medical Research Associates	133	2
60	The leukotriene D-4-receptor antagonist, ICI-204,219, relieves symptoms of acute seasonal allergic rhinitis	American Journal of Respiratory and Critical Care Medicine	1995	Donnelly AL	University of Iowa College of Medicine	133	2
61	A survey of the burden of allergic rhinitis in the USA	Allergy	2007	Schatz M	Kaiser Permanente Medical Center	131	4
62	Allergen drives class switching to IgE in the nasal mucosa in allergic rhinitis	Journal of Immunology	2005	Takhar P	King's College London	131	technology
63	Double-blind, placebo-controlled study comparing the efficacy and safety of fexofenadine hydrochloride (120 and 180 mg once daily) and cetirizine in seasonal allergic rhinitis	Journal of Allergy and Clinical Immunology	1999	Howarth PH	Southampton General Hospital	131	2
64	Allergic rhinitis and its consequences on quality of sleep - An unexplored area	Archives of Internal Medicine	2006	Leger Damien	Assistance Public Hospital of Paris	127	4
65	Validation of the classification of ARIA (allergic rhinitis and its impact on asthma)	Allergy	2003	Demoly P	Hospital Arnaud de Villeneuve	127	4
66	Allergen-induced release of sulfidopeptide leukotrienes (SRS-A) and LTB4 in allergic rhinitis	Allergy	1985	Shaw RJ	Brompton Hospital	127	technology

(continued)

Table 1. Continued.

Rank	Title	Journal	Year	First Author	Institute	Citation	Class
67	Nasal nitric oxide is increased in allergic rhinitis	Clinical and Experimental Allergy	1997	Arnal JF	Hospital Rangueil	124	technology
68	Evaluation of impermeable covers for bedding in patients with allergic rhinitis	New England Journal of Medicine	2003	Terreehorst I	Erasmus Medical Center	123	2
69	The role of leukotriene-D4 in allergic rhinitis	Annals of Allergy	1988	Okuda M	Nippon Medical School	123	technology
70	Quality of life in patients with allergic rhinitis	Annals of Allergy Asthma & Immunology	2000	Thompson AK	McMaster University	122	review
71	Prevalence of allergic rhinitis in the United States	Journal of Allergy and Clinical Immunology	1997	Nathan RA	Colorado Springs	122	4
72	An intranasal Syk-kinase inhibitor (R112) improves the symptoms of seasonal allergic rhinitis in a park environment	Journal of Allergy and Clinical Immunology	2005	Meltzer EO	Allergy and Asthma Medical Group and Research Center (San Diego)	121	2
73	The cost of productivity losses associated with allergic rhinitis	American Journal of Managed Care	2000	Crystal-Peters J	Washington	120	4
74	Segmental bronchoprovocation in allergic rhinitis patients affects mast cell and basophil numbers in nasal and bronchial mucosa	American Journal of Respiratory and Critical Care Medicine	2001	Braunstahl GJ	Erasmus University Medical Center Rotterdam	119	3

(continued)

Table 1. Continued.

Rank	Title	Journal	Year	First Author	Institute	Citation	Class
75	Clinical Practice Guideline: Allergic Rhinitis	Otolaryngology-Head and Neck Surgery	2015	Seidman Michael D	Henry Ford West Bloomfield Hospital West Bloomfield	118	review
76	Implementation of guidelines for seasonal allergic rhinitis: a randomized controlled trial	Allergy	2003	Bousquet J	Hospital Arnaud de Villeneuve	115	2
77	Comparison of the efficacy, safety and quality of life provided by fexofenadine hydrochloride 120 mg, loratadine 10 mg and placebo administered once daily for the treatment of seasonal allergic rhinitis	Clinical and Experimental Allergy	2000	Van Cauwenberge P	Ghent University Hospital	115	2
78	Seasonal and perennial allergic rhinitis: is this classification adherent to real life?	Allergy	2005	Ciprandi G	S. Martino Hospital	114	4
79	Allergic rhinitis: A disease remodeling the upper airways?	Journal of Allergy and Clinical Immunology	2004	Bousquet J	Hospital Arnaud de Villeneuve	114	review
80	Breathing disorders in sleep associated with microarousals in patients with allergic rhinitis	Acta Oto-Laryngologica	1981	Lavie P	Rothschild University Hospital	114	4
81	A placebo-controlled trial of immunotherapy with 2 extracts of Dermatophagoides pteronyssinus in allergic rhinitis, comparing clinical outcome with changes in antigen-specific IgE, IgG, and IgG subclasses	Journal of Allergy and Clinical Immunology	1990	McHugh SM	University of Cambridge Clinical School	113	2

(continued)

Table 1. Continued.

Rank	Title	Journal	Year	First Author	Institute	Citation	Class
82	Allergic rhinitis: Direct and indirect costs	Allergy and Asthma Proceedings	2010	Blaiss Michael S	University of Tennessee Health Science Center	112	review
83	Inflammatory mediators in allergic rhinitis	Journal of Allergy and Clinical Immunology	2004	Gelfand Erwin W	National Jewish Medical and Research Center	112	review
84	Bronchial hyperresponsiveness and airway inflammation markers in nonasthmatics with allergic rhinitis	European Respiratory Journal	2000	Polosa R	University of Catania	112	4
85	Learning impairment and allergic rhinitis	Allergy and Asthma Proceedings	1996	Simons FER	University of Manitoba	112	review
86	Plasma kallikrein during experimentally induced allergic rhinitis - role in kinin formation and contribution to tameesterase activity in nasal secretions	Journal of Immunology	1986	Baumgarten CR	The Johns Hopkins University School of Medicine	111	technology
87	Comparison of a nasal glucocorticoid, antileukotriene, and a combination of antileukotriene and antihistamine in the treatment of seasonal allergic rhinitis	Journal of Allergy and Clinical Immunology	2002	Pullerits T	Göteborg University	110	2
88	Effects of monotherapy with intranasal corticosteroid or combined oral histamine and leukotriene receptor antagonists in seasonal allergic rhinitis	Clinical and Experimental Allergy	2001	Wilson AM	University of Dundee	110	3

(continued)

Table 1. Continued.

Rank	Title	Journal	Year	First Author	Institute	Citation	Class
89	Different effects of nasal and bronchial glucocorticosteroid administration on bronchial hyperresponsiveness in patients with allergic rhinitis	American Review of Respiratory Disease	1992	Aubier M	Hospital Bichat	110	3
90	Molecular spreading and predictive value of preclinical IgE response to Phleum pratense in children with hay fever	Journal of Allergy and Clinical Immunology	2012	Hatzler Laura	Charite University Medical Centre	108	4
91	Requirements for medications commonly used in the treatment of allergic rhinitis - European Academy of Allergy and Clinical Immunology (EAACI) allergic rhinitis and its impact on asthma (ARIA)	Allergy	2003	Bousquet J	Hospital Arnaud de Villeneuve	107	review
92	Overview of comorbid associations of allergic rhinitis	Journal of Allergy and Clinical Immunology	1997	Spector SL	University of California	106	review
93	Randomised controlled trial of homoeopathy versus placebo in perennial allergic rhinitis with overview of four trial series	British Medical Journal	2000	Taylor MA	Glasgow Royal Infirmary	104	2
94	Lower airways remodeling in nonasthmatic subjects with allergic rhinitis	Laboratory Investigation	1996	Chakir J	University Laval	104	4
95	Changes in daytime sleepiness, quality of life, and objective sleep patterns in seasonal allergic rhinitis: A controlled clinical trial	Journal of Allergy and Clinical Immunology	2004	Stuck BA	University Hospital Mannheim	103	4

(continued)

Table 1. Continued.

Rank	Title	Journal	Year	First Author	Institute	Citation	Class
96	Treatment of perennial allergic rhinitis with lactic acid bacteria	Pediatric Allergy and Immunology	2004	Wang MF	China Medical University Hospital	103	2
97	Local production and detection of (specific) IgE in nasal B-cells and plasma cells of allergic rhinitis patients	European Respiratory Journal	2000	KleinJan A	Erasmus University Medical Centre Rotterdam	103	4
98	A dose-ranging study of fluticasone propionate aqueous nasal spray for seasonal allergic rhinitis assessed by symptoms, rhinomanometry, and nasal cytology	Journal of Allergy and Clinical Immunology	1990	Meltzer EO	Allergy and Asthma Medical Group and Research Center (San Diego)	103	4
99	Local allergic rhinitis: Concept, pathophysiology, and management	Journal of Allergy and Clinical Immunology	2012	Rondon Carmen	Carlos Haya Hospital	102	review
100	Fluticasone furoate nasal spray: A single treatment option for the symptoms of seasonal allergic rhinitis	Journal of Allergy and Clinical Immunology	2007	Kaiser Harold B	Minneapolis	102	2

decade was the 2000s (n = 59), followed by the 1990s (n = 25), the 1980s (n = 8), the 2010s (n = 7), and the 1970s (n = 1).

Number of citations

Among these 100 articles, the highest citation count was 2130 and the lowest was 102. The average citation count for a single article in the 1970s, 1980s, 1990s, 2000s, and 2010s was 231.0, 166.0, 197.2, 238.0, and 227.6, respectively.

Published journals

The 100 most influential articles were published in 29 journals. Among these journals, those with more than one article published and its impact factor are listed in Table 2. The top journals were *Journal of Allergy and Clinical Immunology* (n = 34), *Allergy*

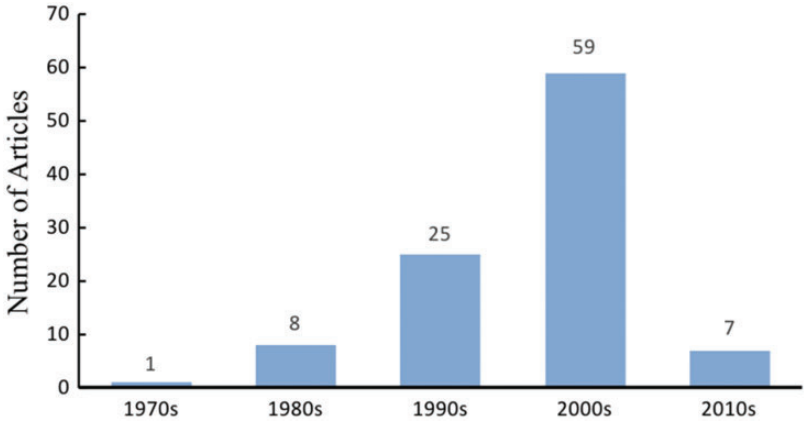

Figure 1. Decades of publication.

Table 2. Journals with more than one published article.

Journal	No. of Articles (n = 86)	Impact Factor 2017
Journal of Allergy and Clinical Immunology	34	13.3
Allergy	12	6.0
Clinical and Experimental Allergy	5	5.2
Annals of Allergy Asthma & Immunology	5	3.3
European Respiratory Journal	4	12.2
New England Journal of Medicine	4	79.3
Allergy and Asthma Proceedings	3	2.2
American Journal of Respiratory and Critical Care Medicine	3	15.2
American Review of Respiratory Disease	3	Not found
Journal of Immunology	3	4.5
Annals of Allergy	2	Not found
British Medical Journal	2	23.6
Current Medical Research and Opinion	2	2.7
The Lancet	2	53.3
Pediatrics	2	5.5

(n = 12), *Clinical and Experimental Allergy* (n = 5), and *Annals of Allergy Asthma & Immunology* (n = 5).

Origins

These articles were mainly from 17 countries. Among these countries (Figure 2), the top three were the USA (n = 34), the UK (n = 14), and France (n = 14). The second tier of countries included Italy (n = 6), which was followed by Canada (n = 6), Belgium (n = 6), The Netherlands (n = 4), Germany (n = 3), Sweden (n = 2), and Japan (n = 2). An equal number of articles originated from Spain, Norway, Israel, The Netherlands, China, Australia, and Argentina (n = 1, each).

First authors

There were 80 first authors who contributed to these articles. There were nine first authors who had published more than 1 article (Table 3). The top three authors included Bousquet J (n = 9), Meltzer EO (n = 5), and Casale TB (n = 3). The number of publications for Bachert C, Bauchau V, Braunstahl GJ, Nathan RA, van Cauwenberge P, and Wilson AM were the same (n = 2, each).

Institutions

These articles came from 71 different institutions. There were 13 institutions with >1 published article (Table 4). Among them, the top three were Hospital Arnaud de Villeneuve (n = 10), Allergy and Asthma Medical Group and Research Center of San Diego (n = 5), and Ghent University Hospital (n = 4).

Table 3. First authors with more than one published article

First Author	No. of Articles (n = 29)
Bousquet J	9
Meltzer EO	5
Casale TB	3
Bachert C	2
Bauchau V	2
Braunstahl GJ	2
Nathan RA	2
van Cauwenberge P	2
Wilson AM	2

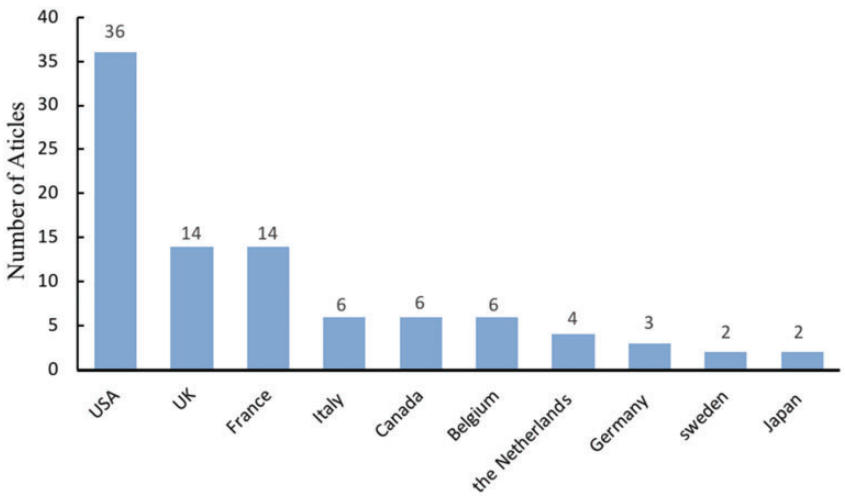

Figure 2. Article counts by origin with >1 published article.

Table 4. Institutions with more than one published article

Institution	No. of Articles (n = 43)
Hospital Arnaud de Villeneuve	10
Allergy and Asthma Medical Group and Research Center (San Diego)	5
Ghent University Hospital	4
Erasmus University Medical Center Rotterdam	3
Johns Hopkins University School of Medicine	3
McMaster University	3
University of Genoa	3
Middlesex Hospital Medical School	2
Royal Brompton Hospital	2
Southampton General Hospital	2
UCB Pharma S.A	2
University of Colorado Health Sciences Center	2
University of Iowa	2

The type of articles

Among these articles, the number of articles on clinical research, reviews, and basic research was 68, 22, and 10, respectively. Among the reviews, there were six articles about guidelines. Most of the basic research articles focused on immune response.

The level of evidence

Among the clinical research articles, 6, 25, 11, and 26 were graded as having Level 1, Level 2, Level 3, and Level 4 evidence, respectively, based on The Oxford 2011 Levels of Evidence.[7]

Study types of clinical articles

The study types of clinical articles mostly included case-series/retrospective studies (n = 26), followed by randomized controlled trials (n = 25), non-randomized controlled cohort studies (n = 11), and systematic reviews/meta-analyses (n = 6). There were 27 of 68 articles that used a questionnaire, such as health-related quality of life (HRQoL) or the rhinoconjunctivitis quality of life questionnaire (RQLQ).

Based on the treatment modalities for clinical research articles, most were immunity therapy (n = 22), followed by intranasal corticosteroids and quality of daily life (n = 10, each).

Discussion

In our study, bibliometric analysis was used to identify the top 100 most influential articles in AR. These articles are representative of the many landmarks in AR over the past decades.

The top three articles were guidelines on Allergic Rhinitis and its Impact on Asthma (ARIA). The results demonstrate that guidelines are the most cited articles, but this is different from other bibliometric studies. These bibliometric studies often reported that basic research articles and clinical research articles are the most cited articles.[5,6,8] Because of the time-dependent citation analysis,[9] recent important articles might not have sufficient citations. For example, the ARIA guidelines 2016 revision[10] and the ARIA score for AR using mobile technology that correlates with the quality of life[11] was not in this top 100 list. This indicates that the number of citations that a paper has received may not reflect its overall historical importance.

With the exception of the 2010s, the number of articles increased by decade. Thus, more than half of the articles in our study were published in the 2000s. The mean number of citations also tended to increase by decade except for the 1970s. These findings are consistent with those of other bibliometric studies.[6,8,12] The results demonstrate that new articles with novel discoveries and advanced technologies continue to be published and receive more citations than previous articles.

Some bibliometric studies reported that journals with high impact factors, such as *NEJM* and *The Lancet*, were the leading journals.[5,13] However, we found that the *Journal of Allergy and Clinical Immunology* was the most productive journal, despite its impact factor of 13.3. Other bibliometric studies[6,12,14] also reported that specialized journals were the leading journals. The results showed that highly influential articles are also published in specialized journals, and these influential articles are not limited to the most well-known general medical journal.

Among the top 100 list, most articles originated from developed countries in Europe and North America. Only one article on the list came from Taiwan China. Another important article on the list came from mainland China and reported the prevalence of self-reported AR in China.[15] Because biomedical research output is largely dependent on a country's gross national product (GNP) and the expenditure allotted for research and development (R&D),[16] authors in China will have an increasingly important place in the field of AR because of their increasing GNP and expenditure on R&D.

Some bibliometric articles reported that the most productive authors and institutions always came from the USA.[6,13,14] In our study, although authors from the USA contributed most of the studies in the top 100 list, it is notable that Bousquet J was the first author who contributed 9 articles and his affiliated institution, Hospital Arnaud de Villeneuve in France, was the most prolific institution. Examination of the articles showed that he contributed most of the guidelines on ARIA. This finding is consistent with the bibliometric article on asthma.[5]

Throughout the top 100 list, most articles were clinical research articles, and basic research articles only accounted for 10% of these publications. This finding is similar to a bibliometric article on asthma.[5] The results may show that referring to clinical evidence is more favored compared with referring to basic research.

Some bibliometric articles on surgical tumors reported that more than half of the articles were low-quality Level 4 and there were many challenges for conducting randomized controlled surgical trials, such as multicenter collaborations, a large number of personnel, and a large funding requirement.[14,17] In our study, nearly half of the clinical articles were Level 1 and Level 2 based on the level-of-evidence grading. This result shows that high-quality level of studies for internal medicine is relatively easy to conduct and that these studies will receive more citations compared with low-quality studies.

There are various therapies for AR. In our study, most treatments for clinical research articles are immunity therapy and intranasal corticosteroids. Additionally, the questionnaires, such as HRQoL and RQLQ, were chosen to assess the clinical symptoms in most of the clinical research articles. To some extent, these findings reflect the performance of the guidelines in clinical practice.

Some limitations of this paper must be mentioned. First, the citation count used for citation analysis did not include self-citations and conference reports. Second, because of the influence of certain time factors, most recently published articles would

be unfavorably affected in the citation analysis. Third, because of the limitations of our search formula and WoS, some well-known papers may have been missed.[18]

Conclusions

To the best of our knowledge, this is the first bibliometric study to identify the most influential articles in the area of AR and to provide a historical perspective on the progress of research on AR. The findings indicate that guidelines and articles with novel discoveries, advanced technologies, and high-quality evidence will receive more citations. Recognition of important historical contributions to this field may guide future investigations into AR.

Author contributions

All authors were involved in the study. Q.-T. Yang conceived and designed the study. Q.-W. Wu analyzed the data and wrote the paper. R. Zheng performed the search strategy and wrote the paper. W.-H. Wang performed the search strategy. H.-J. Qiu and X.-K. Huang collected the data.

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Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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