• Bibliometric Research •

Top 100 cited articles in ophthalmic epidemiology between 2006 and 2016

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Abstract

• AIM: To identify the most-cited articles in ophthalmic epidemiology over the last decade.

• METHODS: We performed a cited reference search on articles that were included in the ISI Web of Science database using the terms "Epidemi*" AND "ophthalm*" AND "population*" during year 2006 to 2016. TOP 100 most cited articles (T100) in ophthalmic epidemiology were short listed and analysed using bibliometrics.

• RESULTS: These top 100 articles in ophthalmic epidemiology were cited between 61 to 333 times. Of these T100 articles, 36% originated from United States, and 34% were published in the *Ophthalmology* journal. The three major topics identified were age-related macular degeneration (AMD, *n*=23), glaucoma (*n*=16) and visual impairment (*n*=12). The top-cited article was a study on outdoor activities and its association with the prevalence of myopia in school-aged children, published in 2008.

• CONCLUSION: This bibliometric analysis provides useful insights into the current development in ophthalmic epidemiology in the past decade and can help recognizing the quality of the researches, discoveries, and trends steering ophthalmic epidemiology.

• **KEYWORDS:** epidemiology; ophthalmology; article; citation; bibliometric analysis

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INTRODUCTION

Bibliometric study is the quantitative analysis of written publications such as journal articles using statistical and mathematical methods[1-2]. This approach is useful in evaluating trends in research over time. Currently, bibliometric analysis is widely used in the determination and evaluation of influential literature[3-4]. Bibliometric study also helps to identify the frequency of citations and thus the impact of scientific articles post-publication[5-6]. Reviewing the most frequently cited articles help researchers to identify areas in certain specialties that may require further investigation.

In the area of ophthalmology, ophthalmic epidemiology has seen significant advancement for the past ten years. Ophthalmic epidemiology study usually involves collaboration of multidisciplinary groups of researchers, including those from the areas of ophthalmology, epidemiology, statistics and public health. Thus, the ophthalmic epidemiology bibliometric analysis encompasses publications from numerous study groups varying among specialties and countries of origin, and appearing in a range of scientific journals. Furthermore, these advances in ophthalmic epidemiology are important as they provide useful information on the trends of eye diseases and have great impact on the promotion of eye and vision health[7-9]. In addition, the most influential articles and the focus of study fields can be evaluated by analyzing the most highly cited articles. In 2008, a literature review and interpretation on population-based studies in ophthalmology has been applied to summarize key questions, and to highlight future insights for this area[10]. However, similar review or bibliometric analysis has not yet been performed in the area of ophthalmic epidemiology since 2008. Hence, the purpose of this work

Table 1 Journals selected for screening

No.	Name of journals	No.	Name of journals
1	*Acta Ophthalmologica*	31	*Journal of Glaucoma*
2	*American Journal of Ophthalmology*	32	*Journal of Neuro-Ophthalmology*
3	*Annual Review of Vision Science*	33	*Journal of Ocular Pharmacology and Therapeutics*
4	*Arquivos Brasileiros De Oftalmologia*	34	*Journal of Ophthalmology*
5	*BMC Ophthalmology*	35	*Journal of Pediatric Ophthalmology & Strabismus*
6	*British Journal of Ophthalmology*	36	*Journal of Refractive Surgery*
7	*Canadian Journal of Ophthalmology-Journal Canadien D Ophtalmologie*	37	*Journal of Vision*
8	*Clinical and Experimental Ophthalmology*	38	*Klinische Monatsblatter Fur Augenheilkunde*
9	*Clinical and Experimental Optometry*	39	*Molecular Vision*
10	*Contact Lens & Anterior Eye*	40	*Ocular Immunology and Inflammation*
11	*Cornea*	41	*Ocular Surface*
12	*Current Eye Research*	42	*Ophthalmic and Physiological Optics*
13	*Current Opinion in Ophthalmology*	43	*Ophthalmic Epidemiology*
14	*Cutaneous and Ocular Toxicology*	44	*Ophthalmic Genetics*
15	*Documenta Ophthalmologica*	45	*Ophthalmic Plastic and Reconstructive Surgery*
16	*European Journal of Ophthalmology*	46	*Ophthalmic Research*
17	*Experimental Eye Research*	47	*Ophthalmic Surgery Lasers & Imaging Retina*
18	*Eye*	48	*Ophthalmologe*
19	*Eye & Contact Lens-Science and Clinical Practice*	49	*Ophthalmologica*
20	*Graefes Archive for Clinical And Experimental Ophthalmology*	50	*Ophthalmology*
21	*Indian Journal of Ophthalmology*	51	*Optometry and Vision Science*
22	*International Journal of Ophthalmology*	52	*Perception*
23	*International Ophthalmology*	53	*Progress in Retinal and Eye Research*
24	*Investigative Ophthalmology & Visual Science*	54	*Retina-The Journal of Retinal And Vitreous Diseases*
25	*JAMA Ophthalmology*	55	*Seminars in Ophthalmology*
26	*Japanese Journal of Ophthalmology*	56	*Survey of Ophthalmology*
27	*Journal Francais D Ophtalmologie*	57	*Translational Vision Science & Technology*
28	*Journal of Aapos*	58	*Vision Research*
29	*Journal of Cataract And Refractive Surgery*	59	*Visual Neuroscience*
30	*Journal of Eye Movement Research*		

was to reviewed the characteristics of the top 100 most cited articles (T100) in ophthalmic epidemiology in the past decade, from 2006-2016. These findings will provide new insights on the research trends in ophthalmic epidemiology.

MATERIALS AND METHODS

Search Strategy From the Journal Citation Reports 2017 database, we identified 59 ophthalmology-related journals. ISI Web of Science (Institute for Scientific Information, Thomson Scientific, Philadelphia, Pennsylvania) database was further used to determine the number of citations of articles published in the identified 59 journals (Table 1) and 4 top general medicine journals including *Journal of The American Medical Association (JAMA)*, *The New England Journal of Medicine (NEMJ)*, *The LANCET* and *The British Medical Journal (BMJ)*. The retrieved articles were strictly limited to studies in the field of ophthalmic epidemiology, searched and filtered using the terms [Epidemi* AND ophthalm* AND population*]. All abstracts for studies discovered during the search process were thoroughly reviewed and evaluated before being included in the study.

Inclusion and Exclusion Criteria The inclusion criteria for articles were as follow: 1) epidemiological studies on eye diseases; 2) population-based study design; 3) cross-sectional or cohort study design; 4) written in English; 5) published between January 2006 and December 2016. We excluded articles for the following reasons: 1) conference abstracts, reviews, letters, and editorials; 2) Meta-analysis; 3) published in languages other than English.

The search was performed by two researchers (Liu L and Wu JY) independently in July 2017. The inconsistent outcomes were resolved by discussion within all the authors. The T100 were selected based on the following parameters: title, journal, citation frequency, authorship, institution, country of origin, and categories of research topics [*e.g.* age-related macular degeneration (AMD), diabetic retinopathy (DR), myopia, and visual impairment]. All contributing authors of the articles

were included in the search to find the most-published, and not just the corresponding author for each paper.

Statistical Analysis All outcomes were exported into Microsoft Excel spreadsheets. We used a median and interquartile range (IQR) to present the average citation number. If more than two articles were cited by the same frequency, they would be provided the same ranking in the list.

RESULTS

Citation Count, Citations per Year and Publication Year The total number of citations of the T100 ranged from 61 to 333, with a median of 99.5 (IQR: 81-146.25). Approximately 6% of the total citation count was from self-citations. The number of citations per year ranged from 6.1 to 33.3. The median number of citations per year was 10.46 (IQR: 8.21-15.24).

Table 2 demonstrates the T100 in ophthalmic epidemiology, categorised by publication year. Year 2008 recorded the highest number of citations (3832) from 31 articles.

Journals, Origins, Institution and Authorship The T100 in ophthalmic epidemiology were published in 11 different journals (Table 3). Among which, were *Ophthalmology*, *Archives of Ophthalmology*, *Investigative Ophthalmology Visual Science*, and *American Journal of Ophthalmology* were the top 4 journals which published 12 or more of these articles each. In addition, there were 2 articles from *JAMA* and 1 article from *The Lancet*, respectively. The latest impact factors of these 11 journals ranged from 1.758 to 47.831 (based on 2016 Journal Citation Reports, Thomson Reuters).

The region of origins of the T100 were shown in Table 4. The T100 were produced from 17 regions. Of which, 36 articles were from USA, with total citation numbers of 4654. There were 18 articles (2443 citations) from Singapore and 16 articles (1765 citations) from China. Notably, there were 2 articles from Kenya and Nigeria regarding visual impairment which gained 76 and 63 citations, respectively.

Distribution by Topic Type Table 5 showed the main research topics published among the T100. In total, 17 fields were covered. Notably, AMD was the most common topic (n=23), followed by glaucoma (n=16), visual impairment (n=12), myopia (n=9), and DR (n=9).

DISCUSSION

In this current bibliometric analysis, we screened 59 ophthalmology-related journals to determine the T100 in field of ophthalmic epidemiology using the ISI Web of Science, for publication year 2006 to 2016. The T100 were published in 11 journals, most were published in *Ophthalmology* (n=34), followed by *Archives of Ophthalmology* (current known as *JAMA Ophthalmology*, n=21) and *Investigative Ophthalmology Visual Science* (n=19). These three journals are associated with the subject category of ophthalmic epidemiology, which in many ways is the cornerstone of population-based eye study. In addition, the T100 were produced by 17 different

Table 2 T100 in ophthalmic epidemiology, categorised by publication year

Publication year	No. of manuscripts in the T100	No. of citations
2008	31	3832
2006	28	3403
2009	14	1684
2007	12	1578
2010	8	1106
2012	3	270
2011	2	305
2013	2	246

T100: Top 100 most-cited articles.

Table 3 Journals which published the T100 in ophthalmic epidemiology

Journals	No. of manuscripts in the T100	IF as of 2016	No. of citations
Ophthalmology	34	8.204	4425
Archives of Ophthalmology	21	5.625	2830
Investigative Ophthalmology Visual Science	19	3.303	2277
American Journal of Ophthalmology	12	5.052	1178
British Journal of Ophthalmology	4	3.806	409
Ophthalmic Epidemiology	3	1.758	496
Journal of The American Medical Association (*JAMA*)	2	44.405	407
Eye	2	2.275	155
Cornea	1	2.01	73
Lancet	1	47.831	111
Ocular Surface	1	4.382	63

IF: Impact factor; T100: Top 100 most-cited articles.

Table 4 Region of origins for the T100 in ophthalmic epidemiology

Regions	No. of articles	Total No. of citations
USA	36	4654
Singapore	18	2443
China	16	1765
Australia	7	1050
Japan	5	833
England	4	513
Netherlands	1	85
Greece	2	143
South Korea	2	186
India	2	176
Kenya	1	76
France	1	125
Taiwan	1	88
Denmark	1	82
Nigeria	1	63
Thailand	1	73
Malaysia	1	69

T100: Top 100 most-cited articles.

Table 5 Topic distribution among the T100 in ophthalmic epidemiology

Topic	No. of articles in the T100
AMD	23
Glaucoma	16
Visual impairment	12
Myopia	9
DR	9
Refractive error	8
Cornea	4
Dry eye	4
Methodology	2
Retinal vein occlusion	3
Amblyopia and strabismus	2
Choroidal	2
Retinal vascular calibre	2
Blepharitis	1
Macular thickness	1
Retinitis pigmentosa	1
Visual field	1

AMD: Age-related macular degeneration; DR: Diabetic retinopathy; T100: Top 100 most-cited articles.

countries, most were originated from the United States (*n*=34). These findings provide insights and trends in ophthalmic epidemiology research that could serve as useful references or future research directions. The most frequently cited article in the field of ophthalmic epidemiology was published in *Ophthalmology* by Rose KA and colleagues in 2008 into the topic of myopia, highlighting that higher levels of total time spent outdoors were associated with less myopia and a more hyperopic mean refraction. In general, our bibliometric findings provide a comprehensive review of landmark articles published in the field of ophthalmic epidemiology; these top cited articles reflect major advances and hot topics over the past decade.

To the best of our knowledge, this is the first bibliometric work on the T100 published in the last ten-year in field of ophthalmic epidemiology study. Bibliometric study provides the quantity and quality of outcomes within a given field, topic, author or location. As a part of bibliometric study, citation analysis is based on the premise that top-cited articles are frequently recommended by experts, this in turn helps to demonstrate emerging topics within each specialty field[11]. Additionally, they help to provide a substantial indication of trends in that field[12-18].

The highest number of articles in the T100 was published in *Ophthalmology*. These articles had the highest impact factor (8.024 in 2016), which may also account for their increased citation frequency. In addition, *Archives of Ophthalmology* changed its name to *JAMA Ophthalmology*[19] in 2013, which is a medical journal under the American Medical Association. This change in journal name may have impacted the citation frequency of articles published in *JAMA Ophthalmology* (formerly known as *Archives of Ophthalmology*) as the name change may have caused confusion among some readers.

The majority of most-cited ophthalmic epidemiology studies focused on AMD. The top-ranked article in the field of AMD was from the Beaver Damn Eye Study where the authors investigated the long-term incident signs of AMD[20]. The top-ranked article in the field of glaucoma was a study researching the association between myopia and glaucomatous optic nerve damage[21]. In the field of visual impairment, the top-ranked article was on the causes of blindness and visual impairment in Beijing Eye Study[22]. Interestingly, we found that among the three major fields of the T100, the top-ranked articles were published in *Ophthalmology*. In addition, *Ophthalmology* has higher impact factor score compared to other ophthalmic journals.

While the current analysis has supplied useful information on the research trends in ophthalmic epidemiology, there are some limitations to our study. Firstly, our search was limited to articles published over the last ten years. Second, we also did not include systemic review and Meta-analysis type of publications for this work. Third, older articles may have a greater chance of being cited due to increased exposure time compared to recent ones. Lastly, there may be bias in our literature search as the only search engine used was Web of Science and only English language publications were analysed.

In summary, this study shows that the popular topics in ophthalmic epidemiology for the past decade are AMD, glaucoma and visual impairment. *Ophthalmology* was the mist highly cited journal. This bibliometric analysis of the T100 in ophthalmic epidemiology provided insights into the current development in this field.

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