

A CITATION ANALYSIS OF THE INDIAN JOURNAL OF OPHTHALMOLOGY (2003–2019): OUTPUT, AUTHORSHIP, COLLABORATION, SUBJECT AND GEOGRAPHICAL PATTERNS

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Abstract

Citation analysis is among the most established techniques of bibliometric research, revealing the intellectual structure, communication behaviour and information-use patterns of a research community. This study reports a citation analysis of the *Indian Journal of Ophthalmology* (IJO), the official peer-reviewed publication of the All India Ophthalmological Society, covering the period 2003–2019. A cleaned, de-duplicated corpus of 2,009 source articles carrying 27,511 cited references was analysed for year-wise distribution, authorship pattern, author productivity, degree of collaboration, dominant subject facets and geographical distribution of contributors. Annual output nearly trebled from 78 articles in 2003 to a peak of 226 in 2018, while the mean reference list lengthened from about 12 to a high of 19.4 references per article. Multi-authored papers dominate (70.3% of the corpus against 12.4% single-authored), yielding an overall degree of collaboration of 0.85 by Subramanyam's measure. Author productivity is highly skewed in the manner predicted by Lotka's inverse-square law, with a compact core of prolific investigators sustaining a disproportionate share of output. Retina and Vitreous is the dominant subject facet (33.7%), followed by cataract, cornea and glaucoma. India supplies 71.8% of contributions, with a diverse international stream from more than 38 countries. The findings characterise IJO as a mature, high-output, strongly collaborative national research platform with meaningful international reach.

Keywords: citation analysis; bibliometrics; Indian Journal of Ophthalmology; authorship pattern; degree of collaboration; Lotka's Law

1. Introduction

Citation analysis examines the frequency, pattern and characteristics of the references appended to scholarly articles. Because reference lists record the sources an author actually consulted and acknowledged, their systematic study reveals the intellectual structure of a discipline, the communication behaviour of its practitioners and the relative influence of authors, journals and document forms (Garfield, 1972; Smith, 1981). Applied to a single journal over a sustained period, the technique yields a longitudinal portrait of a research community: how much it publishes, how deeply it consults the literature, how it organises authorship, which sub-fields command its attention and where its contributors are located.

The *Indian Journal of Ophthalmology* (IJO) is the official, peer-reviewed publication of the All India Ophthalmological Society and one of the leading ophthalmology journals of the Asia-

Pacific region. Despite its standing, no comprehensive citation analysis of the journal spanning the first two decades of the twenty-first century has been available. The present study addresses that gap by analysing every source article published in IJO between 2003 and 2019.

The study pursued seven objectives: to determine (i) the year-wise distribution of citations, (ii) the authorship pattern of contributions, (iii) the productivity pattern of authors, (iv) the degree of collaboration among contributors, (v) the dominant subject facets, (vi) the quantitative research output of the journal, and (vii) the geographical distribution of contributors.

2. Materials and Methods

The raw dataset was compiled at the level of the individual source article. For every article the following attributes were recorded: year of publication, issue number, article number, title, total number of cited references, author names, author country, degree of collaboration, geographical distribution and the form of the cited documents. Before analysis the data were screened for completeness and consistency; thirty-five exact duplicate records arising from repeated data entry were identified and removed so that productivity, collaboration and citation counts would not be artificially inflated. The cleaned corpus comprises 2,009 source articles and 27,511 cited references spanning the publication years 2003–2019. This corpus is the denominator for all article-based tabulations, and the aggregate citation total is held constant across all citation-based tabulations. Where an attribute (for example, author name or country) was not recorded, the article is retained under a ‘Not specified’ category so that every table sums to the corpus total.

Author productivity was counted on a full-counting basis, each appearance of a name being credited once; 3,689 distinct author names were identified across 5,676 authorship appearances. The degree of collaboration (DC) was computed by Subramanyam’s (1983) formula, $DC = N_m / (N_m + N_s)$, where N_m is the number of multi-authored and N_s the number of single-authored papers. Subject facets were assigned through a keyword-based content classification of article titles into thirteen recognised ophthalmic sub-disciplines. Country of origin of the corresponding authorship was normalised before tabulation.

3. Results

3.1 Year-wise distribution of articles and cited references. Table 1 presents, for each publication year, the number of source articles, the cited references they carry, the percentage share of the citation pool and the mean references per article.

Table 1: Year-wise Distribution of Articles and Cited References, IJO 2003–2019

Year	No. of Articles	No. of Cited References	% of Citations	Avg. Ref./Article
2003	78	967	3.51	12.4
2004	27	319	1.16	11.8
2005	80	951	3.46	11.9
2006	97	1,111	4.04	11.4
2007	119	1,368	4.97	11.5
2008	114	1,522	5.53	13.3
2009	105	1,373	4.99	13.1

2010	135	1,354	4.92	10.0
2011	123	1,334	4.85	10.8
2012	119	1,744	6.34	14.7
2013	102	1,269	4.61	12.4
2014	146	2,362	8.59	16.2
2015	81	1,311	4.77	16.2
2016	90	1,468	5.34	16.3
2017	174	3,367	12.24	19.4
2018	226	3,368	12.24	14.9
2019	193	2,323	8.44	12.0
Total	2,009	27,511	100.00	13.7

Source: Compiled from the study data. Percentages are of the total cited-reference pool (27,511).

Both scholarly output and referencing activity follow a broadly upward trajectory across the seventeen-year window. The citation pool grew from 967 references in 2003 to a peak of 3,368 in 2018, with 2017 and 2018 together accounting for roughly one-quarter (24.5%) of all cited references. Annual article output nearly trebled, from 78 articles in 2003 to 226 in 2018, and the largely stable pattern of four issues per year (64 issues in all) indicates that this growth was accommodated by carrying more articles per issue rather than by adding issues — a strategy characteristic of a maturing, high-demand journal. The mean reference count per article, an indicator of the depth of literature consultation, rose from about 11–12 in the mid-2000s to a high of 19.4 in 2017, reflecting wider access to electronic full-text resources and rising evidentiary expectations in manuscript preparation. The dip in 2004 corresponds to a year for which fewer issues were available for indexing and should be read as a coverage artefact rather than a genuine contraction of output.

3.2 Authorship pattern and degree of collaboration. Table 2 gives the distribution of articles by number of authors, with single- and multi-authored subtotals.

Table 2: Distribution of Articles by Number of Authors

No. of Authors	No. of Articles	Percentage
One author (single-authored)	250	12.44
Two authors	296	14.73
Three authors	351	17.47
Four authors	367	18.27
Five authors	197	9.81
Six authors	142	7.07
Seven authors	27	1.34
Eight or more	33	1.64
Multi-authored subtotal	1,413	70.33
Not specified	346	17.22
Total	2,009	100.00

Source: Compiled from the study data.

Multi-authored articles overwhelmingly dominate the journal: 1,413 articles (70.3% of the corpus) were the product of joint effort, against only 250 single-authored contributions

(12.4%). Four-author papers form the single largest band, closely followed by three- and two-author papers; articles with three to five authors together account for the bulk of the corpus, corresponding to the typical composition of a clinical research team — an operating surgeon, one or two associates or residents, and a supporting investigator responsible for imaging, pathology or data analysis. The small tail of papers with seven or more authors generally represents large epidemiological surveys, multi-centre trials and consensus statements.

Applying Subramanyam's formula to the 1,663 articles whose authorship could be classified yields an overall degree of collaboration of 0.85, meaning that roughly six of every seven classifiable contributions were the outcome of joint work. Year-wise values remained close to or above 0.80 throughout the period, ranging from 0.74 (2004) to 0.94 (2014) and exceeding 0.90 in several years; authorship data for 2018 could not be classified and that year is excluded from the year-wise series. The consistency of the measure across the period indicates that collaboration is a stable, deeply embedded feature of the discipline rather than a recent development.

3.3 Productivity pattern of authors. Across 5,676 authorship appearances, 3,689 distinct author names were identified. The distribution is highly skewed: a compact nucleus of investigators accounts for a disproportionate share of the output while the vast majority of contributors appear only once or twice. The most productive contributors are Jyotirmay Biswas (25 contributions), Amod Gupta and Sundaram Natarajan (24 each), Ravi Thomas and Pukhraj Rishi (23 each), followed by Tarun Sharma and Jitendra Jethani (20 each) — a roll-call reflecting the strong institutional bases of ophthalmic research in India, including Sankara Nethralaya (Chennai), the Post Graduate Institute of Medical Education and Research (Chandigarh) and the L. V. Prasad Eye Institute (Hyderabad). This concentration is entirely consistent with Lotka's (1926) inverse-square law of scientific productivity, which predicts that the number of authors producing n papers is inversely proportional to n^2 , and confirms that ophthalmic research publishing in India, like most scientific fields, is sustained by a comparatively small core of highly active investigators.

3.4 Dominant subject facets. Table 3 presents the distribution of articles across thirteen ophthalmic sub-disciplines derived from title-based content classification.

Table 3: Distribution of Articles by Subject Facet

Rank	Subject Facet	No. of Articles	Percentage
1	Retina & Vitreous	677	33.70
2	General / Miscellaneous	562	27.97
3	Cataract & Lens	165	8.21
4	Cornea & Ocular Surface	159	7.91
5	Glaucoma	125	6.22
6	Oculoplasty & Orbit	109	5.43
7	Uveitis & Ocular Inflammation	50	2.49
8	Community & Public Health Ophthalmology	38	1.89
9	Pediatric Ophthalmology & Strabismus	35	1.74
10	Conjunctiva	28	1.39
11	Ocular Oncology	26	1.29

12	Refractive Surgery & Optics	22	1.10
13	Neuro-ophthalmology	13	0.65
Total		2,009	100.00

Source: Compiled from the study data through title-based content classification.

Retina and Vitreous emerges as the single most dominant subject facet, accounting for 677 articles (33.7%) — by a wide margin the largest thematic cluster. This dominance mirrors the global research landscape, in which retinal disease — diabetic retinopathy, age-related macular degeneration, retinopathy of prematurity, and the surgical and pharmacological management of vitreoretinal disorders — represents both a heavy burden of blindness and the most technologically dynamic frontier of the discipline; the particularly high burden of diabetic eye disease in the Indian population lends this concentration an additional public-health rationale. After a large General/Miscellaneous band (editorials, replies, brief communications and interdisciplinary notes), the next most productive facets are Cataract and Lens, Cornea and Ocular Surface, and Glaucoma. Together these four clinical domains constitute the therapeutic core of comprehensive ophthalmology, while smaller but distinct clusters in oculoplasty, uveitis, paediatric ophthalmology, oncology and neuro-ophthalmology confirm that the journal maintains genuine breadth across the full range of sub-specialties.

3.5 Geographical distribution of contributors. Contributions were received from more than 38 countries in addition to India. Table 4 presents the leading countries of origin, with the long tail of nations each contributing four or fewer articles grouped under ‘Other countries’.

Table 4: Geographical Distribution of Contributing Articles

Country / Region	No. of Articles	Percentage
India	1,442	71.78
USA	70	3.48
Turkey	66	3.29
United Kingdom	41	2.04
South Korea	23	1.14
Australia	23	1.14
China	22	1.10
Iran	14	0.70
Singapore	13	0.65
Other countries	92	4.58
Not specified	203	10.10
Total	2,009	100.00

Source: Compiled from the study data. ‘Other countries’ aggregates 30+ nations each contributing four or fewer articles.

India is, by an overwhelming margin, the principal country of origin, contributing 1,442 articles (71.8% of the corpus). Foreign contributions taken together account for 366 articles (about 18%), the remainder being articles for which country could not be determined. Among foreign contributors the United States (70 articles), Turkey (66) and the United Kingdom (41) are the most prominent, followed by South Korea, Australia, China, Iran and Singapore. The pattern is exactly what one would expect of a strong national society journal: it functions primarily as

the publishing platform of the Indian ophthalmic community while attracting a meaningful and geographically diverse stream of international submissions.

4. Discussion

Taken as a whole, the findings paint a coherent and internally consistent portrait of the Indian Journal of Ophthalmology as a mature, high-output and strongly collaborative national research platform. The steady growth in both article volume and average reference length signals a research community that is expanding in size and deepening in scholarly rigour; the sharp acceleration after 2014 coincides with the journal's increasing international visibility and indexing reach, and the lengthening reference lists are consistent with the wider bibliometric literature, which repeatedly documents this trend as authors gain easier access to online full-text resources and journals raise their evidentiary expectations.

The very high degree of collaboration (0.85) and the clear preponderance of multi-authored work confirm that ophthalmic research in India is fundamentally a team enterprise — an unsurprising result given the surgical, diagnostic and interdisciplinary demands of the specialty. The productivity distribution follows the classic skewed pattern anticipated by Lotka's Law, with a compact core of eminent investigators sustaining a large share of the output. The subject analysis identifies retina and vitreous as the dominant thematic frontier, followed by cataract, cornea and glaucoma — together the therapeutic backbone of clinical ophthalmology and, in the Indian context, the sub-specialties most closely tied to the national burden of avoidable blindness. Geographically, the journal is unambiguously anchored in India while drawing a diverse international stream from more than three dozen countries — nationally rooted yet internationally engaged.

Of the hypotheses framed for the study, three were resolved decisively and in line with the descriptive findings: Indian authorship dominates the journal, domestic contribution far exceeds foreign contribution, and collaborative research is markedly more productive than solo research. The hypothesis concerning a preference for online journals and e-books among cited document forms was rejected on the available evidence, but this result must be read with caution because the document-form attribute was coded for only a small early-period sub-sample; what the evidence does show clearly is the enduring centrality of the peer-reviewed journal article as the currency of scholarly citation in ophthalmology.

5. Limitations and Conclusion

Three limitations deserve note. First, authorship attributes could not be determined for 346 articles (17.2%), and country of origin for 203 (10.1%); these are retained as 'Not specified' so that all tables reconcile to the corpus total, but the classified subtotals should be interpreted accordingly — in particular, the year-wise collaboration series excludes 2018, for which authorship data could not be classified. Second, subject facets were assigned from titles alone, which is efficient but coarser than full-text or keyword-field classification. Third, document-form coding covered only an early-period sub-sample, so conclusions about cited source forms are provisional; a complete coding of document forms across the full period would be a valuable extension of the present work.

Within these bounds, the study rests on a cleaned, de-duplicated corpus of 2,009 articles and 27,511 cited references, with every table reconciling to the same corpus totals — a robust and transparent evidentiary basis. The Indian Journal of Ophthalmology emerges from the analysis as the principal voice of Indian ophthalmology: growing steadily in output and rigour, sustained by a collaborative and institutionally concentrated research community, thematically centred on the sub-specialties that matter most to India's burden of avoidable blindness, and respected well beyond national borders.

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