Original Article

Long-Term Ocular and Neurodevelopmental Outcomes of Retinopathy of Prematurity: A Bibliometric and Thematic Evolution Analysis

Ezgi Karataş[1], Seçil Nazife Parlak[2], Merve Nur Güney[2], Yavuz Oruç[1]

[1]Ağrı İbrahim Çeçen University Faculty of Medicine, Department of Ophthalmology, Ağrı, Türkiye
[2]Ağrı İbrahim Çeçen University Faculty of Medicine, Department of Histology and Embryology, Ağrı, Türkiye

Abstract

Objectives: To map the global research landscape on the long-term outcomes of retinopathy of prematurity (ROP) and quantify the representation of four clinically relevant outcome domains: visual and refractive outcomes, structural retinal and macular sequelae, late post-treatment complications, and neurodevelopmental and quality-of-life outcomes.

Materials and Methods: Two Web of Science Core Collection datasets were created on July 21, 2026 and limited to English-language original articles: Dataset A (general long-term ROP outcomes) and Dataset B (long-term outcomes after ROP treatment). Bibliometric analyses were performed in R using the bibliometrix package. A predefined 108-term outcome lexicon was applied to merged Author Keywords and Keywords Plus. Domain distributions were compared using the chi-square test, and representation ratios were calculated with 95% confidence intervals (CI).

Results: Dataset A included 6,946 articles from 1,035 sources, whereas Dataset B included 1,296 articles from 238 sources. The United States was the leading contributor in both datasets. Türkiye ranked third and fourth in publication output but showed the lowest international collaboration rate (0.9%) among leading countries. Visual and refractive outcomes were the most frequently represented domain (1.95% and 4.07% of keyword occurrences), whereas neurodevelopmental and quality-of-life outcomes were the least represented and the only domain underrepresented in the treatment literature (0.60% vs. 0.35%; representation ratio 0.59, 95% CI 0.43-0.83; p=0.003).

Conclusion: Research on long-term ROP outcomes is expanding rapidly, but the transition from acute treatment to survivorship remains incomplete. Greater emphasis on neurodevelopmental and quality-of-life outcomes and stronger international collaboration are needed.

Keywords: Bibliometrics, retinopathy of prematurity, treatment outcome, refractive errors, neurodevelopmental disorders

Introduction

Retinopathy of prematurity (ROP) is a vaso-proliferative disorder of the immature retina and remains a leading cause of preventable childhood blindness worldwide.[1,2] Advances in neonatal intensive care have increased the survival of extremely preterm infants, expanding the population at risk despite established screening and treatment programmes.[2,3] The third edition of the International Classification of Retinopathy of Prematurity (ICROP3) introduced longitudinal concepts such as reactivation, persistent avascular retina, and long-term sequelae, shifting attention from acute disease management toward lifelong outcomes.[1]

Although acute ROP may regress, affected children remain at risk of lifelong ocular complications, including high myopia, strabismus, amblyopia, retinal detachment, and glaucoma.[4,5,6,7] While long-term follow-up data from anti-vascular endothelial growth factor (anti-VEGF) and laser trials have become available, reported outcomes

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Address for Correspondence: Ezgi Karataş, Ağrı İbrahim Çeçen University Faculty of Medicine, Department of Ophthalmology, Ağrı, Türkiye
E-mail: e.karatas.2015@gmail.com
ORCID-ID: orcid.org/0000-0003-0347-7827

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remain predominantly structural and refractive.[8,9] However, severe ROP has also been associated with adverse cognitive, motor, and behavioural outcomes, as well as reduced quality of life, raising the question of whether these dimensions have received comparable research attention.[10,11]

Bibliometric analysis provides a quantitative approach to mapping the intellectual structure and evolution of a research field.[12,13] Previous bibliometric studies have examined overall ROP research, artificial intelligence, or anti-VEGF therapy, but none has specifically focused on long-term outcomes, compared general and post-treatment literature, or quantified clinically relevant outcome domains.[14,15,16]

We therefore conducted a dual-corpus bibliometric analysis to characterise global research on long-term ROP outcomes and to quantify the representation of four predefined clinical outcome domains using a structured outcome lexicon.

Materials and Methods

Data source and search strategy

The Web of Science Core Collection was employed as the sole data source, as it supplies the structured Author Keywords, Keywords Plus, affiliation, and cited-reference fields essential for bibliometric mapping. Combining databases with divergent indexing rules would compromise keyword-level analysis. Both searches were conducted on 21 July 2026. Dataset A (general long-term outcomes) combined a topic search (TS) for ROP and its synonyms (retinopathy of prematurity, retrolental fibroplasia, retinopathy of prematurity survivor*, regressed or treated retinopathy of prematurity) with a second TS block of 48 long-term outcome terms covering follow-up duration, visual and refractive function, structural and imaging endpoints, reactivation, and neurodevelopmental and quality-of-life endpoints.

Dataset B (post-treatment long-term outcomes) combined a TS search for "retinopathy of prematurity" with a TS block of treatment modalities (bevacizumab, ranibizumab, aflibercept, anti-VEGF, laser, cryotherapy, vitrectomy, scleral buckle) and a third TS block of outcome terms (long-term, follow-up, outcome*, recurrence, reactivation, persistent avascular retina, neurodevelopment*, cognitive, motor, refractive, myopia, visual acuity). The full Boolean strings are given in Supplementary Appendix 1.

Inclusion and Exclusion Criteria

Both result sets were restricted to the document type "Article", with review articles excluded and the language limited to English, so that the two corpora would be composed of comparable primary research reports. No time restriction was applied; the retrieved records spanned 1980 to 2026, with 2026 necessarily incomplete. Of 7,193 records retrieved for Dataset A, 6,946 met the inclusion criteria; Dataset B comprised 1,296 records. Full records with cited references were exported in tab-delimited format. Two investigators independently verified the search strings and the refinement steps, and discrepancies were resolved by discussion.

Bibliometric Analysis

Bibliometric analyses were performed using R software (version 4.6.0; R Foundation for Statistical Computing, Vienna, Austria) together with the bibliometrix package (version 5.4.1) and its Biblioshiny web interface (Massimo Aria and Corrado Cuccurullo, University of Naples Federico II, Naples, Italy).[13] The following indicators were extracted for each corpus: annual production and growth rate; average document age; citations per document; numbers of sources, authors, single-authored documents, and co-authors per document; international co-authorship rate; most relevant and most locally cited sources; core journal stratification via Bradford's law; most relevant and most locally cited authors; author productivity distribution via Lotka's law; h-, g- and m-indices; most relevant affiliations; corresponding-author countries with single-country and multiple-country counts; most globally and locally cited documents; keyword co-occurrence; thematic mapping; and trend topics. Because the corpora overlap by design, they are described in parallel and never pooled.

Outcome Domain Lexicon

To move from generic keyword frequencies to clinically interpretable quantities, we constructed a predefined lexicon of 108 entries across four mutually exclusive domains: visual and refractive outcomes (31 entries), structural retinal and macular sequelae (31 entries), late post-treatment complications (20 entries), and neurodevelopmental and quality-of-life outcomes (26 entries). The lexicon was drafted from ICROP3 terminology and major ROP treatment trials and cohort studies. The original list of 108 entries was independently reviewed by two ophthalmologists with expertise in ROP before being finalized (Supplementary Appendix 2).[1,4,8,9,10] Each expert evaluated the relevance of each entry to its assigned outcome domain using a four-point Likert scale. The two reviewers demonstrated high agreement in the assignment of entries to the predefined outcome domains (mean agreement score: 0.90). For the final analysis, variant forms of the same terms were merged to yield 95 unique terms (26/27/18/24 terms in each domain, respectively).

Ethics

This study analysed publicly available bibliographic metadata and involved no human participants, human tissue or animals. Therefore, institutional review board approval and informed consent were not required.

Statistical Analysis

This is a descriptive bibliometric study, and most results are presented as counts, percentages and standard bibliometric indices. The full counting method was used for affiliations and countries, so category percentages may exceed 100%. Annual growth rate is the compound annual growth rate of publication counts. For the outcome lexicon, the distribution of domain-tagged keyword occurrences was compared between corpora with the Pearson chi-square test. For each domain, a representation ratio (share in Dataset B divided by share in Dataset A) was calculated with a 95% confidence interval (CI) from the standard error of the log ratio, and each domain was tested against the remainder of the corpus with the chi-square test. A two-sided $p<0.05$ was considered significant. No individual patient data were analysed and no imputation was required.

Results

Characteristics of the two corpora

Dataset A comprised 6,946 articles published in 1,035 sources between 1980 and 2026 by 24,298 authors, with 6.89 co-authors per document, 16.48% international co-authorships, and 92,252 cited references. Dataset B comprised 1,296 articles in 238 sources by 5,557 authors, with 7.29 co-authors per document, 12.19% international co-authorships, and 12,982 cited references. The annual growth rate was higher in the post-treatment corpus (9.15% vs. 6.87%) and its documents were more recent (mean age 10.9 vs. 12.1 years). Total citations were 201,451 for Dataset A (mean 29.0, median 11 citations per document; h-index 153, g-index 268) and 37,976 for Dataset B (mean 29.3, median 11 citations per document; h-index 85, g-index 148), while 9.6% and 10.3% of documents in the respective datasets were uncited (Table 1).

Annual output rose slowly until the early 2000s and then accelerated in both corpora, peaking in 2022 at 436 and 103 articles, respectively (Figure 1). More than half of all articles were published after 2014.

Sources

The *Journal of AAPOS* (n=252), *Investigative Ophthalmology & Visual Science* (n=242), and the *British Journal of Ophthalmology* (n=195) led Dataset A, whereas *Ophthalmology* and *Retina* (n=79 each) led Dataset B (Table 2). Bradford's law identified a core zone of 16 journals in Dataset A but only 8 in Dataset B, indicating that post-treatment research is published in a more concentrated set of journals. *Pediatrics* had the highest source h-index in Dataset A (h=77; 17,346 citations from 164 articles) and *Ophthalmology* in Dataset B (h=47). The most locally co-cited sources were *Pediatrics* and *Archives of Ophthalmology* in Dataset A and *Ophthalmology* and *Archives of Ophthalmology* in Dataset B, confirming the dual paediatric-ophthalmic identity of the general literature and the strictly ophthalmic identity of the treatment literature.

Authors and Institutions

Quinn GE was the most productive author in both corpora (123 and 50 articles) and had the highest author h-index in Dataset A (h=45; 11,116 citations), followed by Chiang MF (n=121), Hellström A (n=106), Chan RVP (n=91), and Campbell JP (n=88), the last having by far the highest m-index (2.50). Wu WC (n=47), Palmer EA (n=44), Tung B (n=43), and Dobson V (n=42) followed in Dataset

Table 1. Main bibliometric characteristics of the two datasets

Indicator	Dataset A (general)	Dataset B (post-treatment)
Timespan	1980-2026	1980-2026
Documents (original articles)	6,946	1,296
Sources (journals)	1,035	238
Annual growth rate (%)	6.87	9.15
Average document age (years)	12.1	10.9
Cited references	92,252	12,982
Keywords Plus (ID)	5,857	1,257
Author Keywords (DE)	6,832	1,255
Authors	24,298	5,557
Single-authored documents	271	48
Co-authors per document	6.89	7.29
International co-authorships (%)	16.48	12.19
Total citations	201,451	37,976
Mean citations per document	29.0	29.3
Median citations per document	11	11
Uncited documents, n (%)	664 (9.6)	134 (10.3)
h-index	153	85
g-index	268	148

Dataset A: general long-term outcomes of retinopathy of prematurity. Dataset B: long-term outcomes after treatment for retinopathy of prematurity. Citation metrics were computed from the exported Web of Science records

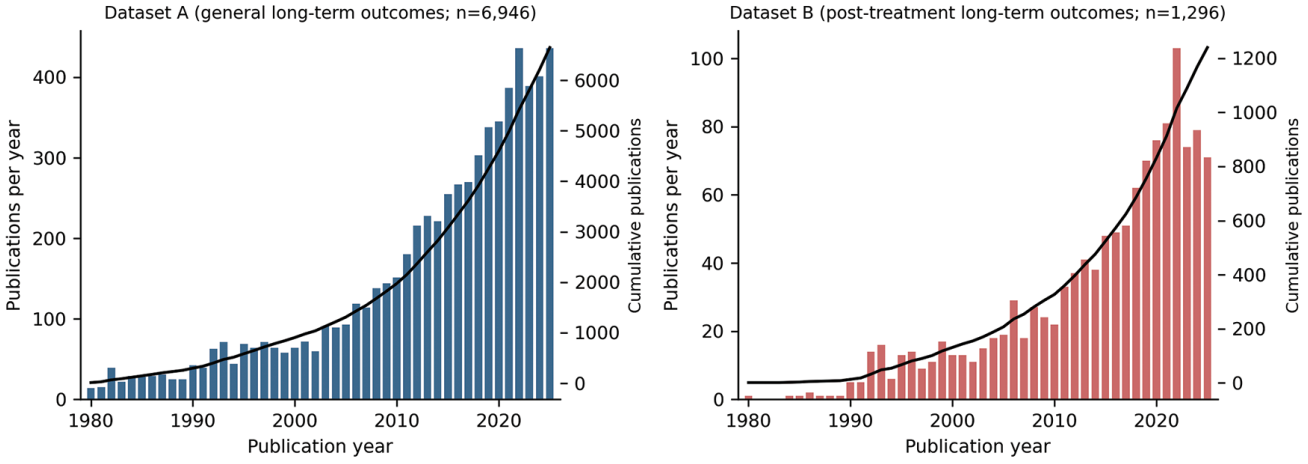


Figure 1. Annual and cumulative scientific production in the two datasets, 1980-2025. Bars show publications per year (left axis) and the black line shows cumulative output (right axis). 2026 is omitted because indexing for that year was incomplete at the time of the search

Table 2. Ten most productive sources in each dataset

Rank	Dataset A - source	n	Dataset B - source	n
1	*Journal of AAPOS*	252	*Ophthalmology*	79
2	*Investigative Ophthalmology & Visual Science*	242	*Retina*	79
3	*British Journal of Ophthalmology*	195	*Archives of Ophthalmology*	58
4	*Ophthalmology*	173	*Journal of AAPOS*	58
5	*Pediatrics*	164	*American Journal of Ophthalmology*	52
6	*Journal of Pediatric Ophthalmology & Strabismus*	158	*British Journal of Ophthalmology*	51
7	*Retina*	150	*Indian Journal of Ophthalmology*	44
8	*Eye*	142	*Eye*	42
9	*Archives of Ophthalmology*	139	*Journal of Pediatric Ophthalmology & Strabismus*	41
10	*American Journal of Ophthalmology*	130	*Graefe's Archive for Clinical and Experimental Ophthalmology*	39

Bradford zone 1 comprised 16 journals in Dataset A and 8 journals in Dataset B

B. Lotka's law was satisfied in both corpora, with 69.5% and 72.6% of authors contributing a single document. Harvard University (n=631) and the University of Pennsylvania (n=424) led the affiliations in Dataset A, while Chang Gung Memorial Hospital (n=118) led Dataset B. The University of Health Sciences Türkiye, with 164 articles, was the most productive Turkish institution and ranked twentieth overall in Dataset A.

Countries and Collaboration

The United States led both corpora as the corresponding-author country (2,235 articles, 32.2% of Dataset A; 407 articles, 31.4% of Dataset B), followed by China. Türkiye ranked third in Dataset A (426 articles, 6.1%) and fourth in Dataset B (116 articles, 9.0%), reflecting a higher relative share in the post-treatment corpus than in the general corpus (Table 3). However, Türkiye exhibited the lowest multiple-country publication rate of any leading country in both corpora (0.9% for both), compared with 15.3% for the United States, 24.8% for the United Kingdom, and 38.5% for Sweden in Dataset A (Figure 2). Türkiye's mean respective citation rates were 10.5 and 10.7 per article, versus 40.6 and 48.0 for the United States and 52.8 and 59.6 for the United Kingdom.

Most Cited Documents

The most globally cited document in Dataset A was the revised ICROP of 2005 (2,444 citations), followed by the 2015 Neonatal Research Network trends report (2,221 citations) and the original oxygen-induced retinopathy model description (1,570 citations). The Early Treatment for ROP (ETROP) trial (1,502 citations), BEAT-ROP (1,160

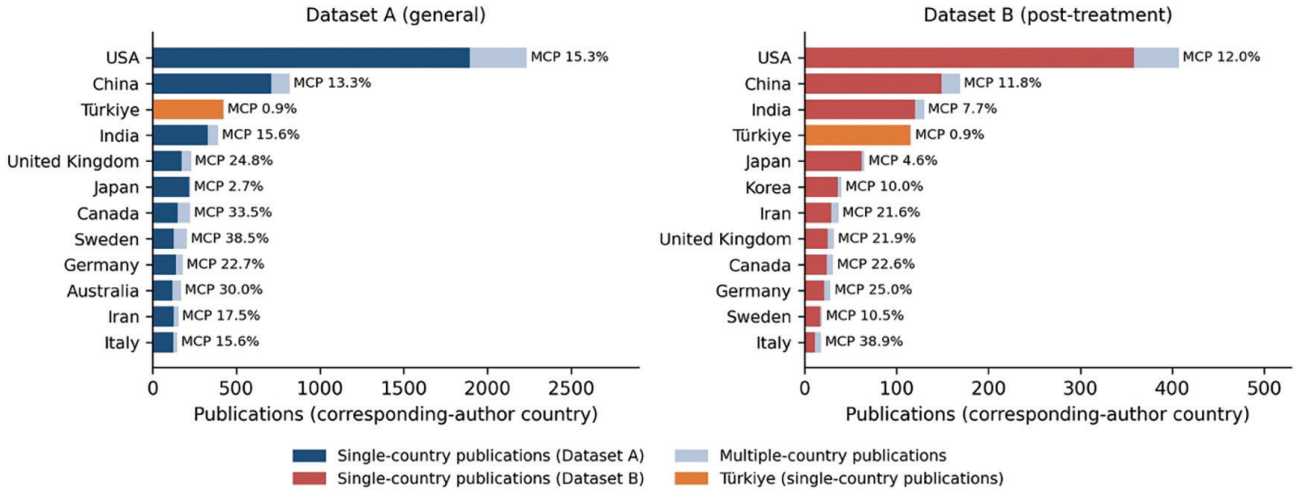


Figure 2. Twelve most productive corresponding-author countries in each dataset, partitioned into single-country and multiple-country publications. Türkiye is highlighted in orange
MCP: Multiple-country publications

Table 3. Ten most productive corresponding-author countries and their collaboration patterns and citation impact

Country	Dataset A			Dataset B		
	Articles (%)	MCP (%)	Citations/article	Articles (%)	MCP (%)	Citations/article
USA	2,235 (32.2)	15.3	40.6	407 (31.4)	12.0	48.0
China	818 (11.8)	13.3	14.6	169 (13.0)	11.8	18.0
Türkiye	426 (6.1)	0.9	10.5	116 (9.0)	0.9	10.7
India	391 (5.6)	15.6	11.6	130 (10.0)	7.7	11.2
United Kingdom	230 (3.3)	24.8	52.8	32 (2.5)	21.9	59.6
Japan	225 (3.2)	2.7	17.3	65 (5.0)	4.6	17.8
Canada	224 (3.2)	33.5	43.3	31 (2.4)	22.6	35.5
Sweden	205 (3.0)	38.5	40.3	19 (1.5)	10.5	18.3
Germany	181 (2.6)	22.7	31.8	28 (2.2)	25.0	33.1
Korea	144 (2.1)	9.0	21.6	40 (3.1)	10.0	23.9

MCP: Multiple-country publications, expressed as a percentage of that country's corresponding-author output

citations), the SUPPORT oxygen-saturation trial (766 citations), and the 2018 American Academy of Pediatrics screening statement (539 citations) headed Dataset B (Table 4).[17,18,19,20,21,22,23,24,25] Local citation analysis reordered these documents: ICROP-2005 and ETROP dominated Dataset A, whereas BEAT-ROP was the most locally cited document in Dataset B, confirming that the post-treatment literature is organised around anti-VEGF therapy.

Conceptual Structure

Keyword co-occurrence analysis identified four clusters in Dataset A and five in Dataset B. In Dataset A, these were labelled "retinopathy of prematurity" (66 terms; 11,792 occurrences), "preterm infants" (89 terms; 10,008 occurrences), "endothelial growth factor" (57 terms; 6,279 occurrences), and "bevacizumab" (38 terms; 4,453 occurrences). In Dataset B, the clusters were "retinopathy of prematurity" (80 terms; 3,694 occurrences), "infants" (57 terms; 1,911 occurrences), "outcomes" (50 terms; 1,009 occurrences), "retinal detachment" (32 terms; 696 occurrences), and "prematurity" (27 terms; 583 occurrences). On the thematic map (Figure 3), no cluster in Dataset B reached the motor-theme quadrant, whereas the outcome-related clusters "retinal detachment" and "outcomes" occupied the low-centrality, high-density quadrant characteristic of niche themes. In Dataset A, the "bevacizumab" cluster fell in the low-centrality, low-density quadrant of emerging or declining themes.

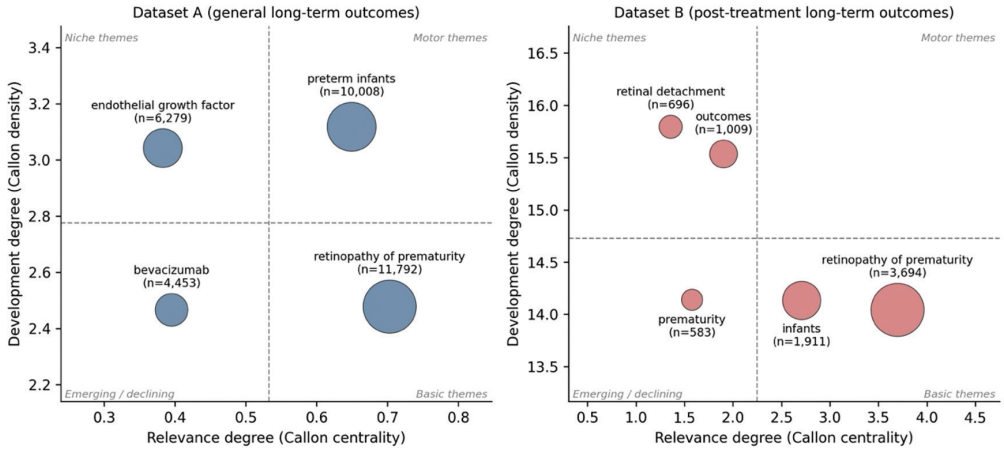


Figure 3. Thematic map of keyword co-occurrence clusters. The horizontal axis is Callon centrality (relevance degree) and the vertical axis is Callon density (development degree); dashed lines mark the corpus means and bubble size is proportional to cluster frequency

Table 4. Five most globally cited documents in each dataset

Dataset	First author, year, journal	Total citations	Citations/year
A	Gole GA, 2005, *Arch Ophthalmol* (ICROP revisited)[17]	2,444	111.1
	Stoll BJ, 2015, *JAMA*[18]	2,221	185.1
	Smith LEH, 1994, *Invest Ophthalmol Vis Sci*[19]	1,570	47.6
	Good WV, 2003, *Arch Ophthalmol* (ETROP)[20]	1,502	62.6
	Alon T, 1995, *Nat Med*[21]	1,330	41.6
B	Good WV, 2003, *Arch Ophthalmol* (ETROP)[20]	1,502	62.6
	Mintz-Hittner HA, 2011, *N Engl J Med* (BEAT-ROP)[22]	1,160	72.5
	Carlo WA, 2010, *N Engl J Med* (SUPPORT)[23]	766	45.1
	Fierson WM, 2018, *Pediatrics*[24]	539	59.9
	Costeloe KL, 2012, *BMJ* (EPICure-2)[25]	532	35.5

Citation counts are those recorded in the Web of Science Core Collection on July 21, 2026

Representation of the Four Outcome Domains

The lexicon matched 2,514 keyword occurrences in Dataset A (4.32% of 58,218) and 952 in Dataset B (8.87% of 10,734). Visual and refractive outcomes formed the best-represented domain in both corpora (1.95% and 4.07%), primarily attributable to myopia, blindness, visual acuity, and visual impairment. Structural retinal and macular sequelae accounted for 0.89% and 1.88%, led by optical coherence tomography, retinal detachment, and choroidal thickness. Late post-treatment complications accounted for 0.88% and 2.56%, led by follow-up, reactivation, complication, and cataract. Neurodevelopmental and quality-of-life outcomes were the least represented in both corpora (0.60% and 0.35%) (Table 5, Figures 4 and 5).

Compared with the general corpus, the post-treatment corpus more prominently featured late complications (representation ratio 2.91), visual and refractive outcomes (2.08), and structural retinal and macular sequelae (2.12). Conversely, neurodevelopmental and quality-of-life outcomes showed reduced representation in the post-treatment literature (0.59), constituting the domain with the lowest proportion of predefined lexicon terms appearing (13 of 24).

Thematic Evolution

Trend topic analysis showed the temporal distribution of terms with a median publication year of 2010 or later (Figure 6). Recent terms included anti-VEGF and reactivation (median year 2022), deep learning (2023), angiography and artificial intelligence (2024), and extremely low gestational age neonates (2026) in Dataset

A and anti-VEGF, reactivation, and type 1 retinopathy (2022), angiography (2023), and persistent avascular retina (2024) in Dataset B. Neither corpus contained recent trend terms explicitly denoting neurodevelopmental outcomes or quality of life. This finding was consistent with the outcome domain analysis, in which neurodevelopmental and quality-of-life outcomes were the least represented domain.

Discussion

This dual-corpus analysis of 6,946 general and 1,296 post-treatment articles shows a field that is growing quickly, is concentrated in a small number of journals and institutions, and is organised around anti-VEGF therapy. Our principal original finding is quantitative: when analysed using a predefined clinical outcome lexicon, research encompassing the transition from acute-phase treatment to survivorship proves selective rather than general. Three of four domains were enriched two- to three-fold in the post-treatment corpus, as would be expected if treatment trials had begun to report longer follow-up. The fourth—neurodevelopmental and quality-of-life outcomes—moved in the opposite direction.

This asymmetry has a plausible explanation and an uncomfortable implication. The explanation is disciplinary: post-treatment outcome research is published in a narrower, more strictly ophthalmic set of journals (8 core journals according to Bradford's law, against 16 in the general corpus), whereas neurodevelopmental endpoints belong to the paediatric and neonatal literature that dominates

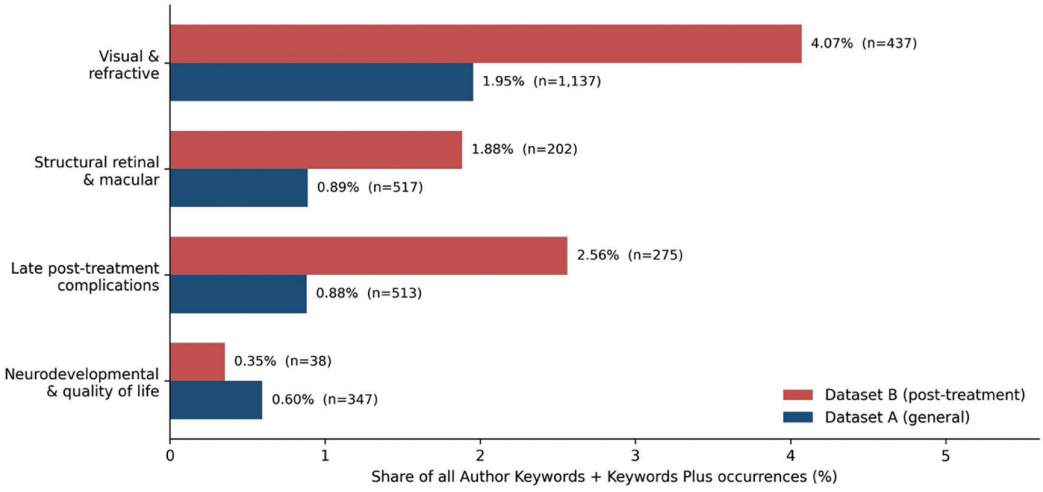


Figure 4. Representation of the four long-term outcome domains, expressed as the percentage of all merged Author Keywords and Keywords Plus occurrences in each dataset. Absolute occurrence counts are shown in parentheses. Three domains are enriched in the post-treatment dataset; neurodevelopmental and quality-of-life outcomes are not

Table 5. Representation of the four long-term outcome domains across the two datasets

Outcome domain	Lexicon terms (n)	Dataset A	Dataset B	Representation ratio (95% CI)	p
		matched terms/occurrences/share			
Visual and refractive outcomes	26	25/1,137/1.95%	25/437/4.07%	2.08 (1.87-2.32)	<0.001
Structural retinal and macular sequelae	27	22/517/0.89%	21/202/1.88%	2.12 (1.80-2.49)	<0.001
Late post-treatment complications	18	17/513/0.88%	16/275/2.56%	2.91 (2.51-3.36)	<0.001
Neurodevelopmental and quality-of-life outcomes	24	23/347/0.60%	13/38/0.35%	0.59 (0.43-0.83)	0.003
All domains combined	95	87/2,514/4.32%	75/952/8.87%	-	-

Share is the percentage of all merged Author Keywords and Keywords Plus occurrences in that dataset (58,218 in Dataset A; 10,734 in Dataset B). The representation ratio is the share in Dataset B divided by the share in Dataset A. p values are from the chi-square test comparing each domain against the remainder of the corpus. The overall distribution of domain-tagged occurrences differed between datasets (chi-square 81.89, df 3, p<0.001)
CI: Confidence interval

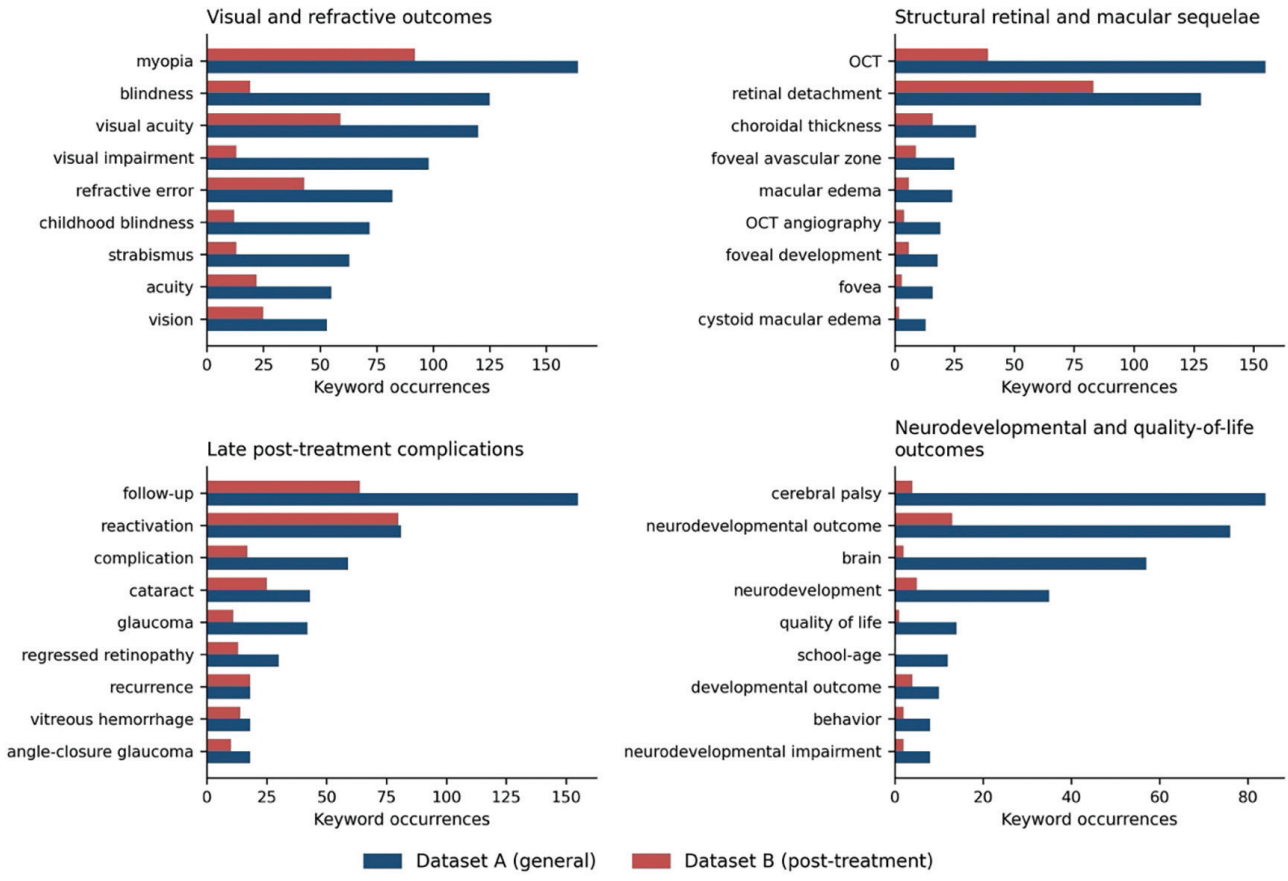


Figure 5. Most frequent lexicon terms within each of the four outcome domains
OCT: Optical coherence tomography

the general corpus, where *Pediatrics* has the highest source h-index. The implication is that the very studies best positioned to answer whether anti-VEGF agents affect the developing brain (those following the treated cohorts) are the least likely to report neurodevelopmental endpoints. Given the documented systemic escape of bevacizumab[26] and the association between severe ROP and adverse cognitive, motor, and behavioural outcomes,[10,11,27] this is a substantive evidence gap rather than a bibliometric artefact. RAINBOW and FIREFLEYE show that long follow-up in ROP trials is feasible.[8,9] Adding validated developmental instruments to their outcome sets would be a small incremental cost.

The temporal analysis reinforces this interpretation. Recent trend topics include anti-VEGF, reactivation, persistent avascular retina, and artificial intelligence. Reactivation and persistent avascular retina are concepts formalised by ICROP3 that are relevant to long-term follow-up.[1] Their presence among recent research themes suggests increasing attention to long-term anatomical monitoring. However, this attention has not been accompanied by a comparable increase in the assessment of visual function and neurodevelopmental outcomes. Long-term anatomical monitoring may therefore not be matched by equally comprehensive functional and neurodevelopmental assessment. The absence of recent trend terms explicitly denoting neurodevelopmental outcomes or quality of life in either corpus suggests that this evidence gap persists despite the growing emphasis on long-term follow-up after ROP treatment.

The findings also carry a specific message for Turkish ophthalmology. Türkiye is the third most productive country in the general corpus and the fourth in the post-treatment corpus, and its relative share is higher in the post-treatment literature. This is a creditable position for a middle-income setting with a large preterm population, and consistent with the national infrastructure demonstrated by the TR-ROP study across 69 neonatal intensive care units.[28] Turkish groups have

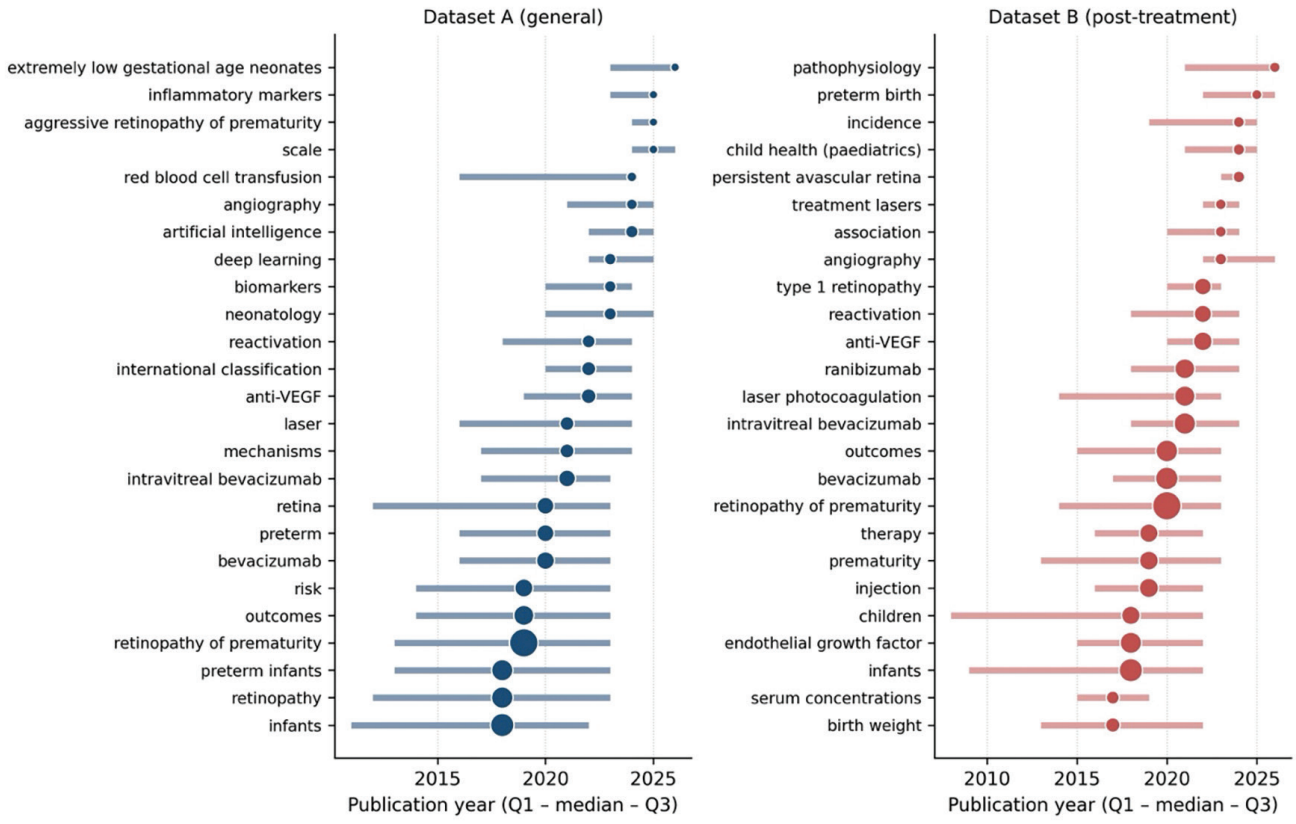


Figure 6. Trend topics with a median publication year of 2010 or later. Horizontal bars span the first to third quartile of the year distribution for each term and the marker denotes the median year; marker size is proportional to term frequency

contributed directly to the domains examined here, including work on macular ectopia and strabismus, on rhegmatogenous detachment in regressed ROP, on foveal hypoplasia and peripheral vitreoretinal interface abnormalities, and on the long-term refractive consequences of different treatment approaches.[5,6,29,30,31] Yet Türkiye's multiple-country publication rate of below 1% is the lowest among all leading countries, and its citation rate per article is one-fifth that of the United Kingdom. The same pattern of high productivity with low international collaboration and low citation impact has been reported for Turkish retinoblastoma and uveal melanoma research.[32,33] Because long-term outcome studies require large samples and prolonged follow-up, they are precisely the studies for which cross-border collaboration yields the greatest return. Embedding Turkish cohorts in international consortia and adding neurodevelopmental and quality-of-life instruments to follow-up protocols already in place would raise both the impact and the clinical value of this substantial national output.

Our results align with the three previous ROP bibliometric studies in identifying the United States as the leading country, anti-VEGF therapy and artificial intelligence as the dominant recent themes, and a small group of authors as central to the field.[14,15,16] They extend those studies by taking long-term outcomes as the unit of analysis, by contrasting a general with a treatment-specific corpus, and by replacing qualitative cluster labelling with a predefined, reproducible lexicon applicable to any future corpus.

Study Limitations

Several limitations should be acknowledged. First, only the Web of Science Core Collection was searched; Scopus, PubMed, and the Turkish TR Dizin database were not included. Although this approach preserved the consistency of the keyword-level analysis, it may have excluded some relevant studies, particularly those published in Turkish. Second, the analysis was restricted to English-language original research articles, excluding reviews, editorials, and non-English publications. As a result, the scientific contributions of countries that predominantly publish in their native languages may be underrepresented. Third, keyword-based analyses depend on the quality and consistency of indexing. Consequently, some studies may

have reported neurodevelopmental outcomes without including the relevant lexicon terms as keywords, leading to their underrepresentation in the analysis. Therefore, the reported proportions should be interpreted as indicators of the relative representation of outcome domains rather than estimates of their true prevalence. Fourth, because the two datasets overlapped by design, comparisons were descriptive in nature, and the chi-square tests should be interpreted as summaries of the observed differences in domain composition rather than as inferential analyses of a broader population of articles. Fifth, as the literature search was conducted before the completion of indexing for 2026, analyses of the most recent research trends were based on a smaller number of publications. Sixth, although the predefined lexicon demonstrated a high level of agreement between two independent ROP experts during its development, its evaluation was limited to two reviewers and did not involve a formal Delphi consensus process. Therefore, future studies using larger multidisciplinary expert panels may further refine and validate the proposed classification. Finally, bibliometric indicators reflect the visibility and research attention devoted to a topic rather than its methodological quality. Accordingly, a well-represented domain should not be assumed to have a correspondingly strong evidence base.

Conclusion

Incorporating validated developmental and quality-of-life instruments into ROP treatment cohort studies and embedding the substantial Turkish output in international collaborative networks are the two changes most likely to improve both the impact and the clinical usefulness of this literature.

Ethics

Ethics Committee Approval: Not required, as this study analysed publicly available bibliographic metadata and involved no human participants or animals.

Informed Consent: Not required, as this study analysed publicly available bibliographic metadata and involved no human participants or animals.

Declarations

Authorship Contributions:

Concept: E.K., Design: E.K., Y.O., Data Collection or Processing: E.K., M.N.G., Analysis or Interpretation: E.K., S.N.P., Literature Search: E.K., Y.O., Writing: E.K.

Conflict of Interest: No conflict of interest was declared by the authors.

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Declaration on the use of Artificial Intelligence (AI): During the preparation of this work, the authors used AI-based tools for bibliometric data processing, figure preparation and language editing. All analyses, interpretations and references were verified by the authors, who reviewed and edited the content and take full responsibility for it.

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