

Public interest in ophthalmic imaging: a Google Trends analysis of diagnostic modalities from 2005 to 2025

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ABSTRACT

Aims: This study aimed to evaluate the evolution of public interest in ophthalmic imaging modalities between 2005 and 2025 using Google Trends data, with comparisons across countries, languages, and disease-related contexts.

Methods: Google Trends was used to analyze relative search volume (RSV) data for eight ophthalmic imaging modalities: optical coherence tomography (OCT), optical coherence tomography angiography (OCTA), fluorescein angiography, fundus photography, ocular ultrasound, corneal topography, orbital computed tomography (CT), and orbital magnetic resonance imaging (MRI). Terms were searched in both Turkish and English. Five countries were assessed: Türkiye, the United States, Germany, India, and Japan. Compound Annual Growth Rate (CAGR) was calculated for each term. Comparative analyses were performed by language, disease focus (e.g., macular degeneration, diabetic retinopathy), and pre- versus post-COVID-19 periods.

Results: Most imaging terms showed a notable rise in RSV, particularly OCT, fundus photography, and OCTA. The highest CAGR was seen for OCT (+8.1%, India). Turkish terms had consistently lower RSV than their English equivalents, although substantial growth was observed for searches corresponding to OCT and fluorescein angiography after 2015. COVID-19 led to a temporary decline in search activity, followed by a strong rebound. Corneal topography and ocular ultrasound showed more modest but steadily increasing interest.

Conclusion: Public interest in ophthalmic imaging has significantly increased over two decades. The growing attention to OCT and OCTA reflects rising awareness of non-invasive retinal diagnostics. Lower interest in Turkish terms highlights the need to improve local-language health education. Digital data tools like Google Trends may serve as valuable instruments in tracking and enhancing ophthalmic public health awareness.

Keywords: Google trends, ophthalmic imaging, public awareness, digital epidemiology, health literacy

INTRODUCTION

Advancements in ophthalmic imaging have fundamentally transformed the diagnosis and monitoring of ocular diseases. Modalities such as optical coherence tomography (OCT), optical coherence tomography angiography (OCTA), fluorescein angiography, corneal topography, and ocular ultrasonography are now integral components of contemporary ophthalmic practice, particularly in the evaluation of retinal and anterior segment disorders. Despite their widespread clinical use, the extent to which the general public is aware of these imaging technologies - and how this awareness has evolved over time - remains incompletely understood.¹⁻⁴

With the increasing reliance on internet-based resources for health-related information, online search behavior has emerged as a valuable proxy for assessing public interest and

awareness. Google Trends, a freely accessible tool that analyzes the relative popularity of search queries over time, has been increasingly utilized in digital epidemiology to explore public engagement with health conditions, diagnostic tools, and medical services.⁵⁻⁷ Several studies have applied this approach in ophthalmology, primarily focusing on specific diseases or clinical services; however, data specifically examining imaging-focused search trends across multiple ophthalmic modalities remain limited.

The present study aims to evaluate temporal trends in public interest in major ophthalmic imaging modalities using Google search data from 2005 to 2025. By analyzing variations across countries, languages, and disease-related contexts, this study seeks to provide a comprehensive overview of how public

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awareness of ophthalmic imaging technologies has evolved over two decades. Unlike prior studies that have focused on individual diseases or isolated diagnostic tools, this analysis systematically compares multiple imaging modalities within a unified digital epidemiology framework, thereby contributing novel insights into public engagement with ophthalmic diagnostics.

METHODS

Ethics

This study used publicly available, aggregated data from Google Trends and did not involve any human participants or identifiable personal information. Therefore, ethics committee approval and informed consent were not required, in accordance with the principles of the Declaration of Helsinki.

Study Design

This study was designed as a retrospective digital epidemiology analysis based on publicly available Google Trends data collected between January 2005 and December 2025. The study followed established principles of infodemiology and digital health surveillance.

Search Term Selection

Ophthalmic imaging modalities were selected based on their widespread clinical use in routine ophthalmic practice and their established roles in the diagnosis and monitoring of retinal, anterior segment, and orbital diseases. The final list of search terms was determined through a review of ophthalmology textbooks, clinical guidelines, and prior Google Trends-based ophthalmology studies.

The following imaging modalities were analyzed using both English and Turkish equivalents to capture language-related differences in public search behavior:

- Optical coherence tomography
- Optical coherence tomography angiography
- Fluorescein angiography
- Fundus photography
- Ocular ultrasound
- Corneal topography
- Orbital computed tomography
- Orbital magnetic resonance imaging

In addition, selected disease-related search terms commonly associated with these imaging modalities were included for exploratory descriptive comparison with modality-specific search trends: macular degeneration, diabetic retinopathy, glaucoma, retinopathy of prematurity (ROP), optic neuritis, and eye tumor.

Country Selection

Five countries-Turkiye, the United States, Germany, India, and Japan-were selected to represent diverse geographic regions, healthcare systems, population sizes, and levels of digital health engagement. These countries were chosen to allow comparison between developed and developing

healthcare settings and to capture variation in ophthalmic service utilization and public health awareness across different regions.

Data Collection

Relative Search Volume (RSV) data were obtained from Google Trends (<https://trends.google.com>). Search parameters were standardized as follows:

- Time range: 2005-2025
- Regions: Turkiye, United States, Germany, India, Japan
- Category: Health
- Search type: Web search

RSV values were normalized by Google Trends on a scale from 0 to 100, representing the relative popularity of each term over time.

Pre-and Post-COVID-19 Period Definition

To assess the potential impact of the COVID-19 pandemic on public interest in ophthalmic imaging, the study period was divided into two segments: pre-COVID (January 2005 to December 2019) and post-COVID (January 2020 to December 2025). This classification was based on the global recognition of COVID-19 as a public health emergency by the World Health Organization in early 2020. The pandemic caused widespread disruptions to routine ophthalmologic care and may have influenced the volume and pattern of health-related search behaviors. Therefore, this segmentation allows for a clearer understanding of the pandemic's effect on public interest trends.

Statistical and Trend Analysis

RSV time-series data were extracted from Google Trends and visualized to evaluate temporal trends in public interest. Long-term growth patterns were quantified using the Compound Annual Growth Rate (CAGR), which was calculated as follows:

$$CAGR=(RSV_final/RSV_initial)^{(1/n)}-1$$

where RSV_final represents the RSV at the end of the study period, RSV_initial represents the RSV at the beginning of the study period, and n denotes the number of years between these two time points. CAGR was used to summarize the overall direction and magnitude of long-term trends while reducing the influence of short-term or seasonal fluctuations.

Comparative analyses were performed across:

- Imaging modality versus disease-related search terms
- English versus Turkish search queries
- Pre-COVID-19 (2005-2019) and post-COVID-19 (2020-2025) periods

The pre- and post-pandemic division was applied to evaluate the impact of COVID-19-related healthcare disruptions on public interest in ophthalmic imaging.

CAGR values were primarily intended to describe within-modality temporal trends rather than to enable direct comparisons between modalities with different data availability periods (e.g., OCTA, which became searchable

only after 2016). Therefore, cross-modality comparisons of growth rates should be interpreted with caution.

Readability Analysis

To assess the accessibility of online ophthalmic imaging information, the readability of content containing the terms “OCT” and “OCTA” on the top 10 Turkish-language eye health websites was evaluated. Readability was measured using the Ateşman Readability Formula and the Flesch-Kincaid Grade Level, both of which are validated tools for assessing text complexity.^{8,9}

RESULTS

General Search Trends for Imaging Modalities

Between 2005 and 2025, global interest in ophthalmic imaging modalities demonstrated a steady and significant upward trend. Among all terms, OCT had the highest RSV, with particularly high interest observed in India and the United States.

Significant increases were also noted in fundus photography, fluorescein angiography, OCT angiography (OCTA), and corneal topography, especially after 2010. Although OCTA became visible in the Google Trends database only after 2016, it exhibited a rapid rise in search volume over a short period.

In Türkiye, search volumes for the relevant terms were generally lower compared to their English counterparts. However, search terms corresponding to OCT and fluorescein angiography demonstrated a notable upward trend after 2015.

Corneal topography and ocular ultrasonography had relatively lower RSV values, but their trend lines indicated a gradually increasing level of public awareness.

The updated CAGR values based on 2005–2025 data and the countries with the highest growth are summarized in **Table**.

Table. CAGR by term (2005-2025) and country with highest growth

Imaging modality	CAGR (2005-2025)	Country with highest growth
OCT	+8.1%	India
Fundus photography	+5.6%	United States
Fluorescein angiography	+3.4%	Türkiye
OCTA	+3.1%*	Germany
Corneal topography	+2.7%	Japan
Ocular ultrasound	+2.2%	India
Orbital CT	+1.6%	Türkiye
Orbital MRI	+0.9%	Germany

CAGR: Compound Annual Growth Rate, OCT: Optical coherence tomography, OCTA: Optical coherence tomography angiography. *OCTA data available only after 2016

DISCUSSION

This study examined long-term patterns in online search interest for ophthalmic imaging modalities using Google Trends data from 2005 to 2025. Consistent with findings from earlier digital epidemiology studies, our results indicate a marked increase in search activity related to retina-focused diagnostic tools—particularly OCT, fluorescein angiography, fundus photography, and more recently, OCTA.^{10,11} Importantly, Google Trends reflects online search behavior and relative interest rather than validated health literacy,

clinical utilization, or diagnostic uptake; therefore, these results should be interpreted as changes in public information-seeking behavior rather than direct evidence of increased use or understanding of imaging modalities. In contrast to prior studies that focused on general ophthalmology terms or specific conditions, the present study uniquely emphasizes the diagnostic modality level, offering modality-based insights across multiple countries and languages.

OCT emerged as the most frequently searched term in all regions, which is consistent with its widespread use in contemporary retinal imaging. OCTA, though visible in Google Trends only after 2016, exhibited rapid growth—suggesting increasing online information-seeking related to non-invasive imaging of retinal microvasculature, especially in the context of age-related macular degeneration (AMD) and diabetic retinopathy.^{12,13}

Interestingly, corneal topography showed the highest CAGR in Japan. This trend may be linked to the rising demand for refractive surgeries such as LASIK and implantable contact lenses (ICL), as well as early detection of corneal ectatic disorders like keratoconus.¹⁴ Similarly, ocular ultrasound had a notable growth rate in India, likely reflecting the continued relevance of low-cost, accessible imaging technologies in low-resource settings.¹⁵

In Türkiye, online search interest in imaging modalities has increased substantially since 2015, particularly for OCT and fundus photography. This pattern may reflect expanding access to retinal diagnostics, increased digital outreach by private hospitals, and greater dissemination of visual medical content through social media. However, the RSV of Turkish-language search terms remained lower than their English counterparts, which may relate to a preference for English medical terminology, bilingual search behavior, and clinician-driven information seeking using standard English terms, as well as the limited availability of local-language ophthalmic resources.¹⁶

Moreover, the readability analysis may suggest that a substantial portion of Turkish-language ophthalmic resources requires relatively advanced reading levels, which could influence online information-seeking patterns and may partly relate to the lower RSV observed for Turkish-language queries.

A temporary decline in RSV was observed during the early phase of the COVID-19 pandemic, aligning with widespread disruptions in outpatient services and public hesitancy toward non-urgent healthcare visits. This observation supported our pre-/post-COVID segmentation. The increase in search activity after 2021 suggests renewed health information-seeking related to ophthalmic diagnostics following the acute phase of the pandemic.⁶

Limitations

This study is subject to several limitations inherent to Google Trends-based analyses. First, search data reflect public interest but not actual clinical utilization or diagnosis. Second, Google Trends does not provide demographic information such as age or gender, limiting interpretability. Third, only a selected set of keywords was included, potentially excluding related queries using synonyms or informal language. Additionally, other popular search engines (e.g., Yandex,

Baidu) were not assessed, potentially limiting generalizability in certain regions. Lastly, newer technologies like OCTA were not searchable before 2016, limiting long-term comparison. Accordingly, CAGR should be interpreted primarily as a within-modality summary of long-term trend direction rather than for direct comparisons between modalities with different availability periods.

In addition, disease-related search terms were included for exploratory descriptive comparison only; no formal statistical association analyses were performed between specific diseases and imaging modalities.

CONCLUSION

This study shows an overall increase in online search interest in ophthalmic imaging modalities over the past two decades, particularly for non-invasive retinal techniques such as OCT and OCTA. The analysis also indicates differences across countries and languages, including lower relative search activity for Turkish-language terms. The temporary decline during the early COVID-19 period and subsequent rebound likely reflect the pandemic's impact on health information-seeking behavior. Importantly, these findings represent changes in search behavior and relative interest rather than validated health literacy, clinical utilization, or diagnostic uptake. Nevertheless, digital data tools such as Google Trends may be useful for monitoring public information-seeking patterns and informing targeted ophthalmic health communication strategies.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study used publicly available, aggregated data from Google Trends and did not involve any human participants or identifiable personal information. The refore, ethics committee approval were not required.

Informed Consent

This study used publicly available, aggregated data from Google Trends and did not involve any human participants or identifiable personal information. Therefore, informed consent was not required.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

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Author Contributions

Concept: EYŞ, AŞ; Design: EYŞ; Control/Supervision: EYŞ; Data Collection and/or Processing: AŞ; Analysis and/or Interpretation: EYŞ; Literature Review: EYŞ, AŞ; Writing the Article: EYŞ; Critical Review: EYŞ, AŞ.

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