Discover Oncology

https://doi.org/10.1007/s12672-026-05535-7

Article in Press

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Received: 6 April 2026

Accepted: 29 June 2026

Published online: 21 July 2026

Cite this article as: Jia M., Cui G., Liu Z. *et al.* Bibliometric analysis of programmed cell death and immunotherapy research in glioma. *Discov Onc* (2026). https://doi.org/10.1007/s12672-026-05535-7

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Bibliometric Analysis of Programmed Cell Death and Immunotherapy Research in Glioma

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Funding: This work was supported by the National Natural Science Foundation of China (81902553,82172685), Natural Science Foundation of Hunan Province (2023JJ30921).

Note：1. Human Ethics and Consent to Participate declarations: not applicable. 2. Consent to Publish declaration: not applicable. 3. Clinical trial number: not applicable.

Abstract

Glioblastoma is the most lethal primary central nervous system malignancy, with limited therapeutic options and poor prognosis. This PubMed-based bibliometric study systematically analyzed publication trends, collaboration patterns, journal and author distributions, and thematic evolution at the intersection of programmed cell death (PCD) and glioma immunotherapy over the period 2006 to 2026. A total of 799 eligible records, including 644 original research articles and 155 narrative reviews, were included. Annual

publications increased steadily, peaking at 131in 2025. China and the United States dominated global output, while international collaboration varied across countries and regions. Keyword co-occurrence analysis identified core themes: apoptosis, necroptosis, pyroptosis, ferroptosis, tumor microenvironment (TME), immunotherapy-related strategies, and prognosis, reflecting a gradual shift from basic PCD mechanisms toward TME-targeted immunotherapy and prognostic stratification. This field is widely distributed across immunology, oncology, molecular biology, nanoscience, and multidisciplinary journals. Author and institutional analyses revealed key contributors within the dataset. In summary, this bibliometric landscape provides a structured overview of research hotspots, collaboration networks, and emerging directions in glioma PCD and immunotherapy. The findings offer descriptive insights for identifying research priorities, knowledge gaps, and collaborative opportunities, while they should be interpreted as observational patterns rather than direct evidence of clinical efficacy or translational priority.

Keywords: Programmed Cell Death; Glioma; Immunotherapy; Tumor Microenvironment; Bibliometric Analysis

Introduction

Glioblastoma (GBM) is the most common and aggressive malignancy of the central nervous system, with a 5-year survival rate below 10%. Dysregulated programmed cell death (PCD) and its crosstalk with the tumor microenvironment (TME) are increasingly recognized as a critical driver of glioma progression and therapeutic resistance. Over the past decade, PCD research has expanded beyond apoptosis to include necroptosis, pyroptosis, PANoptosis, and ferroptosis(1,2), with growing interest in their immunomodulatory roles.

Parallel advances in cancer immunotherapy—including immune checkpoint inhibitors, chimeric antigen receptor (CAR)-T cells, and therapeutic vaccines—have reshaped systemic oncology, yet efficacy in glioma remains limited due to the immunosuppressive TME and blood–brain barrier (BBB). Notably, PCD modulation can enhance tumor immunogenicity and remodel the TME, thereby synergizing with immunotherapy. (3,4). Consequently, the intersection of PCD and glioma immunotherapy has become a rapidly evolving interdisciplinary field, attracting global research efforts. The glioma TME is a complex ecosystem comprising malignant cells, glioma stem cells, microglia/macrophages, myeloid-derived suppressor cells,

lymphocytes, endothelial cells, and extracellular matrix components, collectively establishing profound immune suppression(5,6). Emerging evidence highlights dynamic crosstalk between distinct PCD modalities and immune responses, with context-dependent effects on anti-tumor immunity. Deciphering these interactions is essential for designing combinatorial strategies that simultaneously integrate PCD induction and immune activation in glioma.

Despite rapid progress, the field remains fragmented, with heterogeneous research priorities and evolving concepts such as PANoptosis. While apoptosis historically dominated PCD research, non-apoptotic cell death pathways are gaining attention for their pro-inflammatory and immunogenic potential (7,8) (9). China and the United States lead global publication output, yet international collaboration focused on glioma-specific challenges (e.g., BBB penetration, therapy resistance) remains limited. (1,3) (4). Systematic mapping of research trends is therefore needed to identify hotspots, gaps, and translational directions.

Bibliometrics enables quantitative and visual analysis of scientific output, collaboration networks, and knowledge evolution, particularly in fast-growing interdisciplinary areas. By analyzing publication metrics, citation patterns, and keyword dynamics, bibliometric approaches can uncover research hotspots, influential contributors, and emerging themes, providing a macroscopic view of the intellectual landscape (10,11). However, such analyses are descriptive and do not substitute for experimental or clinical evidence, yet they offer actionable insights for researchers and funding bodies (9).

In this study, we performed a PubMed-based bibliometric analysis of 799 publications spanning 2006–2026 to characterize global research activity at the interface of PCD and glioma immunotherapy.. We systematically evaluated publication trends, country/institutional contributions, journal distribution, author productivity, and keyword evolution (12). Our aim is to identify major research themes, collaborative patterns, and knowledge gaps, thereby providing a descriptive roadmap for future basic and translational studies.. The findings are intended to provide descriptive evidence for understanding research activity and thematic evolution in this field, rather than to establish clinical recommendations or policy priorities(12,13).

Methods

Data Collection

This study adopted a PubMed-based bibliometric analysis focusing on biomedical and translational literature. PubMed was chosen for its standardized indexing (Medical Subject Headings, MeSH), reproducible retrieval, comprehensive coverage of preclinical and clinical studies in neuro-oncology and immunology. While Web of Science and Scopus offer broader citation coverage, they were not included here; accordingly, results represent PubMed-indexed literature only and are not exhaustive of all global publications.

The search was conducted on March 31, 2026, with a publication time window from January 1, 2006 to March 31, 2026. The search strategy combined MeSH terms and title/abstract keywords:: (“Programmed Cell Death”[Mesh] OR “Programmed Cell Death”[tiab] OR “Cell Death”[tiab] OR “Apoptosis”[tiab] OR “Necroptosis”[tiab] OR “Pyroptosis”[tiab] OR “Ferroptosis”[tiab]) AND (“Immunotherapy”[Mesh] OR “Immunotherapy”[tiab] OR “Immune Checkpoint Inhibitor*”[tiab] OR ”CAR-T”[tiab] OR ”Adoptive Cell Transfer”[tiab] OR ”Cancer Vaccine*”[tiab]) AND (“Glioma”[Mesh] OR “Glioma*”[tiab] OR ”Glioblastoma”[tiab] OR ”GBM”[tiab] OR ”Brain Tumor*”[tiab] OR “Brain Cancer**“[tiab]) AND 2006/01/01[PDAT]:2026/03/31[PDAT]. Initial retrieval yielded 809 records. After removing duplicates and excluding non-research article types (comments, letters, editorials, preprints, conference abstracts, corrections, media), 799 records were retained, consisting of 644 original research articles (80.6%) and 155 narrative reviews (19.4%). The screening process is summarized in Figure 1A. The distribution of document types and annual publication trend are shown in Figures 1B and 1C, respectively.

Data Cleaning and Standardization

All records were exported from PubMed and processed in R (V 4.3.0). Prior to analysis, we performed rigorous cleaning: removal of duplicate records, resolution of missing publication years, harmonization of author information and inconsistent institutional names (unifying spelling variants and abbreviations), standardization of country/region names, and consolidation of synonymous keywords (e.g., unifying “programmed cell death” variants

and merging TME-related terms). These steps minimized artificial fragmentation and ensured reliable network analysis.

Bibliometric Analysis and Visualization

Bibliometric analyses were performed using the bibliometrix package in R. Descriptive metrics included annual publication output, document type, country or region productivity, institutional contributions, journal distribution, author productivity, and keyword frequency. Annual trends were assessed via polynomial regression (R^2). Collaboration networks (countries, regions, institutions, journals, authors) and keyword co-occurrence networks were constructed, with node size reflecting frequency and edge thickness representing association strength. Community detection was implemented via the built-in clustering algorithm in bibliometrix. Burst analysis was performed to identify keywords showing rapid increases in attention over time.

Journal impact factors (IF) and JCR quartile classifications were retrieved separately from the 2024 Journal Citation Reports dataset on June 25, 2025, independent of the literature search period, and used only for descriptive journal profiling.

Results

Benchmark Analysis of Included Publications

The PubMed search initially returned 809 records, of which 10 were excluded after eligibility screening and duplicate checking because they were comments, letters, editorials, preprints, conference abstracts, corrections, media items, or other non-research publication types. The final dataset included 799 PubMed-indexed records for bibliometric analysis (Figure 1A). Among these records, 644 were original research articles, accounting for 80.6% of the dataset, whereas 155 were narrative reviews, accounting for 19.4% (Figure 1B). Because narrative reviews may accumulate citations differently from original research articles, document types were reported separately to provide a clearer benchmark description of dataset composition and to reduce potential misinterpretation of article-type-related publication patterns.

Annual output increased markedly across the study period. Publication activity was limited in the early years after 2006, but it rose progressively as immunotherapy, non-apoptotic cell death, and glioma TME research expanded. The annual number of

publications peaked in 2025 with 131 records, representing a more than 50-fold increase compared with 2006. Polynomial regression demonstrated an overall upward trend (R^2 = 0.753; Figure 1C), indicating sustained growth in PubMed-indexed research activity at the intersection of PCD and glioma immunotherapy. This pattern suggests that the topic has shifted from a relatively specialized biological question toward a broader interdisciplinary research field. Nevertheless, publication volume should be interpreted as an indicator of research activity rather than as evidence of clinical impact, therapeutic efficacy, or translational maturity.

Countries and Regions Analysis

Researchers from 37 countries or regions contributed to the final dataset. China ranked first with 351 publications, accounting for 54.0% of total output, followed by the United States with 111 publications (17.1%). Other contributors among the top 10 included Japan (N= 22 publications), South Korea (N= 20), Germany (N= 18), Italy (N= 17), Belgium (N= 10), India (N= 10), Iran (N= 9), and France (N= 8). Collectively, the top 10 countries or regions contributed 576 records, representing 72.1% of the final dataset. These findings indicate that research output was concentrated in a limited number of countries, with China and the United States forming the dominant publication centers.

International collaboration patterns differed from publication-volume patterns. The United States had the highest absolute number of multiple-country publications (MCP= 39) and an MCP ratio of 35.1%, suggesting a relatively strong international collaboration profile among highly productive countries. China had the largest publication output but a lower MCP ratio (33 MCPs; 9.4%), indicating that much of its output was generated through domestic or institution-centered networks. Belgium showed the highest MCP ratio among the top 10 countries or regions (70.0%), followed by Iran (44.4%) and France (37.5%). China showed the highest annual growth rate (36.38%), indicating rapid expansion in this research field. These patterns suggest that publication output and international collaboration represent distinct bibliometric dimensions, which should be interpreted separately.

Institutions Analysis

The top 10 productive institutions contributed between 12 and 20 publications each. Huazhong University of Science and Technology ranked first with 20 records, followed by Southern Medical University with 19 and Central South University with 17. Capital Medical University and Fudan University each contributed 16 records, whereas Harvard Medical School and Soochow University each contributed 15. The First Affiliated Hospital

of Zhengzhou University contributed 13 records, and Sichuan University and Zhejiang University School of Medicine each contributed 12. Nine of the top 10 institutions were located in China, while Harvard Medical School was the only United States institution in the top tier. This distribution is consistent with the country-level pattern and reflects concentrated research activity in Chinese academic and medical centers. However, institutional productivity should not be interpreted as equivalent to citation influence, methodological quality, or clinical translation. However, institutional productivity reflects only publication activity within the PubMed dataset and should not be equated with research quality or citation impact.

Journal Analysis

The 799 publications were distributed across journals spanning oncology, immunology, molecular biology, nanoscience, genetics, developmental biology, and multidisciplinary research. The top 10 journals published 174 articles, representing 21.8% of all included records. Frontiers in Immunology published the largest number of articles (N= 40; IF = 5.7; JCR Q1), followed by Journal for Immunotherapy of Cancer (N= 30; IF = 10.3; JCR Q1) and Frontiers in Oncology (N= 19; IF = 3.5; JCR Q2). ACS Nano and Cancers each published 16 articles, and International Journal of Molecular Sciences published 15. Among the top 10 journals, five were classified as JCR Q1 and five as JCR Q2. The concentration of publications in immunology, oncology, nanoscience, and molecular science journals demonstrates that PCD-glioma immunotherapy research is not confined to a single disciplinary domain but is shaped by the convergence of tumor biology, immune modulation, delivery science, and translational neuro-oncology. These trends indicate a shift from basic mechanistic studies toward tumor microenvironment remodeling, prognostic evaluation, and combination immunotherapy strategies.

Author Analysis

The top 10 productive authors published between 6 and 12 papers each. Michael Lim from Stanford University School of Medicine ranked first with 12 publications, followed by David A. Reardon with 9 publications. Maria G. Castro, Xiang Li, and Michael Weller each contributed 8 publications, while Zhen Li contributed 7. Chen, Pedro R. Lowenstein, Ryosuke Matsuda, and Takayuki Morimoto each contributed 6 publications. These authors were affiliated with institutions in the United States, China, Switzerland, and Japan, suggesting that active research groups are distributed across several

major neuro-oncology and immunotherapy centers. Author productivity in this analysis reflects output within the retrieved PubMed dataset and should not be interpreted as a direct measure of overall academic influence, citation impact, or individual scientific contribution.

Keyword Analysis

Keyword analysis identified high-frequency terms that reflect both experimental foundations and emerging translational directions. The top 20 keywords ranged from 23 to 236 occurrences. “Cell line, tumor” was the most frequent term (236 occurrences), followed by “immunotherapy” and “immunotherapy/methods” (117 occurrences each). “Prognosis” appeared 97 times, and “tumor microenvironment” appeared 92 times, indicating sustained attention to immunotherapeutic approaches, prognostic stratification, and microenvironment-related mechanisms. Other frequent terms included “apoptosis” (N= 53), “gene expression regulation, neoplastic” (N= 53), “mice, inbred C57BL” (N= 52), and “middle aged” (N= 46). Experimental model-related terms such as xenograft assays, animal disease models, cell proliferation, nude mice, and adoptive immunotherapy methods were also represented. These trends indicate a shift from basic mechanistic studies toward tumor microenvironment remodeling, prognostic evaluation, and combination immunotherapy strategies.

Discussion

This PubMed-based bibliometric analysis provides a descriptive map of global research on PCD and glioma immunotherapy from 2006 to 2026. The field showed marked growth in annual publication output, with original research articles constituting the majority of the dataset. This growth likely reflects the convergence of several scientific developments, including the expansion of cancer immunotherapy, increasing recognition of non-apoptotic cell death pathways, improved understanding of the glioma TME, and growing use of molecular and bioinformatic approaches in neuro-oncology (3,14,15). Publication output increased markedly, dominated by original research, reflecting this field’s rapid growth and translational potential.

Country-level and institutional analyses showed that China and the United States were the leading contributors, but their collaboration patterns differed(3,16-19). China contributed the largest number of publications and showed rapid growth, which may partly reflect expanded biomedical

research capacity, institutional investment in oncology and immunology, and increasing participation in molecular medicine and tumor-biology research. The United States produced fewer records than China but had a higher multiple-country publication ratio among top contributors, suggesting stronger international collaboration. These observations help explain publication patterns but should not be overinterpreted. The present study did not include grant-level funding data, field-normalized citation indicators, or article-level quality assessment. Therefore, high publication volume should be understood as research activity within the PubMed-indexed dataset rather than as direct evidence of higher citation impact, methodological quality, or translational influence.

Journal and author analyses further support the interdisciplinary nature of this field. Publications were concentrated in oncology, immunology, molecular biology, nanoscience, and multidisciplinary journals, indicating that glioma PCD-immunotherapy research spans basic mechanisms, immune regulation, drug delivery, and translational neuro-oncology. Nanoscience-related journals may reflect increasing interest in blood–brain barrier penetration, drug delivery systems, immune cargo delivery, and local modulation of the glioma microenvironment. Immunology and oncology journals reflect the clinical motivation to convert cell-death modulation into effective immune activation, whereas molecular biology journals capture the mechanistic foundation of apoptosis, ferroptosis, pyroptosis, necroptosis, and pathway regulation. Productive authors were distributed across established research groups in the United States, China, Switzerland, and Japan. Nevertheless, journal productivity, JCR quartile distribution, and author output are descriptive indicators only. Without citation normalization, h-index comparison, or qualitative assessment of study design, these metrics cannot determine scientific quality or clinical influence.

Keyword evolution revealed a shift from foundational PCD mechanisms toward TME-targeted immunotherapy, prognostic biomarkers, and non-apoptotic cell death pathways. Apoptosis remained an important historical and mechanistic theme, but ferroptosis, pyroptosis, necroptosis, and PANoptosis are increasingly relevant because of their potential links to inflammation, immune activation, antigen release, and therapeutic resistance(3,16) . The increasing prominence of TME- and prognosis-related terms after 2022 suggests that PCD-related glioma research is being

increasingly connected with biomarker development, patient stratification, and combination immunotherapy strategies. This shift is consistent with the broader movement in glioma research from single-pathway models toward integrated microenvironmental and immune-regulatory frameworks. In this context, bibliometric findings can help identify where research attention is concentrated, but they cannot determine whether a hotspot will translate into effective treatment.

The prominence of prognosis-related keywords also indicates that the field is not limited to experimental cell-death biology. Many studies appear to use PCD-related genes, immune signatures, or TME-associated markers to construct prognostic models and stratify glioma patients. This trend may help generate hypotheses for biomarker discovery, but prognostic associations require careful validation across independent cohorts, standardized clinical variables, and clinically relevant endpoints. Therefore, future work should connect bibliometric hotspots with mechanistic experiments, spatial immune profiling, longitudinal clinical datasets, and prospective translational studies before drawing conclusions about therapeutic utility.

The glioma TME is a critical hub of immune suppression, comprising tumor cells, glioma stem cells, microglia/macrophages, neutrophils, myeloid-derived suppressor cells, and stromal components, collectively limiting immunotherapy efficacy(20-22). Previous and recent comprehensive reviews have emphasized that these cellular and non-cellular components interact dynamically to create a spatially heterogeneous and immunosuppressive ecosystem that promotes glioma progression, immune evasion, therapeutic resistance, and limited responsiveness to immunotherapy(22-24). In particular, glioblastoma immunopathology is shaped by the coordinated effects of TAMs/microglia, myeloid-derived suppressor cells, regulatory T cells, glioma stem-like cells, hypoxia, the blood–brain barrier, extracellular matrix remodeling, and altered immune trafficking(23,24). These biological features provide a mechanistic context for the prominence of TME-related keywords in the present bibliometric analysis and suggest that PCD-related research is increasingly being interpreted within a broader immunological and microenvironmental framework(25,26).

Myeloid populations, particularly tumor-associated macrophages and neutrophils, are central regulators of immune suppression, angiogenesis, and therapy resistance, with context-dependent pro- or anti-tumor phenotypes(27). In particular, neutrophils in the glioma TME contribute to

immune suppression, extracellular matrix remodeling, and poor prognosis, representing an emerging therapeutic target(25,28).

Beyond cellular components, glymphatic function and interstitial fluid dynamics influence drug delivery, immune trafficking, and TME remodeling, adding complexity to therapeutic design. The integrated cell death concept PANoptosis, encompassing pyroptosis, apoptosis, and necroptosis, has emerged as a key theme, linking inflammatory cell death to immune activation and anti-tumor responses(29,30). Importantly, such bibliometric trends reflect research attention rather than clinical validation or therapeutic readiness.

Several limitations should be acknowledged. First, data source restriction to PubMed excludes literature indexed exclusively in Web of Science or Scopus, potentially underrepresenting certain journals or regions (20). Second, we excluded non-research article types, which may omit supplementary communications. Third, bibliometric analyses describe research activity patterns and do not assess experimental validity, clinical efficacy, or policy priority. Fourth, bibliometric analyses describe research activity patterns and do not assess experimental validity, clinical efficacy, or policy priority. Fifth, despite standardization, residual inconsistencies in metadata may persist. Collectively, these findings provide a descriptive overview of PubMed-indexed research trends, and further experimental and clinical studies are required to validate translational implications for glioma treatment.

Conclusion

This analysis systematically mapped 799 PubMed publications (2006–2026) at the intersection of PCD and immunotherapy. We observed exponential growth in publications, with China and the United States as leading contributors and heterogeneous international collaboration patterns. Research focus has evolved from basic PCD mechanisms toward TME remodeling, immunotherapy optimization, and prognostic assessment, with ferroptosis and PANoptosis as emerging hotspots. These findings offer a structured landscape of research trends, collaborative networks, and knowledge gaps, providing descriptive guidance for future basic and translational studies. While bibliometric evidence reflects research attention, experimental validation and clinical trials are essential to translate these insights into effective therapeutic strategies for glioma patients.

Data Availability Statement

All data supporting the findings of this study are available within the paper and its Supplementary Information. The raw literature retrieval data used in the bibliometric analysis are provided in Supplementary Table S1.

Declarations

Ethical approval

Not applicable. This bibliometric study was based exclusively on publicly available bibliographic records and did not involve human participants, identifiable personal data, or animals; therefore, ethical approval was not required.

Consent to participate

Not applicable. This study did not involve human participants.

Consent to publish

Not applicable. This manuscript does not contain any individual person's data in any form.

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Figure Legends

Figure 1. Literature screening, document type distribution, and annual publication trends.
(A) Flowchart of literature identification and eligibility screening. The initial PubMed search retrieved 809 records; after excluding 10 non-research entries (comments, letters, preprints, video-audio media, corrections), 799 records were included in final bibliometric analysis. (B) Document type distribution of the 799 included records: Original research articles (n = 644) and narrative reviews (n = 155). (C) Annual publication output from 2006 to 2026, showing a steady increase with peak of 131 in 2025. Polynomial regression confirmed a significant upward trend ($R^2 = 0.753$).

Figure 2. Country-level productivity and international collaboration.
(A) Global distribution map of PubMed-indexed publications by country. (B) Radar chart representing publication output of the top 10 countries. (C) International collaboration network, where node size represents publication volume and edge thickness indicates collaboration strength.

Figure 3. Institutional productivity and collaboration networks.
(A) Bar chart of the top 20 most productive institutions. (B) Institutional collaboration network, with node size proportional to total publications and edge thickness representing co-authorship intensity.

Figure 4. Journal productivity and coupling network analysis**.**
(A) Bar chart of top 20 journals contributing to this field. (B) Journal coupling network; node size corresponds to publication count, and edges denote shared citations.

Figure 5. Author productivity and collaboration networks.
(A) Bar chart of the top 20 most productive authors. (B) Co-authorship network, where node size indicates publication number and edges reflect collaborative relationships.

Figure 6. Keyword co-occurrence and burst analysis.
(A) Co-occurrence network of the top 30 keywords; node size scales with occurrence frequency, and edge thickness represents co-occurrence strength. (B) Temporal timeline of the top 20 burst keywords, highlighting dynamically emerging research themes. All keyword clusters were standardized and harmonized to ensure accurate network mapping.

Table 1. Top 10 countries or regions contributing to PubMed-indexed publications on programmed cell death and glioma immunotherapy.

Table Note: MCP, multiple-country publications; MCP ratio, proportion of publications involving international collaboration.

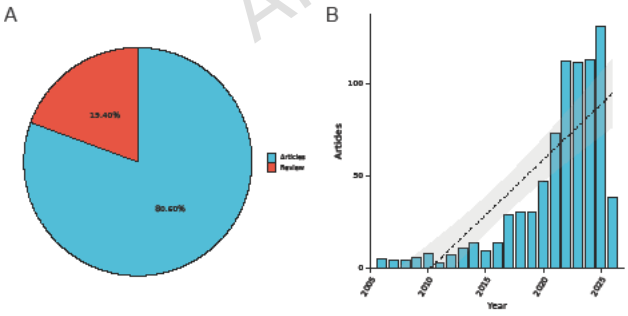
Table 2. Top 10 most productive institutions in PubMed-indexed research on programmed cell death and glioma immunotherapy.

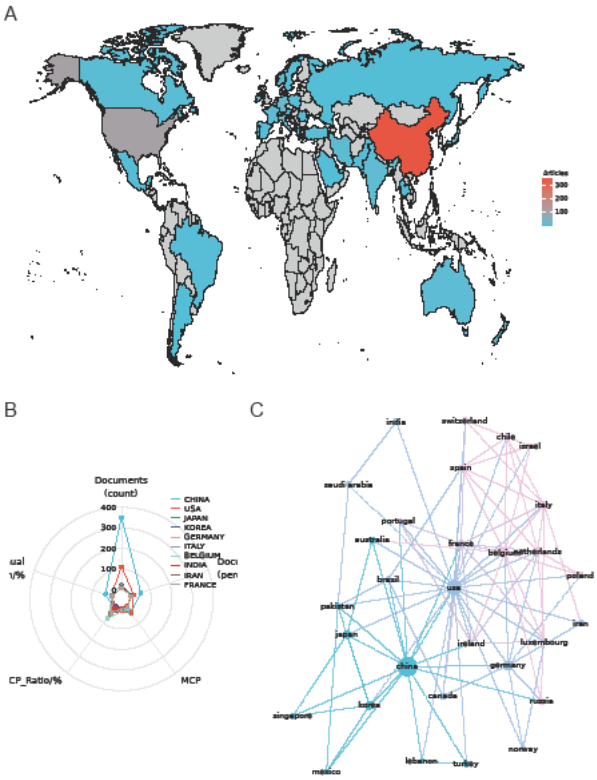
Table 3. Top 10 journals publishing research on programmed cell death and glioma immunotherapy.

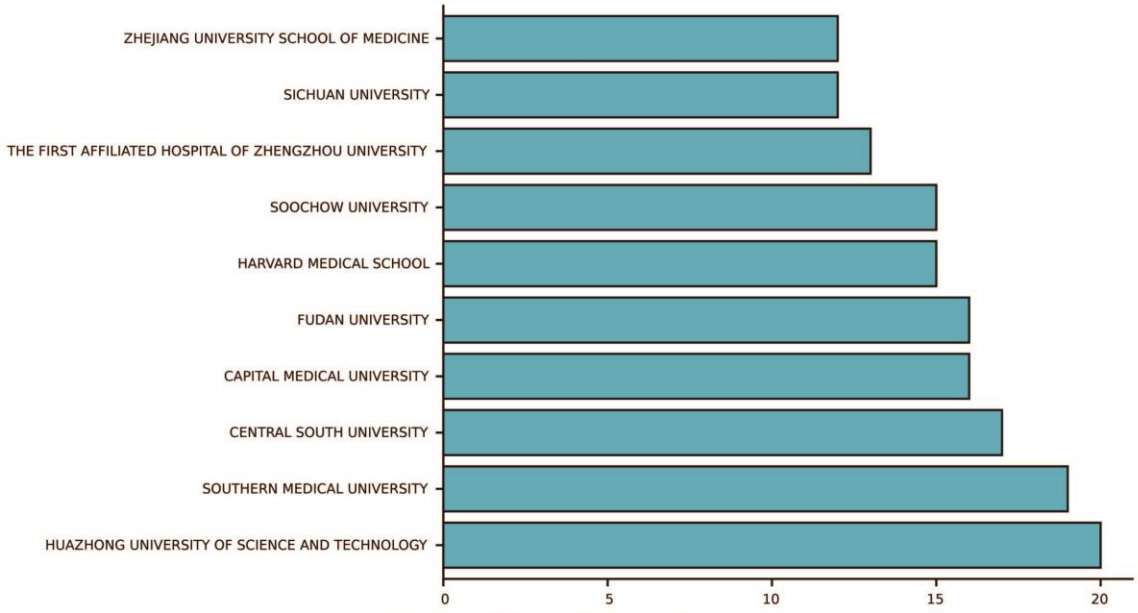
Table Note: IF, impact factor; JCR, Journal Citation Reports. IF and JCR quartile data refer to the 2024 Journal Citation Reports dataset.

Table 4. Top 10 most productive authors in PubMed-indexed research on programmed cell death and glioma immunotherapy.

Table 5. Top 20 high-frequency keywords in PubMed-indexed research on programmed cell death and glioma immunotherapy.

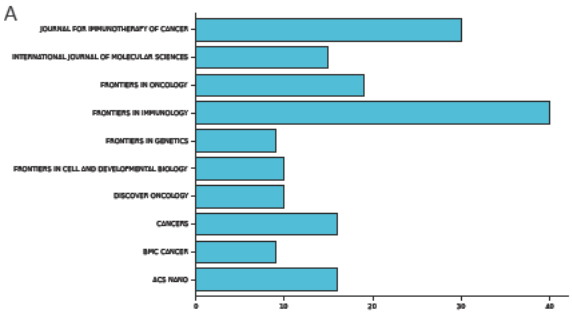


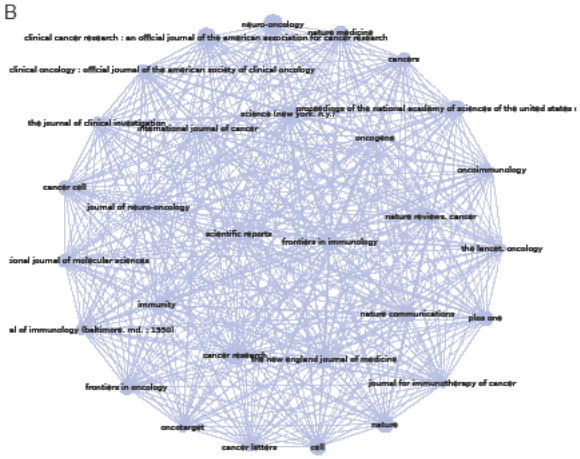


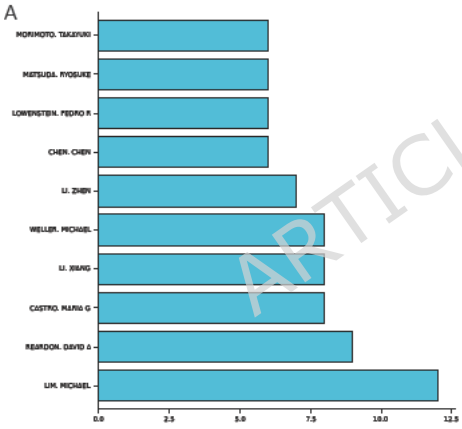


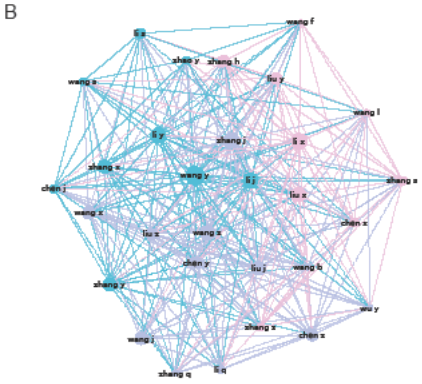
Institutional Collaboration Network

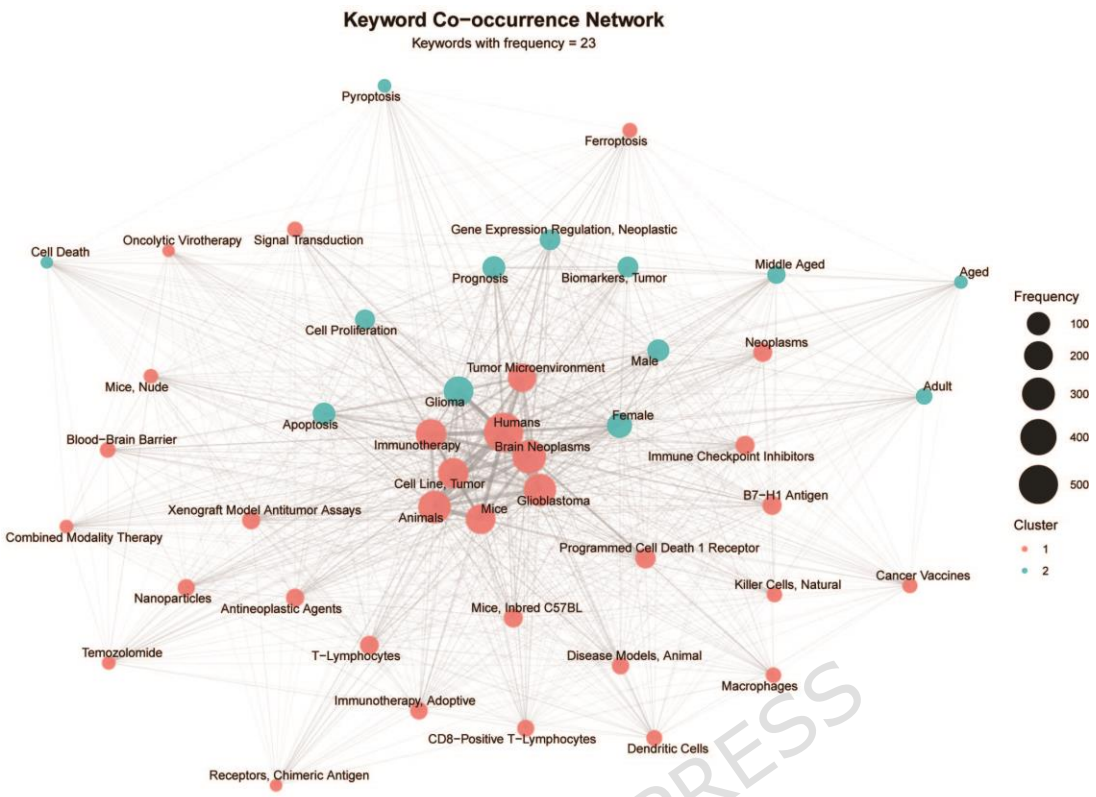
Node size represents publication volume; edge represents institutional collaboration











element	start	end	strength	2006 - 2025
MICE, INBRED C57BL	2006	2008	2.534	
COCULTURE TECHNIQUES	2010	2011	4.048	
IMMUNOTHERAPY, ADOPTIVE/METHODS	2011	2013	2.282	
PROGNOSIS	2022	2025	23.757	
TUMOR MICROENVIRONMENT	2022	2024	14.953	

Rank	Country	Documents (count)	Documents (percent/%)	MCP	MCP_Ratio/%	Annual growth/%
2	CHINA	351	54	33	9.4	36.38
10	USA	111	17.1	39	35.1	6.54
8	JAPAN	22	3.4	3	13.6	6.68
9	KOREA	20	3.1	0	0	3.93
4	GERMANY	18	2.8	3	16.7	5.95
7	ITALY	17	2.6	4	23.5	7.11
1	BELGIUM	10	1.5	7	70	0
5	INDIA	10	1.5	1	10	0
6	IRAN	9	1.4	4	44.4	0
3	FRANCE	8	1.2	3	37.5	0

Rank	University/Institution	Continent	Country	Articles
1	HUAZHONG UNIVERSITY OF SCIENCE AND TECHNOLOGY	Asian	HONG KONG	20
2	SOUTHERN MEDICAL UNIVERSITY	Asian	HONG KONG	19
3	CENTRAL SOUTH UNIVERSITY	Asian	HONG KONG	17
4	CAPITAL MEDICAL UNIVERSITY	Asian	HONG KONG	16
5	FUDAN UNIVERSITY	Asian	HONG KONG	16

6	HARVARD MEDICAL SCHOOL	North America	USA	15
7	SOOCHOW UNIVERSITY	Asian	HONG KONG	15
8	THE FIRST AFFILIATED HOSPITAL OF ZHENGZHOU UNIVERSITY	Asian	HONG KONG	13
9	SICHUAN UNIVERSITY	Asian	HONG KONG	12
10	ZHEJIANG UNIVERSITY SCHOOL OF MEDICINE	Asian	HONG KONG	12

Journal	Articles	IF	JCR	Catalogo
FRONTIERS IN IMMUNOLOGY	40	5.7	Q1	IMMUNOLOGY
JOURNAL FOR IMMUNOTHERAPY OF CANCER	30	10.3	Q1	ONCOLOGY
FRONTIERS IN ONCOLOGY	19	3.5	Q2	ONCOLOGY
ACS NANO	16	15.8	Q1	NANOSCIENCE & NANOTECHNOLOGY
CANCERS	16	4.5	Q1	ONCOLOGY
INTERNATIONAL JOURNAL OF MOLECULAR SCIENCES	15	4.9	Q2	CHEMISTRY, MULTIDISCIPLINARY
DISCOVER ONCOLOGY	10	2.8	Q2	ONCOLOGY
FRONTIERS IN CELL AND DEVELOPMENTAL BIOLOGY	10	4.6	Q1	DEVELOPMENTAL BIOLOGY
BMC CANCER	9	3.4	Q2	ONCOLOGY
FRONTIERS IN GENETICS	9	2.8	Q2	GENETICS & HEREDITY

Author	Articles	Institution	Country
LIM, MICHAEL	12	STANFORD UNIVERSITY SCHOOL OF MEDICINE	USA
REARDON, DAVID A	9	CENTER FOR NEURO-ONCOLOGY	USA
CASTRO, MARIA G	8	UNIVERSITY OF MICHIGAN MEDICAL SCHOOL	USA
LI, XIANG	8	SHENZHEN SIXTH PEOPLE'S HOSPITAL	HONG KONG
WELLER, MICHAEL	8	UNIVERSITY HOSPITAL AND UNIVERSITY OF ZURICH	SWITZERLAND
LI, ZHEN	7	STATE KEY LABORATORY OF RADIATION MEDICINE AND PROTECTION	HONG KONG
CHEN, CHEN	6	SHANDONG LABORATORY OF YANTAI DRUG DISCOVERY	HONG KONG
LOWENSTEIN, PEDRO R	6	UNIVERSITY OF MICHIGAN MEDICAL SCHOOL	USA
MATSUDA, RYOSUKE	6	NARA MEDICAL UNIVERSITY	JAPAN
MORIMOTO, TAKAYUKI	6	NARA MEDICAL UNIVERSITY	JAPAN

keyword	count
CELL LINE, TUMOR	236
IMMUNOTHERAPY	117
IMMUNOTHERAPY/METHODS	117
PROGNOSIS	97
TUMOR MICROENVIRONMENT	92
MALE	85
APOPTOSIS	53
GENE EXPRESSION REGULATION, NEOPLASTIC	53
MICE, INBRED C57BL	52
MIDDLE AGED	46
XENOGRAFT MODEL ANTITUMOR ASSAYS	39
DISEASE MODELS, ANIMAL	38
CELL PROLIFERATION	32
TUMOR MICROENVIRONMENT/IMMUNOLOGY	32
BIOMARKERS, TUMOR/GENETICS	26
GLIOBLASTOMA/THERAPY	26
MICE, NUDE	26
AGED	24
TUMOR MICROENVIRONMENT/DRUG EFFECTS	24
IMMUNOTHERAPY, ADOPTIVE/METHODS	23