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Oral squamous cell carcinoma (OSCC): a comprehensive bibliometric and scientometric analysis

Mehdi Musa Zade, Ashkan Bayat, Farshid Mahboubirad, Mitra Rostami, Mohammad Davoudi, Salar Motamedi, Arash Rezaee, Vahid Ghassemifar, Maryam Mardani, SeyedMehdi Ziaei, Alireza Azani, Ayda Moeinian, Mahtab Moradian, Shabnam Noei Alamdary, Negin Saffarzadeh, Alireza Lotfi,Alireza Ghanbari Gharibdousti, Morteza Hadavi Bavil, Hamed Ghanati, Qumars Behfar

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Running title:

OSCC bibliometric and scientometric analysis (2017–2023)

Abstract

Objectives: Oral squamous cell carcinoma (OSCC) accounts for over 90% of oral malignancies and remains a major health challenge. The 8th edition of the AJCC Cancer Staging Manual (2017), which highlighted depth of invasion (DOI) and extranodal extension (ENE) as prognosticators, reshaped OSCC research. This study provides a bibliometric and scientometric analysis of OSCC research from 2017–2023, mapping global productivity, leading contributors, emerging themes, collaborations, and funding trends.

Methods: Scopus was searched on 12 January 2024 using TITLE-ABS-KEY ("oral squamous cell carcinoma") OR ("retrospective oral cancer") without language or document-type filters. Eligible records included original articles, reviews, and conference papers. Extracted metadata covered publication details, affiliations, funding, keywords, and citations. Descriptive analyses were performed in Excel, while VOSviewer generated co-authorship and keyword networks.

Results: A total of 3,622 OSCC publications were identified, dominated by original articles (81.5%). Annual output increased from 395 in 2017 to 627 in 2021, with sustained growth thereafter. The United States, India, and China were leading contributors, with Chang Gung institutions highly productive. Oral Oncology was the top journal, while NIH, National Natural Science Foundation of China, and Taiwanese agencies were major funders. Emerging themes included HPV, betel quid, microbiome, tumor microenvironment, and checkpoint inhibitors, though collaborations were largely intra-national.

Conclusions: Since 2017, OSCC research has expanded in scope, with increasing focus on molecular and immuno-oncology. However, prevention, early detection, and equitable global collaboration remain underrepresented, highlighting the need for translational rebalancing.

Keywords: Oral Squamous Cell Carcinoma; Bibliometrics; Scientometrics; AJCC Staging; Immuno-Oncology;

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Introduction

Oral squamous cell carcinoma (OSCC) is one of the most frequently diagnosed malignancies worldwide and constitutes the predominant histologic subtype of cancers arising in the oral cavity, accounting for over 90% of cases [1]. Global estimates for 2020 indicated approximately 377,700 new cases and 177,800 deaths from malignancies of the lip and oral cavity, underscoring a substantial and persistent disease burden with marked regional heterogeneity [1]. Incidence is highest in South Asia (notably India, Pakistan, Sri Lanka), Taiwan, and parts of the Pacific, where cultural practices such as betel quid/ areca nut chewing are prevalent, while increasing trends have been recorded in some Western populations due to persistent tobacco and alcohol exposures and changing demographics [1,4–6]. Despite incremental advances in surgery, radiotherapy, and systemic therapy, the 5 year overall survival for OSCC has improved only modestly over recent decades, in part due to late-stage presentation, nodal metastasis at diagnosis, and locoregional recurrence [2,4,7].

OSCC etiology is multifactorial and reflects the interaction of carcinogenic exposures with host susceptibility. Tobacco and alcohol synergistically increase risk in a dose-dependent manner; the combined effect is greater than the sum of individual risks, with multiplicative interactions consistently demonstrated across diverse cohorts [11,14]. High-risk human papillomavirus (HPV) is a well-established driver of a subset of head and neck squamous cell carcinomas (HNSCC), especially within the oropharynx [15,19]. HPV-positive disease confers distinct biology and epidemiology and often portends a more favorable prognosis; however, its role in OSCC (i.e., non-oropharyngeal oral cavity sites) is comparatively limited and variable by geography, necessitating careful site-specific interpretation of HPV-related paradigms [15,20]. In South and Southeast Asia and Taiwan, areca nut and betel quid chewing—sometimes combined with tobacco and slaked lime—contributes substantially to OSCC risk and to the burden of oral potentially malignant disorders (OPMDs), including leukoplakia and oral sub- mucous fibrosis [20,24]. Socioeconomic determinants, nutritional deficiencies, poor oral hygiene, chronic candidiasis, occupational exposures, and chronic mechanical irritation may further modulate risk, though evidence strength varies [8,24–25,43].

A pivotal inflection in the clinical management and research orientation of OSCC occurred with the 8th edition of the American Joint Committee on Cancer (AJCC) Cancer Staging Manual in 2017. Two features—depth of invasion (DOI) and extranodal extension (ENE)—were integrated as key prognosticators that refine risk stratification and decision-making [27,31]. DOI was incorporated into T-category definitions for oral cavity primaries, reflecting strong associations with nodal metastasis and survival, and ENE was recognized as a critical determinant within nodal staging, shaping adjuvant therapy re- commendations [27,31–33,33]. These changes catalyzed a wave of clinical, pathological, and translational studies probing optimized surgical margins, elective neck dissection thresholds, pathology re-porting standards, and adjuvant treatment intensification, while simultaneously accelerating molecular and immune-oncology explorations relevant to OSCC [19,29–30,33–37].

Bibliometric and scientometric methods offer a reproducible framework to map research dynamics—quantifying productivity, influence, thematic evolution, and collaboration networks—thereby contextualizing how clinical inflection points translate into scholarly activity [38]. Prior bibliometric overviews in oral oncology surveyed citation classics, global productivity trends, and influential topics across extended time horizons [41–44]. Yet, to our knowledge, no synthesis has focused specifically on the "post– AJCC 8th edition" era for OSCC, a period during which staging refinements, immunotherapy approvals, and rapid advances in digital/AI-enabled diagnostics have interacted to reshape research priorities [19,33–35,45–47]. A focused analysis of 2017–2023 literature can illuminate whether research

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investment has aligned with disease burden and clinical need, identify gaps across prevention and early detection, and guide future interdisciplinary collaborations.

In this study, we characterize the OSCC research landscape from 2017 to 2023 using Scopus-indexed literature. We quantify trends in publication volume, document types, and citations; delineate geo- graphic and institutional contributions; identify prolific authors and funding patterns; and map thematic clusters via keyword co-occurrence networks. We further interpret these findings in light of the AJCC 8th edition changes, evolving exposure profiles, and emerging technologies. Our goal is to provide actionable insights for researchers, clinicians, funders, and policymakers to better align OSCC research with patient-centered and population-level outcomes.

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Material and methods

Data source and search strategy

We queried Elsevier's Scopus database on 12 January 2024 using the search string: TITLE-ABS-KEY ("oral squamous cell carcinoma") OR TITLE-ABS-KEY ("retrospective oral cancer"). This strategy was selected to maximize recall for OSCC-specific literature while capturing a broad set of clinical observational studies that often self-identify as "retrospective oral cancer" analyses. No language, country, or document-type filters were applied at retrieval to allow an inclusive corpus for screening. Scopus was chosen based on its extensive journal coverage and structured metadata conducive to bibliometric analysis; however, we recognize that complementary databases (e.g., Web of Science, PubMed) capture partially non-overlapping sets of records [38].

Eligibility criteria and screening

We included documents primarily focused on OSCC, encompassing original research articles, reviews, and conference papers. Excluded from quantitative synthesis were editorials, letters, commentaries, corrections/errata, and short notes lacking substantive data. Studies focused exclusively on non-oral head and neck subsites (e.g., larynx, hypopharynx) were excluded unless they provided discrete OSCC subgroup analyses relevant to our aims. Screening of titles/abstracts and document types was conducted programmatically using Scopus metadata fields, followed by manual verification on a subset to ensure category accuracy.

Data extraction and variables

For each included record, we extracted: publication year, document type, language, subject area tags (as per Scopus indexing), author names, author affiliations, country/territory of corresponding affiliation, journal title, funding acknowledgment text and funder IDs (when available), keywords (author keywords and index keywords), and citation counts (as of the retrieval date). When multiple affiliations were listed, we recorded all affiliations for authorship network analyses but attributed country counts using the full counting method (i.e., each country represented among co-authors received one count per paper) to reflect collaborative contributions [40].

Data curation and normalization

Author names were harmonized using an algorithmic approach to merge common variants (e.g., hyphenation differences, middle initials) where Scopus Author IDs suggested identity; however, we elected not to override Scopus IDs where ambiguity persisted, prioritizing precision over recall in author- level aggregation. Institution names were normalized by removing department-level qualifiers and aligning obvious variants (e.g., "Chang Gung Memorial Hospital" vs "CGMH"). For keywords, we per- formed light normalization to merge singular/plural variants and spelling differences (e.g., "tumor" vs "tumour"), and to unify key phrases (e.g., "oral cavity squamous cell carcinoma" -> "OSCC"), while preserving granularity for concepts such as "epithelial–mesenchymal transition" and "extranodal ex- tension."

Analytic approach

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• Descriptive statistics: We summarized annual publication counts, document types, languages, subject areas, top journals, and citation distributions. We highlighted the most productive countries and institutions by full counting, noting that fractional counting yields similar rank order with modest differences for international collaborations.

• Temporal trends: We examined year-over-year growth and identified peak output years, contextualized by external events (e.g., COVID-19 research disruptions) [51].

• Science mapping: We constructed keyword co-occurrence networks and co-authorship networks using VOSviewer (v1.6.20) [39]. For keywords, we applied a ≥5-occurrence threshold to focus on salient topics while avoiding fragmentation. For author-level co-authorship networks, we set a ≥10 publications per author threshold to visualize stable clusters and leadership nodes; for countries, a ≥30-publications threshold highlighted national ecosystems. We used association strength normalization and default clustering parameters, labeling the most influential nodes (based on link strength).

• Funding analysis: We parsed funding acknowledgments, harmonizing sponsor names (e.g., NIH, NCI, NIDCR; NSFC) and reporting frequencies to infer funding landscapes.

Methodological considerations and bias assessment

Bibliometric methods quantify productivity and influence but are not surrogates for methodological quality or patient benefit [38]. Scopus offers robust coverage of biomedical journals but may underrepresent regional publications or non-indexed outputs, potentially inflating Anglophone contributions and publication venues [38,42]. Citation accrual is time-dependent and topic-sensitive; papers from earlier in the window (e.g., 2017–2019) have more opportunity to accrue citations than those published in 2023. We did not de-duplicate preprints that later appeared in journals unless indexed as separate Scopus entries; however, preprints are minimally represented for OSCC compared with other oncology domains. Future triangulation with Web of Science and PubMed, altmetric indicators, and topic modeling could refine estimates and enhance thematic resolution [38,42–44].

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Results

Corpus overview

We identified 3,622 OSCC-relevant publications from 2017–2023 meeting inclusion criteria. Annual outputs rose from 395 in 2017 to 627 in 2021, stabilizing thereafter (Fig. 1). Original articles comprised 81.54% (n=2,956), followed by reviews at 13.65% (n=459) (Fig. 2). The remainder included book chapters (2.07%), letters (1.38%), conference papers (0.97%), short surveys (0.39%), notes (0.30%), editorials (0.30%), and errata (0.08%). English predominated (96.76%); other languages included Russian (1.13%), Spanish (0.61%), Chinese (0.44%), and German (0.39%). Annual output rose from 395 (2017) to a peak of 627 (2021), with sustained volumes in 2022 (n=591) and 2023 (n=599). The 2021 peak and modest subsequent decline likely reflect topic maturation and pandemic-era perturbations to research capacity and healthcare services [51].

Fig. 1. Annual publication trends in OSCC research (2017–2023).

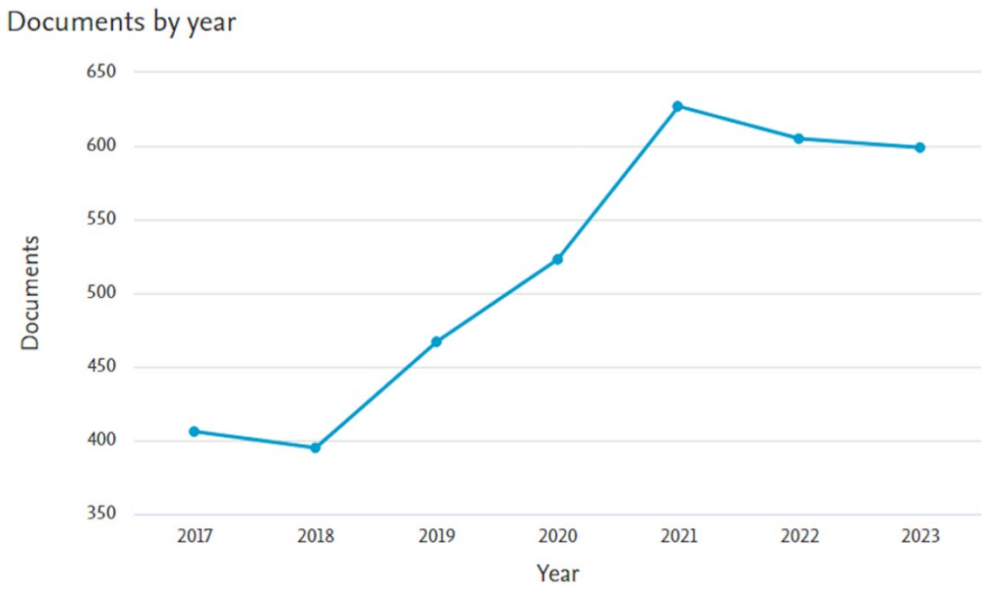
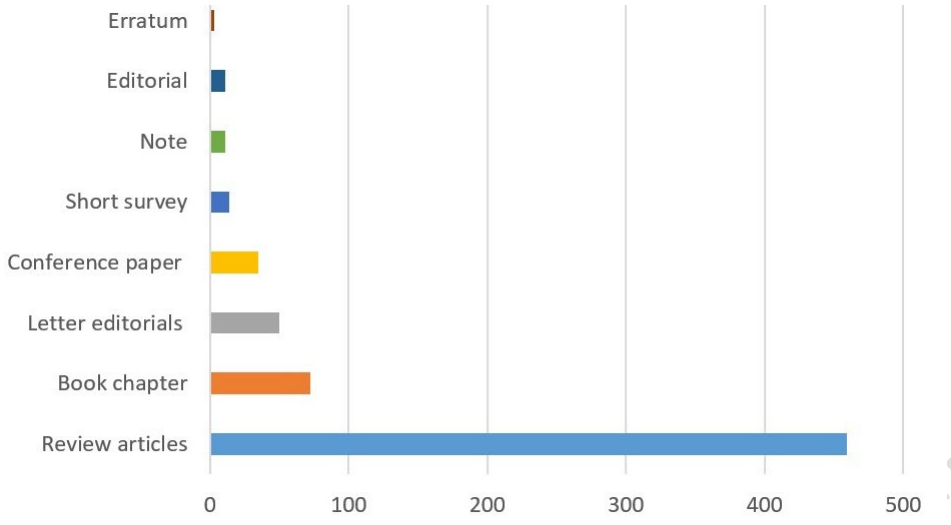


Fig. 2. Distribution of OSCC documents by type (2017–2023).



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Subject areas, journals, and citations

The 2020 cohort accrued the highest cumulative citations. Johnson et al. (2020) had 1,729 citations, the most in this period (Table 1). Medicine accounted for 81.4% of subject area tags, with substantial overlap into Biochemistry/Genetics/Molecular Biology (33.8%) and Dentistry (19.2%) (Fig. 3), reflecting the interdisciplinary nature of OSCC research. Oral Oncology published the greatest number of OSCC papers (n=199), followed by Head & Neck (n=125), Cancers (n=82), and Frontiers in Oncology (n=61) (Fig. 4). The 2020 cohort accrued the largest cumulative citations by retrieval date (n=1,729), consistent with both salience (e.g., consolidation of AJCC8-related management questions) and time for citation accrual. High-impact topics included prognostic modeling incorporating DOI/ENE, immune microenvironment profiling, imaging and pathology AI pilots, and region-specific epidemiology tied to betel quid exposure [27,36–37,47,52].

Fig. 3. Subject area distribution of OSCC research (2017–2023).

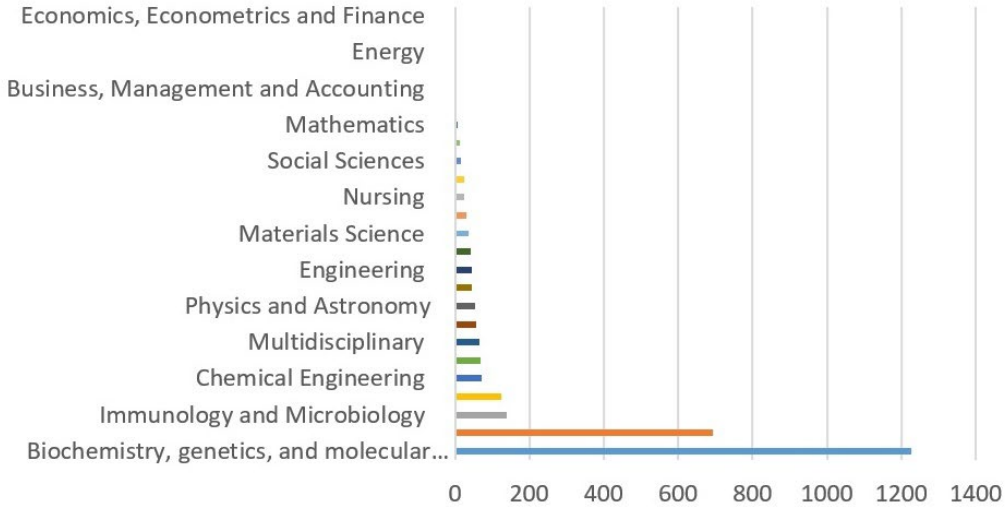

Fig. 4. Annual OSCC output in leading journals (2017–2023).

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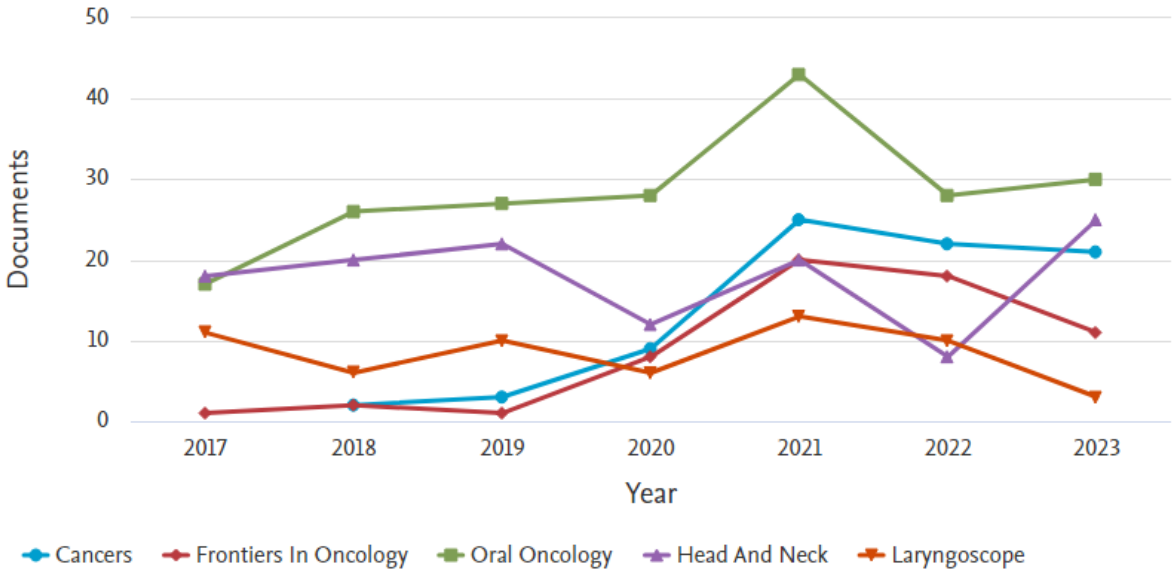

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Table 1. Top-cited OSCC articles (2017–2023).

SCR	First author	Title	Year	Cited by	Source title	Article type	Access type
1	Johnson, D.E.	Head and neck squamous cell carcinoma	2020	1,729	Nature Reviews Disease Primers , 6(1), 92	Review	Open access
2	Lydiatt, W.M.	Head and Neck cancers—major changes in the American Joint Committee on cancer eighth edition cancer staging manual	2017	1,082	CA Cancer Journal for Clinicians , 67(2), pp. 122–137	Origin	Open access
3	Chapple, I.L.C.	Periodontal health and gingival diseases and conditions on an intact and a reduced periodontium: Consensus report of workgroup 1 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions	2018	451	Journal of periodontology , 89, pp. S74–S84	Origin	Open access
4	Cramer, J.D.	The changing therapeutic landscape of head and neck cancer	2019	438	Nature Reviews Clinical Oncology , 16(11), pp. 669–683	Review	subscription
5	Huang, S.H.	Overview of the 8th Edition TNM Classification for Head and Neck Cancer	2017	416	Current Treatment Options in Oncology , 18(7), 40	Review	subscription

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Countries and institutions

By full counting, the United States led in publication volume (n=879; 24.26%), followed by India (n=572; 15.79%), China (n=309; 8.53%), Italy (n=230; 6.35%), and Taiwan (n=193; 5.33%) (Table 2). Prominent

institutions included Chang Gung Memorial Hospital (n=111) and Chang Gung University (n=94) in Taiwan; Tata Memorial Hospital (n=65) in India (Table 3); and the University of São Paulo (n=64) in Brazil, mirroring both disease burden and maturing research ecosystems [20,53]. Notably, Taiwan's institutional prominence aligns with policy attention to betel quid control and long-standing clinical cohorts [31– 32,53].

Table 2. Most productive countries in OSCC research (2017–2023).

Rank	Country	Number of publications
1	United States	879
2	India	572
3	China	309
4	Italy	230
5	Taiwan	193

Table 3. Leading OSCC institutions by publication volume (2017–2023).

Rank	Affiliation	Number of publications	Country
1	Chang Gung Memorial Hospital	111	Taiwan
2	Chang Gung University	94	Taiwan
3	Chang Gung University College of Medicine	68	Taiwan
4	Tata Memorial Hospital	65	Indi
5	Universidade de São Paulo	64	Brazil

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Authors, funding, and collaboration

Prolific authors included Chang K.P. (n=43), Liao C.T. (n=42), Kang C.J. (n=30), and Huang S.F. (n=29), reflecting coherent institutional clusters around OSCC surgery and pathology (Table 5, Fig. 5). Funding acknowledgments most frequently cited the U.S. National Cancer Institute/NIH and NIDCR; substantial support also came from the National Natural Science Foundation of China and Taiwanese agencies (Table

4) [54]. Co-authorship networks were predominantly intra-national across the United States, India, and China; cross- continental ties existed but were comparatively sparse, consistent with broader oncology collaboration patterns [55–56]. Thematic clustering often mirrored institutional strengths (e.g., surgery-pathology- outcomes vs molecular-immunology), with interdisciplinary hubs emerging around computational imaging and biomarker discovery.

Fig. 5. Most productive authors in OSCC research (2017–2023).

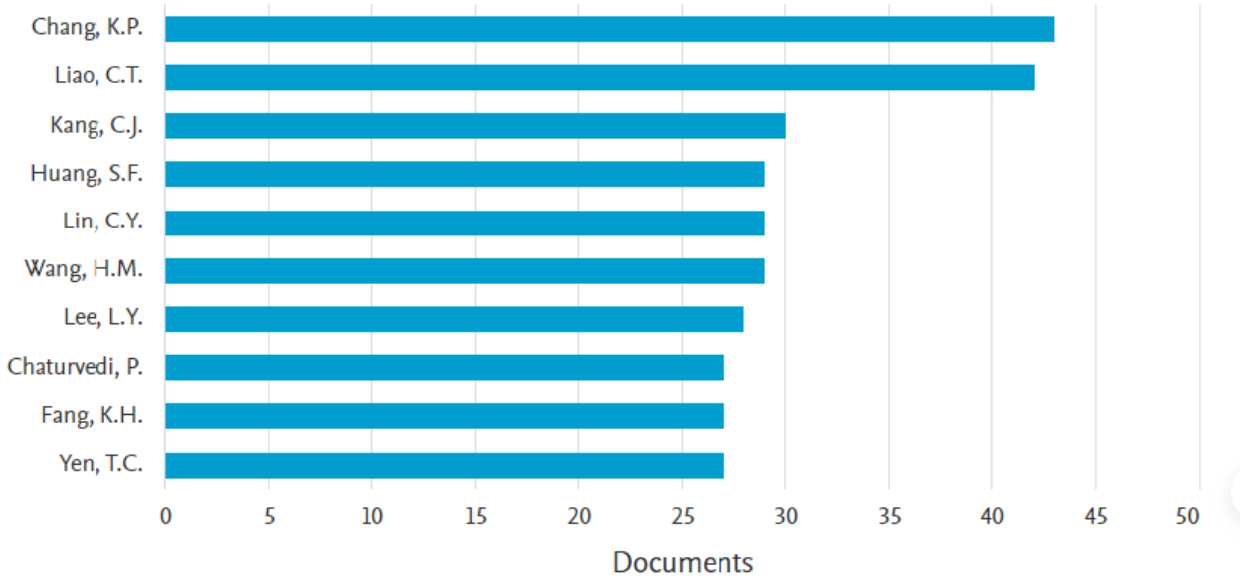

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Table 4. Major funding sponsors of OSCC publications (2017–2023).

Rank	Funding Sponsor	Number of publications	Country
1	National Cancer Institute	194	United States

2	National Institutes of Health	172	United States
3	National Natural Science Foundation of China	106	China
4	National Institute of Dental and Craniofacial Research	63	United States
5	Ministry of Science and Technology	61	Taiwan
6	Society for the Promotion of Science	49	Japan

Table 5. Most active authors publishing OSCC research (2017–2023).

Rank	**Author**	**Number of publications**
1	Chang, K.P.	43
2	Liao, C.T.	42
3	Kang, C.J.	30

Keywords and thematic evolution

High-frequency keywords included “squamous cell carcinoma,” “oral cavity,” “neck dissection,” “depth of invasion,” and “prognosis.” Emerging and expanding clusters featured “HPV,” “betel quid,” “microbiome,” “tumor microenvironment,” “epithelial–mesenchymal transition,” “radiomics,” “computational pathology,” and “checkpoint inhibitors,” mirroring the integration of AJCC 8th prognosticators with immuno-oncology and AI-driven diagnostics [19,27–30,33–37,47,52]. Several clusters reflected prevention and early detection (e.g., “oral potentially malignant disorders,” “diagnostic delay,” “screening”), though their relative volume was smaller than clinical or molecular clusters (Supplementary Fig. S1–S3) [14,24–25,43,45–46,57– 58].

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Discussion

Principal findings in context

In the seven years following the AJCC 8th edition, OSCC research output expanded substantially, peaking in 2021 and remaining at historically high levels thereafter (Fig. 1). The integration of DOI into T-category and ENE into nodal staging sharpened clinical questions around surgical margins, elective neck dissection, and adjuvant therapy. We observed corresponding growth in studies validating DOI thresholds, examining patterns of failure in ENE-positive disease, and standardizing pathology reporting [27,31– 33,33]. In parallel, translational research intensified around the tumor immune microenvironment, epithelial–mesenchymal transition, and the oral microbiome, with AI-enabled methodologies increasingly used to integrate histomorphology, radiology, and molecular signatures [19,34–37,47,52,59–60].

Epidemiology and exposure heterogeneity

The geography of OSCC publications largely mirrors exposure distributions and health-system capacity. Tobacco and alcohol dominate exposure profiles globally [11,14]. In South and Southeast Asia and Taiwan, areca nut/betel quid chewing contributes heavily to OSCC incidence and to OPMD prevalence; publication volume from these regions corresponds to clinical load and policy attention [20,31–32,53]. HPV-related HNSCC paradigms, which transformed management in the oropharynx, do not apply wholesale to OSCC; HPV-attributable fractions are lower and variable by site and region, cautioning against direct extrapolation of de-escalation strategies to oral cavity cancer [15,20]. These nuances reinforce the necessity of site-specific prevention (e.g., areca cessation), risk stratification (e.g., DOI thresholds, perineural invasion), and trial design.

Equity, collaboration, and capacity

Collaboration networks are still predominantly intra-national, anchored by high-income country hubs and select Asian centers [55–56]. Underrepresentation from Africa and parts of Latin America persists, reflecting resource constraints and structural inequities in research funding, biobanking, and data systems [24–25,43]. Equitable progress will require incentives for inclusive consortia, shared infrastructure (e.g., federated learning platforms, harmonized pathology protocols), and policies ensuring fair authorship and data governance. Journals and funders can catalyze this shift by prioritizing multi-center studies with balanced leadership and capacity-building components, especially in regions with high OSCC burden.

Clinical translation and staging-informed management

Evidence supporting DOI and ENE as risk modifiers has strengthened post-2017. In early oral tongue cancer, DOI thresholds help identify candidates for elective neck dissection; however, real-world variation persists in how DOI is measured—particularly in ulcerated lesions and specimens with tangential sectioning—introducing interobserver variability that can alter T-category and downstream management [27,31–33]. ENE recognition in pathology reports is critical given its strong association with recurrence and survival and its role in guiding adjuvant chemoradiation; yet, consistent ENE assessment (microscopic vs macroscopic, measurement conventions) remains a challenge across institutions [30– 31,33]. Harmonizing pathology reporting through international consensus statements, external quality assurance, and targeted training would reduce variability and improve comparability of outcomes.

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Prevention, early detection, and implementation science

Compared with surgical and molecular portfolios, prevention and early detection remain comparatively underrepresented. Betel quid cessation initiatives, taxation and marketing restrictions, graphic warnings, and culturally tailored behavioral interventions show promise but require sustained policy sup- port and rigorous implementation evaluations [24–25,43,53]. Opportunistic screening for OPMDs in dental and primary-care settings—combined with risk-stratified referral pathways—can facilitate earlier diagnosis; however, randomized evidence for mortality reduction in general populations remains mixed, and effectiveness likely hinges on targeting high-risk groups and minimizing diagnostic delay [14,57–58,60]. Embedding implementation science outcomes—feasibility, fidelity, equity, and cost-effectiveness—into OSCC programs can close the evidence–practice gap, particularly in low-resource contexts.

Biomarkers, therapeutics, and trial design

While PD-1 inhibitors improved outcomes in subsets of recurrent/metastatic HNSCC [45–46], OSCC-specific predictive biomarkers beyond PD-L1 remain immature. Despite advances in prognostic modeling, methodological challenges in risk prediction models for head and neck cancers remain significant concerns that affect clinical decision-making and model validation [26]. Multiomic integration—genomics, transcriptomics, spatial immunophenotyping, and microbiome profiling—may stratify response, predict recurrence, and guide adjuvant therapy intensification or de-intensification [19,34–37,52,59– 60]. Pragmatic and adaptive trial designs tailored to OSCC's site-specific biology and morbidity profile are warranted, incorporating endpoints such as functional preservation, swallowing, speech, and patient-reported outcomes. Trials should also prioritize inclusive recruitment from high-burden regions to ensure generalizability and address disparities.

Digital and AI-enabled diagnostics

Computational pathology and radiomics have matured rapidly, with proof-of-concept studies demonstrating accurate classification of histologic patterns and prognostic risk from whole-slide images and imaging features [47]. For OSCC, AI tools could augment grading, quantify tumor budding and peri- neural invasion, and estimate DOI from imaging where biopsy artifacts complicate measurement. Yet generalizability gaps persist due to heterogeneity in scanners, staining protocols, population characteristics, and data curation. Before clinical adoption, models require:

- External validation across continents and health systems.
- Prospective evaluation of clinical utility and workflow integration.
- Health-economic analyses to justify reimbursement.
- Transparent reporting (e.g., TRIPOD-AI, CONSORT-AI), model cards, and bias audits to ensure safety and equity.

Federated learning and privacy-preserving analytics can expand training datasets without centralizing patient data, an approach well-suited to rare subtypes and underrepresented regions.

Quality, metrics, and methodological limitations

Bibliometric indicators (e.g., citation counts, h-index, journal venue) reflect visibility and influence but not necessarily methodological rigor or patient benefit [38]. Citation practices may be affected by language,

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access, and social networks, potentially disadvantaging LMIC-produced research even when highly relevant. Reliance on a single database (Scopus) risks missing regionally important journals; English-language dominance likely inflates Anglophone representation [38,42]. Finally, time-lag biases favor earlier publications within the window. Future studies can mitigate these limitations by triangulating databases, integrating altmetrics and policy citations, employing topic modeling to quantify thematic evolution, and linking bibliometrics to clinical guideline adoption and implementation outcomes [38,42–44].

Actionable recommendations

• Standardize pathology reporting of DOI and ENE with international consensus, external quality assurance, and digital reference atlases to reduce interobserver variability [27,31–33,33].

• Expand LMIC-led consortia targeting areca nut/betel quid cessation, tobacco/alcohol control, and OPMD screening, embedding implementation metrics (feasibility, fidelity, equity, cost) [14,20,24– 25,43,45–46,53,57–58].

• Build multiomic, prospectively curated OSCC cohorts across continents to discover and validate OSCC-specific biomarkers and AI tools; adopt federated analytics to include data from regions with stricter data localization [19,34–37,47,52,59–60].

• Design adaptive, pragmatic trials with patient-centered endpoints and inclusive recruitment; integrate circulating biomarkers and digital pathology into stratification schemas [45–46,48,59].

• Incentivize equitable collaboration through funding calls and journal policies that prioritize cross-continental authorship balance, capacity building, and FAIR data sharing [24–25,43,54].

Conclusions

From 2017–2023, OSCC research expanded substantially and diversified under the influence of AJCC 8th edition staging refinements. Yet prevention, early detection, and equitable collaboration remain comparatively under-resourced, and translational progress toward biomarker-driven therapy is uneven. Aligning research portfolios with implementation-ready public health strategies, OSCC-specific precision oncology, and fair global partnerships will be essential to meaningfully reduce OSCC burden and improve patient outcomes.

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Conflict of Interest

The authors declare that they have no conflicts of interest related to the content of this manuscript.

Ethical Declaration

This study is a bibliometric and scientometric analysis based on previously published, publicly available data and did not involve human participants, identifiable personal data, or animal subjects. Therefore, formal ethical approval was not required. Nevertheless, the protocol was reviewed and deemed exempt from ethics review by the Tehran University of Medical Sciences Research Ethics Committee (TUMS-REC), Tehran, Iran.

Authors' Contribution

- Conceptualization: Hamed Ghanati*, Negin Saffarzadeh‡
- Study design and protocol: Hamed Ghanati*, Mitra Rostami*, Negin Saffarzadeh‡
- Data acquisition (search, screening, extraction): Hamed Ghanati*, Mitra Rostami*, Moein Maddahi, Maryam Mardani
- Data curation and normalization (authors/institutions/keywords): Mitra Rostami*, Mahtab Mottaghi, SeyedMehdi Ziaei
- Analysis and visualization (descriptive stats, VOSviewer mapping): Hamed Ghanati*, Salar Motamedi, Alireza Azani
- Interpretation of results: Negin Saffarzadeh‡, Qumars Behfar†, Mohammad Davoudi
- Drafting of the manuscript: Hamed Ghanati*, Mitra Rostami*
- Critical revision of the manuscript for important intellectual content: Negin Saffarzadeh‡, Qumars Behfar†, Mohammad Davoudi, Mahyar Khanlari Goodarzi, Saba Hakimy

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- Supervision: Negin Saffarzadeh‡, Qumars Behfar†
- Administrative/technical/material support: Alireza Azani, Mahtab Mottaghi
- Final approval of the manuscript: All authors

Notes: *Co-First Authors; †Second Corresponding Author; ‡Corresponding Author

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