Current trends and themes of oral cancer research: A bibliometric analysis of publications from 2011 to 2022 in prominent oral pathology related journals

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ABSTRACT

Objectives: This study presents a comprehensive bibliometric analysis of oral cancer research published in three leading journals (Oral Oncology, Journal of Oral Pathology and Medicine, and Oral surgery Oral medicine Oral pathology and Oral Radiology) between 2011 and 2022 covering oral pathology.
Material and methods: The study identifies publications and citation metrics and evaluates the performance of journals, authors, institutions, and countries as well as identifies the prevalent topics and trends in oral cancer research through an analysis of article titles using the R-studio Bibliometrix package.
Results: The USA, India, and China produced the highest number of publications. The annual scientific production of all of the journals in the current study has increased over time, with noticeable peaks in 2013, 2017 and 2020. The study also identifies the most commonly researched topics, such as "potentially malignant," "lymph node," "HPV," "malignant transformation," and "epithelial dysplasia." Additionally, a thematic analysis of sliced maps showed changing conceptual structures and themes over the years, with emerging themes like "AI" and "oral microbiome" dominating in recent years. Finally, co-citation and co-authorship analysis were conducted to evaluate the intellectual structure and social collaboration structure of the research.
Conclusion: Overall, this study provides valuable insights into the evolving research trends in oral cancer. Some specific clusters of research collaboration were observed among certain countries and institutions. The map of oral cancer research is currently leaning towards AI, microbiome and biomarkers.

1. Background

Cancer of the lip and oral cavity is a significant global health concern with an estimated 373000 incident cases, 199 000 deaths and 5·51 million disability adjusted life years (DALY's) in 2019 alone, according to the Institute for Health Metrics and Evaluation (IHME) latest data on global burden of disease (GBD) [1]. The burden of oral cancer treatment is expected to rise significantly, despite the efforts on early screening and diagnosis [2,3]. There has been a continuous increase in research efforts towards oral cancer encompassing diagnostic, prognostic and therapeutic modalities, qualitative and health system analysis [4].

A bibliometric analysis can help assess, evaluate and visualize research trends and evidence in a particular field, enabling future researchers and stakeholders to make informed decisions regarding research priorities [5,6]. Recent limited bibliometric analysis of oral cancer related publications have primarily focussed on scientometric and performance analysis as well as exploration of the top cited articles in the field [7,8]. However, there has yet to be a detailed analysis of research trends, emerging and declining themes, key areas of current research, prediction of future research path, intellectual and social structure of current oral cancer research. A comprehensive bibliometric analysis should include both the performance analysis, which measures citation and impact counts, and science mapping, which explores the key trends, topics, and collaboration networks among authors, topics, affiliations and countries involved [9].

To address the important questions on the themes, trends and network collaboration of oral cancer research, we conducted an analysis using data from three highly respected journals in the field of oral

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pathology: Oral Oncology (OO), Journal of Oral Pathology and Medicine (JOPM), and Oral surgery Oral medicine Oral pathology and Oral Radiology (OOOO).

2. Methods

The current study's analysis methodology is based on the bibliometric handbook on how to conduct a bibliometric analysis by Rehn *et al* published in 2014 [10]. The study conducted dynamics of performance based on publications/citations, and impact based on various scholarly indexes for journals, authors, affiliations and countries. Different indices were employed to compare journal metrics, including the h-index, g-index and m-index. The h-index of n indicates that among all publications in the journal, n of these publications have received at least n citations each. While the h-index is widely used in isolation, it is complemented by the g-index, which is the largest unique number such that the top g articles receive at least g^2 citations. The g-index often separates publications based on citations to a greater extent than the h-index. The m-index is another variant of the h-index that displays the h-index per year since the first publication. Since the h-index tends to increase with career length, the m-index can be used in situations where career lengths vary [11].

To generate keyword trends and thematic time slices, we performed a trends and themes analysis of articles titles, abstracts and keywords. We generated a thematic map based on centrality and density of keywords, and analysed at different time slices. We analysed the intellectual and social structure by generating network maps using link strengths and node density. All the analyses were conducted using RStudio based on R version 4.2.0 and Biblioshiny, which is a web application based on Bibliometrix package version 4.0.0 for R [12,13].

3. Search strategy

Dimensions, a free-to-use scholarly work database, that provides similar functionality and citation analysis capabilities of Scopus and Web of Science, was used for the literature search in the current study [14]. We used a comprehensive title and abstract search function using the syntax; {(oral) AND (cancer)}, limits were set to filter articles only from 2011 to 2022, published in English language in the three journals of interest namely OO, JOPM, and OOOO. These journals are considered to be the the most relevant and highest indexed journals in the field of oral pathology/oral oncology/oral medicine and surgery. Other journals that were not exclusively focussed on oral diseases, such as journals of oral, head and neck surgery and general cancer based journals, were thus excluded as they were not immediately comparable to dedicated oral pathology journals. The search strategy was evaluated by screening the titles of all identified articles, and corresponding abstracts were reviewed when there was concern regarding the relevance of the article. Refine and limit functionalities in Dimensions web search tool were used to exclude books, book chapters, book series, and policy documents.

4. Results

The comprehensive bibliometric analysis results are presented following the guidelines of the Karolinska institute. The overview of publication and citation metrics are presented first, followed by the analysis of themes and trends of research topics. The analysis concludes with an evaluation of the intellectual structure using co-citation analysis, and social collaboration structure using co-authorship strength.

5. Overview and performance analysis of the journals, authors, institutions and countries

The initial search with the applied search syntax yielded 112,050 published documents. Limiting the search to OO, JOPM and OOOO journals reduced the number to 3,707. Applying the timeline filter for 2011–2022, the final document count was 2347. Of these, 1280 articles were from OO, 632 from OOOO and 435 from JOMP.

The combined annual growth rate of publications across the three journals was 0.89%. The average citation used by each document in the study was 14.63. There were 9456 authors listed as contributors to these publications, of which only 60 were single authored documents, with an average of 6.47 co-authors per article and 50.87% international co-authorship. The annual scientific production displayed an overall increasing trend, with noticeable peaks in 2013, 2017 and 2020. The mean citation per year per published article was highest in 2018 (4.94) and lowest in 2013 (1.58). Cumulative citation analysis showed the highest citation count during 2014–2018.

Individually, there was a gradual growth of publications in all journals included in the study, with OO having a higher number of publications per year, except for the year 2020 when OOOO had more publications. OO published the highest number of oral cancer related articles in 2013 (203 articles) followed by 2020 (135). The OOOO had the highest number in 2020 (163), and JOPM in the year 2019 (49) and 2014 (45). As shown in Fig. 1, OO had higher indexes (h_index: 72, g_index: 98, m_index: 6) compared to that of JOPM (h_index: 40, g_index: 58, m_index: 3.3); and OOOO (h_index: 29, g_index: 45, m_index: 2.4).

The top three countries with the highest number of publications were the USA (465), India (279) and China (228). The top ten countries with the highest number of publications are presented in Table 1. Multi-country production (MCP) ratio, which is a metric to measure international collaborative research, was highest for the USA, followed by China, Brazil, Taiwan and India, whereas India had the highest single country production. The top-cited countries were the USA (9569), the UK (3682), China (3426), Taiwan (2776), Brazil (2677), and India (2612). The institutions/organizations with the highest number of publications were Universidad de Sao Paulo, Brazil (50); Saveetha University, India (45); State University of Campina, Brazil(44); Tata Memorial Cancer Hospital, India (43) and King's College London, UK (39).

The highest publishing authors were Wang Y, Warnakulasuriya S, and Wang C, with 33, 32 and 28 publications, respectively. When considering the fractionalized publication count, which divides authorship among all the authors, the highest fractionized article counts belonged to Warnakulasuriya S (8), Farah CS (6.61), and Sarode GS (5.81). Authors who had the highest number of publications in OO, JOMP and/or OOOO in a specific year were Santo Silva AR (11 articles in 2020, with 24 citations), Farah CS (8 articles in 2019, with 115 citations), and Lopes MA (8 articles in 2020 with 24 citations). Warnakalusuriya S had the highest overall total citations in a specific year with 401 citations in 2011, followed by 249 and 178 respectively in 2015 and 2018. The most cited articles are presented in Table 2. Eight out of the top ten cited articles were published in OO. The top two highest cited articles were on epidemiologic and etiologic association of Human Papilloma Virus (HPV) and oral cancer, followed by two articles on OPMD.

6. Analysis of publication trends and themes over the period of 2011–2021

Initial analysis of the article titles dynamics over the years revealed that the usual terms used in titles and keywords such as "oral squamous cell carcinoma", "mouth neoplasm", "human", "male-female" remain the most prevalent. However, these terms were too general and did not necessarily reflect the focus/aim of the articles related to oral cancer in humans. These terms were therefore selectively removed from the analysis using the functionality in "Bibliometrix" package, to allow the specific topics to emerge. The most commonly researched topics that emerged were "potentially malignant", "lymph node", "HPV", "malignant transformation" and "epithelial dysplasia". The title word occurrence analysis based on the artificial timeline revealed that the most current topics of interest were "therapeutic targets", "potential therapeutic", "sentinel lymph node", "artificial intelligence (AI)" and "HPV". A detailed graphical presentation of trending topics over the years is shown in Fig. 2.
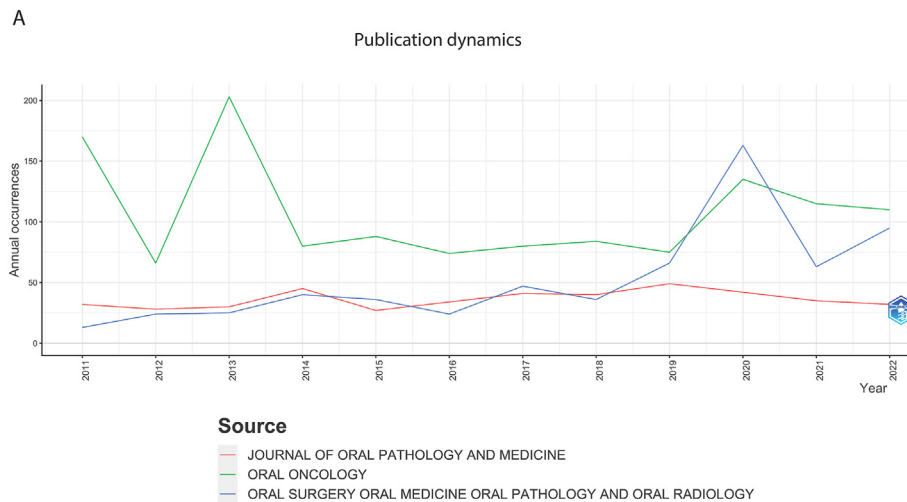
A

Fig. 1. Publication dynamics of the journals over a period of 2011 to 2022. X-axis represents the number of articles published in a year, and Y-axis represents the years.

Table 1
Top ten most productive countries on the topic from 2011 to 2022.

Country	Articles	SCP	MCP	Citations
UNITED STATES	350	135	215	9569
INDIA	257	168	89	2612
CHINA	208	86	122	3426
BRAZIL	178	71	107	2677
TAIWAN	112	19	93	3682
JAPAN	102	55	47	2776
UNITED KINGDOM	78	28	50	1773
AUSTRALIA	74	23	51	2366
NETHERLANDS	73	24	49	1799

SCP: Single country production; MCP: Multi-country production.

The thematic maps were generated for title words, based on inclusion index weighted by word-occurrences, and interpreted as per the method used by Cobo *et al* (2011) [15]. The themes were divided into four time slices for detailed analysis, as shown in Fig. 3.

The analysis of sliced thematic maps showed a changing conceptual structure and themes over the years. "Oral health" and "aerodigestive tract" were a developed theme, and "HPV" was a central theme in 2011–2013. Emerging themes such as "AI", "oral microbiome", and "therapeutic target" dominated during the years of 2021–2022. The thematic analysis indicated that the study of lymph nodes in cancer has evolved significantly since 2011, and systematic reviews on various topics of oral cancer emerged in 2014 and are growing since then. Oral carcinogenesis studies were periodically emerging or declining between 2014 and 2020, and the focus on OPMD and OED was increasing.

7. Intellectual structure of published literature

Intellectual structure is formed by co-citation analysis, which involves tracking pairs of papers that are cited together in the source articles. When these pairs of papers are co-cited by multiple authors, clusters of research begin to form. The co-cited papers in these clusters tend to share some common themes and display collaboration among the clusters. Network maps were generated for articles and journals using the Louvain algorithm and automatic layout method.

The co-citation network of papers displayed three specific clusters, each representing a pair and group of papers that were frequently cited

Table 2
Top ten Most cited articles in the included literature from 2011 to 2022.

| Paper	DOI	Total Citations	TC per Year	Normalized TC	Article type
PYTYNIA KB, 2014, ORAL ONCOLOGY	10.1016/J.ORALONCOLOGY.2013.12.019	348	34.80	12.13	Review
LINGEN MW, 2012, ORAL ONCOLOGY	10.1016/J.ORALONCOLOGY.2012.07.002	273	22.75	9.29	Original article
SPEIGHT PM, 2017, ORAL SURGERY ORAL MEDICINE ORAL PATHOLOGY AND ORAL RADIOLOGY	10.1016/J.OOOO.2017.12.011	250	35.71	11.68	Review
WARNAKULASURIYA S, 2015, JOURNAL OF ORAL PATHOLOGY AND MEDICINE	10.1111/JOP.12339	238	26.44	10.02	Review
SIMARD EP, 2014, ORAL ONCOLOGY	10.1016/J.ORALONCOLOGY.2014.01.016	214	21.40	7.46	Original article
LIU J, 2012, ORAL ONCOLOGY	10.1016/J.ORALONCOLOGY.2012.01.021	191	15.92	6.50	Review
CHO Y, 2011, ORAL ONCOLOGY	10.1016/J.ORALONCOLOGY.2011.08.007	178	13.69	7.01	Original article
BJØRNDAL K, 2011, ORAL ONCOLOGY	10.1016/J.ORALONCOLOGY.2011.04.020	176	13.54	6.93	Original article
YU V, 2015, ORAL ONCOLOGY	10.1016/J.ORALONCOLOGY.2015.10.018	174	19.33	7.33	Original article
JOSEPH JP, 2018, ORAL ONCOLOGY	10.1016/J.ORALONCOLOGY.2018.03.004	161	26.83	8.15	Review

TC: Total citations.
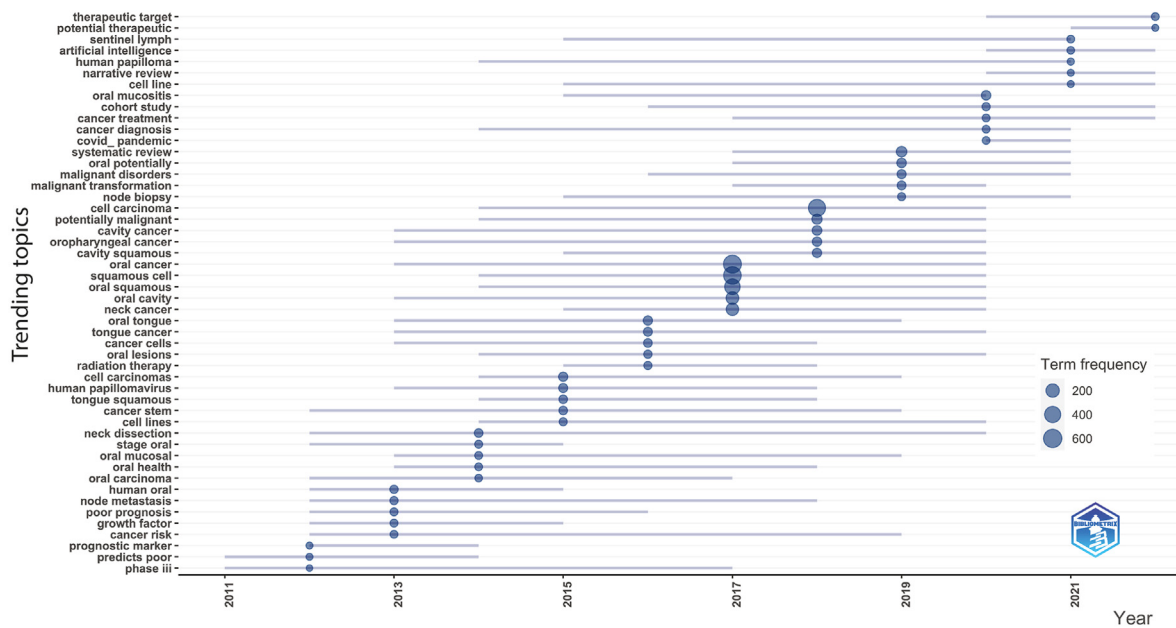
Fig. 2. Graph illustrating the distribution of trending topics over the study period.
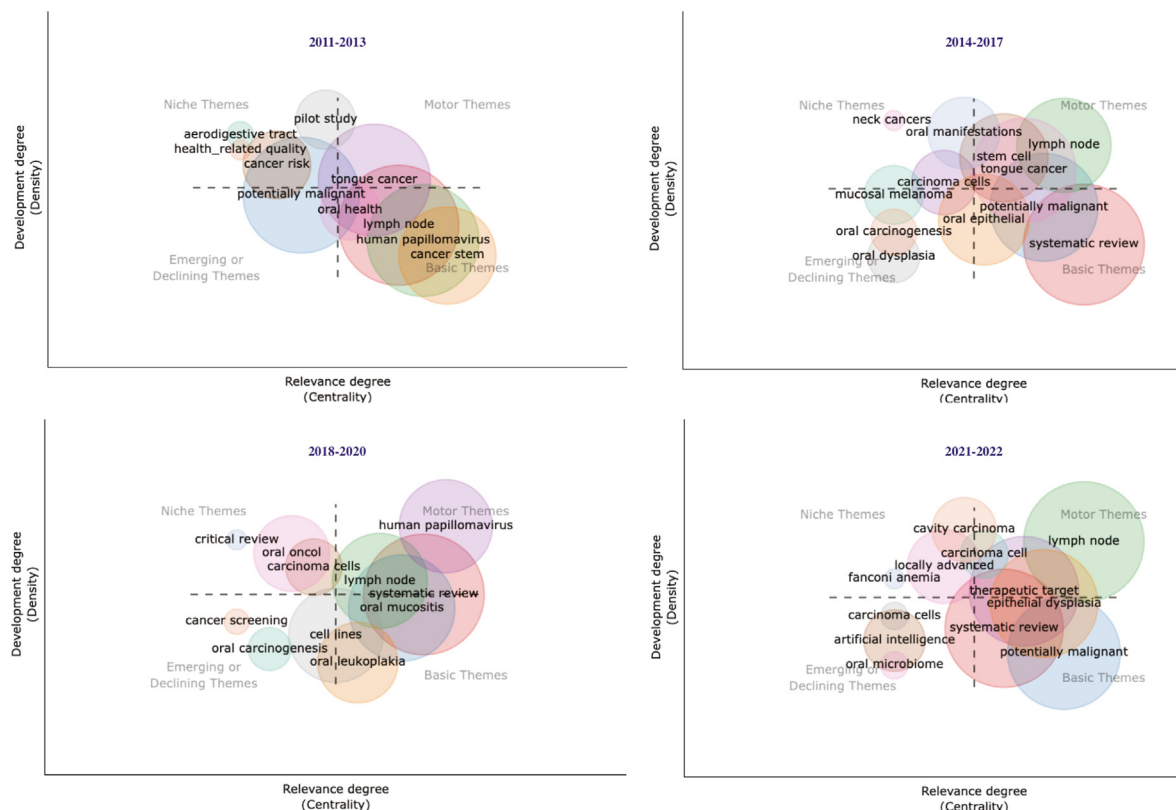

Fig. 3. Thematic evolution of oral cancer related research topics from 2011 to 2022 divided in four time slices. The x-axis represents the degree of relevance or centrality, and the y-axis represents the degree of development of the topic or density.

together (Fig. 4A). The red cluster is the largest consisting of influential articles on the theme of OPMD and pre-malignant cancers, global cancer statistics and review of prognostic and predictive factors. The smaller green cluster consisted of valuable articles related to cancer staging and neck dissection, chemotherapy and radiotherapy. The blue cluster consisted of articles on the theme of HPV and oro-pharyngeal cancer incidence. Among the journals, OO and OOOO shared the same co-citation cluster, whereas JOMP had a different co-citation cluster with other journals (Fig. 4B).

8. Social structure of collaboration

We used the Louvain clustering algorithm and automatic layout method to display the social networks of top twenty institutions and
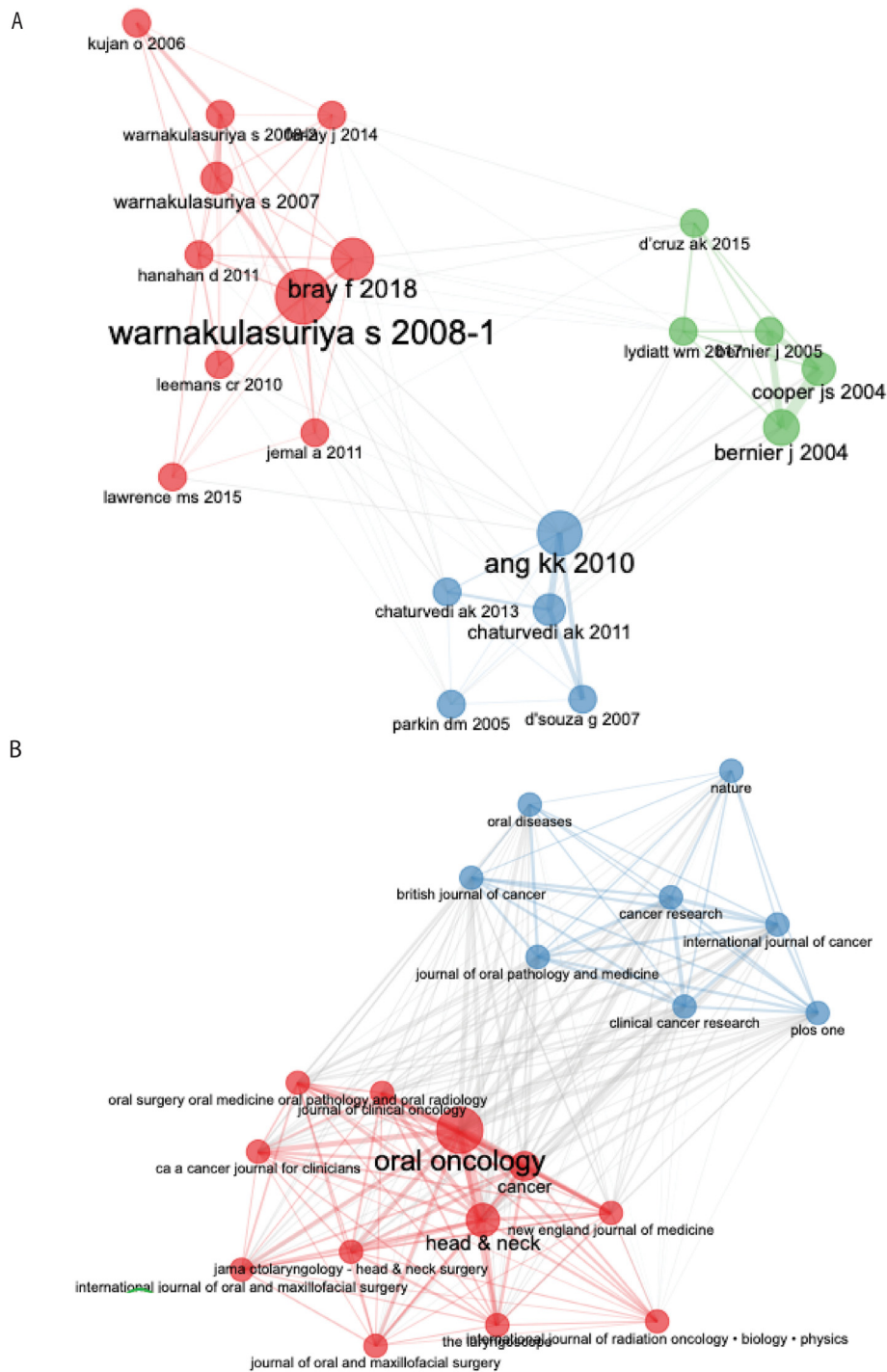
A

B

Fig. 4. (a) Co-citation network of articles published in OO, JOMP and OOOO during 2011–2022. Each cluster is made up of a group of co-cited articles which represent a common topic or theme, and are displayed with different colors. The node size represents the relevance of the article, and line thickness represents a higher co-citation pattern. (b) Co-citation network of journals during 2011–2022. The node size represents the relevance of the journal, and a thicker line represents higher co-citation. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

countries (Fig. 5). There were three major clusters of countries collaborating: the most significant collaboration was led by the USA, which also included China, Japan and South Korea. India led the second cluster with Australia, Saudi Arabia and Malaysia. Several European countries together with Brazil were found to form another colabrative node (Fig. 5A). The strongest collaboration was found between the institutions from South America, Harvard University, USA; University of Florida, USA; and King's College, London, UK. Three smaller clusters each were Shanghai Jiao Tong University, China and Shanghai Ninth People's Hospital, China; Tata memorial hospital, India and Memorial Sloan Kettering Cancer center, USA; and National Taiwan University, Taiwan and China Medical University, China (Fig. 5B).

9. Discussion

To the best of our knowledge, this is the first comprehensive bibliometric analysis of articles published in the field of oral cancer, presenting both the performance analysis and science mapping of oral cancer related publications in the leading dentistry journals OO, JOMP and OOOO over the period of 2011–2022. Our analysis revealed that OO remains the highest publishing, highest cited and most impactful source of oral cancer related articles among the three journals. This observation may be due to the fact that OO is an oncology journal, with a majority of the published articles naturally related to oral cancer research [16]. Other possible explanations include the type (original *versus* review, open access *versus*
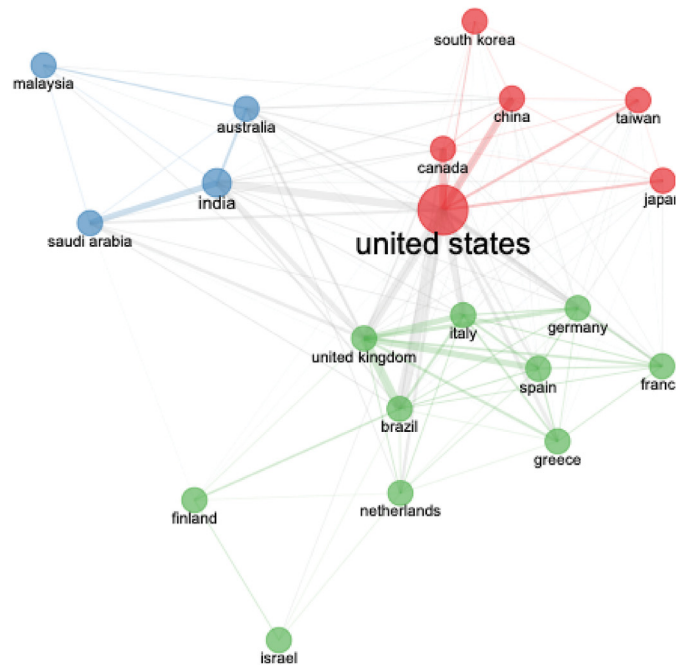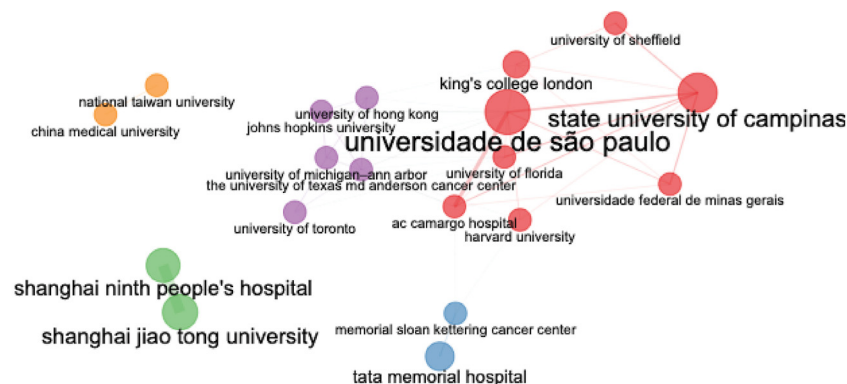
Fig. 5. Collaboration network of countries (a) and institutions (b). Same color denotes the countries and affiliations with highest collaboration, larger node size represents higher contribution, and thicker line strength represents the strength of collaboration between individual institutions and countries. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

subscription based access) and quality of articles published. Additionally, other factors such as number of articles per issue, number of issues per year may have played a part. OO and OOOO publish 12 issues per year whereas JOPM publishes only 10 issues [17,18].

The USA had the highest country-specific publications, followed by India, China, Brazil, UK, and Taiwan. This finding could be related to several factors such as the number of research institutions and researchers in the field, and the availability of patients and resources for research. Indeed, oral cancer incidence/burden may be higher in some of the above countries, and therefore oral cancer research might be a priority area at the institutional and governmental level [19]. It is also possible that the researchers in the above-mentioned countries had a selective preference for publishing in OO, JOPM and OOOO over other cancer-related journals.

The USA was the highest cited country followed by the UK and China. While several factors can influence the citation rates, it is possible that the dominance of original and ground-breaking research articles from these countries contributed to their higher citation rates. Authors with landmark articles on oral cancer statistics, OPMD, and HPV and oropharyngeal cancer remained the highest cited. This may be due to the

fact that these articles were published earlier and had a longer citation window. Additionally, being landmark articles in the field, they were likely to be cited by research articles on similar topics. An interesting observation in the current work was that there has been a gradual evolution of research trends over the years. Research topics such as basic epidemiology, cancer risk factors, carcinogenesis dominated research initiatives during earlier years, whereas research activities focussing on therapeutic targets and biomarkers, sentinel lymph nodes, HPV, oral microbiome and AI were found to be more popular in recent years [20]. The most common current treatment modalities for oral cancer are surgery and/or combination of radiation and chemo-therapies [21]. Because of the lack of well-established clinico-pathological/molecular prognostic/predictive markers, oral cancer patients are often over-treated. The associated morbidity after debilitating surgery drastically decreases the quality of life for the oral cancer survivors [22–24]. Moreover, recent studies have indicated that oral cancer represents a very heterogeneous disease with respect to the molecular changes, and therefore standard therapies are more likely to fail [25]. This underscores the importance of better understanding of oral cancer biology and development of personalized chemotherapeutic treatments for the management of oral

cancer patients. In this line, the results of the current study demonstrated a remarkable change in research focus over the period. Research interest in prognostic biomarkers and therapeutic targets is on the rise as seen in our results. Such research initiatives fuelled with advancements in analytical tools and biochemical assays has led to the identification of a number of prognostic biomarkers and molecular targets in oral cancer [26]. For example, PD-L1 as a promising prognostic and predictive biomarker [27], EGFR as predictive and therapeutic target [28] and PD-1 as therapeutic target have been extensively studied in head and neck squamous cell carcinomas [29]. Moreover, microRNAs (miRNAs), 18–25 nucleotide long non-coding RNA which regulates gene expression either by mRNA degradation or translational repression, are gaining popularity as potential prognostic biomarkers and therapeutic targets in oral cancer [30–34].

Cancer associated fibroblast (CAFs), one of the most important cell types of tumor microenvironment, have been shown to be involved in many aspects of oral cancer progression. The current research initiatives have been putting efforts in identification and validation of CAF-based biomarkers in oral cancer prognosis and therapy [35].

Our findings indicate a definite surge in HPV and oral microbiome as trending research topics in recent years. High risk HPV variants have been shown to be associated with up to 70% of oro-pharyngeal cancers in Western countries [36]. The HPV positive oro-pharyngeal lesions have been suggested to exhibit distinct molecular alterations and demonstrate a more favourable prognosis as compared to the HPV negative lesions [37]. Several studies have investigated the presence of HPV in oral cavity cancer, however, with conflicting results, as studies have reported low to high prevalence rates [38]. However, it is now increasingly accepted that the discrepancy in HPV prevalence in oral cavity cancer is more likely to be related to misclassification of carcinomas in tonsils, soft palate and the posterior 1/3rd of the tongue as oral cavity cancer, and therefore the HPV is less likely to be a risk factor for oral cavity cancer as compared to the oro-pharyngeal cancer [38].

Our analysis revealed a growing interest in oral microbiome in oral cancer research. Studies have suggested that dysbiotic oral and peri-odontal microbiome may increase the risk of oral cancer [39–41]. Furthermore, an increase in abundance of *Fusobacterium periodonticum* and decrease in abundance of *Streptococcus mitis* and *Porphyromonas pasteri* have been associated with the progression of oral cancer [42]. Considering the possible role of alteration in oral microbiota population in the development and progression of oral cancer, it has been suggested that normalization of the dysbiotic microbiome may be useful in both prevention and treatment of cancer. Only a few studies have reported ways to influence oral microbiome to enhance the effectiveness of chemotherapeutic treatment. Furthermore, preliminary studies have proposed that selective oral pathogens may potentially be used as drug delivery carriers, targeting specific therapeutic targets in the pathogenetic cycle of oral cancer. Current trends indicate that there will be more scientific exploration into the molecular and functional association between dysbiotic oral microbiome and oral cancer development, with the potential development towards identification of oral microbiome-based prognostic and therapeutic targets in the future [39–41].

Another emerging research theme is possible application of AI in the diagnosis and management of oral cancer. AI encompasses machine learning, deep learning and neural networks, and is increasingly being used in various aspects of healthcare. Multiple U.S. Food and Drug Administration approved AI tools have already been used in healthcare service pathways including image analysis, histopathological analysis and prognosis prediction [43]. A similar promise of AI was realized by researchers in oral cancer screening, detection, and prognostics [44]. This increased interest is reflected in our results of trending topic analysis, where AI was among the top four trending topics in 2020–2022. We expect more studies on its application in screening, histopathological and radiographic image analysis, prognostication and prediction of oral cancer risk [45]. The precision and accuracy of AI in diagnosis and predicting recurrence are reported to be higher than the existing clinical

strategies and conventional statistics such as cox regression analysis and logistic regression. The accuracy of these learning models on the internal or external validation sets ranged from 85 to 97% for malignant transformation prediction, 78–91% for cervical lymph node metastasis prediction, 64–100% for treatment response prediction, and 71–99% for prognosis prediction [46]. Furthermore, models that include molecular markers in training data are reported to have better accuracy estimates for malignant transformation, treatment response, and prognosis prediction [46]. It is therefore plausible that there may be increasing interest in research activities that combine biomarker based prediction and deep learning approaches to better predict the outcomes of oral cancer, which may help tailor treatment accordingly [47]. The current trend in AI research may indicate a growing interest among medical experts and their deeper involvement in AI based oral cancer research.

The initial trend of oral cancer research was focused heavily on topics such as epidemiology and characteristics of oral cancer and OPMD, probably as a population health approach to identify strata with higher prevalence and apply preventive measures. However, there has been a discernible shift towards research on cellular/molecular pathways and tumor microenvironment, microbiome, therapeutic targets and biomarkers. These areas of research may help clinicians control the pathology at an earlier stage and devise treatment plans based on therapeutic targets, enabling more specific and minimally invasive treatment modalities. The social structure of publications showed a global interest in oral cancer, with leading affiliations and countries collaborating often on similar research. There may be further emphasis on international collaboration among colleagues working on similar research topics in the future.

10. Conclusions

The results of this study indicate that oncology specific journal OO was the top source of oral cancer articles in terms of publication, citation and impact for the period of 2011 to 2022. The United States was the leading country in terms of number of publications and citations in oral cancer research. The research trends have shifted from focus on basic epidemiology, cancer risk factors and carcinogenesis during earlier years to research activities focussing on therapeutic targets and biomarkers, sentinel lymph nodes, HPV, oral microbiome and AI in recent years. The detailed findings of this bibliometric study may guide researchers in planning future projects and initiate research collaborations. Moreover, these results may assist research institutions to align their research activities according to the rising and emerging themes, and the funding agencies to prioritize and allocate resources effectively.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Ren ZH, Hu CY, He HR, Li YJ, Lyu J. Global and regional burdens of oral cancer from 1990 to 2017: results from the global burden of disease study. Cancer Commun 2020;40:81–92. https://doi.org/10.1002/CAC2.12009.

[2] Shield KD, Ferlay J, Jemal A, Sankaranarayanan R, Chaturvedi AK, Bray F, et al. The global incidence of lip, oral cavity, and pharyngeal cancers by subsite in 2012. Ca - Cancer J Clin 2017;67:51–64. https://doi.org/10.3322/CAAC.21384.

[3] Du M, Nair R, Jamieson L, Liu Z, Bi P. Incidence trends of lip, oral cavity, and pharyngeal cancers: global burden of disease 1990–2017. J Dent Res 2020;99: 143–51. https://doi.org/10.1177/0022034519894963.

[4] Petersen PE. Oral cancer prevention and control - the approach of the World Health Organization. Oral Oncol 2009;45:454–60. https://doi.org/10.1016/j.oraloncology.2008.05.023.

[5] Patil S, Sarode SC, Baeshen HA, Bhandi S, Raj AT, Sarode GS, et al. Bibliographic analysis of oral precancer and cancer research papers from Saudi Arabia. Asian Pac J Cancer Prev APJCP 2020;21:13–8. https://doi.org/10.31557/APJCP.2020.21.1.13.

[6] Yang X, Yang X, Ji T, Zhou Q, Liu W. A bibliometric analysis of the papers on oral potentially malignant disorder in Oral Oncology. Oral Oncol 2022;132:105996. https://doi.org/10.1016/J.ORALONCOLOGY.2022.105996.

[7] Hassona Y, Qutachi T. A bibliometric analysis of the most cited articles about squamous cell carcinoma of the mouth, lips, and oropharynx. Oral Surg Oral Med Oral Pathol Oral Radiol 2019;128:25–32. https://doi.org/10.1016/j.oooo.2019.01.076. e6.

[8] Pena-Cristóbal M, Diniz-Freitas M, Monteiro L, Diz Dios P, Warnakulasuriya S. The 100 most cited articles on oral cancer. J Oral Pathol Med 2018;47:333–44. https://doi.org/10.1111/JOP.12686.

[9] Diane Cooper I. Bibliometrics basics. J Med Libr Assoc 2015;103:217–8. https://doi.org/10.3163/1536-5050.103.4.013.

[10] Bibliometrics & verification | Karolinska institutet university library n.d. https://kib.ki.se/en/publish-analyse/bibliometrics-verification#heading-p1874. [Accessed 11 March 2023].

[11] Mondal H, Mondal S. A brief review on article-, author-, and journal-level scientometric indices. Indian Dermatol Online J 2022;13:578. https://doi.org/10.4103/IDOJ.IDOJ_729_21.

[12] Bibliometrix package - RDocumentation n.d. https://www.rdocumentation.org/packages/bibliometrix/versions/4.1.2. [Accessed 11 March 2023].

[13] Aria M, Cuccurullo C. bibliometrix: an R-tool for comprehensive science mapping analysis. J Informetr 2017;11:959–75. https://doi.org/10.1016/J.JOI.2017.08.007.

[14] Hook DW, Porter SJ, Herzog C. Dimensions: building context for search and evaluation. Front Res Metrics Anal 2018;3:23. https://doi.org/10.3389/FRMA.2018.00023.

[15] Cobo MJ, López-Herrera AG, Herrera-Viedma E, Herrera F. An approach for detecting, quantifying, and visualizing the evolution of a research field: a practical application to the Fuzzy Sets Theory field. J Informetr 2011;5:146–66. https://doi.org/10.1016/J.JOI.2010.10.002.

[16] Aims and scope - oral oncology | ScienceDirect.com by elsevier n.d. https://www.sciencedirect.com/journal/oral-oncology/about/aims-and-scope. [Accessed 11 March 2023].

[17] Overview - journal of oral pathology & medicine - Wiley online library n.d. https://onlinelibrary.wiley.com/page/journal/16000714/homepage/productinformation.html. [Accessed 11 March 2023].

[18] Home page: oral surgery, oral medicine, oral pathology and oral radiology n.d. https://www.oooojournal.net/. [Accessed 11 March 2023].

[19] Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. Ca - Cancer J Clin 2018;68:394–424. https://doi.org/10.3322/caac.21492.

[20] Cancer research Insights from the latest Decade, 2010 to 2020 n.d. https://www.cancer.org/latest-news/cancer-research-insights-from-the-latest-decade-2010-to-2020.html. [Accessed 11 March 2023].

[21] Oral cavity (mouth) cancer treatment options, by Stage n.d. https://www.cancer.org/cancer/oral-cavity-and-oropharyngeal-cancer/treating/by-stage.html. [Accessed 11 March 2023].

[22] Barrios R, Tsakos G, Gil-Montoya JA, Montero J, Bravo M. Association between general and oral health-related quality of life in patients treated for oral cancer. Med Oral Patol Oral Cir Bucal 2015;20:e678–84. https://doi.org/10.4317/medoral.20714.

[23] Barrios R, Bravo M, Gil-Montoya JA, Martínez-Lara I, García-Medina B, Tsakos G. Oral and general health-related quality of life in patients treated for oral cancer compared to control group. Health Qual Life Outcome 2015;13. https://doi.org/10.1186/s12955-014-0201-5.

[24] Barrios R, Tsakos G, García-Medina B, Martínez-Lara I, Bravo M. Oral health-related quality of life and malnutrition in patients treated for oral cancer. Support Care Cancer 2014;22:2927–33. https://doi.org/10.1007/S00520-014-2281-5.

[25] Al-Dakkak I. Oral dysplasia and risk of progression to cancer. Evid Base Dent 2010; 113:91–2. https://doi.org/10.1038/sj.ebd.6400745. 2010;11.

[26] Hsieh JCH, Wang HM, Wu MH, Chang KP, Chang PH, Liao CT, et al. Review of emerging biomarkers in head and neck squamous cell carcinoma in the era of immunotherapy and targeted therapy. Head Neck 2019;41:19–45. https://doi.org/10.1002/HED.25932.

[27] Paver EC, Cooper WA, Colebatch AJ, Ferguson PM, Hill SK, Lum T, et al. Programmed death ligand-1 (PD-L1) as a predictive marker for immunotherapy in solid tumours: a guide to immunohistochemistry implementation and interpretation. Pathology 2021;53:141–56. https://doi.org/10.1016/j.pathol.2020.10.007.

[28] Nakamura H, Tamaki S, Yagyuu T, Yamakawa N, Hatake K, Kirita T. Relationship between EGFR expression in oral cancer cell lines and cetuximab antibody-dependent cell-mediated cytotoxicity. Anticancer Res 2019;39:1275–82. https://doi.org/10.21873/ANTICANRES.13238.

[29] Doroshow DB, Bhalla S, Beasley MB, Sholl LM, Kerr KM, Gnjatic S, et al. PD-L1 as a biomarker of response to immune-checkpoint inhibitors. Nat Rev Clin Oncol 2021; 18:345–62. https://doi.org/10.1038/S41571-021-00473-5.

[30] Yete S, Saranath D. MicroRNAs in oral cancer: biomarkers with clinical potential. Oral Oncol 2020;110:105002. https://doi.org/10.1016/j.oraloncology.2020.105002.

[31] Gomes CC, Gomez RS. MicroRNA and oral cancer: future perspectives. Oral Oncol 2008;44:910–4. https://doi.org/10.1016/J.ORALONCOLOGY.2008.01.002.

[32] D'Souza W, Kumar A. microRNAs in oral cancer: moving from bench to bed as next generation medicine. Oral Oncol 2020;111:104916. https://doi.org/10.1016/j.oraloncology.2020.104916.

[33] Zhu L, Li M, Tang G, Shi L, Liu W. Role of salivary miRNAs as noninvasive biomarkers in head and neck squamous cell carcinomas and oral potentially malignant disorders – reply. Oral Oncol 2022;135. https://doi.org/10.1016/j.oraloncology.2022.106224.

[34] Chawla JPS, Iyer N, Soodan KS, Sharma A, Khurana SK, Priyadarshni P. Role of miRNA in cancer diagnosis, prognosis, therapy and regulation of its expression by Epstein-Barr virus and human papillomaviruses: with special reference to oral cancer. Oral Oncol 2015;51:731–7. https://doi.org/10.1016/j.oraloncology.2015.05.008.

[35] Pai SI, Faivre S, Licitra L, Machiels JP, Vermorken JB, Bruzzi P, et al. Comparative analysis of the phase III clinical trials of anti-PD1 monotherapy in head and neck squamous cell carcinoma patients (CheckMate 141 and KEYNOTE 040). J Immunother Cancer 2019;7. https://doi.org/10.1186/s40425-019-0578-0.

[36] Fossum GH, Lie AK, Jebsen P, Sandlie LE, Mork J. Human papillomavirus in oropharyngeal squamous cell carcinoma in South-Eastern Norway: prevalence, genotype, and survival. Eur Arch Oto-Rhino-Laryngol 2017;274:4003–10. https://doi.org/10.1007/S00405-017-4748-8.

[37] Ang KK, Harris J, Wheeler R, Weber R, Rosenthal DI, Nguyen-Tân PF, et al. Human papillomavirus and survival of patients with oropharyngeal cancer. N Engl J Med 2010;363:24–35. https://doi.org/10.1056/NEJMOA0912217/SUPPL_FILE/NEJMOA0912217_DISCLOSURES.PDF.

[38] Søland TM, Bjerkli IH, Georgsen JB, Schreurs O, Jebsen P, Laurvik H, et al. High-risk human papilloma virus was not detected in a Norwegian cohort of oral squamous cell carcinoma of the mobile tongue. Clin Exp Dent Res 2021;7:70–7. https://doi.org/10.1002/CRE2.342.

[39] Herreros-Pomares A, Hervás D, Bagan-Debón L, Jantus-Lewintre E, Gimeno-Cardona C, Bagan J. On the oral microbiome of oral potentially malignant and malignant disorders: dysbiosis, loss of diversity, and pathogens enrichment. Int J Mol Sci 2023:24. https://doi.org/10.3390/ijms24043466.

[40] Ganly I, Hao Y, Rosenthal M, Wang H, Migliacci J, Huang B, et al. Oral microbiome in nonsmoker patients with oral cavity squamous cell carcinoma, defined by metagenomic shotgun sequencing. Cancers 2022;14. https://doi.org/10.3390/cancers14246096.

[41] Ganly I, Yang L, Giese RA, Hao Y, Nossa CW, Morris LGT, et al. Periodontal pathogens are a risk factor of oral cavity squamous cell carcinoma, independent of tobacco and alcohol and human papillomavirus. Int J Cancer 2019;145:775–84. https://doi.org/10.1002/IJC.32152.

[42] Hayes RB, Ahn J, Fan X, Peters BA, Ma Y, Yang L, et al. Association of oral microbiome with risk for incident head and neck squamous cell cancer. JAMA Oncol 2018;4:358–65. https://doi.org/10.1001/jamaoncol.2017.4777.

[43] Muehlematter UJ, Daniore P, Vokinger KN. Approval of artificial intelligence and machine learning-based medical devices in the USA and Europe (2015–20): a comparative analysis. Lancet Digit Heal 2021;3:e195–203. https://doi.org/10.1016/S2589-7500(20)30292-2/ATTACHMENT/C8457399-F5CE-4A30-8D36-2A9C835FB86D/MMC1.PDF.

[44] Ilhan B, Guneri P, Wilder-Smith P. The contribution of artificial intelligence to reducing the diagnostic delay in oral cancer. Oral Oncol 2021;116. https://doi.org/10.1016/j.oraloncology.2021.105254.

[45] Tobias MAS, Nogueira BP, Santana MCS, Pires RG, Papa JP, Santos PSS. Artificial intelligence for oral cancer diagnosis: what are the possibilities? Oral Oncol 2022: 134. https://doi.org/10.1016/j.oraloncology.2022.106117.

[46] Adeoye J, Tan JY, Choi SW, Thomson P. Prediction models applying machine learning to oral cavity cancer outcomes: a systematic review. Int J Med Inf 2021; 154:104557. https://doi.org/10.1016/J.IJMEDINF.2021.104557.

[47] Kar A, Wreesmann VB, Shwetha V, Thakur S, Rao VUS, Arakeri G, et al. Improvement of oral cancer screening quality and reach: the promise of artificial intelligence. J Oral Pathol Med 2020;49:727–30. https://doi.org/10.1111/jop.13013.