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Short Communication

A scientometric study of betel quid chewing and oral cancer and precancerous lesions with distinct regional characteristic



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Scientometric analysis is a useful tool that utilizes bibliometric data to measure scientific output of a disease or region in a particular field. In this report, we comprehensively provide bibliometric characteristics of all the papers on betel quid (BQ)-related cancer and precancerous lesions. There are 1403 papers on BQ-related cancer and precancerous lesions published until 2022 in the Scopus database. China (mainland and Taiwan region), India, United States, and United Kingdom contribute 1214 (86.5%) papers and 34,120 (91.9%) citations of all the papers. The number (457), citations (14,573), and *h* index (60) of the papers originated from Taiwan region stably remain in the first. The most frequent research keyword is arecoline, followed by drug, prevalence, metabolism, carcinogenesis, and pathology. Areca nut and BQ cessation program by Taiwan government has demonstrated a significant positive impact on oral cancer prevention. Collectively, the scientific output of BQ-related cancer and precancerous field represents distinct regional characteristic. BQ-related cancer prevention is still a long way off. Encouragingly, Taiwan region is well ahead in this way.

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Introduction

Areca nut is the principal ingredient in betel quid (BQ), which is the 4th-most commonly consumed addictive substance worldwide, following tobacco, alcohol, and caffeine.¹ BQ is chewed by approximately 600 million people globally, most of whom live in the South and South East Asia, and Pacific Islands.¹ For instance, approximately 23.9% (223.79 million) and over 10% (2.3 million) of general population have BQ chewing habit in India in 2017 and Taiwan region before 2011, respectively.^{2,3} BQ chewing constitutes a major threat to the public health owing to high prevalence in these regions, because it is strongly associated with development of various cancers of upper aerodigestive tract, particularly oral cancer and precancerous lesions.¹ Accordingly, oral cancer accounts for about 10% of all the cancers and contributes to nearly one-third of the total cancer burden in India.⁴ Oral cancer ranks as the 4th leading cause of cancer death for males and the top cancer in young adult males (30–50 years old; Cancer Registry Annual Report in Taiwan Area, 2009).⁴

Scientometric analysis is a useful tool that utilizes bibliometric data to measure scientific output of a disease or region in a particular field, and will help investigators to recognize study hotspots and research trends in the specific field.^{5–8} Given the association of BQ chewing with cancer and precancerous lesions, a series of studies on epidemiology, clinical investigations, and basic medicine have been conducted worldwide with numerous papers published.¹ However, no scientometric analysis has yet been conducted to summarize the citation characteristics of these papers and evaluate scientific output of various countries/regions, contributing institutions and researchers, as well as study topic and design in particular areas and trends. Therefore, we comprehensively provide bibliometric characteristics of all the papers on BQ-related cancer and precancerous lesions for the consideration of the clinicians and investigators.

Materials and methods

As per the methodology described previously,^{5,6} all the English papers on BQ-related cancer and precancerous lesions published until 2022 were retrieved on 20 February 2023 from the Scopus database. According to the search strategy described in [Supplementary Table S1](#), we used medical subject term “areca OR betel” in the title and the synonyms of cancer and precancerous in all fields. To evaluate scientific output of the main countries/regions, we selected “Taiwan”, “India”, “United States”, “United Kingdom”, and “China” in the filter of Country/Region. Data search and extraction were performed independently by two investigators (G.W. and L.S.), and discrepancy of results was resolved in a consensus symposium. The scientometric characteristics of all the eligible papers were reviewed and recorded the following information: title, keyword, citation count, publication year, authorship, affiliation, and country/region of origin. Descriptive statistics and associations were calculated for scientometric characteristics. The Bibliometrix Biblioshiny R-package software (<https://www.bibliometrix.org/home/>; K-Synth Srl Inc., Naples, Italy) was used to analyze the relevant bibliometric data.

Results

Citation characteristics

With the search strategy algorithm, 1403 papers on BQ-related cancer and precancerous lesions were published until 2022. As illustrated in [Fig. 1A](#), the total count of citations is 37,126 and the *h* index is 85. The maximum and mean count of citations is 826 and 26.5, respectively. Among the countries/regions of origin, Taiwan region contributes the largest number of papers (457) and citations (14,573), followed by India (354 papers; 8326 citations), United States (155 papers; 4464 citations), mainland China (123 papers; 1558 citations), and United Kingdom (123 papers; 5199 citations). China (mainland and Taiwan region), India, United States, and United Kingdom contribute 1214 (86.5%) papers and 34,120 (91.9%) citations of all the papers. The information on title, publication year, citation count, authors, affiliation, keywords, and document types of all the papers are presented in [Supplementary Table S2](#).

To concretize the trends of scientific output in BQ-related cancer and precancerous field, we assess the annual number of papers and accumulated citation count during 2007–2022. The annual number of all the papers spirally rises from 41 to 98 during 2007–2022 ([Fig. 1B](#)), and accumulated citations increase from 911 to 2974 during this period ([Fig. 1C](#)). The annual numbers of the papers and accumulated citations originate from Taiwan region, India, United States, mainland China, and United Kingdom are also showed in [Fig. 1B](#) and [C](#). Interestingly, the number of papers originated from Taiwan region decreases from 27 to 15 during 2011–2022, while the accumulated citations still stably remain in the first among the countries/regions. Besides, the types and subject categories of the papers, journal of publication, and contributing authors and institutions are recognized in [Fig. 2](#).

Research characteristics

A list of 160 keywords is automatically recognized in the order of highest to lowest frequency by the database. Based on the frequency of keywords in all the papers on BQ-related cancer and precancerous field ([Fig. 3A](#)), the top-10 study designs, BQ-related disorders and risk factors, and top-20 research keywords are identified. For study design, the most common design is controlled study, followed by major clinical study, animal experiment, and questionnaire ([Fig. 3B](#)). For BQ-related disorders, the most frequent one is mastication disorder, followed by mouth neoplasms, mouth cancer, and squamous cell carcinoma ([Fig. 3C](#)). For BQ-related risk factors, the most common one is male, followed by smoking, adolescent, and cancer risk ([Fig. 3D](#)). For research keywords, the most frequent one is arecoline, followed by drug, prevalence, metabolism, carcinogenesis, and pathology ([Fig. 3E](#)). Interestingly, the researchers from Taiwan region tendentially highlight protein expression and reactive oxygen metabolite, and Indian researchers tendentially highlight protein p53 and antioxidant. Researches on traditional Chinese medicine such as catechin, flavonoid polyphenols are involved by the researchers from mainland China.

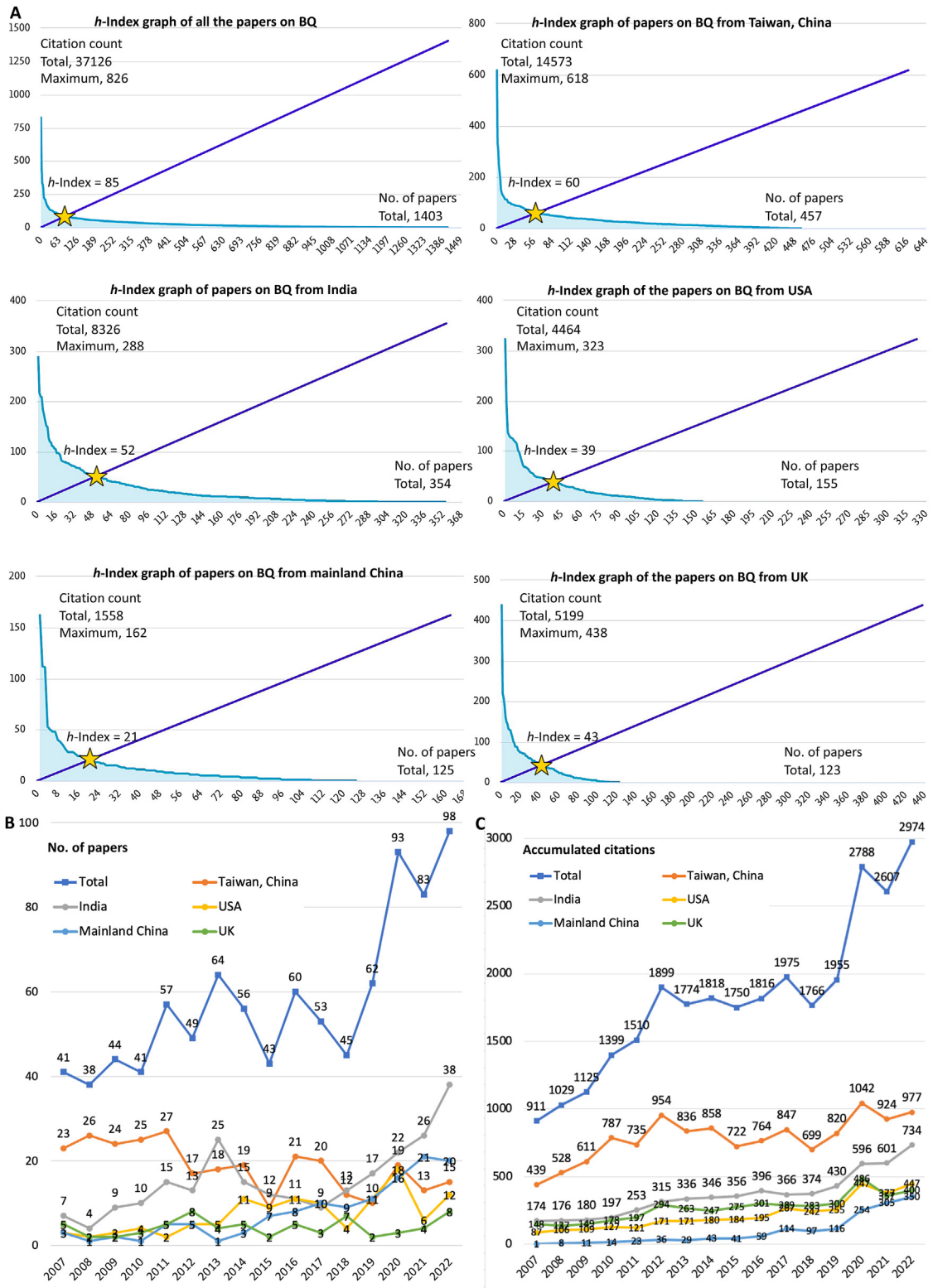


Figure 1 Citation characteristics of the papers on betel quid (BQ)-related cancer and precancerous field. (A) The *h*-index graphs of the whole papers, and the papers from China, India, United States and United Kingdom. (B) The annual number of papers. (C) The accumulated citations.

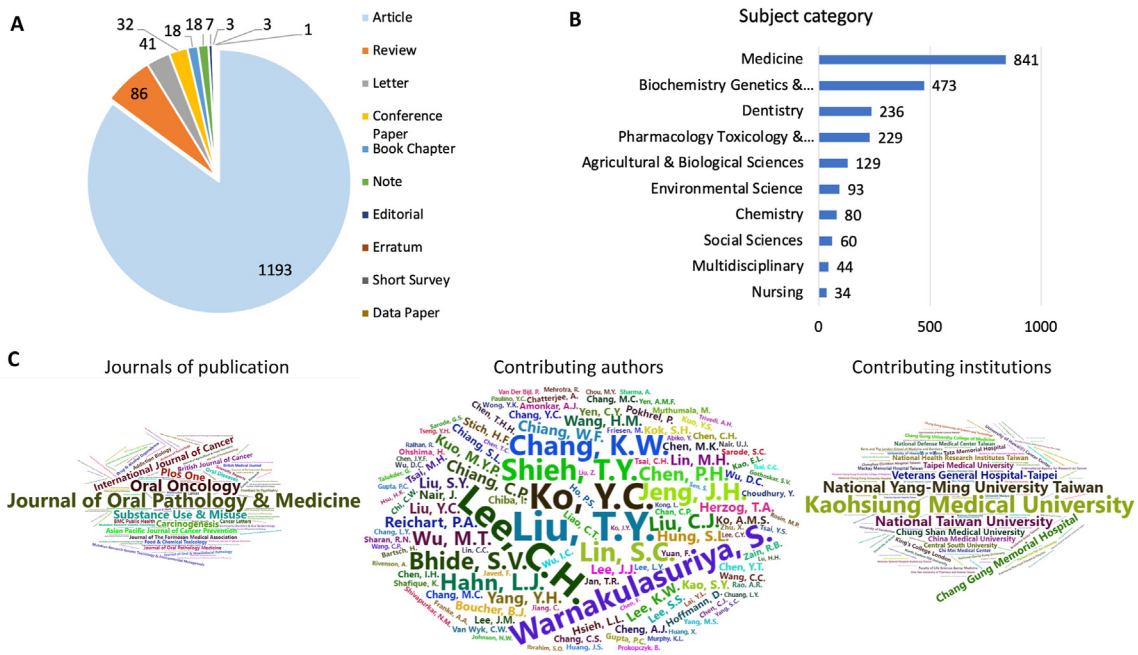


Figure 2 Bibliometric characteristics of the papers on betel quid-related cancer and precancerous field. (A) Document types of all the papers. (B) The ranks of subject category. (C) The cloud graphs of journals of publication, contributing authors and institutions. The journal of publication with largest number is *Journal of Oral Pathology & Medicine* (n = 51), followed by *Oral Oncology* (n = 42), *Substance Use & Misuse* (n = 30), and *Plos One* (n = 28). The contributing author with largest number of articles is Liu T.Y. (n = 41), followed by Lee C.H. (n = 39), Ko Y.C. (n = 36), and Warnakulasuriya S. (n = 30). The contributing institution of origin with the maximum number is Kaohsiung Medical University (n = 129), followed by National Yang-Ming University (n = 85), National Taiwan University (n = 77), and Kaohsiung Medical University Chung-Ho Memorial Hospital (n = 76).

Discussion

BQ chewing is a major public health problem in many South Asian regions and Pacific Islands, largely attributable to its carcinogenic role in upper aerodigestive tract cancers, particularly oral cancer and precancerous lesions.¹ In some American and European countries, areca nut selling is illegal.^{9,10} Encouragingly, areca nut and BQ cessation program by multi-government ministries and agencies through collaboration has demonstrated a significant positive impact on oral cancer prevention in Taiwan region.³ This program could date back to “Areca Prevention Day” on December 3, 1997 to raise public awareness on areca/BQ hazards by government administrations and agencies. Owing to this program, BQ chewing prevalence has significantly decreased from near 18% in 2007 to less than 6% in 2018.³ In mainland China, the National Radio and Television Administration requested to ban on the advertising of areca nut on September 17, 2021,¹⁰ notwithstanding the sales method of areca nut has changed.⁹

Given public health problem of BQ chewing, increasingly large number of the papers have been published. It might be possible all that clinicians and researchers do not always tend to recognize the scientific impact and research characteristics in a designed field. Wang et al.¹¹ previously analyzed the bibliometric characteristics of the BQ-related oral cancer papers retrieved between 1998 and 2017 from the Web of Science database. In this scientometric study, we provide a more comprehensive overview of bibliometric characteristics of all the papers on BQ-related cancer and precancerous lesions during 1923–2022 from the Scopus

database for the consideration of the clinicians and investigators. Scopus database may be of more coverage and accuracy than Web of Science database.^{5,6} We equally highlight the precancerous lesions in the search strategy (Table S1), and observe pharynx and esophageal neoplasms that also recognized as research keywords in Taiwan region, United States, and United Kingdom. Definitely, mouth or oral cavity cancer and oral potentially malignant disorders including oral submucous fibrosis and leukoplakia are the most leading BQ-related disorders (Fig. 3D).¹²

This scientometric study reports the number and citations of the papers on BQ-related cancer and precancerous lesions, as well as the contributing authors and institutions mostly originated from China including Taiwan region, India, United States, and United Kingdom. In China and India, the high scientific output mainly attribute to high prevalence of BQ chewing, clearly representing local and regional characteristics. On the other side, cooperating institutions were largely located in United States and United Kingdom, featuring apparent regionality and specific cooperation-based research strategies that are predominantly affected by the prevalence of oral cancer, research conditions, and technological capabilities. Besides, certain limitations in a bibliometric analysis are that citation counts do not directly reflect quality of a paper but enable a quantitative evaluation of the scientific impact in a designed field. There is definite time effect from publication to the time of the search in bibliometric analysis. And, authors tend to cite previous highly cited papers independently of content and quality through snowball effect.

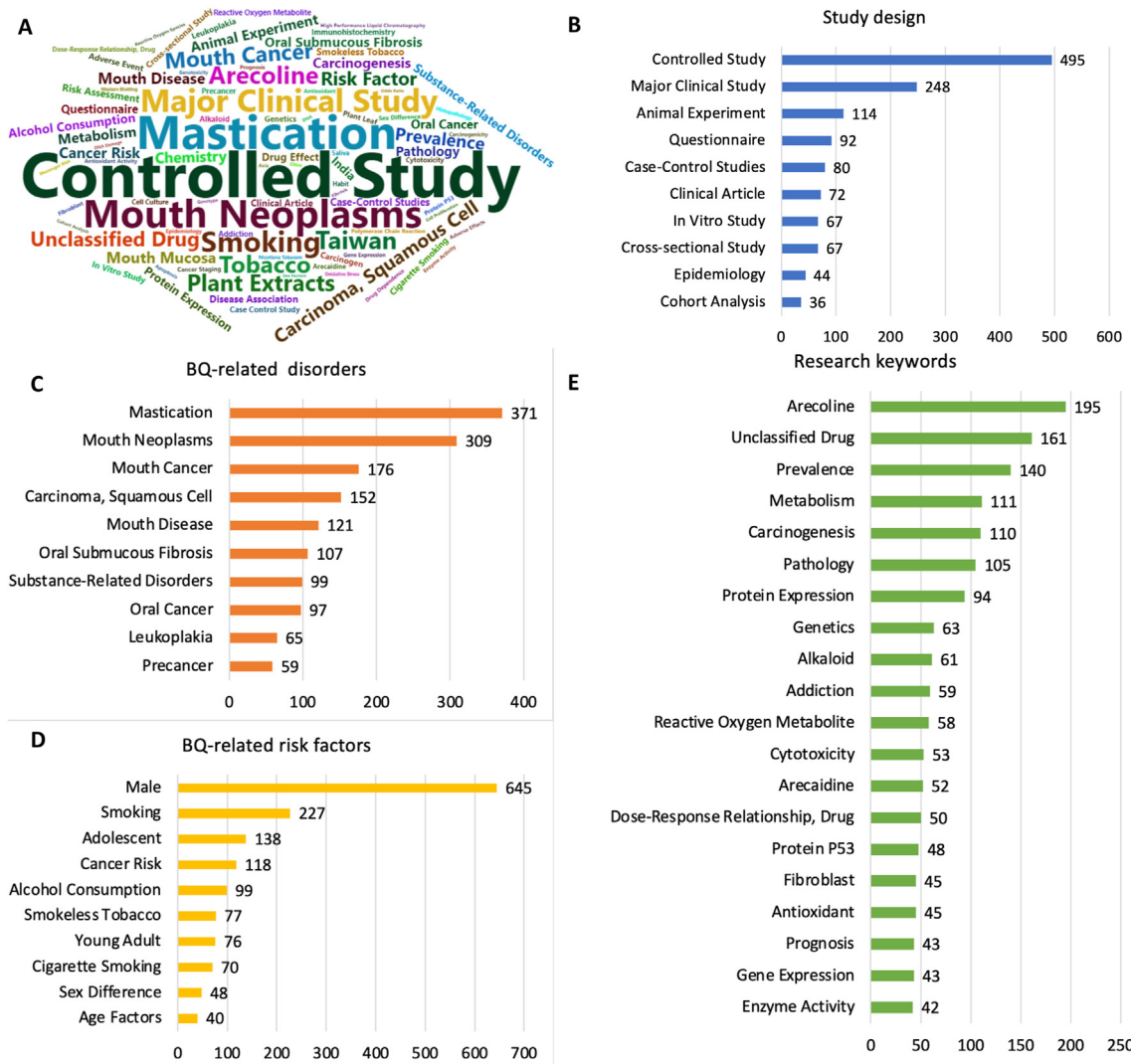


Figure 3 Research characteristics of the papers on betel quid (BQ)-related cancer and precancerous field. (A) The cloud graphs of the main keywords. (B) The ranks of study designs. (C) The ranks of BQ-related disorders. (D) The ranks of BQ-related risk factors. (E) The ranks of the research keywords.

In summary, this scientometric study helps in evaluating the current scenario and research trends in BQ-related cancer and precancerous field. The scientific output of this field represents distinct regional characteristic. BQ-related cancer prevention is still a long way off. Encouragingly, Taiwan region is well ahead in this way. We hold an optimistic attitude to see the declining trend of incidence of BQ-associated disorders afterwards through persistent endeavor of government agencies and cooperating institutions.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jds.2023.03.007>.

References

1. Warnakulasuriya S, Chen THH. Areca nut and oral cancer: evidence from studies conducted in humans. *J Dent Res* 2022; 101:1139–46.

2. Singh PK, Yadav A, Singh L, et al. Areca nut consumption with and without tobacco among the adult population: a nationally representative study from India. *BMJ Open* 2021; 11:e043987.
3. Yang YH, Warnakulasuriya S, Yang HF, Lin LJ, Wang YW. Public health measures to reduce areca nut and betel quid use for control of oral cancer in Taiwan. *Oral Oncol* 2020;108: 104915.
4. Yang J, Wang ZY, Huang L, et al. Do betel quid and areca nut chewing deteriorate prognosis of oral cancer? A systematic review, meta-analysis, and research agenda. *Oral Dis* 2021;27: 1366–75.
5. Xie C, Ou J, Shi H, Liu W. Oral cancer research in Taiwan and mainland China: scientometric analysis with emphasis on distinctive characteristics. *J Dent Sci* 2022;17:1859–63.
6. Liu W, Yang Y, Zhang X, Shi H. Oral potentially malignant disorder research in Taiwan and mainland China: a scientometric analysis. *J Dent Sci* 2022;17:1854–8.
7. Liu FH, Yu CH, Chang YC. Bibliometric analysis of articles published in journal of dental sciences from 2009 to 2020. *J Dent Sci* 2022;17:642–6.
8. Yang LC, Liu FH, Liu CM, Yu CH, Chang YC. Bibliometric analysis of top-cited articles in journal of dental sciences. *J Dent Sci* 2023;18:338–44.
9. Pang L, Kong J. Sale methods of betel nuts in China: cash back and low price repurchase. *Oral Dis* 2022. <https://doi.org/10.1111/odi.14250>.
10. Yi H, Yuan L, Mao Y. Moving forward: the nationwide advertising ban of areca nut in China. *Oral Oncol* 2021;122:105590.
11. Wang M, Xiao C, Ni P, Yu JJ, Wang XW, Sun H. Correlation of betel quid with oral cancer from 1998 to 2017: a study based on bibliometric analysis. *Chin Med J* 2018;131:1975–82.
12. Yuwanati M, Ramadoss R, Kudo Y, Ramani P, Senthil Murugan M. Prevalence of oral submucous fibrosis among areca nut chewers: a systematic review and meta-analysis. *Oral Dis* 2022. <https://doi.org/10.1111/odi.14235> (in press).