

Emergent Patterns, Collaborative Networks and Thematic Evolution on Black Stain and Dental Caries: A Scientometric Study

Frank Mayta-Tovalino¹, Fran Espinoza-Carhuanchó², Jessie Reyes-Carmona³, Cesar Mauricio-Vilchez⁴, Julia Medina⁵, Diego Galarza-Valencia⁶, Carlos Vicuña-Quispe⁷

Received on: 18 April 2024; Accepted on: 21 May 2024; Published on: 14 June 2024

ABSTRACT

Aim: To conduct a scientometric analysis on black stains, and dental caries, with a focus on identifying emergent patterns, collaborative networks, and thematic evolution.

Materials and methods: A retrospective, descriptive, observational study was conducted using a scientometric approach. The Scopus database was utilized for literature search, selecting articles published between 1976 and 2023. The literature search was carried out on February 8, 2024, using AND and OR Boolean operators which were adapted to the search strategy. Finally, SciVal used different scientometric indicators such as “Scholarly Output”, “Views Count”, “Field-Weighted Citation Impact” and the “Citation Count”.

Results: A total of 13 documents from 10 different sources were analyzed, covering a period from 1976 to 2023. Despite an annual growth rate of 0%, each document has an average of 21.08 citations, indicating their relevance in the field. The documents have an average age of 12.9 years and contain 336 references. A total of 143 additional keywords and 26 author keywords were identified. The documents were written by 62 different authors, with an average of 5 coauthors per document and 30.77% international coauthorships.

Conclusion: The results indicate a significant relevance of the documents in the field, a notable collaboration among authors, and a significant thematic evolution in the research topics. The mentioned institutions and sources produced documents with notable results, indicating a significant interest and impact in the field.

Clinical significance: This study provides a detailed view of the trends and patterns in the research of dental caries and black stains. The findings can assist dental health professionals in better understanding the prevalence and impact of these conditions. Furthermore, it can guide future research and treatment strategies in this field.

Keywords: Black stain, Dental caries, Scientometric analysis.

The Journal of Contemporary Dental Practice (2024); 10.5005/jp-journals-10024-3682

INTRODUCTION

Dental stains are produced by the chemical interaction between the compounds that bind to the dental film with the tooth surface, these stains can be classified according to their location (extrinsic, intrinsic, and internalized).¹ Extrinsic stains develop on the tooth's surface or on an acquired film, whereas intrinsic stains arise when pigmented substances infiltrate the structure of the tooth.² Internalized discoloration refers to the incorporation of an extrinsic stain within the tooth substance following tooth development, highlighting a specific type of discoloration known as black stain (BS). This anomaly manifests as dark spots on the teeth, usually on the chewing surfaces.^{1,2} Although their presence can be alarming, black stains generally do not indicate a serious health problem and may be the result of several factors such as natural pigmentation, consumption of certain foods and beverages, or even poor dental hygiene.² Despite this, together with caries, they are two common problems that affect the oral health of millions of people worldwide. In recent years, although the prevalence of dental caries has decreased by 3.6% compared to two decades ago, it continues to affect the permanent teeth of more than 3 billion people,³ with a special incidence in children between 5 and 9 years of age, young adults and in Eastern populations such as India.^{4,5} Although there

¹Academic Department, Vicerrectorado de Investigación, Universidad San Ignacio de Loyola, Lima, Peru

²Academic Department, Grupo de Bibliometría, Evaluación de evidencia y Revisiones Sistemáticas (BEERS), Human Medicine Career, Universidad Científica del Sur, Lima, Peru

³Academic Department, LICIFO, Faculty of Dentistry, University of Costa Rica, San Jose, Costa Rica

⁴⁻⁶Academic Department, Unidad de Investigación, Innovación y Emprendimiento, Faculty of Dentistry, Universidad Nacional Federico Villarreal, Lima, Peru

⁷Academic Department, Sociedad Científica de San Fernando, Universidad Nacional Mayor de San Marcos, Lima, Peru

Corresponding Author: Frank Mayta-Tovalino, Academic Department, Vicerrectorado de Investigación, Universidad San Ignacio de Loyola, Lima, Peru, Phone: +51 1214-2500, e-mail: fmayta@usil.edu.pe

How to cite this article: Mayta-Tovalino F, Espinoza-Carhuanchó F, Reyes-Carmona J, et al. Emergent Patterns, Collaborative Networks and Thematic Evolution on Black Stain and Dental Caries: A Scientometric Study. *J Contemp Dent Pract* 2024;25(4):326–330.

Source of support: Nil

Conflict of interest: None

is no consensus on the epidemiology of dental black spots, it has been reported that they have a prevalence between 2 and 20% worldwide.² Both conditions can cause discomfort, and pain and, if not adequately treated, can have serious long-term consequences for oral health and mood.

Black stains can be caused by certain microorganisms, foods, beverages, chlorhexidine mouthwashes, iron supplements, tooth enamel wear, tooth decay, or tartar build-up. Although black stains on teeth and dental caries are two different conditions since black spots are dark deposits on tooth enamel and are not usually harmful, while caries is a disease that destroys tooth enamel, some association between them has been reported.^{6,7} It has previously been reported that those with black stains are 33% less likely to develop caries, especially in non-permanent teeth.^{6,7} In spite of this, it is still not fully understood how the presence of BS affects the dental caries process; to achieve this it is first necessary to establish the current panorama in which the medical evidence is found and for this, the use of bibliometric studies can be an option since they allow us to identify the scientific productivity of institutions or authors on a certain topic and evaluate the impact of these in the medical literature.⁸ To date, no bibliometric studies evaluating the topic of BS have been published, only those describing caries detection or therapy.^{9,10}

The results of this study hope to generate a greater overview of the problem of BS in the dental health of people and its relationship with the development of caries, also seeking to improve medical practices and health policies. Therefore, the aim of this study was to evaluate the emerging patterns, collaborative networks, and thematic evolution of black spot and dental caries between 1976 and 2023.

MATERIALS AND METHODS

Study Design

A descriptive study with a scientometric approach was conducted using the Scopus database.

Literature Search

The literature search was carried out on February 8, 2024, utilizing the subsequent formula `TITLE-ABS ("black stain" OR "dental black stains" OR "black tooth staining" OR "tooth staining" OR "dental pigmentation" OR "dental stain" OR "dental stains extrinsic") AND TITLE-ABS ("dental caries" OR "tooth decay")`.

Criteria Selection

The primary inclusion criteria for this study were articles published between 1976 and 2023, focusing on black stain and dental caries, and available in the Scopus database. The articles needed to contribute to the understanding of emergent patterns, collaborative networks, and thematic evolution in this field. Exclusion criteria were articles not available in English, articles not accessible in full text, and those that did not directly relate to the study's aim. This ensured a comprehensive and relevant analysis of the subject matter.

Scientometric Analysis

The scientometric analysis was performed considering several key indicators. For example, the 1. "Scholarly Output", "Views Count", 2. the "Field-Weighted Citation Impact" and 3. the "Citation Count". These indicators together provide a comprehensive view of the performance and impact of scientific output in the field of study. Bibliometrix, an R Studio tool, and SciVal were used for data analysis.

Table 1: Scholarly output description

Description	Results
Timespan	1976:2023
Sources (Journals, Books, etc.)	10
Documents	13
Annual growth rate %	0
Document average age	12.9
Average citations per doc	21.08
References	336
Document contents	
Keywords plus (ID)	143
Author's keywords (DE)	26
Authors	
Authors	62
Authors of single-authored docs	1
Authors collaboration	
Single-authored docs	1
Co-authors per doc	5
International coauthorships %	30.77
Document types	
Article	11
Review	2

RESULTS

A total of 52 potential articles were initially found. Of these, 37 were research articles, 14 were reviews, and 1 was a book chapter. However, after a purging process, a total of 13 articles that were published were selected for evaluation. The data analysis covers a period from 1976 to 2023, with a total of 13 papers collected from 10 different sources. Although the annual growth rate is 0%, each document has an average of 21.08 citations, indicating its relevance in the field. The documents have an average age of 12.9 years and contain 336 references. As for the content of the papers, 143 additional keywords and 26 author keywords were identified. The papers were written by 62 different authors, with only one single-authored paper. Collaboration among authors is remarkable, with an average of 5 coauthors per paper and 30.77% international coauthorships. In terms of document types, 11 articles and 2 reviews were found (Table 1).

The aforementioned institutions have produced papers with significant outcomes. Ain Shams University in Egypt authored a paper that garnered 20 views. Both the Chinese Academy of Sciences and the National Human Genome Center of China, which are governmental institutions, each produced a paper that attracted 35 views and received 4 citations. Kangwon and Pusan academic universities in South Korea produced one paper each, receiving 21 views and 2 citations. Nanjing Medical University and Qingdao University in China produced one paper each, receiving 35 views and 4 citations. The Brazilian academic universities, Universidade Federal de Minas Gerais and Universidade Federal dos Vales do Jequitinhonha e Mucuri, produced one paper each, receiving 25 views and 6 citations. Finally, the University of Monastir in Tunisia produced a paper that received 18 views and 3 citations (Table 2).

Scopus sources produced papers with notable results. "Biomedical Research" produced a paper that received 21 views and 2 citations. "Caries Research" produced a paper that received

Table 2: Top-10 most productive institutions

<i>Institution</i>	<i>Sector</i>	<i>Country</i>	<i>Scholarly output</i>	<i>Views count</i>	<i>Field-weighted citation impact</i>	<i>Citation Count</i>
Ain Shams University	Academic	Egypt	1	20	0	0
Chinese Academy of Sciences	Government	China	1	35	0.4	4
Chinese National Human Genome Center	Government	China	1	35	0.4	4
Kangwon National University	Academic	South Korea	1	21	0.05	2
Nanjing Medical University	Academic	China	1	35	0.4	4
Pusan National University	Academic	South Korea	1	21	0.05	2
Qingdao University	Academic	China	1	35	0.4	4
Universidade Federal de Minas Gerais	Academic	Brazil	1	25	0.85	6
Universidade Federal dos Vales do Jequitinhonha e Mucuri	Academic	Brazil	1	25	0.85	6
University of Monastir	Academic	Tunisia	1	18	0.78	3

Table 3: Top-10 Scopus sources

<i>Scopus source</i>	<i>Scholarly output</i>	<i>Views count</i>	<i>Field-weighted citation impact</i>	<i>Citation count</i>
Biomedical Research	1	21	0.05	2
Caries Research	1	25	0.85	6
European Archives of Paediatric Dentistry: Official Journal of The European Academy of Paediatric Dentistry	1	18	0.78	3
Frontiers in Cellular and Infection Microbiology	1	35	0.4	4
Frontiers in Microbiology	1	12	0.99	1
Indian Journal of Dental Research	1	12	0	0
Pediatría de Atención Primaria	1	4	0	0
The Journal of the Egyptian Public Health Association	1	20	0	0

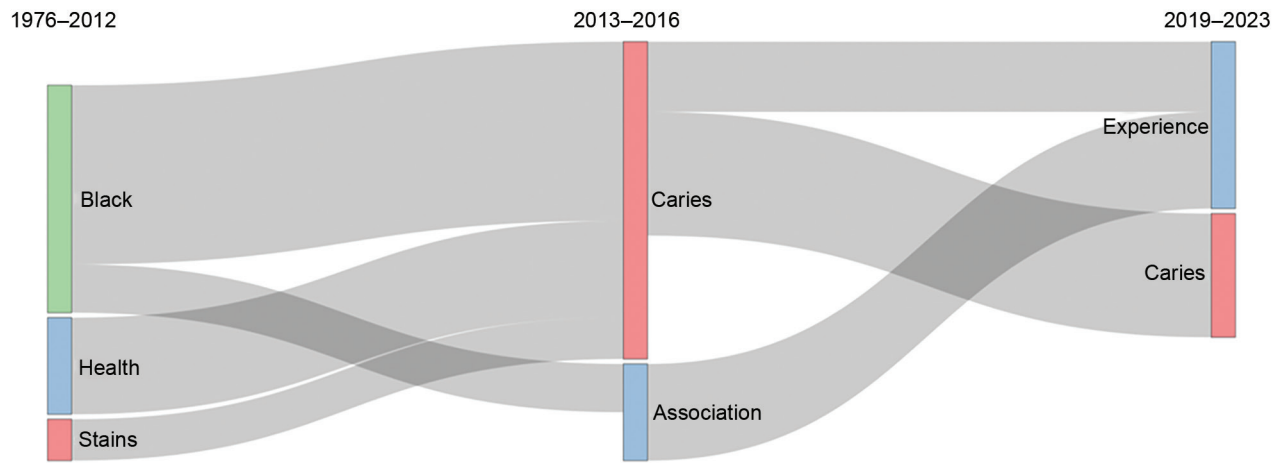


Fig. 1: Thematic evolution on black stain and dental caries

25 views and 6 citations. “European Archives of Paediatric Dentistry,” the official journal of the European Academy of Paediatric Dentistry, produced a paper that received 18 views and 3 citations. “Frontiers in Cellular and Infection Microbiology” and “Frontiers in Microbiology” produced one paper each, receiving 35 and 12 views respectively, and 4 and 1 citations. “Indian Journal of Dental Research” produced one paper receiving 12 views. “Primary Care Pediatrics” and “The Journal of the Egyptian Public Health Association” produced one paper each, receiving 4 and 20 views respectively (Table 3).

The thematic evolution showed significant changes in the research topics. Between 1976 and 2012, the theme “black” evolved

toward “association” and “caries” in 2013–2016, with keywords such as “black”, “children”, “caries”, “prevalence”, “presence”, “lower”, “experience”, “assess”, “examined”, “results”, and “total”. Simultaneously, the theme “health” also evolved into “caries”, with keywords such as “stain”, “aged”, “tooth”, and “population”. The theme “stains” evolved towards “caries” with the keyword “dental”. In 2013–2016, the theme “association” evolved to “experience” in 2019–2023, with keywords such as “association” and “risk”. The theme “caries” remained constant in 2019–2023, but also evolved toward “experience”, with keywords such as “experience”, “assess”, “aim”, “studies”, “tooth”, and “conducted” (Fig. 1).

Tree

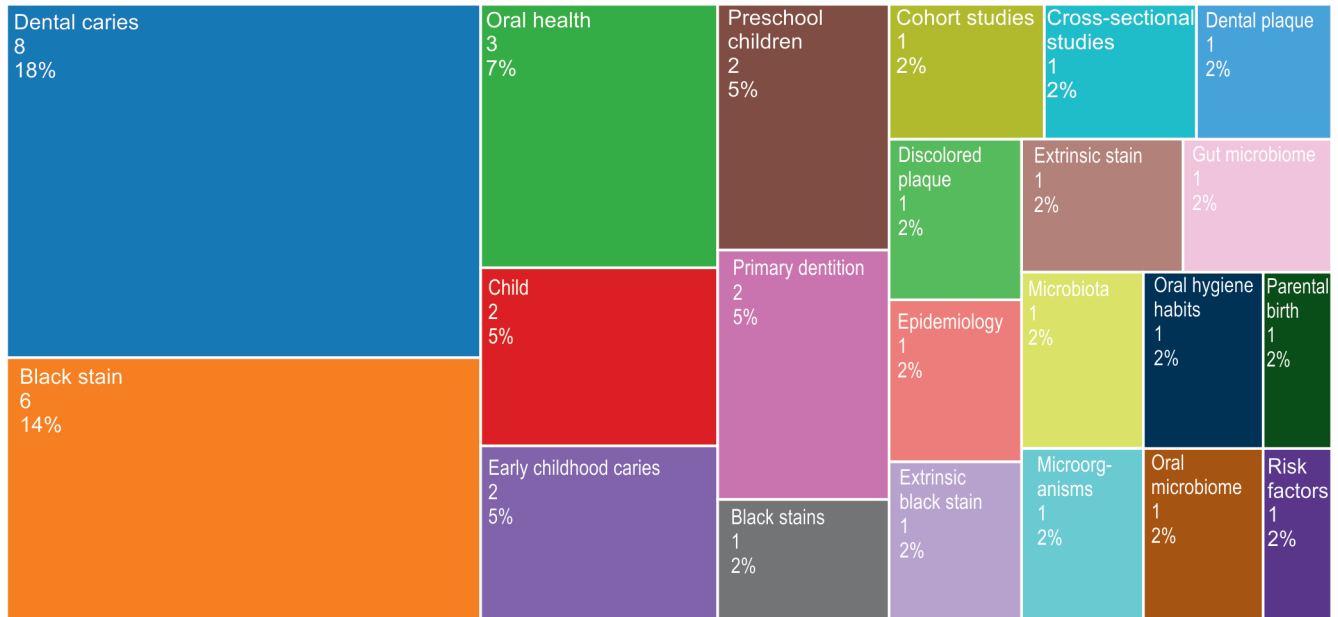


Fig. 2: Tree map on black stain and dental caries

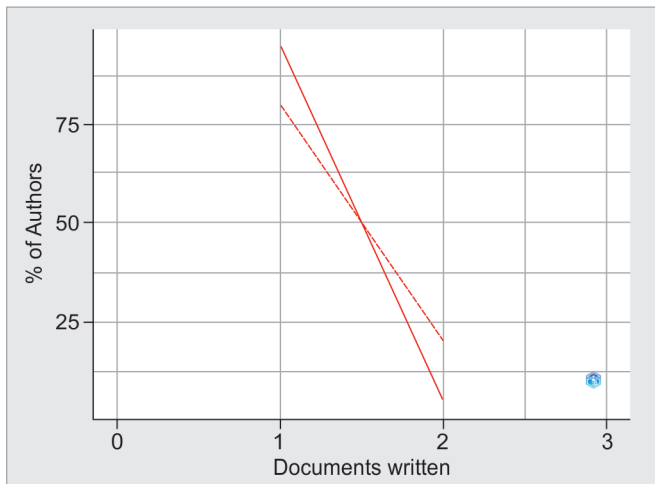


Fig. 3: Distribution of authors according to the Lotka law
The line represents that 95.2% of the total wrote only one scientific article

The most frequent terms in the papers analyzed were “dental caries” with a frequency of 8, followed by “black stain” with a frequency of 6. Other relevant terms included “oral health” (3), “child” (2), “early childhood caries” (2), “preschool children” (2), and “primary dentition” (2). The terms “black stains”, “cohort studies”, and “cross-sectional studies” appeared once each (Fig. 2).

According to Lotka’s law, of the authors analyzed, 59 authors, representing 95.2% of the total, wrote only one paper. On the other hand, 3 authors, representing 4.8% of the total, wrote two papers (Fig. 3).

DISCUSSION

The evidence is extremely scarce on the relationship between BS and dental caries to the point of reporting only 13 publications in more than 60 years of study (11 articles and 2 reviews); despite this,

each publication has an average of 21.08 citations, which indicates great relevance in the field. In addition to this, despite the very small number of studies, there was 30.77% international collaboration.

Most of the most productive institutions are of Chinese origin, this may be because this country has established various health programs for 2030 to improve the dental public health system and the promotion of research in this topic, a scenario that was further enhanced by the COVID-19 pandemic.^{11,12} Despite this, the Brazilian institutions Universidade Federal de Minas Gerais and Universidade Federal dos Vales do Jequitinhonha e Mucuri have the greatest impact in the field. Among their most cited publications (85 citations) is the study by Franca et al.¹³ published in 2014 which sought to describe a sustained release of propolis-based chitosan varnish for the prevention of dental cariogenic biofilms and an *in vitro* antimicrobial activity. Another study of note is the review by de Rezende et al.⁷ which described 18 cross-sectional studies and found that individuals with extrinsic black stains involving primary [median differential (MD): -0.78; 95% CI: -1.09 to -0.48; I2 = 44%] and permanent (MD: -0.50; 95% CI: -0.93 to -0.08; I2 = 86%) teeth had a lower experience of dental caries compared to those without stains.

On the other hand, among the most productive journals, the Swiss journals *Frontiers in Microbiology* and *Caries Research* stand out. Regarding the first journal, the publication of Zheng et al.¹⁴ stands out with 2 citations, which was an epidemiological study with the aim of describing extrinsic BS and exploring the possible role of the oral and intestinal microbiome in its formation and caries prevention in 2,675 children between 3 and 6 years of age, finding that extrinsic BS can become a protective factor for caries. For its part, the journal *Caries Research* has previously been reported to be one of the most productive on the subject of detection and diagnosis of dental caries,^{9,15} which may also justify its greater productivity on the subject of BS and caries. In turn, its most cited publication with 36 citations is the study by França-Pinto et al.¹⁶ which was a cohort that sought to evaluate the prevalence of BS in Brazilian children over a period of 5 years and to investigate its association with dental caries, finding that the presence of BS was

associated with a lower probability of developing dental caries (OR = 0.51; 95% CI: 0.26–0.99).

Regarding the topics evaluated by periods, the topic of “experience” in the last 5 years stands out. This could be explained because this type of study allows us to evaluate a more direct panorama of the experiences reported by each health center, in addition to having great potential for generating real-world evidence and being able to design and carry out confirmatory trials to answer questions on various topics.¹⁷

This study has some limitations and strengths. The main limitation is that the systematic search in this study was limited only to the Scopus database, which excluded any potentially relevant publications published in any other database or the gray literature. Despite this, this study also has several strengths, since the Scopus database was chosen because it is a multidisciplinary database that indexes high-quality publications, making it one of the main databases recommended for bibliometric studies.^{18,19} and also allows a more precise and specific search than other databases such as PubMed or Web of Science, which ensures that the publications evaluated in this study are the most current and related to the objective of this study.²⁰ In addition to all this, it is hoped that these results will encourage the production of future studies that evaluate the relationship between black spots and dental caries.

There are several promising areas for future research about black spots and dental caries. These include the study of genetic factors that influence their development, the efficacy of various preventive measures, the long-term effects of these conditions on oral and general health, and the exploration of new and more effective treatment methods. In addition, it would be beneficial to investigate the impact of public health policies on the prevalence of these conditions. These areas of research could provide valuable insights and contribute to the advancement of dental health science.

CONCLUSION

This study revealed an average of 21.08 citations per document and remarkable collaboration between authors. Despite an annual growth rate of 0%, the analyzed papers provide a rich source of information, with 143 additional keywords and 26 author keywords identified. The thematic evolution shows significant changes in research topics over time. The institutions and sources mentioned have produced papers with remarkable results, indicating significant interest and impact in the field. In summary, the findings underscore the importance of continued research in this field to advance our understanding and management of dental caries and BS.

ACKNOWLEDGMENTS

The author would like to extend his gratitude to Universidad San Ignacio de Loyola for its unwavering support in the preparation of this scientific manuscript.

REFERENCES

- Asokan S, Varshini KR, Geetha Priya PR, et al. Association between black stains and early childhood caries – A systematic review. *Indian J Dent Res* 2020;31(6):957–962. DOI: 10.4103/ijdr.IJDR_327_20.
- Janjua U, Bahia G, Barry S. Black staining: An overview for the general dental practitioner. *Br Dent J* 2022;232(12):857–860. DOI: 10.1038/s41415-022-4345-0.
- Wen PYF, Chen MX, Zhong YJ, et al. Global burden and inequality of dental caries, 1990 to 2019. *J Dent Res* 2022;101(4):392–399. DOI: 10.1177/00220345211056247.
- Qin X, Zi H, Zeng X. Changes in the global burden of untreated dental caries from 1990 to 2019: A systematic analysis for the Global Burden of Disease study. *Heliyon* 2022;8(9):e10714. DOI: 10.1016/j.heliyon.2022.e10714.
- Jain N, Dutt U, Radenkov I, et al. WHO's global oral health status report 2022: Actions, discussion and implementation. *Oral Dis* 2024;30(2):73–79. DOI: 10.1111/odi.14516.
- Mousa HRF, Radwan MZ, Wassif GOM, et al. The association between black stain and lower risk of dental caries in children: A systematic review and meta-analysis. *J Egypt Public Health Assoc* 2022;97(1):13. DOI: 10.1186/s42506-022-00107-3.
- de Rezende VS, Fonseca-Silva T, Drumond CL, et al. Do patients with extrinsic black tooth stains have a lower dental caries experience? A systematic review and meta-analysis. *Caries Res* 2019;53(6):617–627. DOI: 10.1159/000500476.
- Donthu N, Kumar S, Mukherjee D, et al. How to conduct a bibliometric analysis: An overview and guidelines. *J Bus Res* 2021;133(5):285–296. DOI: 10.1016/j.jbusres.2021.04.070.
- Ganesh C, Victor Samuel A, Purushothaman D, et al. Bibliometric analysis of dental caries detection. *Cureus* 2023;15(6):e40741. DOI: 10.7759/cureus.40741.
- Torres-Loyola A, Rojas-Arana C, Munive-Degregori A, et al. Bibliometric Analysis of the Current Landscape of Global Scientific Production on the Development of Vaccines against Dental Caries. *Int J Dent* 2022;2022:7678891. DOI: 10.1155/2022/7678891.
- Zhou X, Xu X, Li J, et al. Oral health in China: From vision to action. *Int J Oral Sci* 2018;10(1):1. DOI: 10.1038/s41368-017-0006-6.
- Cai H, Cheng YT, Ren XL, et al. Recent developments and future directions of oral healthcare system and dental public health system in China in light of the current Global Emergency. *Sichuan Xue Xue Bao Yi Xue Ban* 2022;53(1):43–48. DOI: 10.12182/20220160303.
- Franca JR, De Luca MP, Ribeiro TG, et al. Propolis-based chitosan varnish: drug delivery, controlled release and antimicrobial activity against oral pathogen bacteria. *BMC Complement Altern Med* 2014;14:478. DOI: 10.1186/1472-6882-14-478.
- Zheng L, Cao T, Xiong P, et al. Characterization of the oral microbiome and gut microbiome of dental caries and extrinsic black stain in preschool children. *Front Microbiol* 2023;14:1081629. DOI: 10.3389/fmicb.2023.1081629.
- Melo M, Sanz JL, Forner L, et al. Current status and trends in research on caries diagnosis: A bibliometric analysis. *Int J Env Res Public Health* 2022;19(9):5011. DOI: 10.3390/ijerph19095011.
- França-Pinto CC, Cenci MS, Correa MB, et al. Association between black stains and dental caries in primary teeth: Findings from a Brazilian population-based birth cohort. *Caries Res* 2012;46(2):170–176. DOI: 10.1159/000337280.
- Liu F, Panagiotakos D. Real-world data: A brief review of the methods, applications, challenges and opportunities. *BMC Med Res Methodol* 2022;22(1):287. DOI: 10.1186/s12874-022-01768-6.
- Blakeman K. Bibliometrics in a digital age: Help or hindrance. *Sci Prog* 2018;101(3):293–310. DOI: 10.3184/003685018X15337564592469.
- Kokol P. Discrepancies among Scopus and Web of Science, coverage of funding information in medical journal articles: A follow-up study. *J Med Libr Assoc* 2023;111(3):703–708. DOI: 10.5195/jmla.2023.1513.
- AlRyalat SAS, Malkawi LW, Momani SM. Comparing bibliometric analysis using PubMed, Scopus, and Web of Science databases. *J Vis Exp* 2019;(152). DOI: 10.3791/58494.