A Bibliometric Analysis of Articles on Pit and Fissure Sealants During 2012 - 2023

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ABSTRACT

Background: Pit and fissure sealants have become an essential preventive approach for occlusal caries, mainly in the young population. In the last decade, tremendous research has been done in sealant materials, effectiveness, application procedures, and clinical results; therefore, the trends, collaboration networks, and influential contributions need to be summarized in a structured manner. To conduct a deep bibliometric analysis of the published articles on pit and fissure sealants between 2012 and 2023, to track research trends, key contributors, collaborative networks, and gaps in the literature.

Methods: Articles were obtained from Scopus, Web of Science, and PubMed databases with a bibliometric analysis of articles published from 2012 to 2023. The metrics were calculated using the package Biblioshiny in R while VOSviewer was used in the analysis of authorship, citation, and thematic network.

Results: A total of 1,215 articles with 4,059 authors was analyzed, averaging 4.56 authors per paper, attesting to the high collaboration level. The United States, Brazil, and India are known to lead the sealant research activities. Sealant research tends to indicate the extent to which the world is going in the preventive dentistry field. Trends indicated a maximum output in 2015 and 2019 followed by a decline in subsequent years, indicating an overall annual decline in the rate of publication of -2.16%. Thematic analysis found that the most common themes of research were sealant efficacy, material innovation, and application techniques.

Conclusion: Analysis Dramatic progresses in pit and fissure sealant research are highlighted due to an increasing global network. However, areas include improved long-term clinical follow up and optimizing retention when these sealants are put on under different conditions. Gaps should be addressed on how to innovate materials, form, and techniques and strategies for sealants that aim for evidence-based preventive recommendations and guidelines in public health dental practice.

1. Introduction

Pit and fissure sealants have gained immense attention as a preventive approach for occlusal surfaces of dental caries. The occlusal surface of molars has intricate pit and fissure architecture which can act as a food and dental plaque retentive site thereby increasing the propensity for the development of dental caries (1). Being on a cariogenic diet, phase of eruption of teeth, and having deep pits and fissures, which favor the retention of food debris and dental plaque, increases the risk of dental caries in children, thus making prophylaxis vital for this age group. To prevent dental cavities, many sealant materials have been used extensively. Each tooth should ideally be sealed "as soon as sufficiently erupted" in order to truly avoid the development of cavities (2).

Patients who are seen long after tooth eruption are at a higher risk of developing caries, but if they are seen while a tooth is not fully erupted, a sealant may not adhere well because of the presence of crevicular fluid, which causes moisture contamination from the surrounding gingiva (3). Adhesion and retention often define how effective various pit and fissure sealants are. Thus, the focus on enhancement of retention continued in the development of new sealing materials; hence, a modification of the usual etch-and-rinse methods previously advised occurred. This field has gained interest, and the literature published has greatly increased in the last ten years (4).

With bibliometric analysis-the statistical review of literature-published research on a topic across disciplines is becoming increasingly critical in terms of assessing its growth, development, and impact (5). The review concerning pit and fissure sealants can therefore provide insight into research trends and dominant studies to build a framework for the structured understanding of such developments. Such a time frame depicts improvement in the materials, discovery of novel long-term effects, and technological advancements in methods

of application (6).

By analyzing these publication patterns, authorship networks, citation counts, and thematic clusters, bibliometric analysis can identify key contributors to the field, impactful studies to be followed, and emerging research hubs (7). Such an approach not only provides a very comprehensive snapshot of existing work but also helps pinpoint the gaps, emerging trends, and future opportunities for researchers as well as policymakers. With pit and fissure sealants remaining a cornerstone of caries prevention programs around the world, it is critical to monitor the accrual of knowledge in this area in order to guide evidence-based practice and shape future research priorities (8).

This study utilized the use of bibliometric methods in analyzing publication trends, key contributors, and sources of literature on pit and fissure sealants published from 2012 through 2023. This research identifies the most influential authors, journals, and production trends, which makes it a rich exploration of the current state and future directions of this field.

2. Materials and Methods:

Pit and fissure sealants articles from 2012 to 2023 underwent a bibliometric analysis. The extracted datasets were from the Scopus, Web of Science, and PubMed databases. A statistical tool was then used to derive metrics for publications, most relevant authors, source impact, and trends in production.

2.1Data Sources

- The datasets used were from articles published in Scopus, Web of Science, and PubMed.
- The terms used for extraction were "pit and fissure sealants," "dental caries prevention," and "sealant application."

2.2Bibliometric Tools

- Key metrics generated by R-Software using the Biblioshiny package (9)
- Visualization tools used for authorship and sources analysis were VOSviewer software (10).

3. Results

Authorship and Collaboration Patterns:

A total of 4,059 authors wrote the 1,215 articles published between 2012 and 2023, with an average of 4.56 co-authors per document, showing a very high level of collaboration in this field. Only 79 articles were single-authored, which further underlines the importance of collaborative research in dental science. Furthermore, 19.42% of the publications involved international co-authorship, reflecting a significant degree of global collaboration.

- Author Keywords: The 1,880 unique keywords used in the paper were able to capture the scope of topics and themes on Pit and Fissure Sealants.
- References: The 1,215 documents referenced 31,182 other works, showing a strong network of knowledge transfer in the field.
- Average Citations: Articles on Pit and Fissure Sealants had an average of 13.17 citations per document, which means the field has impacted the broader dental research community.

3.1 Most Relevant Authors

Figure 1 illustrates the most contributing authors to research on pit and fissure sealants from 2012 until 2023. Frencken JE (11) contributed to a total of 26 published documents, followed by Kühnisch J (12) with 16 documents. Other contributing relevant authors are Hickel R at 15, Leal SC at 14, and Mulder J with 12.

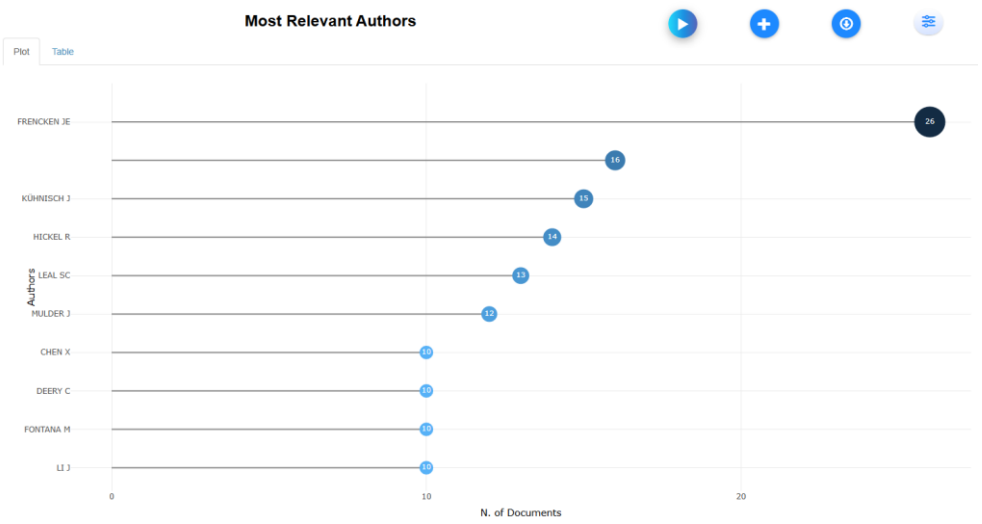

Figure 1. Most Relevant Authors to research on Pit and Fissure Sealants from 2012 to 2023.

3.2 Source Impact

Impact Source Figure 3: Impacts of the Leading Source Journals The H-Index measures the impact from the leading source journals; the H-index of journals of BMC Oral Health, Journal of Dental Research, and Pediatric Dentistry is noted to be 15 indicating a great contribution to pit and fissure sealant literatures.

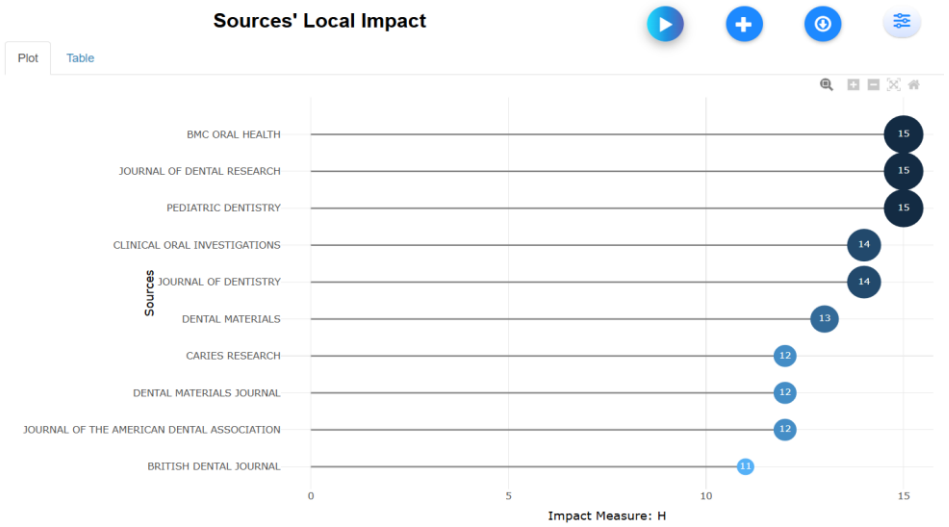

Figure 2. Sources' Local Impact to research on Pit and Fissure Sealants from 2012 to 2023.

3.3 Annual Scientific Production

The scientific production on pit and fissure sealants, as reflected in the second image, varies throughout the period 2012–2023. The peaks around 2015 and 2019 witnessed a sharp drop in articles published in the last couple of years. Over 120 articles were published in one year during 2014 and 2019; however, in 2022 and 2023, the articles went below 90. This is reflected by the negative annual growth rate of -2.16%.

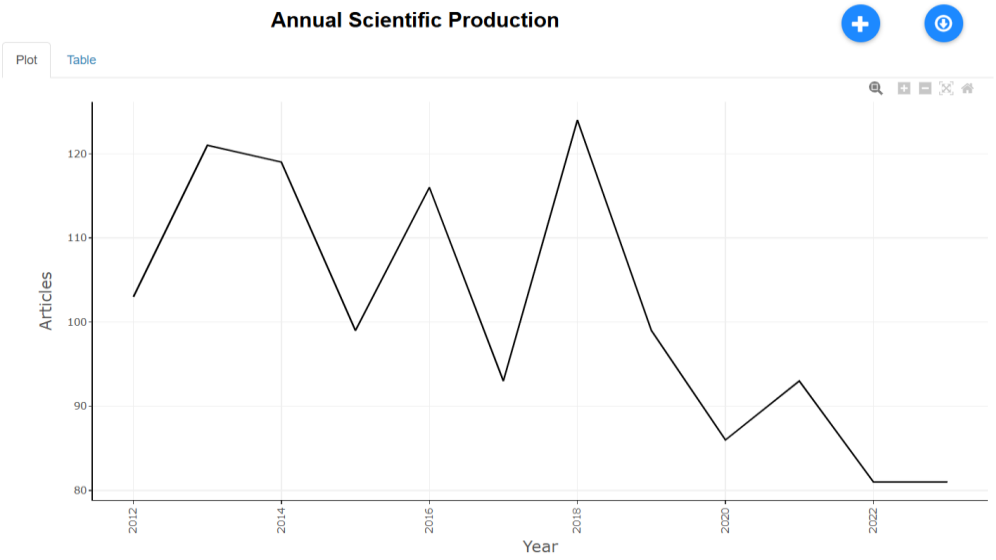

Figure 3. Annual Scientific Production to research on Pit and Fissure Sealants from 2012 to 2023.

3.4 Most Relevant Sources:

The first graph illustrates the number of articles published in the top-ranked journals in Pit and Fissure Sealants research. The most productive source was the Journal of the American Dental Association (JADA), with 43 articles. The second most productive journal was Pediatric Dentistry with 42 articles, followed by BMC Oral Health with 39 articles. Other notable journals include Journal of Dentistry, British Dental Journal, and Clinical Oral Investigations, each of which publishes more than 27 articles. These are among the most relevant sources of Pit and Fissure Sealants literature, a concentration of research output within prominent dental and pediatric-focused publications.

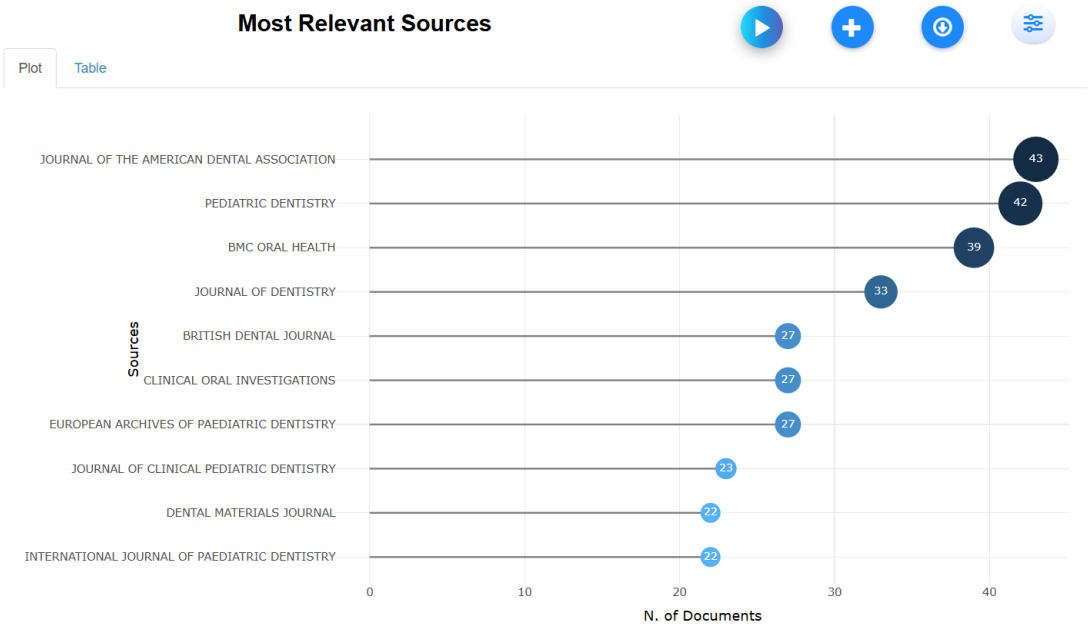

Figure 4. Most relevant sources to research on Pit and Fissure Sealants from 2012 to 2023.

3.5 Most Cited Countries:

The largest contributor to research on pit and fissure sealants was the USA from 2012 to 2023, with 2193 citations. Brazil followed it with 1206 citations, Germany with 1062 citations, and India with 1040 citations. Other contributors were countries such as the United Kingdom, China, and the Netherlands, though at fewer citations. It will be evident from the map that the USA is by far the country with more research, while countries such as India and Brazil also have a relatively increasing visibility in the map of world dental research. Figure

5 shows the distribution of top 10 cited countries according to the citation range from USA and Iran with the intensity in research activity.

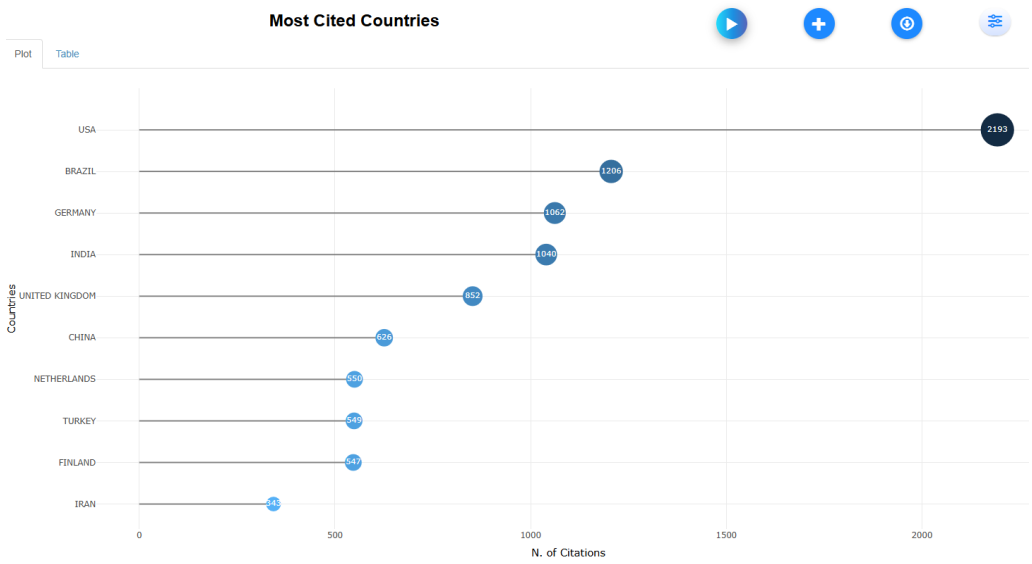

Figure 5. Most cited countries to research on Pit and Fissure Sealants from 2012 to 2023.

3.6 Collaboration and Corresponding Author Countries:

The international collaboration part of the analysis is shown in Figure 6. Again, USA and India dominate corresponding authorship, although more pronounced in the MCP cases compared to SCP, again demonstrating strong collaborative work based in those countries. Next follow the UK and Germany, and as usual, one gets a good impression that such publications result from well-collective research activities. On the other hand, for Iran, Saudi Arabia, and Turkey, less international cooperation is seen with more single-country outputs. The role of international collaborations would be very important in determining the scope and impact of the research.

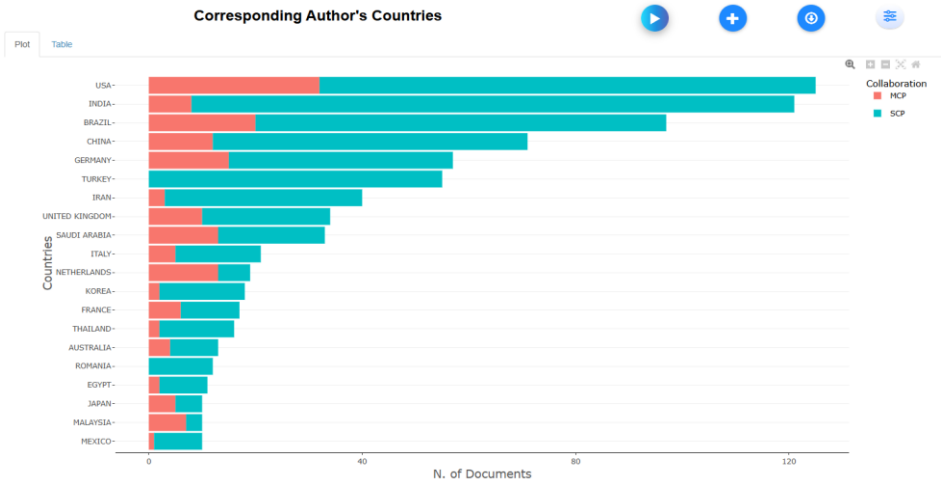

Figure 6. Corresponding Author's countries to research on Pit and Fissure Sealants from 2012 to 2023.

3.7 Citation Dynamics over Time:

Figure 7 Average citations per year. The general trend is negative. The average citations were highest around 2012 and 2016, peaking at around 2 citations per paper. Since 2020, however, the trend has been sharply downward with an average of 0.5 citations in 2023. This could be due to a shift in attention to research or a reduction in the visibility of articles published within the last few years. However, this can be interpreted as the relatively recently published articles have yet to have a chance to generate citations.

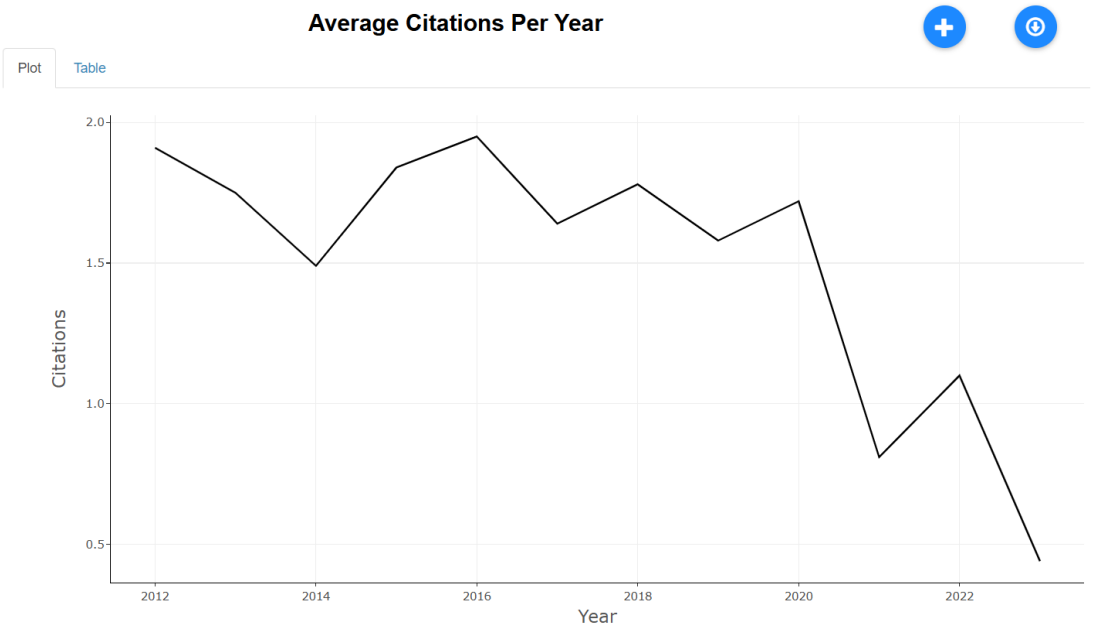

Figure 7. Average citations per year to research on Pit and Fissure Sealants from 2012 to 2023.

3.8 Most Relevant Affiliations

The graph Most Relevant Institutions shows the institutions most strongly contributing to research into the field, and number of articles linked to each of these institutions. The largest figure is the University of São Paulo, which accounts for 90 articles concerning pit and fissure sealants. This is followed by Saveetha University with 74 articles and Cardiff University with 50 articles. Other prominent institutions include King Saud University, Sichuan University, and University of Heidelberg, each publishing between 35 and 39 articles. The broad international representation from universities in Brazil, India, Saudi Arabia, China, and Germany shows the interest of the international community in the topic and the significant contributions of emerging and established research centers.

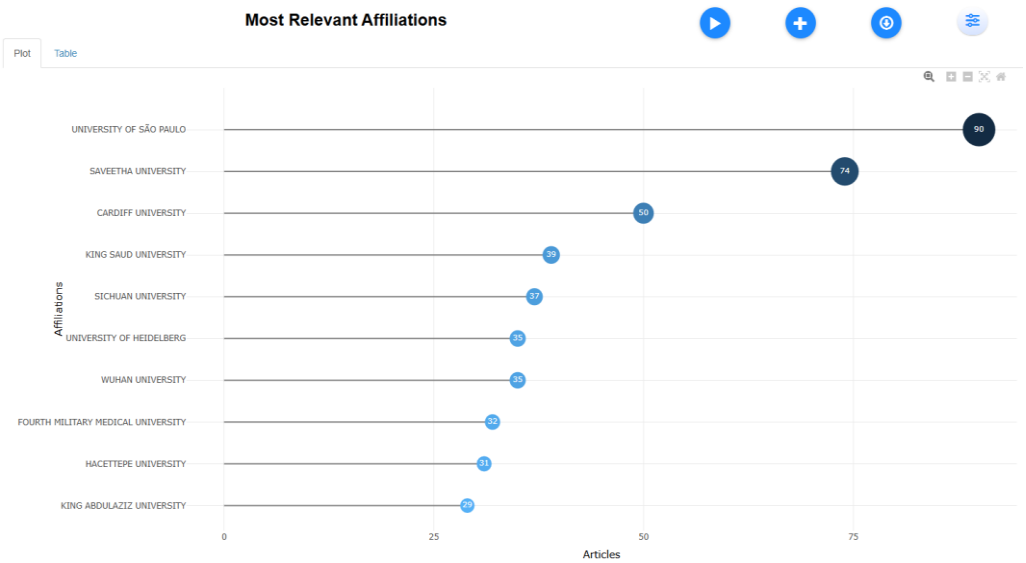

Figure 8. Most relevant Affiliation to research on Pit and Fissure Sealants from 2012 to 2023.

3.9 Co-Citation Network

A co-citation network demonstrates how well-represented their respective key authors are at associating with other citation items by the number of times each has been referenced with each other. Most large clusters show co-citation between research groups of considerable impact or papers: The biggest node is found under Simonsen R.J., 2002 - that one is the mother of the most important studies up till this point. Several nodes come

close, the other nodes being Beiruti N., 2006 and Mickenautsch S., 2011 in each of its major cluster. This is further shown as there exist linkages to the several other research foci found in the field of the domain, and all are clustered in different colored segments signifying various kinds of communities in research, topics vary from clinical trails that indicate effectiveness of dental sealants to longterm epidemiologic studies on general oral health.

The network identifies the key contributors to foundational knowledge in the area of pit and fissure sealant research as well as the evolution, over time, of the scientific discussion. Papers that are published by such authors as Ahovuo-Saloranta A. and Bravo M. form strong connections with a broad multitude of other studies that can be seen as broadly influential to the research landscape.

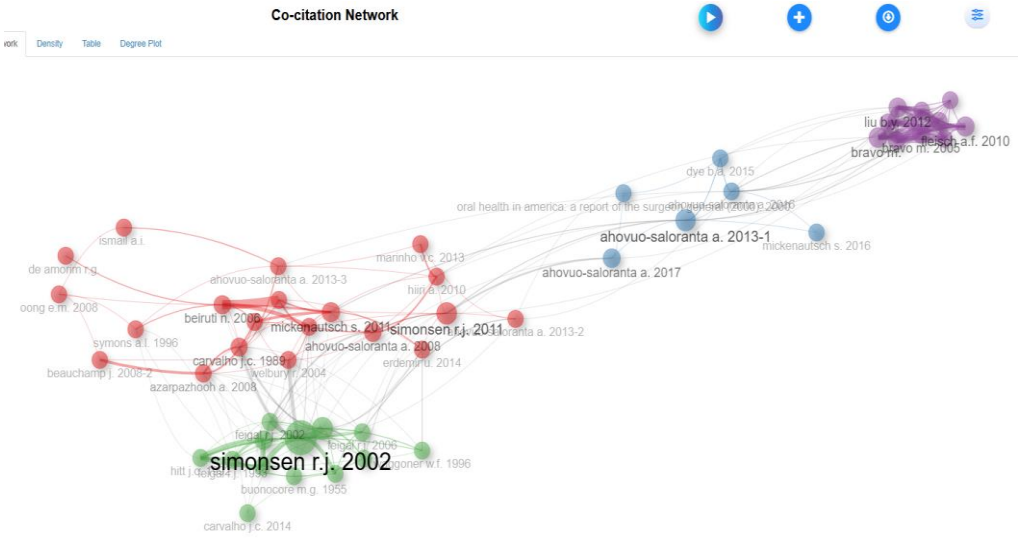

Figure 9. Co-citation Network to research on Pit and Fissure Sealants from 2012 to 2023.

3.10 Countries' Scientific Production

The world map titled Countries' Scientific Production highlights the geographical pattern of output of research of pit and fissure sealants. The map outlines countries whose contribution is noted, with the darker blue marks indicating greater activity of published work. The United States, China, Brazil, and India lead in output, due to a solid academic and clinical interest in each of those regions. This is complemented by marked contributions in Europe, significantly from Germany, the UK, and Scandinavian countries.

Interestingly, the middle-income countries like Brazil and India have been doing increasingly more in recent years, maybe due to the increasing dental health initiatives and more significant academic focus on preventive dentistry in these countries.

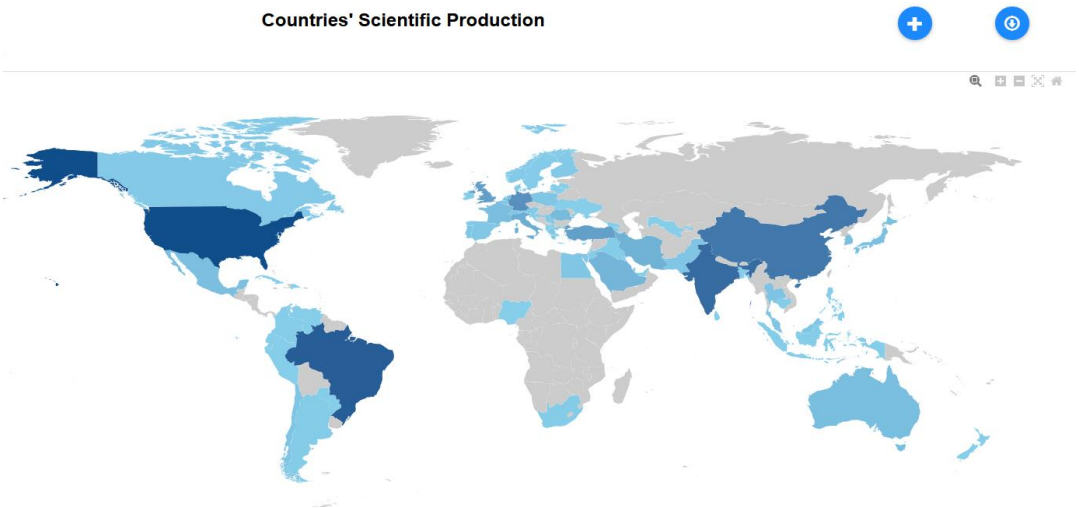

Figure 10. Countries' scientific production to research on Pit and Fissure Sealants from 2012 to 2023.

4. Discussion

The study is a bibliometric analysis of articles about pit and fissure sealants, from 2012 up to 2023. It shows significant trends regarding the frequency of publication, collaborative efforts, geographical focus, and the evolution of themes in research. Specifically, the study continues from former bibliometric reviews of pit and fissure sealants as represented by the thorough 50-year review conducted by San-Martin et al. in 2013 (13) (14), whereby a historical perspective was built on the use, development, and global distribution of sealant research.

4.1 Research Trends and Output

The data indicate variations in the output of published materials over the analyzed period with peak years in 2015 and 2019 followed by a decline in 2022-2023. This is well aligned with historical findings indicating that sealant research experienced a steady interest during times when innovations were seen in dental materials. As similar with San-Martin et al.'s research, there has been this suggestion that given this move in material composition as well as application methods applied when sealants were applied on structures, "there has been a good correlation between research activity, especially when research activity spikes up (15).

4.2 Authorship and Cooperation

Given such findings, this has emerged a figure of 4.56 authors per article and has nudged researchers being more collaborative rather than putting a sole piece of themselves by authoring an article; in the sense a figure of 6.5% articles are singles authored. This is close to what San-Martin et al. (13) noted, in which single-authored manuscripts reduced from 32.1% to 17.6% over the last 50 years. International collaboration increased at 19.42%, showing a worldwide network searching for answers on caries prevention in different populations (16).

4.3 Geographic Distribution of Research

Our study has identified the United States, Brazil, and India as leaders in the studies on sealants. Thus, this trend can be considered to be valid if viewed from the previous review conducted by San-Martin et al. This regional supremacy among the high-output countries would represent the already developed as well as the developing regions focusing on preventive oral health. Conversely, this rise in the contribution of the middle-income country towards the research field represents the rising demand for dental health programs and preventive measures being adopted in these countries (17).

4.4 Thematic Focus and Change

The four dominant themes identified—application techniques, retention, caries prevention efficacy, and material innovation—each evolved in focus over the decade analyzed. Each of these follows the historical pattern observed in data from 1962 through 2011, in which the research focus transitioned from basic clinical trials to meta-analyses and randomized controlled trials. In both reviews, the increasing application of glass ionomer-based sealants shows a continued emphasis on efficacy and longevity in clinical use (18).

4.5 Citation Patterns and Impact

The citation patterns indicate that the most influential studies are those of Frencken et al. and Kühnisch et al., which have greatly influenced the area by providing evidence regarding the effectiveness and cost-effectiveness of sealants. This is in line with the continued influence of seminal studies published from the 1960s forward, which defined the core of preventive dentistry practices and guided the subsequent guideline development (19) (20).

4.6 Future Directions

However, within the bibliometric evidence presented here, there are opportunities for further investigation, namely innovations in adhesive technology or improved retention under a variety of environmental conditions, and more robust clinical trials comparisons between glass ionomer versus resin-based sealants (21) (22). In their bibliography audit, San-Martin et al. predicted advances within coming years that focused on next-generation materials; the study here confirms that pattern through the present analysis. When taken together, these gaps help to fortify clinical guidelines in addition to providing evidence at this level to inform evidence-informed policy development in pursuit of public health efforts meant to prevent caries amongst various vulnerable populations (23) (24).

5. Conclusion

This bibliometric review of pit and fissure sealant research from 2012 to 2023 highlights the increasing complexity and collaborative nature of the field and underscores key trends and contributors in preventive dentistry. The findings seem to confirm the value of sealants as a cornerstone of caries prevention, though they raise areas that require further examination. Specifically, sealant material innovation needs to continue in order to ensure more retention and longevity in diverse clinical settings. Furthermore, the trend of the annual publications downwards means that the focus on the impact of sealants in public health could be resumed. Growth of research in understudied regions and into long-term clinical effectiveness will further enhance evidence-based practice and policy development for reducing caries incidence globally.

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