

Evaluation of Scholarly Literature on Periodontics Produced by Saudi Arabia from 2012 to 2021

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ABSTRACT

Objective: The objective of this study is to evaluate the bibliometric indicators on periodontics research published from 2012 to 2021.

Methodology: The targeted data was extracted from the Scopus database. The bibliographic details of the selected documents (articles and reviews only) were downloaded for data analysis. The bibliometric parameters of articles with citations by years, frequently used journals, international research collaboration, frequently used keywords and top-10 most cited have been examined. Microsoft Excel, VOSviewer and Biblioshiny software were employed to visualize the data.

Results: A total of 1,323 articles have been produced by Saudi Arabian authors and the share of Saudi Arabia was counted as 4.40% in the global research output. All these articles gained an average of 9.61 citations per article and about 27% of the research has been published in top-10 journals. The highest preference in international research collaboration was found with the United States and India. "Periodontics" and "Dental Implants" were the top keywords. Slightly more than 16% (n=2,078) of the citations were gained by top-10 most cited articles.

Conclusion: Saudi Arabia contributed a noteworthy research and played a leading role in the Arab World.

Key words: Periodontics, Saudi Arabia, Bibliometrics, Research evaluation, Citation impact

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INTRODUCTION

Saudi Arabia is an important country and plays a leading role in scholarly and scientific research, particularly in the Arab countries, and generally in the world [1,2]. The government has been providing adequate supports to patronize innovative research activities [3,4]. The

publications of research findings assist the researchers to share their findings, knowledge and innovative ideas [5].

The evaluation of medical research in the Saudi Arabian context has been frequently performed by researchers [4,6-8]. Haq, et al. examined the research growth in dentistry in Saudi Arabia from 1998 to 2017 [9]. Saudi Arabia contributed 38% of the dental research in 22 Arab countries and the highest number of papers were published in Journal of Contemporary Dental Practice. The significant growth of publications was found from 24 papers in 1998 to 456 papers in 2017 with an average annual growth rate of 17.97. Alfadley, et al. examined the research growth on endodontics in six countries of Gulf Cooperation Council (GCC) regions from 2001 to 2020 [10]. GCC region contributed 2.82% of the worldwide

research on endodontics and Saudi Arabian affiliated authors contributed 80% of the total literature in GCC. Haq, et al. pointed out that dental research produced by Saudi Arabia from 2009 to 2018 gained 5.83 cites/paper [11]. The research on the sub-category of dentistry "Engineering biomedical" got the highest citation impact and review articles attained more citations as compared to research articles. Although King Saud University produced a maximum number of papers, the research contributed by King Faisal Specialized Hospital & Research Centre obtained the highest citation impact similarly United States was on the top in international research collaboration, but the papers contributed by Saudi Arabia in research collaboration with Italy got the highest citations.

The growth of knowledge has been manifolded in the 21st century and it is imperative to evaluate the salient features of research publications to pinpoint the main characteristics of a specific area of knowledge [12]. Alan Prichard devised the term bibliometric, earlier known as statistical bibliography. In fact, the bibliometric is a quantitative research procedure that employed statistics and mathematics on the published materials [13]. The findings of these studies illustrated the research trends, the pattern of publications, preferred areas of research, research collaboration, citation impact and more advanced structures of publications. The outcomes of research analysis are important to articulate research policies, allocation of funds for research, and decision-making process [14,15].

Nieri et al examined the 55 citation classic articles having at least 100 citations on the subject area of periodontology published in four core journals between 1990 to 2005 [16]. The highest number of articles (56%) was published in the Journal of Periodontology. Faridi, et al. reviewed the 100 top-cited articles on implant dentistry indexed in Web of Science published during the period from 1981 to 2009 [17]. Slightly less than one-third (n=32) of the total articles were published in the Clinical Oral Implant Research. Ahmad et al analyzed top-100 most cited articles published in Periodontology 2000-2009 [18]. These articles were published between 1993 to 2014 and the highest number of the articles (n=12) was published in 1997. The study used all three databases (Web of Science, Scopus, and Google Scholar) to count the citations. The highest number of citations was recorded in Google Scholar, followed by Scopus and Web of Science. Ahmad and Slots assessed the five most-cited articles on periodontology published in three core journals from 2005 to 2019 [19]. The study opined that the quality of open access journals has been low as compared to subscription-based journals.

The review of relevant literature exposed that no research has been done to examine the share of Saudi Arabian authors in periodontics research in the global perspective and its bibliometric indicators. The present study was conducted to fill this knowledge gap to evaluate the research outcome on Periodontics contributed by Saudi Arabian authors from 2012 to 2021.

The following research questions were formulated to conduct the study:

What is the share of Saudi Arabia in the global research on periodontics from 2012 to 2021?

What is the pattern of publications and citations of periodontics research contributed by Saudi Arabia by year?

Which are the more preferred sources of publications for periodontics research by authors in Saudi Arabia?

What is the status of international research collaboration by Saudi Arabia in periodontal research?

Which keywords have been frequently used and what are the salient characteristics of top cited articles?

METHODOLOGY

The bibliometric research technique has been employed to examine the research output of Saudi Arabia in the knowledge area of periodontics. The Scopus database of Elsevier's used as the source of data. The advanced search option was applied, and the term "periodontics" was written in the search box.

Inclusion/exclusion criteria: The time frame of ten years from 2012 to 2021 was selected and all the documents published before and after this date were excluded. We selected the "article" and "review" from the index of document type and all other types of documents were not considered for data analysis.

To achieve the first objective of the study, the global research output was measured to assert the position of Saudi Arabia and identify the top-10 productive countries in periodontics research. The bibliometric indicators such as periodic growth with citation impact, frequently used journals, research collaborating countries, most cited papers and keywords were evaluated on the dataset of Saudi Arabian research on periodontics.

The Scopus database indexed each and every article/document under Saudi Arabia credit in which at least one author has mentioned the affiliated address of Saudi Arabia.

The dataset is limited to one data source as the Scopus provides the comprehensive coverage of literature as compared to PubMed and Web of Science. Ethical consideration is not required for this study as the data was extracted from publicly available database.

RESULTS

Global perspective of periodontics research

A total of 30,036 documents (Article and Review only) were found on the subject of Periodontics in the Scopus database that was published during the span of the ten years from January 1st, 2012 to the last week of December 2021. About one-fourth of the total articles (n=7,021; 23.38%) were produced by the United States, followed by India (n=5000; 16.65%), Brazil (n=3154;



Figure 1: Distribution of articles by years (n=1,323).

10.50%) and Italy (n=2898; 9.65%). The authors affiliated with Saudi Arabia contributed 1323 (4.40%) papers on periodontics and occupied the 8th position at global level.

Chronological distribution of articles and citations

Figure 1 demonstrates the involvement of Saudi Arabian authors in periodontics research by year. A growing trend was obvious, except for the year 2018. There was only 49 (3.70%) articles published in 2012 and 406 (30.68%) articles were published in the first five years (2012 to 2016) of the targeted period, while 917 (69.32%) articles were published in the last five years (2017-2021). All the selected articles (n=1,323) gained 12,722 citations with an average of 9.61 citations per article and 44 articles quantify h-index scale. The highest ratio citation (29.43 cites/article) was found against the 89 articles that were published in 2015, followed by 49 articles (22.10 cites/article) published in the year 2012.

Frequently used journals

The analysis of the most preferred sources of publication on periodontics research in Saudi Arabia reveals that more than one-fourth (n=353; 26.68%) of the articles were published in the top-10 journals shown in Table 1. The maximum number of articles have been published in the Journal of Contemporary Dental Practice (n=79), followed by Saudi Dental Journal (n=58) and Journal of Periodontology (n=35). The articles published in Journal of Periodontology have gained the highest citation impact (17.26 cites/article) in the top-10 journals. This journal recorded the maximum Cite Score 7.1 according to the metrics of 2020 and having top ranked with Quartile-1 (Q1). There are only two Q1 and four each in Q2 and Q3 journals.

International research collaboration

Table 2 illustrates the collaboration network of Saudi Arabian authors in periodontics research. The majority of the research (n=541; 41%) was generated with the collaboration of the authors affiliated with the United

Table 1: Top-ten most preferred sources of publications in periodontics research.

Serial No.	Name of Journal	CiteScore 2020	Total Articles	Citations	Citations Impact
1	Journal of Contemporary Dental Practice	1.3 (Q3)	79	205	2.59
2	Saudi Dental Journal	3.8 (Q3)	58	557	9.6
3	Journal of Periodontology	7.1 (Q1)	35	604	17.26
4	International Journal of Periodontics and Restorative Dentistry	2.2 (Q2)	31	140	4.52
5	BMC Oral Health	3.2 (Q2)	28	231	8.25
6	Saudi Medical Journal	2.0 (Q2)	28	298	10.64
7	Photodiagnosis and Photodynamic Therapy	4.1 (Q1)	26	282	10.85
8	Journal of Pharmacy and Bioallied Sciences	1.6 (Q3)	23	18	0.78
9	World Journal of Dentistry	2.1 (Q3)	23	13	0.57
10	Journal of Oral Implantology	2.3 (Q2)	22	103	4.68

States (n=291; 22%) and India (n=251; 19%). The proportion of citations has been higher in the United States as compared to India. Pakistan occupied the 3rd rank with 91 (6.87%) articles, followed by Egypt (n=87; 6.57%) and United Kingdom (n=63; 4.76%). Only 38 articles were written with the collaboration of Germany, but these articles gained the maximum citations (43.15 cites/article), followed by Canada (34.16 cites/articles). The lowest citation impact was recorded against the articles written with the collaboration of Malaysia. This analysis is limited to the top-10 countries.

Saudi Arabian researchers collaborated with different authors affiliated with 88 countries of the world. The VOS viewer software illustrated the co-occurrence network of 40 countries comprised of eight clusters, who contributed five or more than five articles each. The red color circles represent the first cluster of 11 countries (Brazil, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Sudan, Syria, Turkey, and Yamen), The green color circles represent the second cluster of 10 countries

Table 2: International research collaboration.

Serial No.	Country	Total articles	Total citations	Citation impact	H-Index
1	United States	290	4,898	16.88	33
2	India	251	1,883	7.5	20
3	Pakistan	91	1,123	12.34	16
4	Egypt	87	658	7.56	15
5	United Kingdom	63	1,684	26.73	15
6	Malaysia	62	349	5.62	10
7	Canada	42	1,435	34.16	13
8	Germany	38	1,640	43.15	17
9	Italy	35	984	28.11	9
10	Netherlands	35	526	15.02	12

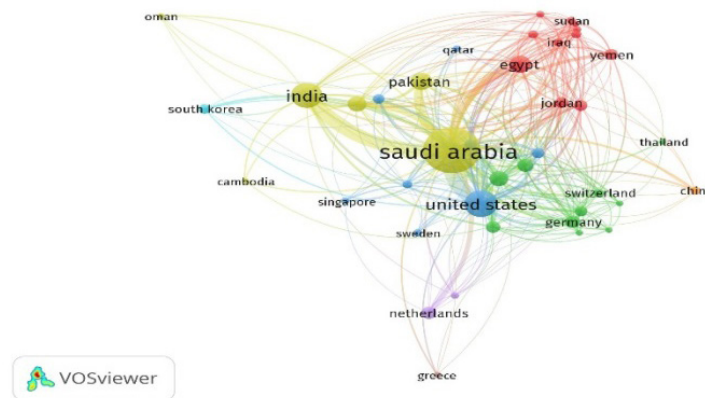


Figure 2: Co-occurrence network of 40 countries generated by VOSviewer software.

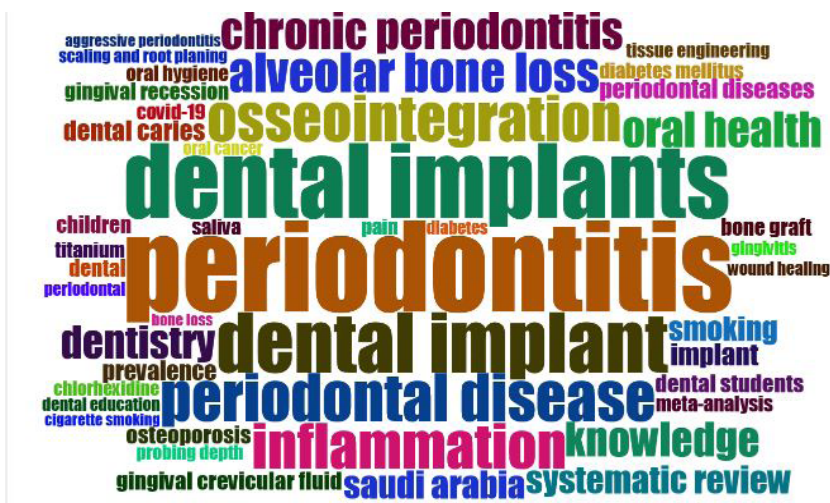


Figure 3: Author's used top-50 keywords graph generated by Biblioshiny software.

(Canada, Denmark, Finland, Germany, Italy, Japan, New Zealand., Switzerland, Thailand, and United Kingdom). The blue color circles represent the third cluster of eight countries (Australia, Hong Kong, Qatar, Singapore, Spain, Sweden, United Arab Emirates and United States). Out of 40 countries, 29 countries consisted of the first three clusters of co-occurrence network as shown in Figure 2.

Keywords analysis

The word count graph produced by the Biblioshiny software illustrated the occurrence of Author's used top-50 keywords (Figure 3). The keywords Periodontitis was used most frequently, followed by dental implants,

periodontal disease, osseointegration, inflammation, alveolar bone loss, chronic periodontitis.

Most-cited articles

The bibliographic and citation details of the top-10 most cited articles are presented in Table 3. These ten articles gained 2,078 citations with a mean ratio of 207.8 cites/article. The top-three articles gained more than 300 citations each. The highest number of most cited articles were published in the years 2015 and 2014 with four and three articles, respectively. The analysis of authorship pattern showed that eight articles were the result of research collaboration while two articles were

Table 3: Top-10 most cited articles.

Serial No.	Bibliographic Description of article	Total Citations
1	Khan, A.A., et al., 2015. Diagnosis and management of osteonecrosis of the jaw: a systematic review and international consensus. <i>Journal of Bone and Mineral Research</i> , 30(1), pp.3-23.	630
2	Paravina, R.D., et al., 2015. Color difference thresholds in dentistry. <i>Journal of Esthetic and Restorative Dentistry</i> , 27, pp.S1-S9.	347
3	Sheikh, Z., et al., 2015. Biodegradable materials for bone repair and tissue engineering applications. <i>Materials</i> , 8(9), pp.5744-5794.	319
4	Yu, B., et al., 2014. Wnt4 signaling prevents skeletal aging and inflammation by inhibiting nuclear factor- κ B. <i>Nature Medicine</i> , 20(9), pp.1009-1017.	141
5	Khan, A.A., et al., 2017. Case-based review of osteonecrosis of the jaw (ONJ) and application of the international recommendations for management from the international task force on ONJ. <i>Journal of Clinical Densitometry</i> , 20(1), pp.8-24.	113
6	Patil, S., et al., 2015. Clinical appearance of oral <i>Candida</i> infection and therapeutic strategies. <i>Frontiers in Microbiology</i> , 6, p.1391.	112
7	Zafar, M., et al., 2016. Potential of electrospun nanofibers for biomedical and dental applications. <i>Materials</i> , 9(2), p.73.	112
8	Alqahtani, M.Q., 2014. Tooth-bleaching procedures and their controversial effects: A literature review. <i>The Saudi Dental Journal</i> , 26(2), pp.33-46.	102
9	Abou Neel, E.A., et al., 2014. Tissue engineering in dentistry. <i>Journal of Dentistry</i> , 42(8), pp.915-928.	101
10	Halawany, H.S., 2012. A review on miswak (<i>Salvadora persica</i>) and its effect on various aspects of oral health. <i>The Saudi Dental Journal</i> , 24(2), pp.63-69.	101

written by a single author pattern. These articles were published in eight different journals, two articles each were published in *Materials* and *Saudi Dental Journal*.

DISCUSSION

We examined the bibliometric characteristics of periodontics; the most used word is periodontal or research in periodontics produced by the Saudi Arabian affiliated authors from 2012 to 2021 as observed in the Scopus database. The PubMed database indexed 5,288 journals, while another source, Web of Science's Master List contained of 24,931 journals (<https://mjl.clarivate.com/>). The Scopus database provides the bibliographic and citations counts of 43,132 journals and other sources (<https://www.scopus.com/sources.uri>). Scopus database has been used widely to review the publication growth of different countries, institutions, and subjects [20].

Saudi Arabian authors contributed 4.40% of the total research on periodontics. Alfadley, et al. reported that Saudi Arabia shared 2.47% of the total dental research during 2019 and attained the 9th position worldwide in dental research [10]. Our findings are also in line with this research, as in periodontal research Saudi Arabia is standing on 8th rank in the total global research production.

Citation counts provide the detail of how many times an article has been cited. Garfield asserted that the citation counts indicated the quality and excellence of research [21]. In the present study, the selected articles (n=1,323) gained 12,722 citations (average 9.61 cites/article) and the articles published in 2015 gained the highest citation impact (29.43 cites/articles), out of 10, most cited articles; four articles were published in 2015. The earlier study on dental research in Saudi Arabia from 2009 to 2018 [11] exposed the low average citation impact (5.83 cites/paper), as compared to the current study. Alfadley, et al. described that the endodontic research of Saudi Arabia from 2001 to 2020 gained an average of 9.09 citations per paper [10].

About 27% of the total literature on periodontics was

published in top-10 journals. Haq and Alfouzan stated that 50% of the total papers on dentistry produced by Saudi Arabia from 1998 to 2017 were published in top-15 journals [11]. Interestingly, our study and Haq, et al. study [11] found similar journals at the top-two level, *Journal of Contemporary Dental Practice* and *Saudi Dental Journal*.

The analysis of international research collaboration shows that two-thirds of the total articles (n=869; 66%) were the results of international research collaboration. The United States has been the top preference in international research collaboration. One-third of the articles (n=454) have been considered as indigenous research of Saudi Arabia. Although the highest number of research has collaborated with the United States, but the highest citation impact has gone to the articles written in collaboration with Germany.

Although our study has not performed the subject dispersion of the articles, the analysis of the keywords fills this gap and assists to identify the strong areas of research in periodontology. The most frequently used keyword is periodontitis, followed by dental implants, and periodontal disease.

The most cited article entitled "Diagnosis and management of osteonecrosis of the jaw: a systematic review and international consensus" published in 2015 gained 630 citations. Ten top-cited articles gained almost 16% of the total citations.

The study is limited to the articles indexed in the Scopus database and we only used scholarly material like articles and reviews. Future researchers can use other databases like Web of Science and Google Scholar to compare the findings of the present study. We didn't identify the most productive authors and institutions; future studies can include these indicators in their analysis. This study supports understanding of the pattern of periodontics research in Saudi Arabia. Policy-makers can use these findings to revisit the research priorities and encourage researchers to submit quality research to national journals, so the impact of local journals can be enhanced.

CONCLUSION

The current study demonstrated the research performance of Saudi Arabia in the sub-category of dentistry, periodontics. Saudi authors contributed 4.40% to the total global research output. The promising growth from 49 articles in 2012 to 281 articles in 2021 is probably related to an increasing quality of dental education, provision of high-tech dental laboratories and flourishing culture of research in Saudi Arabia. These efforts have also positive effects on the dental health of the community. Saudi Arabian dental researchers have been motivated well to attain distinction in all areas of dental research. Out of 1,373 articles identified by the Scopus database, slightly more than one-third (n=454; 34%) of the research was indigenous and 66% was the outcome of international research collaboration. There is a need to enhance the post-graduation training opportunities in dentistry by offering doctorate-level programs and upgrading the existing dental research organization to further accelerate the quantity as well as the quality of periodontal research in Saudi Arabia.

AUTHORSHIP DECLARATION

All authors have contributed considerably, and all authors are in agreement with the present manuscript.

DISCLOSURE STATEMENT

The authors declare no potential conflicts of interest with respect to the authorship and/or publication of this article.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Khansa Ababneh: Conceptualization, Investigation, Project administration, Writing – review & Editing. Abdulsalam Alshammari: Conceptualization, Investigation, Formal Analysis, Validation. Naif Alrubaig: Conceptualization, Investigation, Writing-original draft, Formal Analysis. Sultan Althenyan: Conceptualization, Investigation, Formal Analysis. Abdulaziz Alghannam: Investigation, Formal Analysis. Abdullah Aljarallah: Conceptualization, Investigation, Writing – review & Editing. Abdullah Alhathlol: Conceptualization, Investigation, Writing – review & Editing. Rakan Aleisa, Conceptualization, Investigation, Writing – review & Editing. Ikram Ul Haq: Conceptualization, Investigation, Writing – review & Editing.

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