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# Bibliometric Appraisal on Dental Research at Kingdom of Saudi Arabia from 1998-2017

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## ABSTRACT

**Purpose:** Scholarly research is considered as a yardstick to measure progress and development in any country, institution, or subject or individual. This study describes the growth of publications in the field of dentistry by researchers affiliated to the Kingdom of Saudi Arabia (KSA) during two decades from 1998 to 2017.

**Research Design:** This observational and quantitative analysis on dental research growth in KSA is based upon the data retrieved from Scopus database. This study was carried out at the College of Dentistry, King Saud bin Abdulaziz University for Health Sciences (KSAU-HS). Bibliometric indicators such as year-wise growth, productive author, research-type, source publication, productive national institutions, international research collaboration and collaborating countries have been used to illustrate research performance of KSA. Relevant bibliometric studies on medical and dental research have been reviewed. Microsoft Excel used for data analysis.

**Key Findings:** The results of the study provide various characteristics of dental literature published during the projected period. Total of 6,415 research items produced by 22 Arab countries, a share of KSA counted 2,427 (37.83%) documents. Nearly half of the research items (n=1,209; 49.81%) published during the last three years from 2015 to 2017. *Journal of Contemporary Dental Practice* published 242 articles. King Saud University (KSU) appeared highest prolific national institution (n=938) and Alexandria University with 67 papers grasp top rank in international research collaborating institutions. United States (US) with 474 papers stood at the top in collaborating countries. Most of the papers have been written on the subject of dental procedures, resin, dental caries, tooth prosthesis and dental implants. Dr. Shankargouda Patil affiliated with Jazan University found as the most instrumental author with 60 publications in his credit.

**Conclusions/Implications:** Findings of this study illustrate that dentistry has been progressing over the years in KSA. High tech dental research has a direct impact on the oral health and wellbeing of citizens. KSA researchers are thriving for more informed dental practices and research-based education leading to quality oral health care to their community.

**Keywords:** dentistry; oral health research, Scholarly publication; bibliometric analysis; Saudi Arabia; Scopus; Biomedical publications

## **Introduction**

KSA is the largest country in the Arab world, investing sizeable amount on the provision of quality education and hi-tech health care facilities to its citizens. Numbers of higher education institutions increased during the last two decades similarly the growth of scholarly publications have also been amplified (Haq, AlFouzan, & Baladi, 2017). Research publications help authors to disseminate their findings, knowledge and novel ideas (Warraich, & Ahmad, 2011). Assessment of published literature to a specific area of knowledge on targeted period is considered critical to understanding the tendency (Baladi, Al-Mutairi, Al Harthy, & Haq 2017). Professional progress of any researcher, journal, institution, country, or region in the specific field of knowledge can be measured through quantitative and qualitative estimation of research output (Alanazi, Baladi, & Haq, 2018). Quantitative assessment of research publication is an important scale to assess the productivity of dental researchers. Scholarly literature has been playing a vital role in keeping the dental practitioners aware of the latest trends, technologies and practice (Bernstein, et. al. 2018).

The term bibliometric has been introduced by Alan Prichard in 1969, it is quantitative research technique used for physically published items (Hertzel, 2013). A related term “Scientometrics” has also the same purpose to analyze the quantitative characteristics of knowledge (van Raan, 1997). A review of relevant literature exposes that number of authors has presented a bibliometric analysis on different branches of medical and dental sciences. Adequate bibliometric studies on various disciplines of medical and allied health sciences have been carried out in the Saudi Arabian perspective. But no comprehensive study on dental research has been conducted. This report on dental research productivity analysis in KSA is intended to fill this gap. The aim of this study is to examine the bibliometric characteristics of dental sciences literature with authorship affiliated to KSA published from 1998 to 2017.

## **Objectives**

This study has been carried out to achieve the following objectives:

1. To identify the worldwide share of Arab countries and especially KSA in the field of dentistry, the data of one year 2017 was analyzed.
2. To assess the year-wise growth of dental literature published by KSA during the projected period.
3. To find out productive authors and productive national institutions.
4. To evaluate the research-type and journals frequently used for publication.
5. To identify the research collaborating international organizations and counties.

## **Research Methodology**

This retrospective and quantitative analysis on dental research growth by researchers affiliated with KSA is based upon the data retrieved from Scopus database. Scopus a multidisciplinary bibliographical citations database, covers more than 60 million periodical publications, over 113,000 soft copies of books and more than 7.2 million conference papers. “Saudi Arabia” has been written in the main search and selected the option of “affiliated country” from a drop down button. Date filter command was used from 1998 to 2017. The publications data on dentistry of 22 Arab countries was downloaded one by one to find out a share of KSA. The study conducted at College of Dentistry, King Saud bin Abdulaziz University for Health Sciences (KSAU-HS)

from November 2018 to January 2019. Bibliometric indicators such as year-wise growth, productive author, research type, source publication, productive national institutions, international research collaboration and collaborating countries have been used to illustrate research performance of KSA. The spreadsheet of Microsoft Excel used for data analysis.

### **Limitations**

The data used in the study is limited to Scopus indexed journals. The number of publications might be higher if the search has been applied on the Google Scholar database. But Google Scholar does not provide affiliated search approach. Scopus provides a list of frequently used keywords, subject-wise segregation of literature is based upon keyword, which helps to identify the strong and neglected areas of dental research in KSA.

### **Results**

The results of this study exclusively deal with dental research in KSA from 1998 to 2017. Before going to detail, the researchers attempt to present the position of 22 Arab countries specifically KSA in global research outlook. For this purpose, the worldwide publications record on dentistry only for one the year 2017 has been examined. Figure-1 reveals that total 12,528 documents published on dentistry around the world. United States (US) stands at the top with 2,299 (18.35%) publications followed by Brazil with 1,824 (14.55%) publications. Arab countries altogether produced 940 publications (7.50%), almost half of the publications (n=456; 3.63%) produced by KSA and it occupies 12<sup>th</sup> position in dental research output worldwide. University of Sao Paulo, Brazil produced 461 research documents, this number is higher than the total number of publications of KSA during 2017.

**Figure -1, Dental Research Productivity Worldwide during 2017**

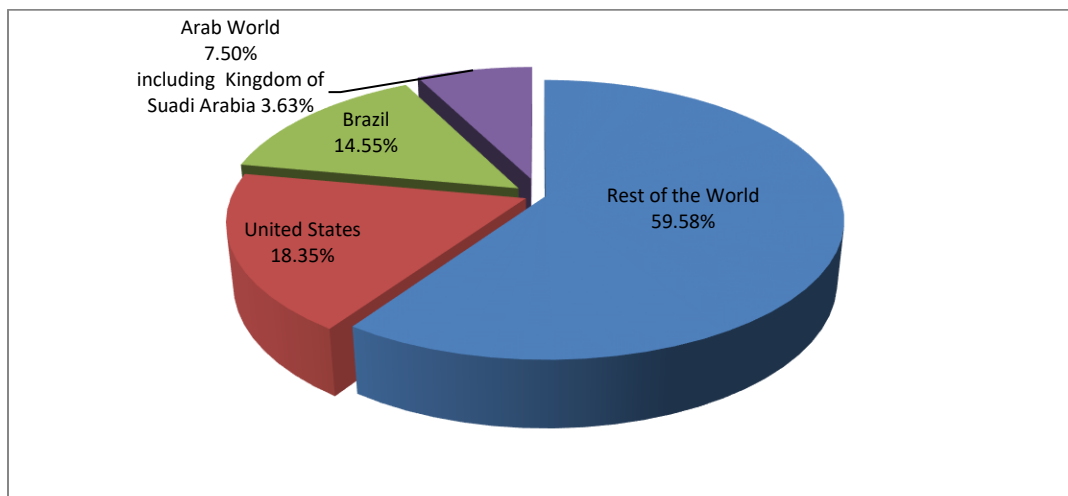


Table-1 describes that 6,416 research items produced by 22 Arab countries on dental research during the two decades. KSA has contributed significantly in research productivity with 2,427 (37.38%) publications, followed by Egypt (n=1,285; 20.03%), Jordan (n=718; 11.19%), United Arab Emirates (UAE) (n=410; 6.39%) and Kuwait (n=409; 6.37%). Nine Arab countries have less than 100 publications whereas three Arab countries didn't produce any research on dentistry. Twenty years period has been further divided into four equal phases of five years each. The first phase of 1998-2002 shows that only 401 (6.25%) research items have been produced by the Arab world. Only two countries, KSA and Jordan reached to 100 plus and three countries Egypt (58),

Kuwait (44) and Lebanon (31) reached in double figure, eleven countries produced less than 10 publications and six countries didn't produce any publications on dentistry during 1998-2002. The last phase of 2013-2017 found to be most productive, more than half of research (n=3598; 56.07%) produced in this period. The research productivity on dentistry by authors affiliated with KSA is prominent in all four phases.

**Table -1; Research on Dentistry in Arab World**

| Country    | 1998-2002 | 2003-2007 | 2008-2012 | 2013-2017 | Total | Percentage |
|------------|-----------|-----------|-----------|-----------|-------|------------|
| KSA        | 135       | 215       | 478       | 1,599     | 2,427 | 37.83      |
| Egypt      | 58        | 108       | 405       | 714       | 1,285 | 20.03      |
| Jordan     | 101       | 175       | 218       | 224       | 718   | 11.19      |
| UAE        | 4         | 24        | 124       | 258       | 410   | 6.39       |
| Kuwait     | 44        | 116       | 97        | 152       | 409   | 6.37       |
| Lebanon    | 31        | 35        | 65        | 138       | 269   | 4.19       |
| Iraq       | 4         | 15        | 40        | 109       | 168   | 2.62       |
| Morocco    | 2         | 11        | 57        | 77        | 147   | 2.29       |
| Tunisia    | 2         | 29        | 60        | 46        | 137   | 2.14       |
| Yemen      | 1         | 4         | 7         | 119       | 131   | 2.04       |
| Sudan      | 6         | 8         | 24        | 51        | 89    | 1.39       |
| Qatar      | 5         | 4         | 14        | 39        | 62    | 0.97       |
| Algeria    | 1         | 8         | 16        | 15        | 40    | 0.62       |
| Bahrain    | 1         | 8         | 16        | 15        | 40    | 0.62       |
| Palestine  | 0         | 4         | 12        | 17        | 33    | 0.51       |
| Oman       | 1         | 4         | 11        | 10        | 26    | 0.41       |
| Syria      | 5         | 3         | 2         | 7         | 17    | 0.26       |
| Libya      | 0         | 0         | 0         | 6         | 6     | 0.09       |
| Mauritania | 0         | 0         | 0         | 2         | 2     | 0.03       |
| Somalia    | 0         | 0         | 0         | 0         | 0     | 0.00       |
| Comoros    | 0         | 0         | 0         | 0         | 0     | 0.00       |
| Djibouti   | 0         | 0         | 0         | 0         | 0     | 0.00       |
| Total      | 401       | 771       | 1,646     | 3,598     | 6,416 |            |

Table-2 below presents year-wise distribution research on dentistry produced by researchers affiliated with KSA. Total of 2,427 research items has been identified by the targeted database with an average annual growth rate of 17.97. Lowest annual growth rate (-23.50) was recorded during 1999 and the highest annual growth rate (44.90) was reported during 2010. Only 350 (14.42%) research published during the first 10 years from 1998-2007 and majority of research (n=2077; 85.58%) produced during 2008-2017. A growing trend of research in the second decade witnessed because of KSA government concert efforts to promote higher education and research. Government not only financially patronized the education sector but also increased the number of research institutions and universities in KSA during the last decade. Following formula has been used to calculate the average annual growth rate:-

$$= (1/\text{Numbers of Years}) * \text{LN}(\text{Last Amount}/\text{Initial Amount}) * 100$$

**Table – 2; Chronological distribution of Publications (n=2427)**

| Year   | Total Publications | Percentage | Cumulative Number | Cumulative Percentage | Annual Growth Rate |
|--|--------------------|------------|-------------------|-----------------------|--------------------|
| 1998   | 24                 | 0.98%      | 24                | 0.98%                 |                    |
| 1999   | 15                 | 0.61%      | 39                | 1.60%                 | -23.50             |
| 2000   | 24                 | 0.98%      | 63                | 2.59%                 | 23.50              |
| 2001   | 33                 | 1.35%      | 96                | 3.95%                 | 15.92              |
| 2002   | 39                 | 1.60%      | 135               | 5.56%                 | 08.35              |
| 2003   | 40                 | 1.64%      | 175               | 7.21%                 | 01.27              |
| 2004   | 40                 | 1.64%      | 215               | 8.85%                 | 00.00              |
| 2005   | 36                 | 1.48%      | 251               | 10.34%                | -05.27             |
| 2006   | 40                 | 1.64%      | 291               | 11.90%                | 05.27              |
| 2007   | 59                 | 2.43%      | 350               | 14.42%                | 19.43              |
| 2008   | 66                 | 2.71%      | 416               | 17.14%                | 05.61              |
| 2009   | 44                 | 1.81%      | 460               | 18.95%                | -20.27             |
| 2010   | 108                | 4.44%      | 568               | 23.40%                | 44.90              |
| 2011   | 136                | 5.60%      | 704               | 16.76%                | 11.53              |
| 2012   | 124                | 5.10%      | 828               | 34.11%                | -04.62             |
| 2013   | 175                | 7.21%      | 1,003             | 41.36%                | 17.23              |
| 2014   | 215                | 8.85%      | 1,218             | 50.18%                | 10.29              |
| 2015   | 308                | 12.69%     | 1,526             | 62.87%                | 17.97              |
| 2016   | 445                | 18.33%     | 1,971             | 81.21%                | 18.40              |
| 2017   | 456                | 18.76%     | 2,427             | 100%                  | 01.22              |
| Average Annual Growth Rate of Publications from 1998 to 2017 |                    |            |                   |                       | 17.97%             |

Examination of top dental research producing institutions resulted that KSU with 938 publications found the most productive institution in dental research in KSA followed by King Abdulaziz University (KAU) with 374 publications and Imam Abdulrahman Bin Faisal University with 142 publications as shown in Table-2. Only five institutions produced more than 100 publications during the study period. Most of the research originated from 11 universities, only three hospitals and the KSA Ministry of Health included among the top 15 national institutions.

**Table-2 Top 15 Productive national research institutions**

| Rank | Institutions                           | No of Publications | Percentage |
|------|--|--------------------|------------|
| 1    | KSU                                    | 938                | 38.64%     |
| 2    | KAU                                    | 374                | 15.40%     |
| 3    | Imam Abdulrahman Bin Faisal university | 142                | 5.85%      |
| 4    | Jazan University                       | 135                | 5.56%      |
| 5    | King Khalid University                 | 105                | 4.32%      |
| 6    | Taibah University                      | 94                 | 3.87%      |
| 7    | Prince Sattam Bin Abdulaziz University | 66                 | 2.71%      |
| 8    | Ministry of Health, KSA                | 57                 | 2.34%      |

|    |  |    |       |
|----|--|----|-------|
| 9  | Jouf University  | 54 | 2.22% |
| 10 | King Faisal Specialist Hospital and Research Centre    | 53 | 2.18% |
| 11 | King Saud bin Abdulaziz University for Health Sciences | 49 | 2.01% |
| 12 | Riyadh Colleges of Dentistry and Pharmacy              | 40 | 1.64% |
| 13 | Riyadh Military Hospital                               | 34 | 1.40% |
| 13 | King Abdulaziz Medical City- Riyadh                    | 34 | 1.40% |
| 14 | Al Qassim University                                   | 27 | 1.11% |

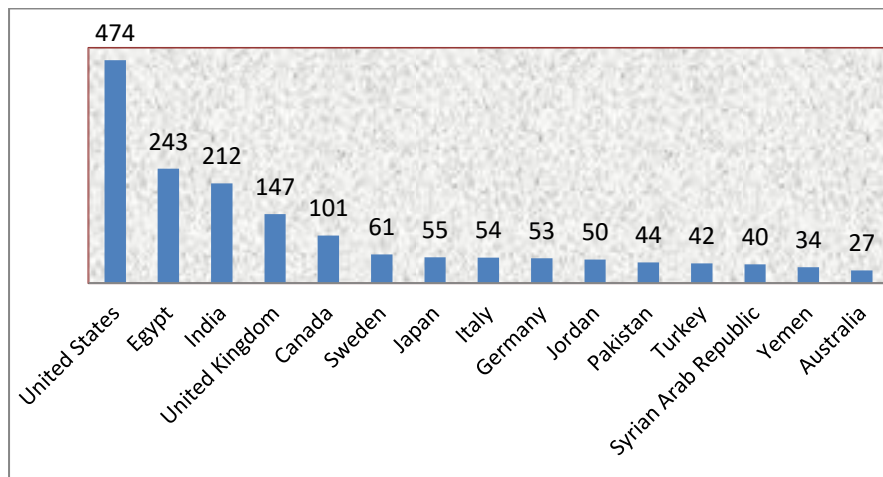
Table-3 explains the scenario of international collaboration, among the top 15 collaborating institutions, the top five institutions belong to Egypt. Alexandria University is at the top institute with 67 publications followed by Cairo University with 52 and Al-Azhar University with 51 publications. Six US institutions are included in top 15 collaborating organizations. One institution each from India, Sweden, Turkey and Jordan collaborated in research publications on dentistry with KSA affiliated authors.

**Table-3; Top 15 International collaborating institutions**

| Rank | Institutions  | Country | No. of Publications |
|------|---|---------|---------------------|
| 1    | Alexandria University                               | Egypt   | 67                  |
| 2    | Cairo University                                    | Egypt   | 52                  |
| 3    | Al-Azhar University                                 | Egypt   | 51                  |
| 4    | University of Tanta                                 | Egypt   | 43                  |
| 5    | Mansoura University                                 | Egypt   | 40                  |
| 5    | Dr. D. Y. Patil Dental College & Hospital           | India   | 40                  |
| 6    | University of Michigan, Ann Arbor                   | US      | 39                  |
| 7    | Boston University                                   | US      | 37                  |
| 8    | University of Michigan, School of Dentistry         | US      | 34                  |
| 9    | Goteborgs Universitet                               | Sweden  | 32                  |
| 10   | Erciyes Universitesi                                | Turkey  | 31                  |
| 10   | University of Rochester                             | US      | 31                  |
| 11   | Jordan University of Science and Technology         | Jordan  | 28                  |
| 12   | Tufts University                                    | US      | 27                  |
| 12   | University at Buffalo, State University of New York | US      | 27                  |

Country-wise research collaboration states that majority of publications (n=474; 19.53%) produced with the collaboration of authors belong to US, followed by Egypt (n=243; 10.01%), India (n=212; 8.73%), United Kingdom (UK) (n=147; 6.05%) and Canada (n=101; 4.16%) as shown in Figure-2 and Table-4. There are only ten countries in research collaboration with 50 or more than 50 publications.

**Figure-2; Top 15 Collaborated countries with KSA Authors**



**Table-4; Top 15 Collaborated countries with SA Authors**

| Country              | Publications (n) | Percentage |
|----------------------|------------------|------------|
| US                   | 474              | 19.53%     |
| Egypt                | 243              | 10.01%     |
| India                | 212              | 8.73%      |
| UK                   | 147              | 6.05%      |
| Canada               | 101              | 4.16%      |
| Sweden               | 61               | 2.51%      |
| Japan                | 55               | 2.26%      |
| Italy                | 54               | 2.22%      |
| Germany              | 53               | 2.18%      |
| Jordan               | 50               | 2.06%      |
| Pakistan             | 44               | 1.81%      |
| Turkey               | 42               | 1.73%      |
| Syrian Arab Republic | 40               | 1.64%      |
| Yemen                | 34               | 1.40%      |
| Australia            | 27               | 1.11%      |

Table-5 elucidates the name and affiliation of top 20 contributors with the number of publications in the targeted period. Among these 20 researchers, only five KSA nationals, other 15 belong to 6 different countries either working here in KSA or collaborating with KSA affiliated researchers. Five researchers originally belong to India, four from Pakistan, two from US and Syria each, one from Lebanon and Turkey each. Dr. Shankargouda Patil, Indian national, presently belongs to Department of Maxillofacial Surgery and Diagnostic Science, College of Dentistry, Jazan University, is a most fertile author with 60 publications trailed by Dr. Fawad Javed, Pakistani national, presently serving at KSU with 55 publications. Dr. Khalid Al-Hezaimi, a KSA national affiliated of KSU stood on 3<sup>rd</sup> position with 54 publications. There are only two KSA nationals amongst the top ten researchers.



Table – 5; Top-20 Productive Researchers

| Rank | Researcher                   | Nationality | Present Affiliation   | Articles |
|------|------------------------------|-------------|---|----------|
| 1    | Dr. Shankargouda Patil       | India       | Department of Maxillofacial Surgery and Diagnostic Science, College of Dentistry, Jazan University, KSA       | 60       |
| 2    | Dr. Fawad Javed              | Pakistan    | Growth Factors and Bone Regeneration Research Chair, KSU, KSA   | 55       |
| 3    | Dr. Khalid Al-Hezaimi        | KSA         | Dept. of Periodontics and Community Dentistry, Growth Factors and Bone Regeneration Research Chair, KSU, KSA  | 54       |
| 4    | Dr. Sukumaran Anil           | India       | College of Dentistry, KSU, KSA. & Department of Periodontics, Saveetha Dental College, Chennai, India         | 48       |
| 5    | Dr. Khalid Almas             | Pakistan    | Preventive Dental Science Dept., College of Dentistry, Imam Abdulrahman Bin Faisal University, Dammam, KSA    | 35       |
| 6    | Dr. Sachin Chakradhar Sarode | India       | Dept. of Oral Pathology and Microbiology, Dr. D.Y. Patil Dental College and Hospital, Pune, India             | 34       |
| 7    | Dr. Tancan Uysal             | Turkey      | Dept. of Orthodontics, Faculty of Dentistry, Erciyes University, Kayseri, Turkey                              | 34       |
| 8    | Dr. Gargi Sachin Sarode      | India       | Dept. of Oral Pathology and Microbiology, Dr. D.Y. Patil Dental College and Hospital, Pune, India             | 31       |
| 8    | Dr. Hom-Lay Wang             | US          | Division of Periodontics, College of Dentistry, KSU, KSA. And School of Dentistry, University of Michigan, US | 31       |
| 9    | Dr. George E. Romanos        | US          | Dept. of Periodontology, Stony Brook University, US   | 23       |
| 9    | Dr. Fahim Vohra              | Pakistan    | Dept. of Prosthetic Dental Sciences, College of Dentistry, KSU, KSA   | 23       |
| 10   | Dr. Mohammad D. Al Amri      | KSA         | Dept. of Prosthodontics, College of Dentistry, KSU, KSA   | 22       |
| 11   | Dr. Kusai Baroudi            | Syria       | Dept. of Pediatric Dentistry and Orthodontics, Al-Farabi Dental College, Riyadh, KSA                          | 21       |
| 11   | Dr. Ziad A. Salameh          | Lebanon     | Dept. of Prosthetic Dental Sciences, College of Dentistry, KSU, KSA   | 21       |
| 12   | Dr. Sharat Chandra Pani      | India       | Pediatric and Preventive Dentistry, Riyadh Colleges of Dentistry and Pharmacy, KSA                            | 20       |

|    |                            |          |   |    |
|----|----------------------------|----------|---|----|
| 12 | Dr. Bassel Tarakji         | Syria    | Oral Maxillofacial Sciences, Al Farabi College, Riyadh, KSA                                       | 20 |
| 13 | Dr. Youssef S. Al Jabbari, | KSA      | Dept. of Prosthetic Dental Science and Dental Biomaterials Research, College of Dentistry, KSUKSA | 19 |
| 13 | Dr. Abdulaziz Al-Rasheed   | KSA      | Periodontics Division, College of Dentistry, KSU, KSA   | 19 |
| 13 | Dr. Nasser Salem Nooh      | KSA      | Oral and Maxillofacial Surgery Dept. of College of Dentistry, KSU, KSA                            | 19 |
| 13 | Dr. Muhammad Sohail Zafar  | Pakistan | Dental BioMaterials, College of Dentistry, Taibah University, Madinah, KSA                        | 19 |

Research type analysis shows in Table-6 that most of the research produced in the form of Original/Research Articles (n=2,079; 85.53%) followed by Review Articles (n=212; 8.73%) and Editorial (n=40; 1.64%). The score of book chapters and Letter have been found low with 29 (1.19%) each. Dental researchers are least interested in writing books on dentistry, only 2 books identified during the period of 20 years.

**Table-6; Research-type distribution**

| Research Type    | Quantity | Percentage |
|------------------|----------|------------|
| Article          | 2,076    | 85.53%     |
| Review           | 212      | 8.73%      |
| Editorial        | 40       | 1.64%      |
| Book Chapter     | 29       | 1.19%      |
| Letter           | 29       | 1.19%      |
| Note             | 10       | 0.41%      |
| Erratum          | 8        | 0.32%      |
| Short Survey     | 8        | 0.32%      |
| Article in Press | 7        | 0.28%      |
| Conference Paper | 6        | 0.24%      |
| Book             | 2        | 0.08%      |
| Total            | 2427     | 100%       |

Table-7 reports that half of the research items (n=1215; 50.06%) published in top 15 journals published from seven countries including 3 journals of KSA. Majority of research (n=566; 23.32%) published in eight journals published from the US, *Journal of Contemporary Dental Practice* published 242 papers. Two hundred and fifty-four papers (10.46%) published in three journals published from KSA, *Saudi Dental Journal* ranks second with 164 papers. One hundred and thirty-four papers published in three Indian Journals and 80 papers published in 2 journals published from the UK.

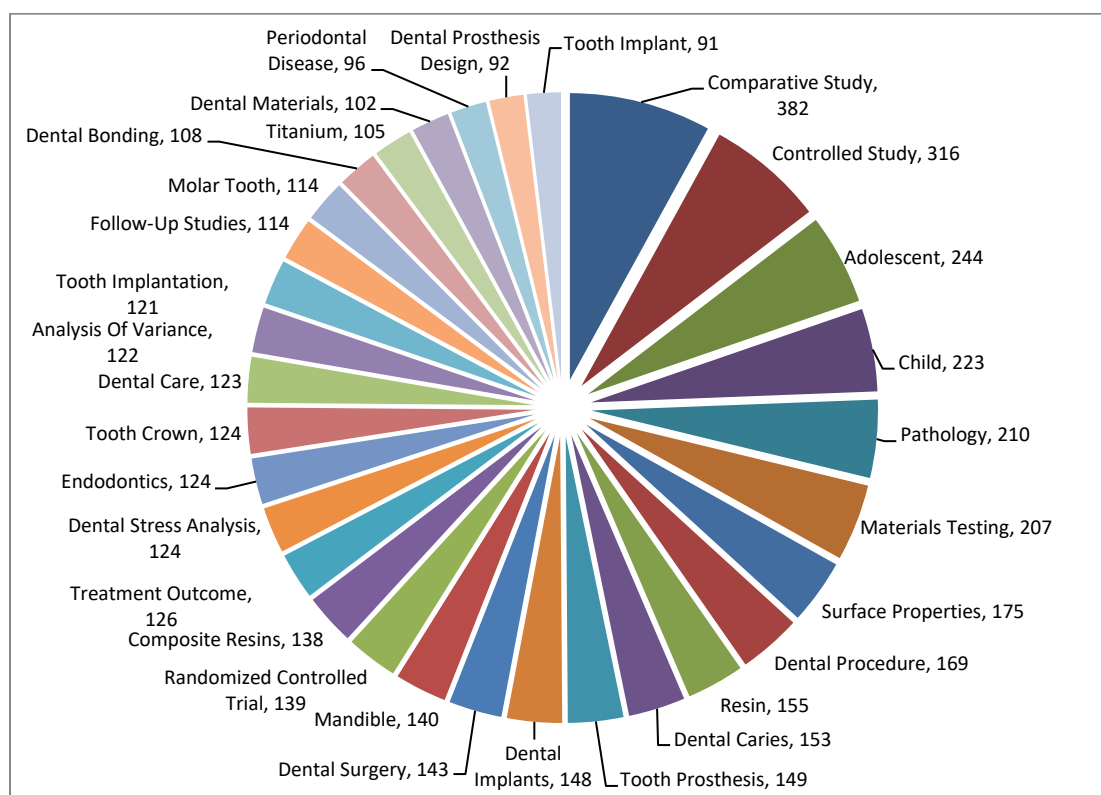
**Table-7; Top-20 Source Publications / Journals (n=1215; 50.06%)**

| Rank | Source / Journal Title   | Country    | Publications |
|------|--|------------|--------------|
| 1    | Journal of Contemporary Dental Practice                                | US         | 242          |
| 2    | Saudi Dental Journal   | KSA        | 164          |
| 3    | Journal of Prosthetic Dentistry  | US         | 79           |
| 4    | Journal of International Oral Health                                   | India      | 58           |
| 5    | Journal of Endodontics   | US         | 54           |
| 6    | European Journal of Dentistry  | Turkey     | 51           |
| 6    | International Journal of Dentistry                                     | Egypt      | 51           |
| 6    | Journal of Periodontology  | US         | 51           |
| 6    | Saudi Journal For Dental Research                                      | KSA        | 51           |
| 7    | Journal of Prosthodontics  | UK         | 50           |
| 8    | Journal of International Society of Preventive and Community Dentistry | India      | 45           |
| 9    | Dental Materials   | Netherland | 43           |
| 10   | Journal of Clinical Pediatric Dentistry                                | US         | 40           |
| 11   | Saudi Endodontic Journal   | KSA        | 39           |
| 12   | Journal of Dentistry   | Netherland | 36           |
| 13   | Implant Dentistry  | US         | 35           |
| 14   | American Journal of Orthodontics and Dentofacial Orthopedics           | US         | 33           |
| 15   | Angle Orthodontist   | US         | 32           |
| 16   | World Journal of Dentistry   | India      | 31           |
| 17   | BMC Oral Health  | UK         | 30           |

Scopus database produced the list of 161 keywords frequently used in 2,427 research items. Some of the commonly used keywords included in Figure-3.

## Discussion

This study reveals that 6,416 dental publications produced by 22 Arab countries during the last two decades. More than one third (37.83%) of the publications on dentistry has been produced by researchers of KSA. The remarkable growth of research found in KSA, there were only 24 publications in 1998 and reached on to 456 in 2017 with an average annual growth rate of 17.97%. KSU is the most productive institutions in dental research with 938 publications (38.64%). More than 50% of publications have been produced by the two national institutions, KSU and KAU. Amongst the top 15 collaborating institutions, five belongs to Egypt and six are affiliated to the US. Almost 20% of publications co-authored with researchers of the US. Among 20 productive authors, only five researchers are KSA national, others are either working here as an expatriate or collaborate with local researchers. More than half (50.06%) of the research published in top 15 journals, and almost one quarter (23.32%) articles published eight journals published from the US. Journal of Contemporary Dental Practice appeared as the most favorite journal with 242 articles. Majority of documents published in the shape of the original research article.

**Figure-3; Frequently used keywords**

Meo, et. al. (2013) analyzed the research progress and prospects of KSA in comparison with total research productivity. This study analyzed 15 years (1996-2012) data retrieved from Web of Science that KSA produced 103,804 documents in all sciences, 27,246 (26.24%) papers related to various subject areas of medical sciences with 7.07 citation impact. 631 papers written on dentistry with 5.95 citation impact and 27 papers received Hirsch Index. Authors predicted that KSA will become a regional hub in research and development. Latif (2015) examined the research productivity of KSA researchers from 2008 to 2012. PubMed database was used to draw the results, 1,562 biomedical papers published with 312.4 papers per year during the study period. A bulk of publications was originated by the researchers of KSU. Original research articles found preferred study design and 23% papers published in none Impact factor journal and 49% papers published in the journal having a less than 1 impact factor. Authors suggested sound research training and sufficient funding can increase the quality and quantity of publications.

Haq, & Al-Fouzan, (2018) indicated in their study that there are 29 dental colleges and 7 journals on dental sciences published in KSA. This study analyzed 144 publications on dentistry produced by the researchers of King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) from 2007 to 2017. Research articles found most frequent research-type with 104 (72.22%) articles and majority of research done on the sub-area of *Public Health Dentistry* (n=44;30.55%) and *Endodontics* (n=32; 22.22%). The journal "*Oral Health and Dental Management*" published 9 articles followed by *The Saudi Dental Journal* and *Saudi Endodontic Journal* with 8 articles each. A four-author pattern was found in 28 (19.44%) articles. Researchers collaborated with 14 national institutions, KSU was on the top with 35 articles and 26 international institutions belong to 14 different countries of the world. USA, Canada and India are on the top with 5 articles each.

Prof. Khalid Al-Fouzan with 25 articles found as a productive author. **Khan et. al. (2015)** carried out a study on articles of 2 Pakistani dental journals, Journal of Pakistan Dental Association and Pakistan Oral and Dental Journal published during 2003-2012. Total 581 research items published, a majority of publications (n=482; 73.7) designated as original articles, followed by case report (n=78; 13.4%). All articles have been divided into 8 clinical research areas, the research area of orthodontics with 126 (344%) articles found common than oral and maxillofacial surgery (n=82; 22.4%). **Ahmed (2016)** examined the dental publications produced by Libyan authors. A Total 40 articles found in PubMed indexed journals during the period of 2003 to 2013. More than one-third work (n=15; 37.5%) published during the year 2013. Original research articles counted in 25 in a research-type analysis, followed by 9 case report and one review article. Majority of articles (n=17; 42.5%) produced by the authors affiliated to Al-Arab Medical Sciences University, Libya.

**Saquib et. al. (2017)** presented a bibliometric analysis on cardiovascular research in KSA published during 30 years from 1986 to 2015. PubMed database produced the list 548 publications, 295 studies found eligible. The majority of publications related to cerebrovascular diseases include hypertension (32.9%) and coronary heart diseases (28.8%). More than half of the articles (54.6%) published from 2006-2015. **Jahan & Al-Saigul (2017)** reported the quantitative evaluation of 655 research articles related to primary health care research in KSA published during 1983 to 2011. The relevant literature has been searched on PubMed and Google Scholar. Original research articles in research-type and cross-sectional study design have been frequently used. Majority of publications produced from Riyadh province and universities sector produced more research as compared to health care institutions. Authors concluded that although KSA has well-established primary health care set up the research productivity found very low and gave practical suggestions to improve research literature. **Haq and Fouzan, (2017)** conducted a bibliometric study on the research output of KSAU-HS during 2005-2015 based upon the Web of Science record. Total of 775 publications produced during this period. Research on Medicine found on the top with 119 (15.35%) articles, only 14 articles on dentistry. Frequently used journals, national and international research collaboration and authorship pattern have also been calculated.

**Mawafi (2012)** examined the anesthesia research by KSA authors published in Web of Science Indexed Journals from 2000 to 2008. Total 173 documents published in 15 journals, 41 documents published in Anesthesia and Analgesia, followed by 19 publications in British Journal of Anaesthesia. Majority of research carried out in the university sector, and rising tendency found in the last decade. **Algahtani, et. al. (2017)** conducted a study on neurology research in KSA based on the PubMed database. This database produced the 1292 documents published from 1996 to 2015. Sixty-seven percent of documents emerged from Riyadh province and King Faisal Specialist Hospital and Research Centre found to be productive institute, amounting 23% of total documents. More than half of papers published in journals low impact factor and the majority of documents followed the case study as research-type. The study suggested that there is a need to improve the quality of research. **Jamjoom (2016)** reported the status of clinical neuroscience research in KSA during 1996-2014 based on Scimago Journal and Country Rank (SJR) result. KSA produced 1189 documents, which received 8820 citations and 40 documents reached on H-indexed scale. The Study concluded that KSA researchers need innovative ideas to publish their research in high impact factor journal.

**Alhaider et. al. (2015)** examined the pharmaceutical research produced by KSA published from 2001 to 2010. Total 1386 papers produced by KSA authors with an average annual growth rate of

14.21% and 3.36 citations impact. Forty percent of papers were written with international collaboration, Egypt, US and India found preferred collaborating countries. The highest number of papers were written by the authors belong to KSU, and H. Y. Aboul-Enein found a productive author with 85 publications. Majority of publications appeared in the *Saudi Pharmaceutical Journal*. Paper concluded that KSA will emerge the most productive pharmaceutical research country in near future. El Rassi, et. al. (2018) examined the medical research productivity of Arab countries published during 2007-2016. The data was retrieved from the Web of Science database. Total 76,978 papers produced 22 Arab countries, 1.6% share in global research output. Egypt occupied top rank with 24,692 (32.1%) publications, followed by KSA (n=21,897; 28.4%) and Tunisia (n=8,769; 11.4%). Research papers of Lebanon received the highest citation impact (13.4) and Qatar produced the highest numbers in proportion with populations as 1156 papers per 1 million populations. Meo at. al. (2017) observed that although numbers of research papers increased by KSA authors, but the number of citations reduced. Dental researchers should try to submit their manuscript in impact factor journal.

## **Conclusion**

Findings of this study illustrate that dentistry has been progressing over the years in KSA. High tech dental research has a direct impact on the oral health and wellbeing of citizens. KSA researchers are striving well to achieve excellence in dental research by delivering quality education and the provision of oral health care services to the local community. There is a need to enhance international research linkage and collaboration in dental research. The number of doctorate-level research institutions should be increased more to boost the quality and quantity of research.

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