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Open Access Publishing Trends in Kingdom of Saudi Arabia (1980-2020)

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Abstract

The purpose of this bibliometric study was to examine the status of Open Access (OA) scholarly productivity in the Kingdom of Saudi Arabia (KSA) from 1980 to 2020. To meet the objectives of the study, a bibliometric method was used and data on KSA publications were retrieved from InCites tool of Clarivate Analytics. The study revealed that KSA is positioned at the 41st place in open access publications in the world and has the highest percentage of OA publications among the countries of the world. The last ten years found a momentous increase in OA publications in KSA. The citation graph of OA publications has also increased and highest citations were recorded in the year 2015. The King Saud University was on the top in publishing OA publications but the most cited works were observed by the authors affiliated with King Abdulaziz University. The impact factor of the top 15 OA journals of KSA ranged from 0.59 - 4.76. The highest collaborated country was the USA in the OA research works of Saudi researchers. The county achieved better OA publications in the subject of clinical medicine, however, a small number of OA publications were found in the subject of economics, and business. This study recommended that the KSA government should take steps to further promote OA publications and raise funds to support this model. Similarly, all KSA academic and funding institutions should make policies to acknowledge and promote OA publications.

Keywords: Open access publications; bibliometrics, open-access; Kingdom of Saudi Arabia, research productivity, Open Access-Kingdom of Saudi Arabia.

Introduction

The concept of open access (OA) publishing is not new. The idea is circulating in the academic world for the last two decades especially when Los Alamos National Laboratory (LANL) initiated the concept of OA repository in early 1991 (Halpern, 1998; Laakso, 2011; May, 2020).

Many developed countries keep floating this idea with different concepts and thoughts. The model has been named “open access” (OA) as publications are accessible to readers at no cost. It allows users to read and reuse the publications without any access barriers for lawful purposes (Piwowar et al., 2018). Another less strict definition elaborated as to see all publications freely available online without any barrier (Willinsky, 2003). Moreover, Piwowar et al. (2018) stated that open access published papers are available through gold (journals), green (repositories), and bronze (articles without license information) models.

For the last fifteen years, different societies and institutions from the world were focusing to provide research without any barriers. Therefore, these societies and institutions were promoting OA publishing. It included research funding institutions such as the Bill and Melinda Gates Foundation (BMGF), Brazilian Institute of Information in Science and Technology (BIIST) (McCabe & Snyder, 2005; Minniti et al., 2018; Piwowar et al., 2018). Similarly, some online platforms such as 1Science and Science Open were increasing the value of OA, and numerous browser extensions such as Unpaywall, and Canary Haz were enhancing the importance of OA publishing (Piwowar et al., 2018). Pirated websites like Sci-Hub provide access to paywall published material openly (Bohannon, 2016).

The growth of OA has increased significantly. Piwowar et al. (2018) determined the status of OA articles and divided the 67 million articles into three types: (1) articles that contained a Crossref, (2) current articles that were indexed by Web of Science, and (3) articles those users search and find through different open-access databases. The authors concluded that OA research works received 18% more citations than Non-Open Access (N-OA) research works. Therefore, many academic institutions from developed and developing countries decided to decline their big deals of toll-access subscriptions with publishers. Similarly, it has been highlighted that the online

percentage of OA articles is increasing and more than 50% of articles are freely available online (Archambault et al. 2014). Chadwell and Sutton (2014) predicted that by the year 2034, OA publishing will be by default publishing trend in the world and 100% of the scholarly material will be made available through OA repositories.

AlRyalat et al. (2019) explored the growth of research articles from 1998 to 2018 in the Web of Science (WOS) database. The study identified the number of OA articles and journals were increased from 9.5% to 24% in almost all disciplines for the last two decades, however, the growth of medical OA articles is higher than all. Moreover, in KSA some bibliometric studies have been conducted to investigate the status of OA publications such as Alhibshi et al. (2020) conducted a study to analyze the OA and N-OA research productivity in Neurosciences during 2013-2018, Alryalat et al. (2019a) compared OA publications using PubMed, Scopus, and Web of Science databases with focus to elaborate how to use these databases for further bibliometrics studies, AlRyalat, et al. (2020) focused on Retraction Watch Database in the study and evaluated nine retractions causes on publishing the OA and N-OA publications by the KSA researchers, AlRyalat (2019) focused on the impact of the open-access status on medical journal indices. However, these studies have some limitations such as no study investigated the evolution of OA publications from its beginning to till now, its status, most ranked institutions, collaborative countries in OA publications with KSA, and subject dispersions of KSA in OA publications. This study explores thoroughly the status of OA publishing in KSA from 1980-2020 with a focus on OA productivity and shares of KSA, top OA research producing institutions and universities, the most preferred journals for OA publishing by KSA researchers, major OA collaborative countries, and subject desperation in OA publications in KSA from 1980 to 2020.

Research Objectives

This study has the following research objectives:

1. To explore the major research producing countries and their share in open access (OA) from 1980 to 2020.
2. To find the status of open access productivity of KSA from 1980 to 2020.
3. To know the top open access research producing institutions and organizations of KSA.
4. To highlight the most preferred OA journals by the researchers of KSA.
5. To know the major research collaborative countries of KSA.
6. To examine the subject desperation of Saudi Open access publications.

Literature Review

The practice of research publications free of cost and free of barriers termed as open access publications (Brainard, 2021; Wang et al., 2015; Yuan & Hua, 2011). Some researchers predicted that OA will be the future of academia. Chadwell and Sutton (2014) predicted that OA publishing will be by default publishing trend in the world in the future. Similarly, in KSA according to Alhoori et al. (2015), OA articles received a higher value in metrics than non-open access (N-OA) articles. The research studies on OA in different indexing databases, such as Web of Science, Scopus, and SciELO reported that OA publications are increasing (Alryalat et al., 2019a; Minniti et al., 2018).

Gargouri et al. (2012) checked the growth and percentages of green and gold types of OA and found significantly upward publishing percentage in both types. Similarly, Hajjem et al. (2006) analyzed the growth of OA on cross-disciplinary and also found that citation impact of OA articles is higher than N-OA articles. Likewise, Laakso, (2011) investigated the development of OA publishing from 1993 to 2009 and concluded that the OA publishing trend is significantly

increasing. Likewise, to know the reasons behind the regular upward graph of OA publishing, Kuballa et al. (2019) analyzed the benefits of OA productivity. The author observed that the OA publications embody (1) fast publishing process, (2) high visibility, (3) free available and accessible, (4) index in well renowned bibliographic databases, (5) better chances of funding from organizations, and (7) brings better publishing opportunities for structurally developing countries.

Expectedly, the OA article's citation count is higher because of its visibility and accessibility. A study compared the difference between OA and N-OA citation count and found that OA journals significantly received more citations compared to N-OA journals. Since OA journals tend to get more citations, so it is understandable that researchers choose OA journals to get more citations (Chua et al., 2017). Likewise, other studies highlighted that the articles published in OA journals have more impact and got more citations than subscription-based commercially available databases/journals (Eysenbach, 2006; Yang et al., 2018).

Four areas from the Web of Science (WOS) database, electrical and electronic engineering, philosophy, political science, and mathematics were examined to know whether OA article publishing creates a greater impact on citation when authors keep articles available online for everyone. The finding showed that all four disciplines got more citations with greater research impact (Antelman, 2004). Another research took a sample of seven thousand journals from WOS and found rapidly OA article impact is increasing especially in the physics discipline (Harnad & Brody, 2004). In the comparison of OA vs N-OA journals, AlRyalat et al. (2019), collected a list of 5835 medical journals from Scopus database and found that OA journals have significantly higher CiteScore and source normalized impact per research paper.

To acknowledge the importance of OA publication, many high-quality N-OA journals have adopted the hybrid model. It is open for authors to adopt OA or N-OA model to publish within the

same journal. The authors or their funding institutes have to bear the publishing cost to make it openly available to all (McCabe & Snyder, 2005).

A study was conducted to analyze the OA publications' productivity of Latin America & Caribbean (LA&C) countries between 2005-2017. The authors selected the WOS and SciELO citations to get OA index data. The study confirmed that all LA&C countries contributed and strongly intensified OA publications. To improve the quality and excellence of OA publications and productivity, Mexico, Argentina, and Peru have approved the national OA Law (Minniti et al., 2018).

The research studies indicate that OA publishing is strengthening researchers to compete with traditional publishing. Researchers from different countries acknowledge the concept of OA and considering it as a future of the publishing world (Chadwell & C. Sutton, 2014). Therefore, in 2019, Incites platform on the WOS added further features of OA and added DOAJ Gold, Green published, Green accepted, and Bronze categories that support the concept of OA.

To follow the suit, Saudi Arabian institutions and researchers also contributed to promoting OA publishing. At the institutional level, at the “2nd international conference on scientific publishing 2015”, King Abdulaziz City for Science and Technology (KACST) began a strategic partnership with Springer publisher and launched 7 OA journals (Khelifi et al., 2015).

Researchers in Saudi Arabia conducted some bibliometric studies in particular fields. Bibliometric research was conducted to evaluate the KSA’s research output in computer science from1978 - 2012. The study concluded that King Fahad University of Petroleum and Minerals and King Saud University were the top research producing institutions contributing 70% of total OA publications (Al-Khalifa, 2014).

OA publishing trend is increasing due to the associated benefits of fast publications, high visibility, attracting high number of citations, and free of barriers accessibility. Previous studies predicted that OA publications will be the future of academia. At the international level, a sufficient number of studies checked the perception of scholars/researchers, cost, and usage of OA journals and OA publishing. The studies conducted in Saudi Arabia focused to evaluate the OA publishing trends in specific subject areas, journals, and institutions. As per the authors' best knowledge, no specific study was published in Saudi Arabia that exclusively analyzed the evolution and trends in OA publishing in the country. Till the time of this study, no specific research was carried out to identify the active institutions, preferred journals, collaborating countries, and international institutions involved in OA publishing in KSA. This study will be the first of its kind in the country to fill the existed gap in the literature.

Material and Method

Bibliometrics is a statistical analysis method based on a quantitative approach (Makar & Trost, 2018), that assesses the growth of literary works (Blakeman, 2018). Bibliometric analysis is widely used and the most popular method to check the performance and productivity level of any scholarly and scientific field (Alhibshi et al., 2020). The method is applied to evaluate the research performance of authors, departments, journals, universities, countries, and regions, etc. (Hirsch, 2005).

Web of Science is the most popular bibliographic database that covers the leading high-quality publications from all fields and disciplines (Diem & Wolter, 2013). The database contains the most accurate, systematic, in-depth, and well-managed data that allows the analysis of institutional, or even regional research productivity (Bornmanna & Leydesdorff, 2013). The

database provides additional filters to retrieve the relevant and accurate data (Torres-Salinas & Orduña-Malea, 2014) that help the researchers in bibliographic analysis.

The InCites tool that is based on Web of Science data was used to retrieve the data on open access publications of KSA. To achieve the objectives of this research, work all the bibliographic data were retrieved, sorted, and downloaded from InCites The data was downloaded by performing queries in InCites:

1. Searching the top 15 countries publishing the most publications by selecting the location filter in the databases.
2. The country name "Kingdom of Saudi Arabia" added in the location filter to retrieve open access and non-open access publications
3. Segregated the retrieved data in (a) open access publications and (b) non-open access publications and arranged it on yearly bases
4. Finding the top 30 journals publishing OA, and Non-OA publications of KSA
5. Finding the top institutions of KSA publishing OA and Non-OA with percentage of cited documents, and citation impact.

All types of research publications were selected to sketch down the trends of open access publications in KSA. All files were downloaded in CSV format. To ensure the validity of the data, the whole search process was repeated twice to ensure the accuracy of the data. Later, the CSV file was transferred in Microsoft Excel format to analyze the data.

The open access history of KSA was traced to 1980 as the data showed 10 publications in the year. first publication, Therefore, this study covered a period of 41 years (1980-2020). The data include the publications with at least one author affiliated with KSA. The data was searched, retrieved, collected, and downloaded on 31 December 2020.

Results

The 41 years results of Incite, WOS (1980-2020) related to global productivity on OA., This section elaborates OA publishing trends of KSA, top research producing institutions of KSA, top journals publishing OA research, top collaborating countries in OA publishing, and discipline wise OA productivity of KSA. The results are based on the 41 years of data retrieved from InCites.

Global Productivity on Open Access

Top 15 research producing countries from 1980 to 2020 (arranged in respect of percentage in OA publishing), their open access publications with rank, and percentage of OA publications with rank are enlisted in Table 1. It has been found that the United State of America is ranked first in total publications (n= 19432284) and also in open access research producing country (n=3673838). KSA ranked at 45th in total publications (n=214780) and ranked at 41 in open access publications (n= 61964). However, KSA has the highest percentage of 28.82 of OA publications ranked followed by Netherlands, and Spain with 28.74% and 26.35%, respectively. The lowest percentage (14.86) of open access publications was recorded for India in the list of top 15 countries.

Table 1

Top Research Productive Countries with OA publications and Ranks (1980 – 2020)

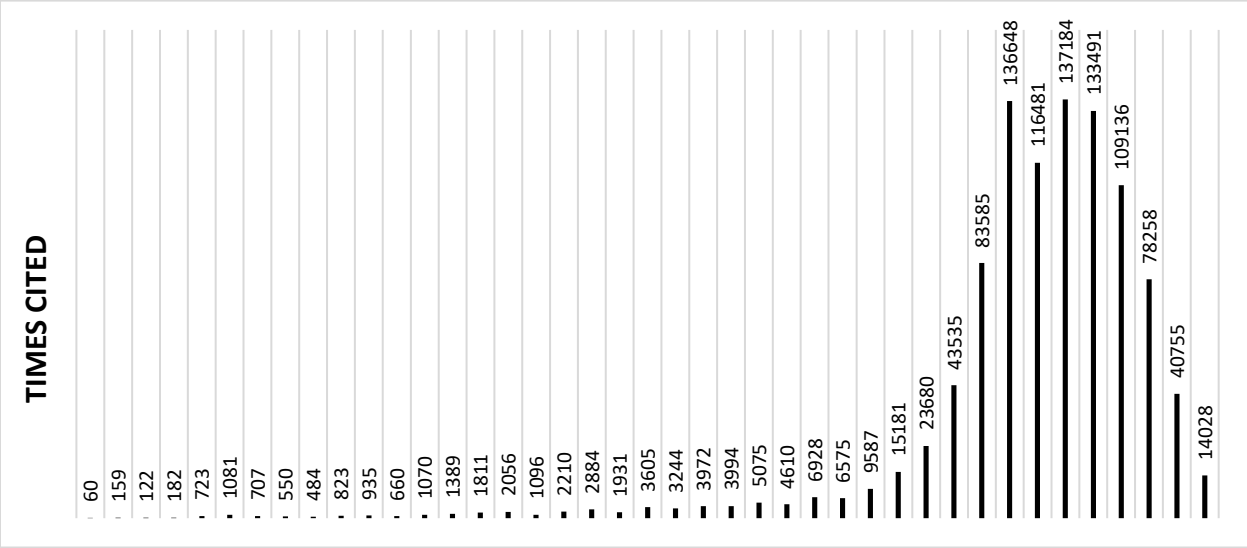
Sr. No	Name	Percentage of OA Publications and Rank	Total Publications and Rank	OA Publications and Rank
1.	Saudi Arabia	28.84 (1)	214780 (45)	61964 (41)
2.	Netherlands	28.74 (2)	1326986 (13)	381466 (12)
3.	Spain	26.35 (3)	1637440 (12)	431543 (10)
4.	England	25.36 (4)	4403119 (4)	1116656 (4)
5.	United Kingdom	25.03 (5)	5117784 (3)	1281415 (2)
6.	South Korea	22.21 (6)	1218978 (14)	270768 (15)
7.	Australia	21.95 (7)	1797510 (10)	394694 (11)
8.	Japan	21.62 (8)	3482759 (6)	753259 (6)
9.	Italy	21.13 (9)	2216248 (9)	468381 (9)
10.	China	20.63 (10)	5466964 (2)	1128124 (3)
11.	Germany	19.45 (11)	4016387 (5)	781305 (5)
12.	Canada	19.28 (12)	2596401 (8)	500791 (8)
13.	France	19.11 (13)	2806988 (7)	536506 (7)

14.	USA	18.9 (14)	19432284 (1)	3673838 (1)
15.	India	14.86 (15)	1669415 (11)	248114 (16)

Open Access Publishing Trend in KSA

The chronological distribution of the open access research productivity of KSA from 1980 to 2020 is highlighted in Figure 1. A linear trend in the publication growth rate was found from 1980 to 2010 but after 2010 to onward, the annual publication growth increased significantly.

As shown in Figure 1, in the year 1980 only 10 open access publications were published with 60. Further, it increased gradually till 2010 and reached 1022 open access publications with 23680 total citations. The graph of open access publications and their associated citations sharply increased with 1744 publications, and 43535 citations in the year 2011. The most productive year in terms of number of publications was 2020 with a total of 10436 publications and 14028 total citations. The year 2015 received the highest citations (n=137184) with 5158 total OA publications. Almost 88% of the total OA research publications are reported in the last 10 years (2011-2020).



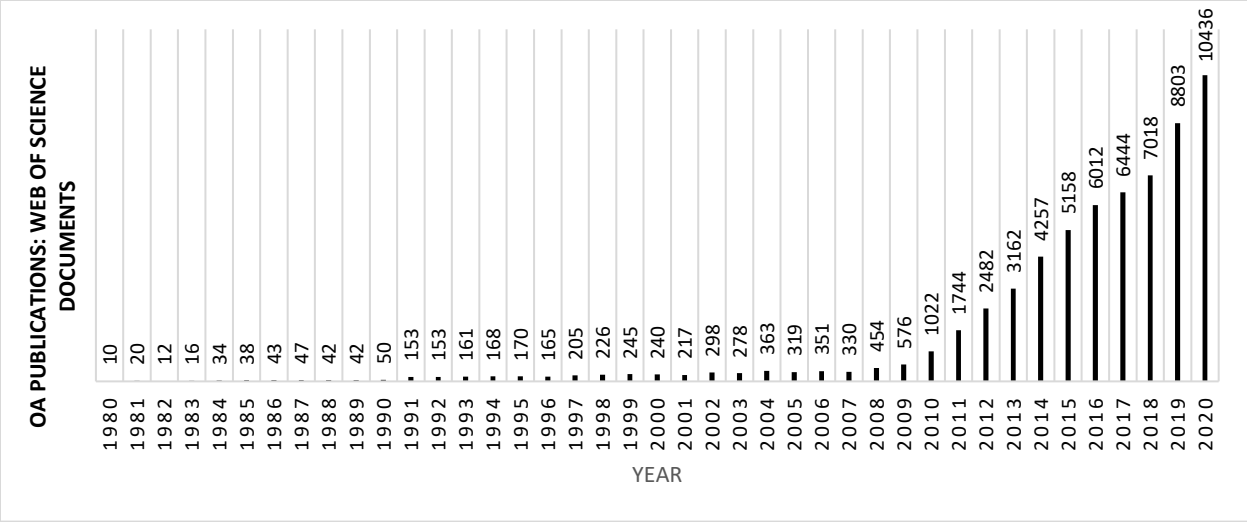


Figure 1. Chronological distribution of Saudi open access publications and citations (1980-2020)

Top Research Producing Institutions of KSA

The top 20 open access and non-open access research-producing institutions of KSA are listed in Table 2. King Saud University Riyadh was on the top with a total of 56806 publications. The same university ranked first with the highest open access publications (n= 17099, 30.1%) and highest non-open access publications (n=39707, 69.9%) followed by King Abdul-Aziz University with 40977 total publications, 13256 OA publications (32.35%), and 11314 N-OA publications (31.16%).

The King Fahd University of Petroleum & Minerals was at top third with 21178 total publications and 18660 N-OA publications (88.11%). Among the top 20 research producing institutions of KSA, Ministry of Health – Saudi Arabia, was at bottom of list with 1357 total publications (OA publications = 747, N-OA=610). Moreover, 13 out of 20 top research productive institutions of KSA published more than 1000 OA publications. Whereas, remaining also published more than 500 OA publications.

As shown in Table 2, most cited publications (OA & N-OA) were published by King Abdul-Aziz University (n= 844430), with the most cited OA publications (n=359003, 42.51%), and N-OA publications (n=485427, 57.49%).

King Saud University received the second-highest number of overall citations (n=673970) receiving 212894 (31.59%) citations to OA publications while 461076 (68.41) citations to N-OA documents. Moreover, it has been concluded that although Ministry of Health was at last position in total publications (n= 1357), OA publications (n= 747), and N-OA publications (n=610) yet ranked well in total citations (n=43675) and OA citations (n=36637). Among top 20 research-producing institutions of KSA, researchers of King Fahd University of Petroleum & Minerals, King Abdulaziz City for Science & Technology, King Faisal Specialist Hospital & Research Center, and King Khalid University have less interest in OA publishing.

Table 2

A Detail of Open and Non-Open Access Publications, Total Citations with Open Access and Non-Open Access Citations, Establish Date and Region with University Name (1980-2020).

Sr. No	Name	TP	OA-P (rank & %)	N-OA P %	TC	OA-Citation %	N-OA Citation %	Born	Region
1.	King Saud University	56806	17099(2) (30.1)	39707 (69.9)	673970	212894 (31.59)	461076 (68.41)	1957	Riyadh
2.	King Abdulaziz University	40977	13256(1) (32.35)	27721 (67.65)	844430	359003 (42.51)	485427 (57.49)	1967	Western
3.	King Fahd University of Petroleum & Minerals	21178	2518(9) (11.89)	18660 (88.11)	274998	28521 (10.37)	246477 (89.63)	1963	Eastern Province
4.	King Abdullah University of Science & Technology	17268	7085(3) (41.03)	10183 (58.97)	377165	169220 (44.87)	207945 (55.13)	2009	Western
5.	King Faisal Specialist Hospital & Research Center	10531	2890(4) (27.44)	7641 (72.56)	155632	61116 (39.27)	94516 (60.73)	1975	Riyadh
6.	King Saud Bin Abdulaziz University for Health Sciences	6066	2552(5) (42.07)	3514 (57.93)	81435	49460 (60.74)	31975 (39.26)	2005	Riyadh
7.	King Khalid University	6016	1599 (24) (26.58)	4417 (73.42)	40784	8437 (20.69)	32347 (79.31)	1998	Southern Province
8.	Imam Abdulrahman Bin Faisal University	5860	1775 (16) (30.29)	4085 (69.71)	39508	11901 (30.12)	27607 (69.88)	1975	Eastern Province
9.	Taibah University	4933	1578 (19) (31.99)	3355 (68.01)	37110	10623 (28.63)	26487 (71.37)	2003	Taif

10.	King Faisal University	4842	1305 (18) (26.95)	3537 (73.05)	40524	11250 (27.76)	29274 (72.24)	1975	Eastern Province
11.	Umm Al Qura University	4833	1419 (21) (29.36)	3414 (70.64)	33870	9295 (27.44)	24575 (72.56)	1981	Mecca
12.	King Khalid University Hospital	3951	1210 (10) (30.63)	2741 (69.37)	55676	23175 (41.62)	32501 (58.38)	1982	Riyadh
13.	Taif University	3836	1035 (26) (26.98)	2801 (73.02)	30392	7312 (24.06)	23080 (75.94)	2004	Taif
14.	Jazan University	2577	916 (15) (35.55)	1661 (64.45)	24341	12806 (52.61)	11535 (47.39)	2006	Jazan Province
15.	King Abdulaziz City for Science & Technology	2388	620 (17) (25.96)	1768 (74.04)	34603	11535 (33.34)	23068 (66.66)	1983	Riyadh
16.	King Abdulaziz Medical City Riyadh	2224	853 (12) (38.35)	1371 (61.65)	34431	20597 (59.82)	13834 (40.18)	1983	Riyadh
17.	Alfaisal University	1892	865 (6) (45.72)	1027 (54.28)	46817	37198 (79.45)	9619 (20.55)	2007	Riyadh
18.	University Hail	1543	558 (11) (36.16)	985 (63.84)	29254	22633 (77.37)	6621 (22.63)	2005	Hail Province
19.	King Fahad Medical City	1438	687 (8) (47.77)	751 (52.23)	36210	30794 (85.04)	5416 (14.96)	2004	Riyadh
20.	Ministry of Health - Saudi Arabia	1357	747 (7) (55.05)	610 (44.95)	43675	36637 (83.89)	7038 (16.11)	1950	Riyadh

Note. TP=total publications; OA-P= open access publication; N-OA P= non open access publications; TC=total citation; and Born mean the university when established.

Most Productive OA Journals of KSA

Table 3 presented a list of the top 15 journals publishing OA. The Saudi Medical Journal was at the top in total and OA publications with 9076, and 6011 publications in each category. Whereas seven journals (serial number 2, 5, 6, 7, 8, 9, & 14) are open access journals while the remaining eight journals (1, 3, 4, 10, 11, 12, 13, & 15) were publishing both OA and N-OA articles. Arabian Journal of Chemistry received the highest number of citations followed by Saudi Medical Journal with 30460 and 14737 citations, respectively. All of the top 15 journals are registered in Journal Citation Reports of Clarivate Analytics and have impact factor. Arabian Journal of Chemistry has the highest impact factor (4.76) among these journals.

Table 3

Top 15 Open Access Journal of KSA (1980-2020).

Sr. No	Name	TP	OA Pub (ranking)	OA-TC	OA-C % per article	IF
1.	Saudi Medical Journal	9076	6011 (1)	14737	57.34	1.2
2.	Arabian Journal of Chemistry	2734	2734 (2)	30460	86.83	4.76
3.	Saudi Journal of Biological Sciences	1767	1751 (3)	13749	74.81	2.8
4.	Annals of Saudi Medicine	4367	1630 (4)	7864	69.39	0.92
5.	Journal of Saudi Chemical Society	1105	1105 (5)	12771	89.41	3.52
6.	Saudi Pharmaceutical Journal	1054	1054 (6)	10057	80.46	2.88
7.	Journal of King Saud University Science	895	895 (7)	2708	55.87	3.82
8.	Saudi Journal of Gastroenterology	718	718 (8)	3762	77.58	1.99
9.	Journal of Taibah University for Science	629	629 (9)	2273	64.55	1.86
10.	Applied Nanoscience	1545	625 (10)	9462	89.92	2.88
11.	Neurosciences	1033	258 (11)	561	64.73	0.59
12.	Arabian Journal of Geosciences	6071	208 (12)	1458	54.81	1.33
13.	Complex & Intelligent Systems	192	181 (13)	618	48.07	3.79
14.	Bulletin of Mathematical Sciences	144	144 (14)	950	79.17	2.24
15.	Arabian Journal for Science and Engineering	6890	133 (15)	586	56.39	1.71

Note. TP=total publications; OA= open access; TC=total citation; IF= impact factor; OA-C= open access citation

International Collaboration for Open Access Publications

It has been found that during the study period, from 1980-2020, Saudi Arabian authors, universities, institutions, and research bodies collaborated with 204 countries for open and non-open access research works. For open access publishing, authors affiliated with Saudi institutes collaborated with 197 countries. The topmost 20 international OA research collaborative countries from 197 countries were identified and enlisted in Table 4 with total collaboration (T. Col), open-access collaboration (OA-Col), non-open access collaboration (N-OA Col), and open access total citations (OA-TC).

It has been found that the USA is the top collaborative country with KSA in publishing open access research works (n=10835) with 841525 total citations. Whereas total collaborations were n= 28648, open-access collaborations were n= 10835 (37.82%), and non-open access collaboration were 17813 (62.18%). Egypt was the most collaborative country with KSA in publishing both types (open and non-open access) research works with n=30779 but stand second in publishing open access research works (n=9816) with 344468 total citations. On the other side, Switzerland stood last in collaboration with KSA in publishing total research work (n=2605) but stand highest in collaboration of open access publishing with 1701 (65.3%) from the total publications. Similarly, Taiwan stood second last in collaboration with KSA in publishing total research work (n=2680) but stands second highest in collaboration of open access publishing with 1550 (57.84%) from the total publications (see Table 4).

Table 4

Top 20 International Countries Collaborated with KSA for Open Access Publications (1980-2020).

Sr. No	Name	T. Col	OA-Col / ranking /%	N-OA Col / %	OA-TC

1.	USA	28648	10835 (37.82) (14)	17813 (62.18)	841525
2.	Egypt	30779	9816 (31.89) (20)	20963 (68.11)	344468
3.	United Kingdom	14128	7031 (49.77) (7)	7097 (50.23)	402023
4.	England	12342	6245 (50.6) (6)	6097 (49.4)	374143
5.	China Mainland	14783	5177 (35.02) (18)	9606 (64.98)	474094
6.	Pakistan	13401	4971 (37.09) (15)	8430 (62.91)	221590
7.	India	13966	4655 (33.33) (19)	9311 (66.67)	284016
8.	Germany (fed rep ger)	8060	3835 (47.58) (8)	4225 (52.42)	307956
9.	Canada	9176	3235 (35.26) (17)	5941 (64.74)	255570
10.	Australia	6937	3122 (45.01) (10)	3815 (54.99)	237562
11.	Malaysia	7426	3098 (41.72) (13)	4328 (58.28)	131030
12.	France	6788	3026 (44.58) (11)	3762 (55.42)	227761
13.	Italy	5486	2841 (51.79) (5)	2645 (48.21)	231301
14.	Spain	4875	2674 (54.85) (4)	2201 (45.15)	224427
15.	South Korea	5239	2302 (43.94) (12)	2937 (56.06)	191216
16.	Turkey	5475	2029 (37.06) (16)	3446 (62.94)	143861
17.	Japan	3878	1746 (45.02) (9)	2132 (54.98)	252968
18.	Switzerland	2605	1701 (65.3) (1)	904 (34.7)	155131
19.	Netherlands	2987	1679 (56.21) (3)	1308 (43.79)	176304
20.	Taiwan	2680	1550 (57.84) (2)	1130 (42.16)	114181

Note. TC=Total collaboration; TC=total citation; CI = citation impact

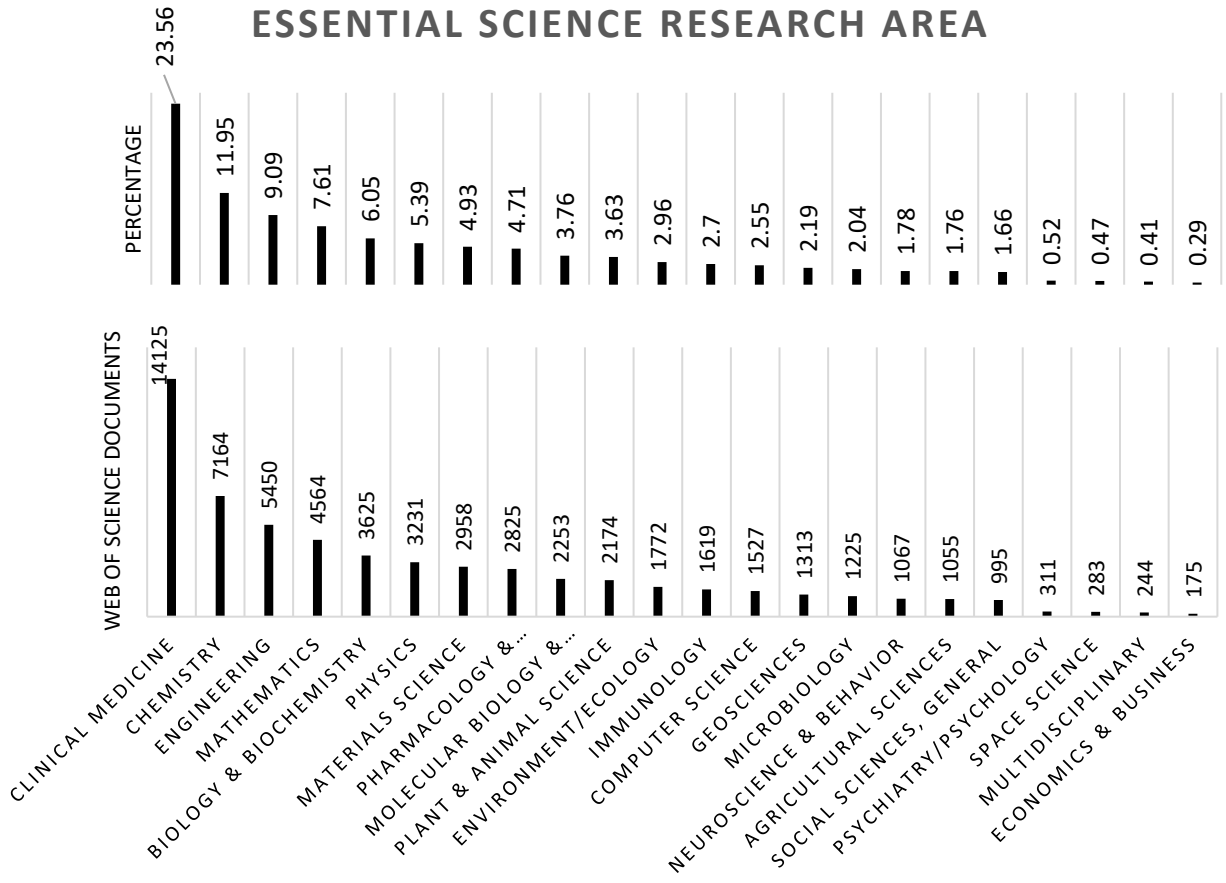
Discipline-Wise Distribution

Figure 2 shows the subject-wise open access productivity and share according to "Essential Science Indicators Research Area" in InCites.

The Essential Science subject dispersion scheme is classified into twenty-two broad subject disciplines by InCites. Therefore, the 22 broader subjects in the Essential Science Indicators Research area indicated that Clinical Medicine ranked highest in open access publications in KSA with (14125; 23.56%) publications followed by chemistry (n=7164; 11.95%), and Engineering (n=5450; 9.09%), respectively. The subject category of Economics and Business had the lowest number of publications 175 (0.29%).

Figure 2

KSA Subject-Wise OA Productivity and Share according to Essential Science Indicators Research Area, in Web of Science (1980-2020).



Note: Trends of sum of percentage and sum of Web of Science documents for essential science research area. For pane sum of Web of science documents. The marks are labeled by some of

Discussion

This bibliographic study documented the KSA OA productivity trend from 1980 to 2020. This study was based on the InCites, WOS database. The study covered major research producing countries, their share in open access publishing with a focus on KSA, the study analyzed the OA publishing status of the country that explored the top OA producing institutions/organizations of KSA, top journals publishing OA access research of the country, and major collaborating countries.

OA publication year-wise trend showed that although the OA publishing was started in 1980 in KSA yet it boosted from 2011-2020 as above 85% of the total OA research publications

were published during this period. Similarly, a study conducted by Al-Khalifa, (2014) concluded that KSA publications rise with exponential growth during the year 2008-2013. This exponential growth may have several reasons such as huge investment in the education sector (Onsman, 2011), the number of higher education institution (HEI) increased, (Alshuwaikhat et al., 2016), Ministry of Education initiated scholarship programs for HEI (Alamri, 2011) and institutions and research organization start giving primary importance to scientific research which also incorporated with the employee's promotion criteria (Al-Youbi, 2017). In the comparison of the top 15 OA research producing countries, KSA's OA publications share showed that KSA researchers are taking more interest in the OA model.

Whereas, among the top 15 open access journals published in KSA, Saudi Medical Journal contributed to the highest number of OA publications. Furthermore, it has been comprehended that the impact factor of the top 15 journals published in KSA ranged between 1 to 3, and the impact factor of one open-access journal (Arabian Journal of Chemistry) was 4.76. These OA journals got more citations as compare to N-OA journals which were also found in a previous study (Chua et al., 2017). These 15 OA publishing journals covered the subjects of life science, clinical, preclinical & health, and physical science disciplines. No journal related to arts and humanities area appeared in the list of top 15 journals publishing OA research of KSA. InCites, WOS ranked the top 15 Saudi-based journals in the most acceptable journals with high impact factors and most cited journals. Therefore, these journals of KSA taking a big part in enhancing the quality and the number of OA publications. Similarly, A study conducted by Antelman (2004) on engineering and medical disciplines from ISI WOS found that OA publishing created a great impact on the publishing domain and got higher citation impact as compare to N-OA.

All KSA publications have categorized into 22 broader subjects in the default Essential Science Indicators Research Areas scheme of WOS. the publications distribution among subject

categories shown that pharmacology & toxicology, material science, physics, biology & biochemistry, mathematics, engineering, chemistry, and clinical medicine were taken a great number of N-OA and OA research publications as compare to others subjects categories. These subject categories secured the highest number of citations as well. A study conducted on medical journals from the Scopus database confirmed the above findings that medical journals with OA publications significantly have a higher Cite Score (AlRyalat et al., 2019).

The list of top 20 institutions shown that most research-producing institutions are government-funded universities. The researchers affiliated with KSA institutions are in favor to adopt the OA publication model. The graph of this interest increased constantly but jumped high after 2011. Similarly, it was claimed in the previous study that from the year 2010 to onward, the big number of research publications has been seen in N-OA and OA publication (Alamri, 2011)

The countries' research collaboration is based on the relation that is built on common interests. The OA publications collaboration count showed that the USA, Egypt, and the United Kingdom were the top collaborative country with KSA. The collaboration share of the top 20 counties for OA publications with KSA range between 31.89 to 65.3 percentage.

This study found that OA publishing has many benefits such as: receiving more citations, easy accessibility resulting in producing dynamic readers, and attracting sponsors. KSA government should take steps to enhance open access publication and raise funds to promote it. All academic institutions should make policies to acknowledge open access publications. Further, KSA universities should open new platforms to support the OA publishing model. There should be a clear policy on ownership, IR contents, quality standards, copyright issues, and related matters in KSA. Moreover, it is found that although KSA researchers focused on OA

publishing with the collaboration of different countries yet there is an extreme need to enhance this collaboration with developing countries.

Limitations of the Study and Future Research

Data was retrieved only from InCites database of the Web of Science, whereas other citation databases did not use. The scope of research is restricted to the period of 1980-2020, while the result may diverge if it is filtered by different dates/filters. A comparison of OA publishing data affiliated to KSA researchers from different databases is recommended. Empirical study and systematic review on the topic are also suggested. Scopus and Google Scholar can be used for future studies. A study may conduct to reveal the collaboration patterns in the KSA.

Conclusion

This study concluded that OA publishing trend in KSA is constantly gaining popularity. The OA model facilitated the collaboration process and attracted researchers from around the world to work together especially in the field of life sciences. KSA has the highest percentage of OA publications among the countries of the world. Moreover, the year-wise trend showed that KSA is contributing to the InCites since 1980 but got the momentum from 2011 to 2020.

Open access publications were getting preference by the researchers working in universities in KSA as King Abdul-Aziz University was on the top in OA research producing institutions, followed by King Saud University. Whereas, King Abdullah University of Science and Technology, Western Province, was at the top third in OA publications. From the topmost journals of KSA, fully open access journals successfully got better citations and ranked in high impact factor. Moreover, KSA researchers focused on OA publishing with the collaboration of various countries of the world. This study recommended that the KSA government should take necessary steps to further promote OA publications and raise funds to support this model.

Similarly, all KSA academic and funding institutions should make policies to acknowledge and promote OA publications.

References

Al-Khalifa, H. S. (2014). Scientometric assessment of Saudi publication productivity in computer science in the period of 1978-2012. *International Journal of Web Information Systems, 10*(2), 194-208. doi:doi.org/10.1108/IJWIS-01-2014-0001

Al-Youbi, A. (2017, December 1). The development and advancement of higher education in Kingdom of Saudi Arabia. QS Asia News Network. https://qswownews.com/higher-education-in-saudi-arabia/

Alamri, M. (2011). Higher education in Saudi Arabia. *Journal of Higher Education Theory and Practice, 11*(4), 88-91.

Alhibshi, A. H., Alamoudi, W. A., Haq, I. U., Rehman, S. U., Farooq, R. K., & AlShamrani, F. J. (2020). Bibliometric analysis of Neurosciences research productivity in Saudi Arabia from 2013-2018. *Neurosciences, 25*(2), 134-143. doi:10.17712/nsj.2020.2.20190087

Alhoori, H., Ray Choudhury, S., Kanan, T., Fox, E., Furuta, R., & Giles, C. L. (2015). *On the relationship between open access and altmetrics*. Paper presented at the iConference 2015 Proceedings.

AlRyalat, S., Saleh, M., Alaqraa, M., Alfukaha, A., Alkayed, Y., Abaza, M., . . . Alshamiry, M. (2019). The impact of the open-access status on journal indices: a review of medical journals. *F1000Research, 8*, 266. doi:10.12688/f1000research.17979.1

Alryalat, S. A., Azzam, M., Massad, A., & Alqatawneh, D. (2020). Retractions of research papers by authors from the Arab region (1998-2018). *European Science Editing, 46*, e51002.

Alryalat, S. A. S., Malkawi, L. W., & Momani, S. M. (2019a). Comparing bibliometric analysis using PubMed, Scopus, and Web of Science databases. *JoVE (Journal of Visualized Experiments)*(152), e58494. doi:10.3791/58494

Alshuwaikhat, H. M., Adenle, Y. A., & Saghir, B. (2016). Sustainability assessment of higher education institutions in Saudi Arabia. *Sustainability, 8*(8), 750.

Antelman, K. (2004). Do open-access articles have a greater research impact? *College & Research Libraries, 65*(5), 372-382.

Blakeman, k. (2018). Bibliometrics in a digital age: help or hindrance. *Science Progress, 101*(3), 293-310. doi:http://dx.doi.org/10.3184/003685018X15337564592469

Bohannon, J. (2016). Who's downloading pirated papers? Everyone. In: American Association for the Advancement of Science.

Bornmanna, L., & Leydesdorff, L. (2013). The validation of (advanced) bibliometric indicators through peer assessments: A comparative study using data from InCites and F1000. *Journal of Informetrics, 7*(2), 286-291. doi:http://dx.doi.org/10.1016/j.joi.2012.12.00

Brainard, J. (2021). Open access takes flight. Science, 371(6524). 16-20. 10.1126/science.371.6524.16

Chadwell, F., & C. Sutton, S. (2014). The future of open access and library publishing. *New library world, 115*(5/6), 225-236. doi:10.1108/NLW-05-2014-0049

Chua, S., Qureshi, A. M., Krishnan, V., Pai, D. R., Kamal, L. B., Gunasegaran, S., . . . Kew, P. (2017). The impact factor of an open access journal does not contribute to an article's citations. *F1000Research, 6*(208). doi:10.12688/f1000research.10892.1

Diem, A., & Wolter, S. C. (2013). The use of bibliometrics to measure research performance in education sciences. *Research in Higher Education, 54*(1), 86-114. doi:http://dx.doi.org/10.1007/s11162-012-9264-5

Eysenbach, G. (2006). Citation advantage of open access articles. *PLoS biology, 4*(5), e157.

Gargouri, Y., Larivière, V., Gingras, Y., Carr, L., & Harnad, S. (2012). Green and gold open access percentages and growth, by discipline. *arXiv preprint arXiv:1206.3664*.

Hajjem, C., Harnad, S., & Gingras, Y. (2006). Ten-year cross-disciplinary comparison of the growth of open access and how it increases research citation impact. *arXiv preprint cs/0606079*.

Halpern, J. Y. (1998). A computing research repository. *D-Lib Magazine*.

Harnad, S., & Brody, T. (2004). Comparing the impact of open access (OA) vs. non-OA articles in the same journals. *D-lib Magazine, 10*(6). doi:10.1045/june2004-harnad

Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National academy of Sciences, 102*(46), 16569-16572. doi:https://doi.org/10.1073/pnas.0507655102

Khélifi, N., Robens, J., & Alghamdi, M. (2015). *New Publishing Trends and Open Access in the Kingdom of Saudi Arabia (eg Springer/KACST Journals): An integral part of the*

National Plan for Science, Technology and Innovation (MAARIFAH). Paper presented at the 2nd International Conference on Scientific Publishing, Riyadh, KSA.

Kuballa, S., Schulze, M., Mielke, C., Taddicken, M., & Haux, R. (2019). Identification of Influencing Factors Regarding the Decision for or Against an Open Access Publication of Scientists of Medical Informatics: Description and First Results of Group Discussions and Interviews. *Studies in health technology and informatics, 264*, 1248-1252. doi:10.3233/SHTI190426

Laakso M, W. P., Bukvova H, Nyman L, Björk B-C, Hedlund T. (2011). The Development of Open Access Journal Publishing from 1993 to 2009. *PLoS ONE, 6*(6). doi:org/10.1371/journal.pone.0020961

Makar, S. M., & Trost, A. M. (2018). Operationalizing Bibliometrics as a Service in a Research Library. *Information Outlook (Online), 22*(5), 21-34.

May, C. (2020). Academic publishing and open access: Costs, benefits and options for publishing research. *Politics, 40*(1), 120-135.

McCabe, M. J., & Snyder, C. M. (2005). Open Access and Academic Journal Quality. *American Economic Review, 95*(2), 453-459. doi:10.1257/000282805774670112

Minniti, S., Santoro, V., & Belli, S. (2018). Mapping the development of Open Access in Latin America and Caribbean countries. An analysis of Web of Science Core Collection and SciELO Citation Index (2005–2017). *Scientometrics, 117*(3), 1905-1930. doi:10.1007/s11192-018-2950-0

Onsman, A. (2011). It is better to light a candle than to ban the darkness: Government led academic development in Saudi Arabian universities. *Higher Education, 62*(4), 519-532.

Piwowar, H., Priem, J., Larivière, V., Alperin, J. P., Matthias, L., Norlander, B., . . . Haustein, S. (2018). The State of OA: A large-scale analysis of the prevalence and impact of Open Access articles. *PeerJ, 6*, e4375. doi:10.7717/peerj.4375

Torres-Salinas, D., & Orduña-Malea, E. (2014). Ruta dorada del open access en Web of science. *Anuario ThinkEPI, 8*, 211-214.

Wang, X., Liu, C., Mao, W., & Fang, Z. (2015). The Open Access Advantage Considering Citation, Article Usage and Social Media Attention. In. Ithaca: Cornell University Library, arXiv.org.

Willinsky, J. (2003). The nine flavours of open access scholarly publishing. *Journal of Postgraduate Medicine, 49*(3), 263.

Yang, S., Xing, X., & Wolfram, D. (2018). Difference in the impact of open-access papers published by China and the USA. *Scientometrics, 115*(2), 1017-1037.

Yuan, S., & Hua, W. (2011). Scholarly impact measurements of LIS open access journals: based on citations and links. *The Electronic Library*, *29*(5), 682-697. doi:10.1108/02640471111177107