Available online at **www.ijmrhs.com**

ISSN No: 2319-5886

International Journal of Medical Research & Health Sciences, 2021, 10(1): 130-140

Clinical Neuroscience Research in Saudi Arabia: A Bibliometric Appraisal of Productivity and Worldwide Ranking

Anas M Bardeesi[1], Aimun A B Jamjoom[2], Momen A Sharab[1], Abdulhakim B Jamjoom[1*]

[1]Section of Neurosurgery, King Khalid National Guards Hospital and
King Saud bin Abdulaziz University for Health Sciences, Jeddah, Saudi Arabia
[2]Division of Neurosurgery, Western General Hospital, University of Edinburgh, United Kingdom
**Corresponding e-mail: jamjoomab@gmail.com*

ABSTRACT

Objectives: *To assess the performance of clinical neuroscience research in Saudi Arabia by determining its worldwide ranking and by considering its position in the context of five country-specific characteristics.* ***Methods:*** *Scimago Journal and Country Rank (SJR) were used to determine Saudi Arabia's worldwide ranking in clinical neuroscience during 1996-2018. The country's annual productivity was correlated with the median output for the worldwide top 50 countries. The data were also correlated with five country-specific characteristics and examined statistically.* ***Results:*** *Saudi Arabia's productivity and rankings were total documents: 2,032 (rank 38), total cites: 20,337 (rank 40) and cites per document: 10.01 (rank 132). The country's annual output correlated significantly with the median for the top 50 ranking countries in total documents and cites per document but not in total cites. Four of the five country-specific characteristics correlated significantly with two or three of the bibliometric indicators. Saudi Arabia's country-specific characteristics rankings were GDP per capita: 26, the percentage spent on research and development: 41-42, number of clinical neuroscience journals enlisted in SJR: 22-31, and number of universities amongst the world top 500: 22-28.* ***Conclusions:*** *The steady annual increase in Saudi Arabia's clinical neuroscience total documents is encouraging. Allowing for the country's specific characteristics, its rankings may be considered below expectation. Saudi Arabia's relatively small total cites number and low cites per document rank reflect the country's researchers publishing in low impact journals. Saudi Arabia needs to improve the quality of its research and to undertake more international collaborative research.*

Keywords: Saudi Arabia, Bibliometrics, Clinical neuroscience, Citation analysis, Worldwide ranking, Scimago Journal, Country Rank

INTRODUCTION

Bibliometrics is the use of statistical methods to evaluate the published literature quantitatively and qualitatively [1]. To objectively do so, a set of validated tools are utilized to continuously follow and assess research productivity in terms of the amount of scientific output and its impact on further research work [2]. The bibliometric evaluation of research can be carried out at the level of the publishing journal, the researcher and researching department, the scientific conference, the research type, the medical specialty, the country, and the world region [3-11]. The increasing interest in the evaluation of global scientific productivity and worldwide ranking stimulated a plethora of bibliometric publications concerning the different medical specialties and originating from numerous countries. Their findings are considered useful in providing a reference for comparison, in decision-making concerning the progress of research programs and the allocation of resources [4,5].

Over the last four decades, researchers from Saudi Arabia have contributed to the national and international medical and biomedical literature. Meo, et al. reported that Saudi Arabia's research performance in global medical sciences had markedly increased during the period 2006-2012, but the number of cites had decreased [12]. Latif described a linear progression in Saudi Arabia's biomedical research production during 2008-2012, but most publications were in low Impact Factor (IF) journals [13]. Rohra, et al. observed that the IF of six Saudi journals indexed by

the Institute for Scientific Information (ISI) had improved over the period 2007-2014, especially in the fields of pharmaceutical sciences and neurosciences [14]. The appraisal of the impact of Saudi Arabia's research in the field of clinical neuroscience was limited to a few studies that focused on the analysis of the country's research output relating to epilepsy, neurology, and neuroscience research [8,15,16]. Only one neuroscience-related article addressed Saudi Arabia's productivity and worldwide ranking in a global context [17]. However, the data reported in that article were limited to 2014 and the temporal changes in productivity over the years were not examined.

Bibliometric studies, such as this study, have been possible because of the extensive data that are currently available on online sources. SCImago Journal and Country Rank (SJR), is an online public portal that supplies information related to the performance of countries and journals on a wide range of scientific fields [3]. The data, which is updated yearly, are based on several bibliometric indicators that include total document, citable documents, total cites, self-citations, cites per document, and h-index. The SJR site provides lists of worldwide rankings for countries and journals.

Objectives

To evaluate the performance of clinical neuroscience research in Saudi Arabia by determining it's worldwide ranking based on the quantity and citation impact of its research in the specialty. It is also aimed to compare the country's annual output in clinical neuroscience with the yield from the worldwide top 50 countries and to consider its rankings in the context of five country-specific characteristics that may influence a country's position amongst the top 50 countries in the world.

METHODS

This study was conducted at King Khalid National Guards Hospital, Jeddah, Saudi Arabia. No ethical approval was obtained for his study, as the information presented was public with no human participation. The SJR site was searched on the 1st of April 2020 using the parameter "medicine" for the subject area, "clinical neurology" for the subject category, "all regions" for the country, and "1996-2018" for the year [3]. The site was also searched for "clinical neurology" journals published by "all regions/countries" during "2018" and found to have 363 international journals that covered the full range of clinical neuroscience specialties which included 36 neurosurgical journals. As a result, it was considered appropriate to refer to "clinical neurology" in the SJR site as "clinical neuroscience" thereafter in this article.

Using this site, the worldwide top 50 countries in clinical neuroscience were ranked based on the number of their total documents. The quantity and quality of research in each of these countries in the specialty were evaluated using three bibliometric indicators: total documents, total cites, and cites per document. 1996 to 2018 annual productivity records relating to the three parameters were tabulated for the top 50 ranking countries in clinical neuroscience. Data connecting to the annual output for Saudi Arabia were correlated to the median yield for the top 50 ranking countries by calculating the Pearson correlation coefficient using Social Sciences Statistics 18 with significance being reached when the p-value was <0.05.

Also, information about five country-specific characteristics was collected for the top 50 ranking countries in clinical neuroscience. These included the total population size in 2018 from the Worldometer website, the Gross Domestic Product at purchasing parity per capita (GDP per capita) in 2015 from the International Monetary Fund database, the percentage of GDP spent on Research and Development (R and D) in 2015 from the World Bank web site, the number of universities amongst the world top 500 in 2018 from the Shanghai ranking web site and the number of clinical neuroscience journals enlisted in SJR site in 2018 [3,19-22]. Data for the five country-specific characteristics and the three bibliometric indicators were correlated by calculating the Pearson correlation coefficient using Social Sciences Statistics 18 with significance being reached when the p-value was <0.05.

RESULTS

Based on total documents in clinical neuroscience during 1996-2018, Saudi Arabia was ranked 4th in the Middle East. Saudi Arabia's productivity and worldwide ranking based on the three bibliometric parameters were as follows: Total documents 2032 (rank 38), total cites 20337 (rank 40), and cites per document 10.01 (rank 132). Table 1 shows the productivity for the worldwide top 50 countries ranked by their total documents in clinical neuroscience. Amongst the top 50 ranking countries, the median (range) for the three bibliometric indicators during 1996-2018 were: Total documents 5253 (790-242758), total cites 89017 (7797-7117460), and cites per document 18.03 (7.79-39.82).

Table 1 Productivity for the worldwide top 50 countries listed by total documents in clinical neuroscience during 1996-2018 using three indicators

Country	Total Documents (Rank)	Total Cites (Rank)	Citation per document (Rank)
USA	242758 (1)	7117460 (1)	29.32 (18)
Germany	65680 (2)	1652709 (3)	25.16 (30)
Japan	62071 (3)	992561 (6)	15.99 (79)
UK	56979 (4)	1941207 (2)	34.07 (8)
Italy	46695 (5)	1071291 (5)	22.94 (38)
Canada	36586 (6)	1182783 (4)	32.33 (14)
France	34484 (7)	915717 (7)	26.55 (25)
China	29604 (8)	307606 (13)	10.39 (130)
Spain	25495 (9)	481417 (11)	18.88 (56)
Netherlands	22495 (10)	820433 (8)	36.47 (7)
Australia	21820 (11)	628589 (9)	28.81 (21)
Brazil	16067 (12)	207728 (20)	12.93 (101)
Turkey	15777 (13)	168418 (22)	10.67 (126)
Switzerland	15720 (14)	430017 (12)	27.35 (24)
South Korea	15664 (15)	229111 (18)	14.63 (90)
India	14864 (16)	137486 (23)	9.25 (140)
Sweden	12652 (17)	485835 (10)	38.4 (5)
Belgium	9468 (18)	279665 (15)	29.54 (16)
Austria	8863 (19)	289421 (14)	32.65 (13)
Taiwan	7666 (20)	128403 (24)	16.75 (72)
Denmark	7658 (21)	251502 (16)	32.84 (12)
Israel	7288 (22)	213174 (19)	29.25 (19)
Poland	7096 (23)	87446 (26)	12.32 (106)
Finland	5993 (24)	238667 (17)	39.82 (4)
Norway	5415 (25)	178880 (21)	33.03 (10)
Czech Rep.	5091 (26)	60015 (32)	11.79 (113)
Iran	4376 (27)	35146 (36)	8.03 (154)
Russia	4277 (28)	33314 (37)	7.79 (157)
Greece	4135 (29)	73039 (28)	17.66 (66)
Portugal	3593 (30)	90588 (25)	25.21 (29)
Mexico	3570 (31)	41166 (35)	11.53 (117)
Hungary	3378 (32)	60912 (31)	18.03 (60)
Argentina	3320 (33)	64762 (30)	19.51 (50)
Ireland	2881(34)	75949 (27)	26.36 (26)
New Zealand	2597 (35)	72923 (29)	28.08 (22)
Singapore	2370 (36)	43308 (34)	18.27 (59)

Hong Kong	2360 (37)	56653 (33)	24.01 (33)
Saudi Arabia	2032 (38)	20337 (40)	10.01 (132)
Egypt	1870 (39)	17938 (42)	9.59 (136)
Chile	1703 (40)	22122 (39)	12.99 (99)
South Africa	1553 (41)	31632 (38)	20.37 (46)
Thailand	1452 (42)	18824 (41)	12.96 (100)
Croatia	1183 (43)	13660 (45)	11.55 (116)
Cuba	1052 (44)	8858 (53)	8.42 (151)
Colombia	1039 (45)	12661 (46)	12.19 (108)
Serbia	949 (46)	15113 (43)	15.93 (81)
Slovakia	918 (47)	11012 (47)	12 (111)
Malaysia	857 (48)	10163 (49)	11.86 (112)
Romania	806 (49)	7797 (57)	9.67 (135)
Slovenia	790 (50)	14233 (44)	18.02 (61)
Median (Range)	5253 (790-242758)	89017 (7797-7117460)	18.03 (7.79-39.82)

The median (range) annual productivity [and worldwide rank (range)] for Saudi Arabia during the period 1996-2018 were as follows: Total documents 68 (22-230) [rank 45 (32-54)], total cites 722 (101-2072) [rank 45 (24-54)], and cites per document 13.09 (0.44-24.7) [rank 151 (46-180)]. The median (range) annual productivity for the worldwide top 50 countries during the same period was as follows: Total documents 239.5 (85-404), total cites 4094 (284-7261.5), and cites per document 26.35 (0.79-31.7). The temporal trends in Saudi Arabia's annual productivity compared to the median of the top 50 ranking countries in clinical neuroscience during 1996-2018 are illustrated in Figure 1 for total documents, Figure 2 for total cites, and Figure 3 for cites per document. The figures demonstrate a steady increase in Saudi Arabia's total documents over the years in contrast to the variable yield that was seen in total cites and cites per document. Table 2 summarizes the correlation results between the annual output for Saudi Arabia and the median for the top 50 ranking countries using the three bibliometric indicators. A significant correlation was observed between the two groups in total documents ($p<0.00001$) and cites per document ($p=0.0002$) but not in total cites ($p=0.1069$).

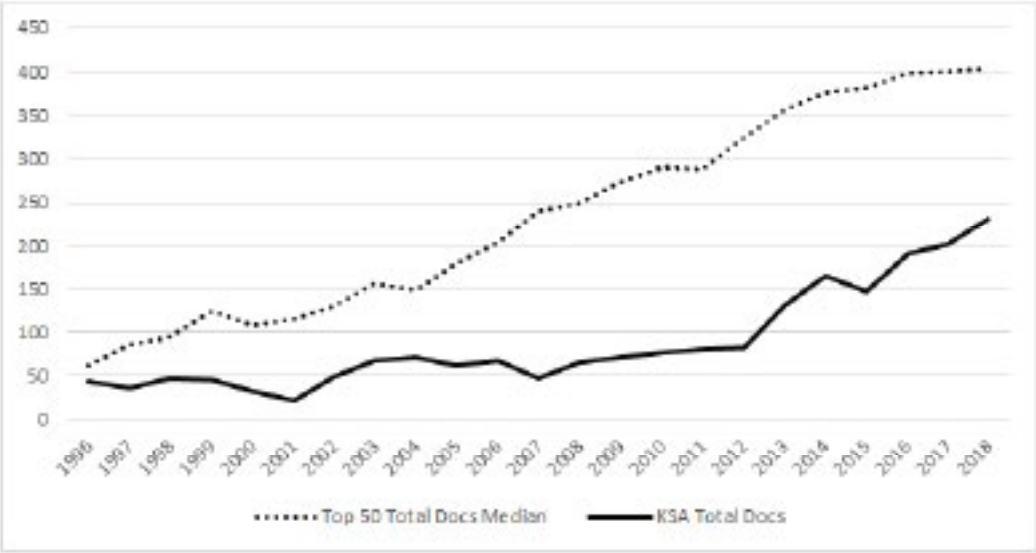

Figure 1 Temporal trends for Saudi Arabia's total documents in clinical neuroscience during 1996-2018 compared to the median of the top 50 ranking countries

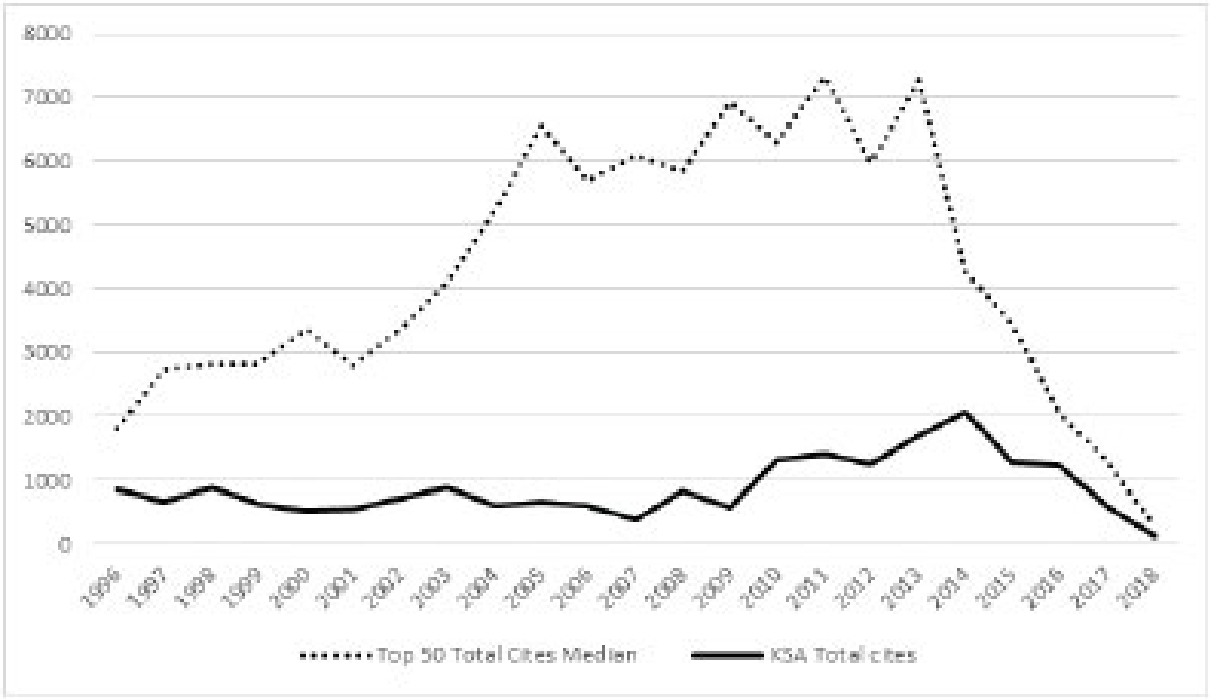

Figure 2 Temporal trends for Saudi Arabia's total cites in clinical neuroscience during 1996-2018 compared to the median of the top 50 ranking countries

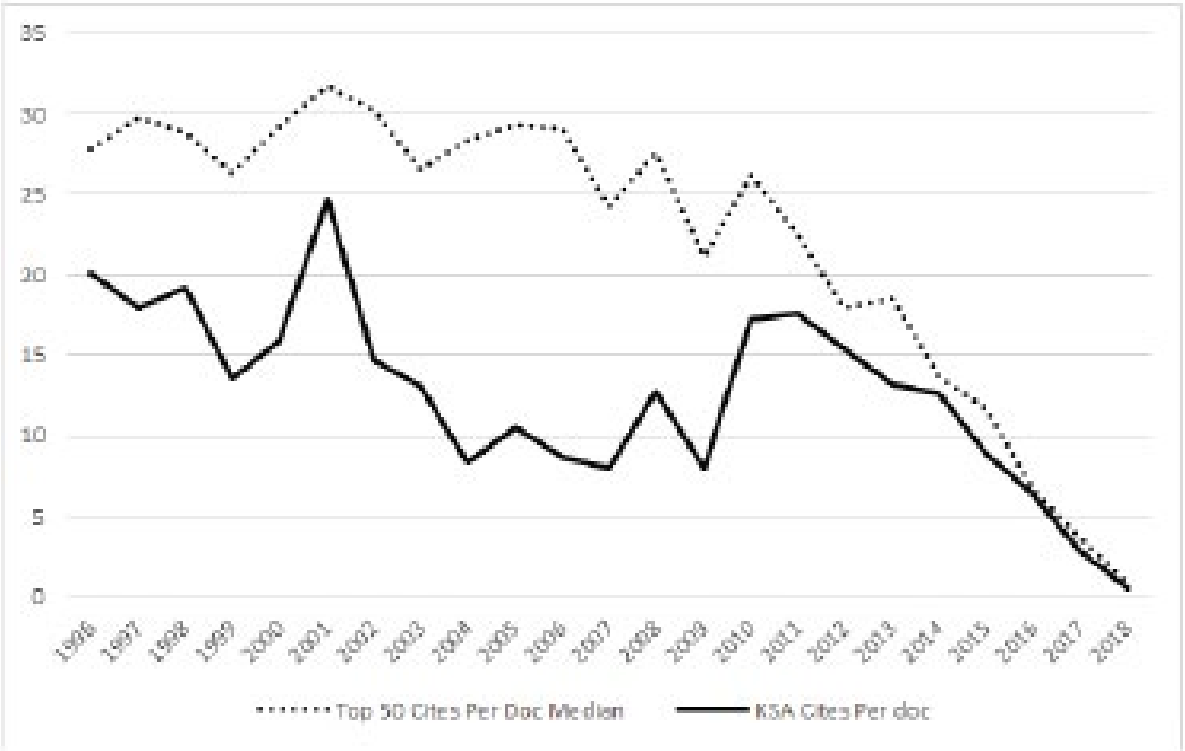

Figure 3 Temporal trends for Saudi Arabia's cites per document in clinical neuroscience during 1996-2018 compared to the median of the top 50 ranking countries

Table 2 Correlation between the productivity of Saudi Arabia and the median for the top 50 ranking countries in clinical neuroscience during 1996-2018 using three indicators

Indicator (1996-2018)	Saudi Arabia	Median for Top 50 Ranking Countries	R-Value	p-value	Significance
Annual total Documents Median (Range)	68 (22-230)	239.5 (85-404)	0.872	<0.00001	Sig
Annual total Cites Median (Range)	722 (101-2072)	4094 (284-7261.5)	0.345	0.1069	NS
Yearly citations per Document Median (Range)	13.09 (0.44-24.7)	26.35 (0.79-31.7)	0.696	0.0002	Sig

Table 3 illustrates the country-specific characteristics for the worldwide top 50 countries in clinical neuroscience ranked by total documents. Saudi Arabia's country-specific characteristics (and their rank) amongst the worldwide top 50 countries were as follows: Population size: 33,702,756 (rank 23), GDP per capita: $23,538 (rank 26), percentage of GDP spent on R and D: 0.82% (rank 41-42), number of clinical neuroscience journals enlisted in SJR: 1 (rank 22-31) and number of universities amongst the world top 500: 4 (rank 22-28).

The median (range) for the five country specific characteristics for the top 50 ranking countries in clinical neuroscience were as follows: Population size: 24,312,306 (2,077,837-1,427,647,786), GDP per capita: $25, 576 ($2,037- $83,161), percentage of GDP spent on R and D: 1.34% (0.24%- 4.55%), number of clinical neuroscience journals enlisted in SJR site:

1 (0-103) and the number of universities amongst the world top 500: 4 (0-139).

Table 3 The five country-specific characteristics for the worldwide top 50 countries ranked by their total documents in clinical neuroscience

Country	Population	GDP per capita ($)	Percentage of GDP on R and D	NS journals in SJR site	Universities in the world top 500
USA	327,096,265	62,868	2.79%	103	139
Germany	83,124,418	47,662	3.02%	28	36
Japan	127,202,192	39,304	3.21%	12	16
UK	67,141,684	42,579	1.66%	69	39
Italy	60,627,291	34,320	1.35%	7	15
Canada	37,074,562	46,290	1.55%	1	18
France	64,990,511	42,953	2.19%	11	19
China	1,427,647,786	9,580	2.15%	3	51
Spain	48,692,858	30,733	1.20%	5	10
Netherlands	17,059,560	53,228	1.99%	41	11
Australia	24,898,152	56,420	1.92%	0	23
Brazil	209,469,323	8,958	1.26%	5	6
Turkey	82,340,088	9,405	0.96%	6	1
Switzerland	8,525,611	83,161	3.37%	15	8
South Korea	51,171,706	33,320	4.55%	7	10
India	1,352,642,280	2,037	0.60%	8	1
Sweden	9,971,638	54,356	3.33%	1	11
Belgium	11,482,178	46,696	2.59%	0	7
Austria	8,891,388	51,343	3.16%	1	6
Taiwan	23,726,460	25,007	2.45%	1	6

Denmark	5,752,126	60,897	3.06%	0	5
Israel	8,381,516	41,728	4.54%	0	6
Poland	37,921,592	15,425	1.03%	4	2
Finland	5,522,576	49,737	2.76%	0	4
Norway	5,337,962	81,550	2.11%	0	3
Czech Rep	10,665,677	23,112	1.79%	2	1
Iran	81,800,188	5,416	0.83%	2	2
Russia	145,734,038	11,289	1.11%	6	4
Greece	10,522,246	20,317	1.13%	0	3
Portugal	10,256,193	23,437	1.32%	1	4
Mexico	126,190,788	9,797	0.49%	2	1
Hungary	9,707,499	16,484	1.35%	2	0
Argentina	44,361,150	11,658	0.54%	0	1
Ireland	4,818,690	78,334	1.04%	0	4
New Zealand	4,743,131	41,204	1.23%	0	4
Singapore	5,757,499	64,578	2.62%	0	2
Hong Kong	7,371,730	48,450	0.86%	0	5
Saudi Arabia	33,702,756	23,538	0.82%	1	4
Egypt	98,423,598	2,573	0.72%	10	1
Chile	18,729,160	15,901	0.36%	1	2
South Africa	57,792,518	6,353	0.82%	0	4
Thailand	69,428,453	7,848	1%	0	0
Croatia	4,156,405	14,870	0.86%	1	0
Cuba	11,338,134	N/A	0.43%	0	0
Colombia	49,661,048	6,641	0.24%	0	0
Serbia	8,802,754	7,223	0.92%	0	1
Slovakia	5,453,014	19,579	0.88%	0	0
Malaysia	31,528,033	11,072	1.44%	1	2
Romania	19,506,114	12,269	0.50%	1	0
Slovenia	2,077,837	26,145	1.86%	0	1
Median (Range)	24312306 (2,077,837-1,427,647,786)	25576 (2,037-83,161)	1.34% (0.24%-4.55%)	1 (0-103)	4 (0-139)

Table 4 summarizes the correlation findings between the five country-specific characteristics and the three bibliometric indicators for the worldwide top 50 countries in clinical neuroscience. It showed that GDP/capita and several neuroscience journals enlisted in the SJR site had a significant correlation with total documents, total cites, and cites per document. The percentage of GDP spent on R and D had a significant correlation with total documents and cites per document but not with total cites while the number of universities amongst the top 500 appears to have a significant correlation with total documents and total cites but not with cites per document. The population size did not have a positive correlation with any of the three bibliometric indicators.

Table 4 Correlation between the five country-specific characteristics and the three productivity indicators for the worldwide top 50 countries in clinical neuroscience

Country-Specific Characteristics	Productivity Indicator	R-Value	p-Value	Significance
Population size	Documents	0.188	0.1911	NS
	Cites	0.111	0.4437	NS
	Cites per document	0.259	0.0695	NS
GDP per Capita	Documents	0.295	0.0399	Sig
	Cites	0.338	0.0176	Sig
	Cites per document	0.792	<0.0001	Sig
GDP spending on R and D	Documents	0.289	0.0419	Sig
	Cites	0.276	0.0533	NS
	Cites per document	0.553	<0.0001	Sig
Universities in the world top 500	Documents	0.952	<0.0001	Sig
	Cites	0.948	<0.0001	Sig
	Cites per document	0.27	0.0576	NS
Clinical neuroscience journals in SJR	Documents	0.865	<0.0001	Sig
	Cites	0.893	<0.0001	Sig
	Cites per document	0.288	0.042	Sig

DISCUSSION

The SCImago Journal and Country Rank is a free-access portal that includes journals and scientific indicators covered by the Scopus database [3]. It is computed using an algorithm that reflects not only the number of cites but also the prestige of the citation source [23]. The SJR portal excludes self-citations in its calculation and is reported to enhance the under-estimation in the ranking of specialized journals that have specific self-citation tendencies [24].

The site has been validated as a suitable alternative to the well-established journal IF and other scientometric measures for pediatric neurology and neurosurgery [23,25]. Furthermore, it has been utilized in the evaluation of the scientific productivity and worldwide ranking in several publications related to neurosciences and stroke research [11,26].

The first medical journal from Saudi Arabia, the Saudi Medical Journal, was established in 1979 and the country's sole neuroscience journal [Neuroscience (Riyadh)] was established in 1996 [7]. Saudi Arabia's research productivity, which has been increasing over the years, appears to be more visible in some medical disciplines than others [7,10]. The performance of clinical neuroscience had been good but has room for improvement [8,15-17]. The specialty's productivity was ranked 7th out of 46 specialties during 1996-2014 [7]. It also had a negative Relative Specialization Index (RSI) score which implied that the contribution of Saudi Arabia's clinical neuroscience researchers to the country's total medical literature was lower than the contribution of the world's clinical neuroscience researchers to the overall world's total medical literature [7]. Nevertheless, articles published in recent years reported a definite increase in Saudi Arabia's neuroscience research productivity. The output however was specialty and sub-specialty dependent, dominated by publications from the older well-established universities, international collaborative work, and a selected number of proliferative researchers [8,15,16].

The data in this study show that Saudi Arabia's researchers' productivity compared to the median output for the top 50 ranking countries in clinical neuroscience during 1996-2018 was lower for total cites 20337/89017 (22.8%) compared to total documents 2032/5253 (38.7%) and cites per document 10.01/18.03 (55.5%). Saudi Arabia's ranking during the 23 years was lower using cites per document (rank 132) compared to total documents (rank 38) and total cites (rank 40). Besides, the annual trends for clinical neuroscience research in Saudi Arabia demonstrated a clear increase in total documents in contrast to the fluctuating output that was seen in total cites and cites per document. These observations were supported by the finding that the annual productivity from Saudi Arabia correlated significantly with the median for the top 50 ranking countries in total documents and cites per document but not in total cites. Hence it is fair to conclude that the country's worst productivity in clinical neuroscience was using total cites and its worst worldwide

ranking was using cites per document. These findings are not surprising, and they reflect the previously recognized trend for Saudi Arabia's researchers to publish in local journals with low IF [12,13,16]. The question of whether Saudi Arabia's researchers should publish their quality articles in international or national journals remains controversial. Publications in high IF journals are more likely to attract high citation numbers and improve the country's worldwide ranking and international academic standing. Alternatively, good publications in local journals will help to enhance their IF and likely to prove more valuable in the long term.

The impact of the various country-specific characteristics on scientific productivity relating to different medical specialties has been of interest in recent years. A bibliometric indicator-dependent positive impact was reported for GDP per capita, spending on R and D, number of universities, and number of Institute of Scientific Information (ISI) indexed journals [27]. We have observed in this study that amongst the top 50 countries in the world in clinical neuroscience, four of the five country-specific characteristics correlated positively with two or three of the bibliometric indicators. These were: GDP/capita and the number of neuroscience journals enlisted in SJR site (total documents, total cites and cites per document), the number of universities amongst the top 500 (total documents and total cites), and the percentage of GDP spent on R and D (total documents and cites per documents).

Saudi Arabia's ranking amongst the top 50 countries based on three of these country-specific characteristics were: GDP/capita: 26, the number of neuroscience journals enlisted in SJR site: 22-31, and the number of universities amongst the top 500: 22-28. Comparing the country's ranking based on these features with the country's rankings using total documents (rank 38), total cites (rank 40), and cites per document (rank 132) would suggest that Saudi Arabia's clinical neuroscience researchers may be under-performing and not producing high impact quality research. Furthermore, considering the positive correlation between R and D expenditure and cites per document that was observed in the study and others [27], it is possible that Saudi Arabia's relatively low percentage of GDP spent on R and D (0.82%) may be relevant to its low worldwide ranking using cites per document.

There are several limitations to the study. The study was reliant on the accuracy of the online search engine SJR. It is possible that there were miscalculations, particularly with multi-national publications. The contribution of Saudi Arabia's researchers to the multi-national articles could not be defined. The change in the number of researchers involved over the years which would influence productivity was not available. The five country-specific parameters used were recorded at fixed and different time points. There may have some specialty and topic overlap. The worldwide rankings were based on data from a wide range of clinical neuroscience journals of varying subspecialty, country of origin, age, and academic strength. It can be argued that the three bibliometric indicators used may not provide a true reflection of the quality of research particularly for publications in local journals. The study was also dependent on the correctness of the data in the web sites used for the five country-specific characteristics.

CONCLUSION

Saudi Arabia's worldwide ranking in clinical neuroscience during 1996-2018 was 38 for total documents, 40 for total cites, and 132 for cites per document. Allowing for its GDP/capita, the number of listed neuroscience journals in the SJR site, and the number of universities amongst the top 500, Saudi Arabia's performance in clinical neuroscience research may be considered below expectations. The country's relatively low total cites number and low cites per document rank may reflect the recognized trend for Saudi Arabia's researchers to publish in local journals with low IF. Saudi Arabia's neuroscience research needs innovative ideas that are required for publications in high impact journals. The country needs to improve its R and D expenditure, participate in more international collaborative research projects, and develop its elite research minds by establishing more clinical academic departments staffed by PhD-holders. Saudi Arabia's universities need to establish strong Ph.D. programs that are linked to high ranking international universities. Ultimately the only way for Saudi Arabian researchers to improve their standing in the world of neuroscience is to produce better quality research and publish it in the more established high IF international journals.

DECLARATIONS

Authors' Contribution

Anas M Bardeesi: Data collection, literature, and manuscript review.

Aimun AB Jamjoom: Data analysis and manuscript writing.

Momen A Sharab: Data collection, literature, and manuscript review.

Abdulhakim B Jamjoom: Study design, methodology, data analysis, and manuscript writing.

Conflict of Interest: The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

[1] Xie, Lin, et al. "Bibliometric and visualized analysis of scientific publications on atlantoaxial spine surgery based on Web of Science and VOSviewer." *World Neurosurgery,* Vol. 137, 2020, pp. 435-42.

[2] Lin, Guang-Xun, et al. "Worldwide research productivity in the field of full-endoscopic spine surgery: A bibliometric study." *European Spine Journal,* Vol. 29, No. 1, 2020, pp. 153-60.

[3] SCImago Journal and Country Rank. https://www.scimagojr.com/

[4] Jamjoom, Aimun AB, et al. "Academic productivity of neurosurgeons working in the United Kingdom: Insights from the h-index and its variants." *World Neurosurgery,* Vol. 86, 2016, pp. 287-93.

[5] Jamjoom, Aimun AB, Angus B. Gane, and Andreas K. Demetriades. "Randomized controlled trials in neurosurgery: An observational analysis of trial discontinuation and publication outcome." *Journal of Neurosurgery,* Vol. 127, No. 4, 2016, pp. 857-66.

[6] Kiraz, Murat, and Emre Demir. "A Bibliometric analysis of publications on Spinal Cord injury during 1980-2018." *World Neurosurgery,* Vol. 136, 2020, pp. e504-13.

[7] Jamjoom, Abdulhakim B. "Medical speciality research in Saudi Arabia: A bibliometric assessment of productivity and worldwide ranking." *Journal of Health Specialties,* Vol. 5, No. 1, 2017, pp. 23-29.

[8] Alhibshi, Amani H., et al. "Bibliometric analysis of Neurosciences research productivity in Saudi Arabia from 2013-2018." *Neurosciences Journal,* Vol. 25, No. 2, 2020, pp. 134-43.

[9] Akhaddar, Ali. "Contribution of Moroccan Neurosurgeons to the World Neurosurgical Data in PubMed: A Bibliometric Evaluation Over Time." *World Neurosurgery,* Vol. 126, 2019, pp. 59-65.

[10] Al-Bishri, Jamal. "Evaluation of biomedical research in Saudi Arabia." *Saudi Medical Journal,* Vol. 34, No. 9, 2013, pp. 954-59.

[11] Forero, Diego A., et al. "Scientific productivity in neurosciences in Latin America: A scientometrics perspective." *International Journal of Neuroscience,* Vol. 130, No. 4, 2020, pp. 398-406.

[12] Meo, S. A., A. Hassan, and A. M. Usmani. "Research progress and prospects of Saudi Arabia in global medical sciences." *European Review for Medical and Pharmacological Sciences,* Vol. 17, No. 24, 2013, pp. 3265-71.

[13] Latif, Rabia. "Medical and biomedical research productivity from the Kingdom of Saudi Arabia (2008-2012)." *Journal of Family and Community Medicine,* Vol. 22, No. 1, 2015, pp. 25-30.

[14] Rohra, Dileep K., Vikram K. Rohra, and Peter Cahusac. "Institute for Scientific Information-indexed biomedical journals of Saudi Arabia: Their performance from 2007-2014." *Saudi Medical Journal,* Vol. 37, No. 11, 2016, pp. 1251-57.

[15] Baeesa, Saleh S., et al. "Publications pattern of clinical epilepsy research in Saudi Arabia." *Neurosciences,* Vol. 22, No. 4, 2017, pp. 255-60.

[16] Algahtani, Hussein, et al. "Neurology research in Saudi Arabia: Urgent call for action." *Sultan Qaboos University Medical Journal,* Vol. 17, No. 3, 2017, pp. e324-28.

[17] Jamjoom, Abdulhakim B. "State of clinical neuroscience research in Saudi Arabia: Where do we rank in the world?." *Neurosciences,* Vol. 21, No. 3, 2016, pp. 268-70.

[18] Social Science Statistics. https://www.socscistatistics.com/

[19] Population 2018. http://www.worldometer.info

[20] International Monetary Fund. "World Economic Outlook Database, October 2018." https://www.imf.org/en/Publications/WEO/weo-database/2018/October

[21] The World Bank. "World Bank Open Data." https://data.worldbank.org/

[22] Academic ranking of world universities. http://www.shanghairanking.com/

[23] Kianifar, Hamidreza, Ramin Sadeghi, and Leili Zarifmahmoudi. "Comparison between impact factor, eigenfactor metrics, and scimago journal rank indicator of pediatric neurology journals." *Acta Informatica Medica,* Vol. 22, No. 2, 2014, pp. 103-06.

[24] Siebelt, Michiel, et al. "Citation analysis of orthopaedic literature; 18 major orthopaedic journals compared for Impact Factor and SCImago." *BMC Musculoskeletal Disorders,* Vol. 11, No. 1, 2010, pp. 1-7.

[25] Yuen, Jason. "Comparison of impact factor, eigenfactor metrics, and Scimago journal rank indicator and h-index for neurosurgical and spinal surgical journals." *World Neurosurgery,* Vol. 119, 2018, pp. e328-37.

[26] Alarcon-Ruiz, Christoper A., et al. "A bibliometric analysis of the Latin American research on stroke 2003-2017." *World Neurosurgery,* Vol. 129, 2019, pp. e545-54.

[27] Meo, S. A., et al. "Impact of GDP, spending on R&D, number of universities and scientific journals on research publications in pharmacological sciences in Middle East." *European Review for Medical and Pharmacological Sciences,* Vol. 17, No. 20, 2013, pp. 2697-705.