

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

Library Philosophy and Practice (e-journal)

Libraries at University of Nebraska-Lincoln

2020

An Appraisal of Research delineate of Jordan during 2015 to 2019: A Reflection from Scopus Database

Omar Al Jaradat
omjar2@bau.edu.jo

Follow this and additional works at: <https://digitalcommons.unl.edu/libphilprac>



Part of the [Scholarly Communication Commons](#), and the [Scholarly Publishing Commons](#)

Al Jaradat, Omar, "An Appraisal of Research delineate of Jordan during 2015 to 2019: A Reflection from Scopus Database" (2020). *Library Philosophy and Practice (e-journal)*. 4657.
<https://digitalcommons.unl.edu/libphilprac/4657>

An Appraisal of Research delineate of Jordan during 2015 to 2019: A Reflection from Scopus Database

Dr. Omar Mohammad Al-Jaradat

Department of Library and Information Science,
Irbid University College, Al-Balqa Applied University, Jordan.
(E-mail ID: omjar2@bau.edu.jo)

Abstract:

The study is perceived to find the research performance of Jordanian Institutes during the last five years in scopus database. Jordan has produced a total of 14722 research articles published in national and international journals during 2015 to 2019 with a continuous gradual increase both in publications as well as in citations. The public and older universities have performed better as compared to the private and newly established universities. Although, the major chunk of articles has been published in national journals however, as far as the citations are concerned, the international journals have taken a lead. A total of 4767 journals have been used for publications, however, 227 have been identified as the core collection journals. The non local journals with high impact factor and citescore have got the maximum citations, although very less no. of articles have been published by Jordanian researchers. The medicine, engineering, computer science, mathematics, etc. are the top contributing subjects while as the finance, economics, neuroscience, veterinary, and decision sciences are weaker subjects. The keywords analysis also reflects the strong hold of medicine and health researches in the country. The Lancet has been identified as the top cited journal followed by New England Journal of Medicine, The Lancet Neurology, IEEE Access, JAMA Oncology and the less cited journal were International Journal of Recent Technology and Engineering, Journal of Engineering and Applied Sciences, Jordan Journal of Physics, International Journal of Scientific and Technology Research. Khader YS with 195 articles, Alzoubi KH with 143 articles and Khabour OF with 106 articles all from the Jordan University of Science and Technology are the top authors in Jordan. A total of 2208 articles are written by single authors and 12514 by multiple authors with a highly skewed correlation been identified between the authors and the no. of authors with 27979 authors contributing

only single publication while as 195 articles have been published by only one author. The United States followed by Saudi Arabia and United Kingdom has been identified as the top collaborated countries of Jordan and the countries like Tajikistan, Solomon Islands and Cambodia are weakly collaborated. It is found that the highly cited articles are published in the Lancet Journal and with more collaboration of authors more citations have been identified. The top ranked articles in terms of citations have been published by the highly collaborated authors. The Jordanian researchers are citing mostly the newer research which may be related with the stronger areas of knowledge like medicine, computer sciences, engineering as per the Reference Publication Year Spectroscopy (RPYS).

Keywords:

Jordanian Research output, Scopus, Assessment of research articles, ranking of journals, authorship pattern, Jordan, weak and strong subjects of research, research collaboration.

1. Introduction:

Research is the first impression of growth and development of a country and the research publications are lifelines which represent that research. The different forms of publications are the direct reporting of the research profile of a nation which reflects the overall picture of the developments taking place in that nation. They are the pipelines of national growth and their assessment is imperative to infer the portfolios of research performance amongst and within a country. One of the majorly used methods of assessing the research is the quantitative and qualitative methods used in bibliometrics. It uses a number of indicators to evaluate and identify the key factors responsible or hinder a research process of any organisation or a country. It has become a standard tool of science policy and research management and all significant compilations of science indicators heavily rely on statistics of research publication and its impact (Glänzel, 2003). The bibliometric analysis is performed at the macro-level constituting a country or a region to determine the country's performance in different areas of research, meso-level constituting of universities, research organisation and other institutes to find their research profile and pattern of publications and at the narrower i.e., micro-level constituting of programmes, departments, groups or

individual researchers to determine their contributions and impact (**Raan, 2003**). Bibliometrics can be applied to support strategic decision making, evaluation of research institutes and research groups, or to provide information for assessing candidates for a scientific position, peer review process and sometimes can also be used to define indicators for allocating research funding (**Waltman & Ed Noyons, 2018**). Such analysis can also be used in science policies reports of nations. It is used for identification of different scientific indicators, analysis of scientific results and predicting the strength and trending areas of a research field (**Asad Abdi, Norisma Idris, Alguliyev, Rasim M., & Aliguliyev, Ramiz M., 2018**). The bibliometric analysis is a valuable tool for assessing the changes of forecasting and strategic development in research and innovation which in turn can help in identifying the emerging and declining areas of research. It is an efficient tool for identification of experts, centers of excellence, seminal works and show trends of research and technology change (**Hervé Rostaing, 2003**).

The present study has undertaken the Jordan as the country for analysing its research performance and contributions in different fields of knowledge during the last five years. There are 10 public, 24 private universities and 44 community colleges in Jordan which are managed by the Ministry of Higher Education and Scientific Research (MHESR). The Ministry works through the Higher Education Council, the Scientific Research Support Fund and the Higher Education Accreditation Commission of Jordan (**Ministry of Higher Education, 2020**). Besides, there are many research institutes and centers which are specific in different science and technology domains for conducting specialized projects and other research activities in consultation and coordination with Jordanian universities. The higher education in Jordan observed major developments during last few decades which can be reflected from the increasing number of higher education and research institutes, enrolment of students, faculty members, administrative and academic staff and the national expenditure spent on the sector. There are about 2,82,403 students, of which 42,000 are foreign students from 105 countries, 10,812 are teaching staff and 1,168 programs of study are offered by Jordanian universities and colleges (**Report of EU on overview of the higher education system, 2017; SPHERE Consortium EU,**

2020; Mahafzah, 2017). With such a structure of higher education and research, the study highlights different facets and patterns of Jordanian research output along with the representation of stronger and weaker subjects, universities, prolific authors, citations and journals used by the Jordanian researchers for their publications.

2. Objectives:

The mainstay of the present study is to represent the research outlay of Jordan in the last five years using the scopus database with the following objectives pursued to infer and discuss the results:

- (i) To determine the overall research structure of Jordan during last five years
- (ii) To find the strong and weak universities and research institutes, subjects, journals and prolific authors in Jordan
- (iii) To find the citations of the publications and their patterns
- (iv) To identify the collaboration of Jordan with other authors and countries.
- (v) To find the highly cited articles and Reference Publication Year Spectroscopy (RPYS) of cited references.

3. Methodology:

The study aimed at identifying the research performance of Jordan in the last five years which is represented by the Jordanian universities, colleges and other research organisations. The research data was retrieved from scopus database which is one of the comprehensive bibliographic and citation database indexing multiple subject areas. Of the four search options provided by scopus, we have used the advanced search option by adopting the following search strategy for downloading the necessary data:

AFFILCOUNTRY (Jordan) **AND** (LIMIT-TO (DOCTYPE, "ar"))
AND (LIMIT-TO (PUBYEAR, 2019) **OR** LIMIT-TO (PUBYEAR, 2018) **OR** LIMIT-TO (PUBYEAR, 2017) **OR** LIMIT-TO (PUBYEAR, 2016) **OR** LIMIT-TO (PUBYEAR, 2015)).

Using the statement, we retrieved a total of 14722 journal articles published during 2015 to 2019. The other document types were excluded mainly because authors are more interested to know the publications in journals and not other forms of research output. For analysing the articles retrieved, we used the following software and applications to fulfil the objectives and to get the relevant results:

- (i) *Biblioshiny*: It was used to analyse the year-wise output, citations data, laws and affiliated institutes, etc.)
- (ii) *Bibexcel*: It was used to analyse the author and their affiliations.
- (iii) *Texmaker*: It was used to merge the separate BibTex files of Scopus. As we know that scopus permits only 2000 records to be downloaded at a single point of time. So, we used multiple BibTex files and merge them using Texmaker.
- (iv) *MS-Excel*: It was used to further analyse the citation data of articles, institutes, authors and also for creating the figures.

4. Review of Related Literature:

A number of studies have been undertaken to explore the research status of different subject areas and that of research institutes in middle east or amongst different countries in the middle east. There were fewer studies which have explored the Jordanian research output in some specific subject areas and institutes and not on the overall status of the whole country including all subjects and research institutes. A study explored the medical and paramedical fields using PubMed database and found that about 72% of the articles were published in journals with assigned impact factors and the Jordan University of Science and Technology followed by Jordan University were the leading institutes of medical research (**Hayajneh, Hayajneh & Miqdady, 2010**). There is a significant rise in toxicology research in the Arab world with Egypt, Palestine, Saudi Arabia and Jordan having higher research output. More collaboration with Saudi Arabia, Egypt, and UAE, followed by United Kingdom and Germany was found (**Zyoud, Al-Jabi, Sweileh & Awang, 2014**). The research output in the Integrative and Complementary Medicine (ICM) field from the Arab world region is increasing and most of publications were driven by societal use of medicinal plants and herbs. There should be more national and international researches to improve the research output in the region (**Zyoud, Al-Jabi & Sweileh, 2015**). Analysing contributions of authors to the Internet of things research, the Arab nations are performing better in IoT research than that of the environmental and medical science research (**Kaba & Ramaiah, 2019**). Exploring open-access status and its impact on journal indices in oncology journals, it found that the publishing in oncology OA

journals results in more citations (**AlRyalat, et. al., 2019**). There is a rapid increase in the research of gastroenterology and hepatology field during the last two decades and Japan has emerged to be the 2nd highest country with research output in the field (**Khamees, et. al., 2019**). There is no correlation between the size or quantity of production and the chronology of years in general, and that the annual production rate of Jordan books as 1106.2 no. of books with 95.49% of the books in Arabic language. There are more books on the areas covered in humanities and social sciences than science and technology (**Suleiman, Sarhan, Tawalbeh, & Ahmed, 2016**). There is a need for Arab policy makers and funding agencies to allocate research funding on Arab nursing research so that health care needs of Arab individuals and families can be addressed (**Dardas, Sawair, Nabolsi & Simmons, 2018**). Except Lebanon and Jordan, there is a modest international research collaboration and engagement from Arab countries on Syrian refugees and displaced literature (**Sweileh, 2018**). The research output in the 22 Arab countries has increased by almost 160% on mental health in the past ten years. The collaboration and quality of publications has also improved (**Zeinoun, Akl, Maalouf & Meho, 2020**). The narrative reviews and experimental studies are the most common types of studies among the top cited articles on squamous cell carcinoma of the mouth, lips, and oropharynx and United States among 19 countries were found dominating the research output (**Hassona & Qutachi, 2019**). There is a significant increase (ten-fold) in collaboration in Palestinian research with other countries resulting a steady growth in its research output since the Oslo peace accord (**Sweileh, et. al., 2014**). USA is the most productive country in telomere length in children followed by Europe and Asia and the genomic and epidemiological research is being widely explored by global researchers (**Valera-Gran, D. et. al., 2020**). The research publications on refugees, asylum seekers and internally displaced people have been increased and articles are being published in high quality journals. The journals covered are not only general medicine and public health, but also mental health and psychology publications (**Sweileh, 2017**). The scientists from Egypt and Turkey produced 75 % of the total publication in physics amongst Iran, Iraq, Jordan, Saudi Arabia, Egypt, Syria, and Turkey. Except Iran, the three most active subjects for the countries were the

condensed matter physics (Uzun, 1996). There is a gap in environmental research productivity between Arab countries and other Middle Eastern countries. Saudi Arabia has recorded the highest share as well as h-index followed by Egypt. The most productive institute was the American University of Beirut in Lebanon and France was the most collaborated country for the environmental science research (Zyoud, et.al., 2017). The Nursing and midwifery research in Arab countries has significantly increased however it still lags in quantity and quality as compared to developed nations. The University of Jordan was the most productive institution while the American University of Beirut ranked first in the overall percentage of documents published in Q1 ranked journals (Sweileh, et. al., 2019).

5. Results:

5.1 Annual Total Research Publications and Citations

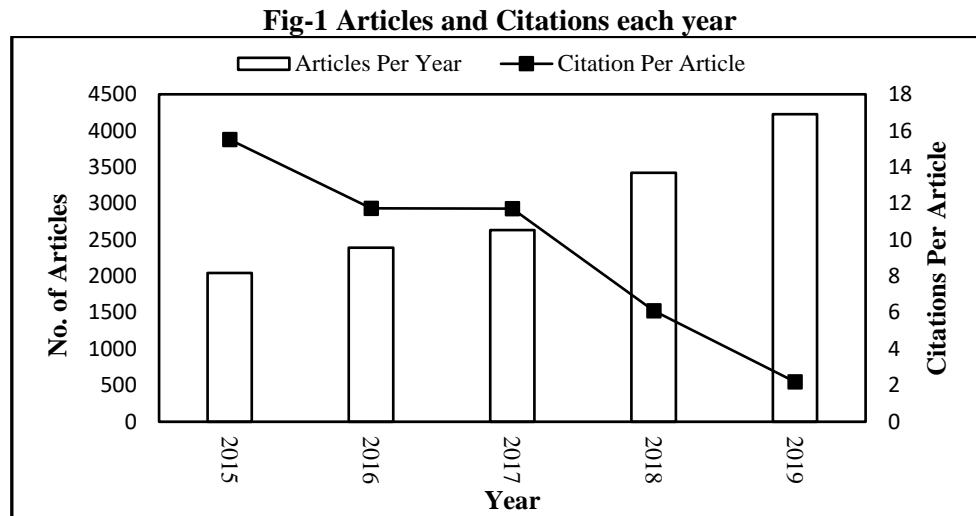
A total of 14722 articles were retrieved during 2015 to 2019 which had got the 120928 number of citations with an average citation of 8.21 per article. Of the total articles, 4290 were open access and 10432 were non open access articles. The number of research articles contributed from Jordan is showing a continuous growth from 2046 articles in the year 2015 and 4227 in the year 2019 as represented in table 1. As per the citable years, the year 2015 has got the highest no. of citations with 15.51 as the average citations per article and the year 2019 being the most recent, has got less no. of citations with an average rate of citations per article as 2.20. It is worthwhile to mention here that the no. of articles and citations are that of an individual year and not the cumulative value of proceeding years.

Table-1 Yearwise Distribution of Articles

Year	Articles	Citations	MeanTCperArt	MeanTCperYear	Citable Years
2015	2046	31736	15.51	3.10	5
2016	2391	28052	11.73	2.35	4
2017	2635	30872	11.71	2.34	3
2018	3423	20934	6.11	1.22	2
2019	4227	9334	2.20	0.44	1
Total	14722	120928	8.21	1.64	5 years

It is to mention that the number of articles increases each passing year and the citations decrease, because the number of citable years is more to earlier 2015 as

compared to 2019 and similar is the case with the citations per article as represented in figure 1.



5.2 Contribution by Universities/Institutes

The research institutes are the veins of research and developmental activities of a nation and hence their performances of research are inevitable. The public universities are leading the show in the overall research contribution in Jordan with almost 76% of literature being published by first five universities. The University of Jordan and Jordan University of Science and Technology constitutes about 50% of Jordanian research output in the last five years. The table 2 shows only the top 20 research institutes with a trend of research output growth proportionate with the establishment of the university representing the analogy of, the older university, the more research output. This may be because the older universities have developed higher infrastructure for undertaking the research. It is also found that King Hussein Cancer Center has occupied its position among the top 10 research institutes in Jordan research profile during the last five years.

Table-2 Top 20 Universities/Institutes

S. No.	NU	P	YE	T	TP (% Total)
1	The University of Jordan	Amman	1962	Public	4045 (27.48%)
2	Jordan University of Science and Technology	Irbid	1986	Public	3224 (21.90%)
3	Hashemite University	Zarqa	1995	Public	1482 (10.06%)
4	Yarmouk University	Irbid	1976	Public	1292 (8.78%)
5	Al-Balqa Applied University	Al'Salt	1997	Public	1192 (8.10%)
6	Mutah University	Mu'tah	1981	Public	673(4.58%)
7	Al Al-Bayt University	Mafraq	1993	Public	535 (3.64%)
8	German Jordanian University	Amman	2005	Public	485 (3.30%)
9	King Hussein Cancer Center	Amman	1997	Public	437(2.97%)

10	Al-Zaytoonah University of Jordan	Amman	1993	Private	417 (2.83%)
11	Al-Hussein Bin Talal University	Ma'an	1999	Public	416 (2.82%)
12	Applied Science Private University	Amman	1991	Private	388 (2.63%)
13	Princess Sumaya University	Amman	1991	Private	330 (2.24%)
14	Tafila Technical University	Tafilah	2005	Public	277 (1.89%)
15	Al-Ahliyya Amman University	Amman	1990	Private	276 (1.88%)
16	Zarqa University	Zarqa	1994	Private	265 (1.80%)
17	University of Petra	Amman	1991	Private	228 (1.54%)
18	Philadelphia University Jordan	Amman	1989	Private	215 (1.47%)
19	Isra University	Amman	1991	Private	212 (1.45%)
20	Middle East University, Jordan	Amman	2005	Private	150 (1.02%)
NU= Name of the University, P=Place, YE = Year of Establishment, T=Type, TP=Total Publications					

5.3 Contributing Journals

There were a total of 4767 no. of journals which have been used by the researchers of the Jordan for their publications and of which majority of them are from other countries like USA, UK, Pakistan, etc. indicating that the Jordanian researchers prefer to publish their research findings from international publishers. It was found that the Dirasat: Human and Social Sciences published by the university of Jordan has contributed more articles followed by Journal of Theoretical and Applied Information Technology published by the Little Lion Scientific, Pakistan with 273 and 123 no. of articles respectively. Except Plos One from USA, the top nine contributing journals are having lesser citation impact as represented from their SNIP, SJR and CiteScore like Dirasat: Human and Social Sciences have got only 12 citations, Jordan Medical Journal with only 23 citations, Jordan Journal of Civil Engineering with 86, Jordan Journal of Mechanical and Industrial Engineering with 109, Jordan Journal of Biological Sciences with 75.

Table-3 Highly contributed journals

S. No.	Name of the Journal	Publisher	Country of origin	Articles	%age (14722)	2019		
						SNIP	SJR	CiteScore
1	Dirasat: Human and Social Sciences	University of Jordan	Jordan	273	1.86	0.069	0.139	0.0
2	Journal of Theoretical and Applied Information Technology	Little Lion Scientific	Pakistan	123	0.83	0.494	0.229	1.2
3	Jordan Medical Journal	University of Jordan	Jordan	86	0.59	0.14	0.107	0.1
4	International Journal of Advanced Computer Science and Applications	Science and Information Organization	United Kingdom	79	0.53	0.382	0.156	0.6

5	Jordan Journal of Civil Engineering	Jordan University of Science and Technology	Jordan	64	0.43	0.596	0.202	0.7
6	Desalination and Water Treatment	Desalination Publications,	USA	59	0.40	0.476	0.327	2.7
7	Italian Journal of Pure and Applied Mathematics	Forum Societa Editrice Universitaria Udinese SRL	Italy	59	0.40	0.484	0.205	0.8
8	Jordan Journal of Mechanical and Industrial Engineering	Hashemite University	Jordan	57	0.39	0.725	0.388	1.2
9	Jordan Journal of Biological Sciences	Hashemite University	Jordan	55	0.38	0.386	0.182	0.7
10	Plos One	Public Library of Science	USA	55	0.38	1.205	1.023	5.2

While applying the Bradford law, it is worthwhile to note that first 227 journals constitute the first Bradford zone which is representing only 4.76% of journals and contributing 32.98% articles. The rest of the 95.24% of journals are represented by second and third zone contributing respectively 33.98% and 33.03% of articles.

Table-4 Bradford Zones

S. No.	Zone	No. of Journals	%Age	No. of Articles	%Age
1	First Zone	227	4.76	4856	32.98
2	Second Zone	1020	21.40	5004	33.98
3	Third Zone	3520	73.84	4862	33.03
Total		4767	100	14722	100

5.4 Highly Cited Journals

The Jordanian researchers are publishing their research output not only in local journals but also in foreign well known journals which is represented by the citations of the articles received during the last five years. A total of 120928 citations have been received by 14722 articles with an average of 8.21 per article reflected from the high impact and citescore journals. Of the 4767 journals, the Lancet journal has occupied the first position with 9926 citations with only 34 articles being published by Jordanian authors. The Lancet journal is one of the prestigious publications from Elsevier for publishing the high standard original medical research articles. It is currently ranked second among 150 journals in the field of General and Internal Medicine with 73.4 CiteScore and 60.392 Impact Factor. This is followed by New England Journal of Medicine published by Massachusetts Medical Society with 611

citations from only 4 articles, IEEE Access with 473 citations from 51 articles but with a less average citation per article. The table 5 provides only the list of top 10 highly cited journals which is arranged on the basis of total number of citations and not on average citation per article. It is found from the table that none of the local journals from Jordan are finding any place in the list which reflects that the local journals are getting lesser citations as compared to the international journals. Also, a perception that a large number of articles of a journal are getting maximum number of citations does not seem fit here as many highly cited journals are having lesser number of research articles.

Table-5 Highly Cited Journals

S. No	Name of the Journal	Total Citations (120928)	No. of Articles (14722)	Avg. Citation Per Article	Publisher	Cite Score (2019)	SNIP (2019)	SJR (2019)
1	The Lancet	9926 (8.20)	34 (0.23)	291.94	Elsevier	73.4	21.313	14.554
2	New England Journal of Medicine	611 (0.50)	4 (0.03)	152.75	Massachusetts Medical Society	66.1	13.212	18.291
3	IEEE Access	473 (0.39)	51 (0.35)	9.27	IEEE	3.9	1.734	0.775
4	The Lancet Neurology	402 (0.33)	5 (0.03)	80.4	Elsevier	44.6	10.251	11.258
5	JAMA Oncology	371 (0.30)	4 (0.03)	92.75	American Medical Association	29.6	5.622	7.593
6	Journal of the American College of Cardiology	329 (0.27)	1 (0.006)	329	Elsevier	29.0	5.885	9.989
7	The Lancet Gastroenterology and Hepatology	301 (0.25)	2 (0.01)	150.5	Elsevier	17.1	4.191	5.299
8	Advances in Engineering Software	265 (0.22)	1 (0.006)	265	Elsevier	9.5	2.745	1.24
9	Future Generation Computer Systems	261 (0.22)	14 (0.10)	18.64	Elsevier	10.2	2.687	1.216
10	Soft Computing	256 (0.21)	13 (0.09)	19.69	Springer Nature	4.7	1.593	0.705

5.5 Highly Contributed and Cited Authors

The authors are the engines of research production and it is always pertinent to find the most prolific authors in any field of research or a country. There are a total of 110965 author occurrences and 42699 authors who have contributed their output in Jordan literature during the last five years. It is apparent from the table 6 that the top ranked universities in Jordan are having highly productive authors as reflected from Jordan University of Science and Technology with maximum top places occupied by the university followed by University of Jordan and Applied Science Private University. It is found that Khader,YS has maximum number of research publications

and citations during the last five years followed by Alzoubi KH and Khabour OF from the Jordan University of Science and Technology. Mubarak MS from the University of Jordan occupies 4th rank among the authors. It is pertinent to mention here that the multiple names used by the authors in their publications have been added separately and only unique titles of each author have been cumulated e.g. the name variants of Khader YS in the scopus database are: Khader, Yousef Saleh ; Khader, Y. S. ; Khader, Yusuf ; Kassa, Tesfaye Dessale ; Khader, Yousef ; Khader, Y. ; Khader, Yousef Y. ; Khader, Yusuf S. ; Saleh Khader, Yousef ; Khader, Yousuf ; Khader, Yousef S. ; Mayosi, B. M. ; Khader, Yusif ; Khader, Yosef ; Khader, Youcef ; Khader, Yusef Saleh and similarly Alzoubi KH has been indexed as Alzoubi, Karem H, Alzoubi Karem, AlZoubi Karem, Alzoubi Korem H, etc. The recent affiliation of the authors has been used in the present study. It is to mention here that the h-index of the authors is their total publication index and not that of the last five years publication.

Table-6 Top 10 Highly Contributed and Cited Authors

SN	Author	Affiliation	NP	TC	h-index
1	Khader YS	Jordan University of Science and Technology, Amman, Jordan.	195	35390	75
2	Alzoubi KH	Jordan University of Science and Technology, Irbid, Jordan.	143	920	34
3	Khabour OF	Jordan University of Science and Technology, Irbid, Jordan.	106	824	27
4	Mubarak MS	University of Jordan, Amman, Jordan.	75	666	28
5	Jararweh Y	Jordan University of Science and Technology, Irbid, Jordan.	74	1395	30
6	Alquran M.	Jordan University of Science and Technology, Irbid, Jordan.	56	698	22
7	Kasabri, V	University of Jordan, Amman, Jordan.	48	150	14
8	Paris, H	University of Jordan, Amman, Jordan.	47	2460	24
9	Al-Ayyoub, M	Jordan University of Science and Technology, Irbid, Jordan.	46	923	29
10	Basheti, I. A.	Applied Science Private University, Amman, Jordan.	45	223	16

5.6 Authorship Pattern

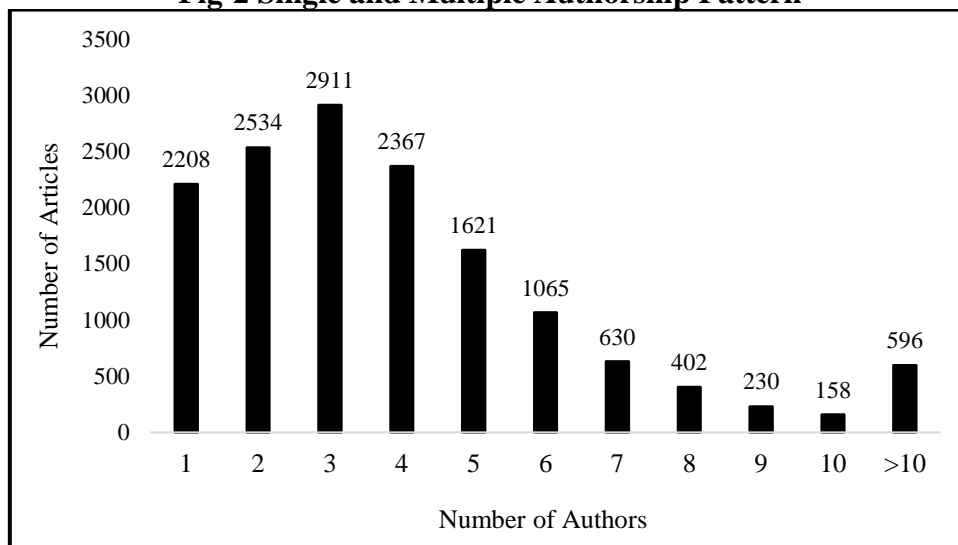
Out of the total articles, it is found that 2208 articles are written by single authors and 12514 by multiple authors with maximum number of articles being published by three and followed by two and four authors. So, it is clear that the Jordanian researchers prefer more collaborative work rather than individual contributions which is an important trend of research in Jordan. There are many studies which are supporting the multi-authorship pattern of research in fetching the overall impact and citations of

the publications and Jordanian research is at an advantageous position in terms of collaboration of research as maximum articles are published with multiple authors.

Table-7 Yearwise Authorship Pattern

No. of Authors	No. of Articles					Total	%age (14722)
	2015	2016	2017	2018	2019		
1	322	394	422	514	556	2208	14.99
2	351	425	451	565	742	2534	17.21
3	421	470	483	679	858	2911	19.77
4	303	411	409	572	672	2367	16.07
5	240	259	277	356	489	1621	11.01
6	153	147	190	257	318	1065	7.23
7	80	85	131	153	181	630	4.27
8	49	58	65	95	135	402	2.73
9	34	47	48	49	52	230	1.56
10	18	16	33	37	54	158	1.07
>10	75	79	126	146	170	596	4.04
Total						14722	100

Fig-2 Single and Multiple Authorship Pattern



The present study also tried to find the applications of Lotka's law in the overall productivity of authors and it was found that 27979 authors produced only one article, 5890 only two, and 2397 only three and on the other side, 195, 143, 106 articles have been written by only one author. The findings are in proxim of the Lotka law which the Jordanian research has reflected in its pattern of author productivity.

Table-8 Lotka's Law of Author Productivity

Documents written	No. of Authors	Proportion of Authors
1	27979	0.655
2	5890	0.138
3	2397	0.056
4	1374	0.032
5	845	0.02
6	740	0.017
7	482	0.011
8	584	0.014
9	289	0.007
10	221	0.005
- - - - -	- - - - -	- - - - -
- - - - -	- - - - -	- - - - -

Documents written	No. of Authors	Proportion of Authors
45	1	0
46	3	0
47	2	0
48	1	0
56	1	0
74	1	0
75	1	0
106	1	0
143	1	0
195	1	0

5.7 Subject Areas

One of the fundamental aspects of research assessment is to find the stronger and weaker subject areas and in case of Jordan, it was found that the articles have been produced in 24750 areas of knowledge in which the medicine, engineering, computer sciences are stronger areas of research while as the Economics, Econometrics and Finance, Neuroscience, Veterinary, Decision Sciences, etc are the weaker areas of interest among the authors of Jordan. The subject areas mentioned in the table 9 are the headings available in scopus and there are multiple subject headings which have been used for a single article and hence 14722 articles have got 24750 subject headings. This may be probably because of the multi-disciplinary and interdisciplinary nature of subjects. Along with that, the broader subject areas assigned to articles makes it difficult to exactly find the specific areas of research which could have been used to determine the research trends and emerging new areas of research in Jordan.

Table-9 Top 10 subject areas

S. No.	Subject Areas	No. of Articles	%age (14722)*
1	Medicine	2903	19.71
2	Engineering	2789	18.95
3	Computer Science	2205	14.98
4	Social Sciences	1729	11.75
5	Mathematics	1549	10.52
6	Biochemistry, Genetics and Molecular Biology	1230	8.36

7	Agricultural and Biological Sciences	1109	7.53
8	Environmental Science	1079	7.32
9	Chemistry	1061	7.20
10	Physics and Astronomy	1018	6.91

5.8 Research Collaboration in Jordan

The Jordanian research is widely collaborated across many countries with USA and Saudi Arabia at the top of collaboration list constituting 23.12 % of total collaboration of Jordan. This is followed by UK, UAE, Germany, Malaysia and the less favourable collaboration are witnessed by Afghanistan, Albania, Argentina, Bangladesh, Botswana, Indonesia, etc.

Table-10 Highly Collaborated Countries

S. No.	Country	No. of Articles	%age (14722)
1	United States	1909	12.97
2	Saudi Arabia	1495	10.15
3	United Kingdom	916	6.22
4	United Arab Emirates	739	5.01
5	Germany	723	4.91
6	Malaysia	569	3.86
7	Canada	509	3.46
8	Australia	506	3.44
9	Egypt	494	3.36
10	Italy	408	2.77
11	India	400	2.71
12	Pakistan	292	1.98
13	China	279	1.89
14	Qatar	275	1.87
15	Japan	258	1.75
16	France	256	1.74
17	Turkey	243	1.65
18	Spain	239	1.62
19	Palestine	237	1.60
20	Iran	234	1.59

5.9 Highly Cited Articles

The highly cited articles are the outcome of major collaborative research projects funded by Bill & Melinda Gates Foundation as Global Burden of Disease (GBD) study. These studies provide a unique and comprehensive framework to systematically assess national trends in age-specific and sex-specific all-cause and cause-specific mortality with many authors and contributors across the globe. Secondly the articles are published in the highly cited and impactful journals like the Lancet and the New

England Journal of Medicine. The Lancet is one of the reputed journals in the field of Medicine published by Elsevier from United Kingdom with a Citescore of 73.4 (2019) and Impact Factor of 60.392 (2019). Its SNIP is 21.313 and SJR is 14.554 and publishes high quality original research and review articles. While as the New England Journal of Medicine is published by the Massachusetts Medical Society from USA with a Citescore of 66.1 (2019) and Impact Factor of 74.699 (2019). Its SNIP is 13.212 and SJR is 18.291 and is known as the world’s leading high quality medical science journal.

The article “*Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 19.2 million participants*” is also a result of global collaborative project on obesity and provides the longest and most complete picture of trends in adult BMI, including, for the first time, in underweight and severe and morbid obesity, which are of enormous clinical and public health interest. It is funded by Wellcome Trust, Grand Challenges Canada.

The 8th article “*Health Effects of Overweight and Obesity in 195 Countries over 25 Years*” published in the New England Journal of Medicine provides a comprehensive assessment of the trends in high body-mass index (BMI) and the associated disease burden at the global level. It assessed the trends of prevalence of overweight and obesity among children and adults between 1980 and 2015 using the Global Burden of Disease study data which may be the reason for its high citations

Table-11 Top 10 Highly Cited Articles

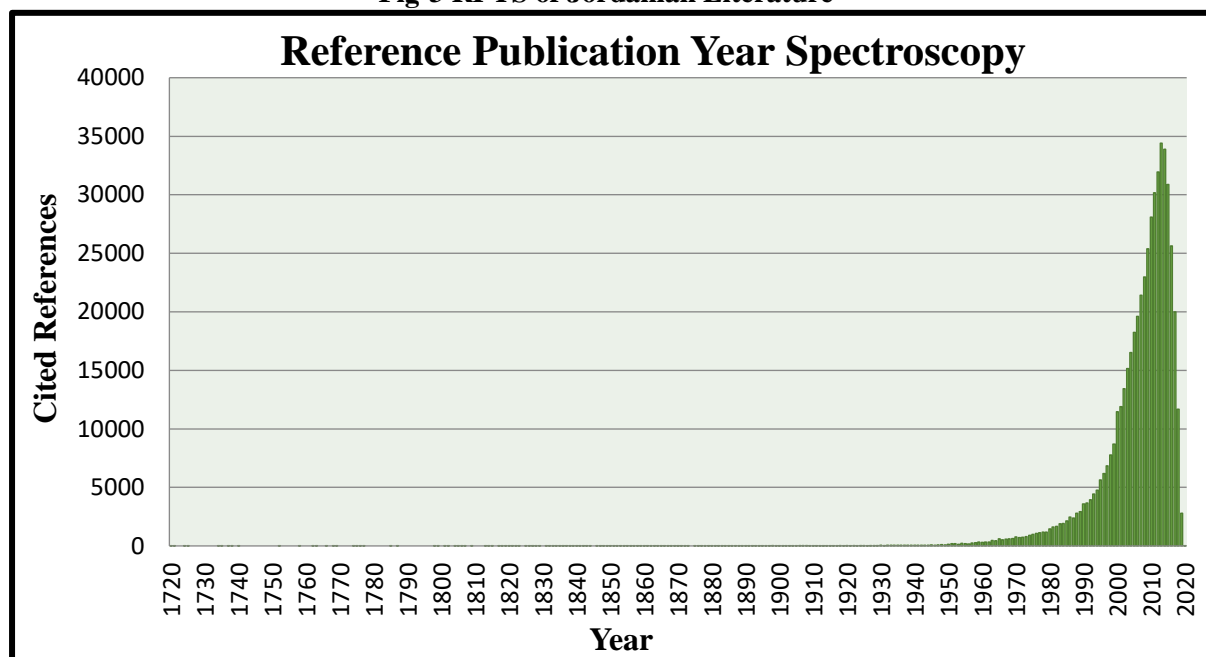
Year	Article Title	No. of Citations	Name of the Journal	Citescore (IF)	Author Name	No. of Authors
2015	Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: A systematic analysis for the Global Burden of Disease Study 2013	3896	The Lancet	73.4 (60.392)	Naghavi, M. et al. (2015)	717
2015	Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: A systematic analysis for the Global Burden of Disease Study 2013	2992	The Lancet	-	Vos, T et. al. (2015)	679
2016	Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015	2369	The Lancet	-	Wang, H. et. al. (2016)	771
2016	Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–2015: a	2350	The Lancet	-	Vos, T et. al. (2016)	640

	systematic analysis for the Global Burden of Disease Study 2015					
2016	Trends in adult body-mass index in 200 countries from 1975 to 2014: A pooled analysis of 1698 population-based measurement studies with 19.2 million participants	1790	The Lancet	-	Di Cesare, M. et. al. (2016)	744
2017	Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016	1683	The Lancet	-	Vos, T. et. al. (2017)	727
2016	Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015	1512	The Lancet	-	Forouzanfar M.H, et. al. (2016)	650
2017	Health effects of overweight and obesity in 195 countries over 25 years	1493	New England Journal of Medicine	66.1 (74.699)	Afshin A, et. al. (2017)	153
2017	Global, regional, and national age-sex specific mortality for 264 causes of death, 1980-2016: A systematic analysis for the Global Burden of Disease Study 2016	1430	The Lancet	73.4 (60.392)	Naghavi M. et. al. (2017)	600
2015	Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks in 188 countries, 1990-2013: A systematic analysis for the Global Burden of Disease Study 2013	1375	The Lancet	-	Forouzanfar M.H, et. al. (2015)	720

5.10 Reference Publication Year Spectroscopy (RPYS) Analysis

There were a total of 509270 number of references which have been used by the authors in their articles starting from year 1720 to 2020. As it is apparent from the figure 3 that the older references have been used very less as compared to the new ones with the peak of the curve at 2013 with 34414 references being cited by the Jordanian authors. In 1999, there were 8706 no. of citations which rose upto 11454 in the year 2000. The highest no. of references has been used from the year 2011 with 30167 no. of citations to 2015 with 30887 references and there after the curve again tends to decrease because of the recent literature. It can be inferred that the Jordanian research uses mostly the newer references which may be related with the stronger areas of research like medicine, computer sciences, engineering which needs new and nascent research for backing an argument.

Fig-3 RPYS of Jordanian Literature



Discussion:

The higher education and research system in the Hashemite Kingdom of Jordan is offered through public and private universities, community and university colleges and research institutes which are specialised in medicinal, health, environmental and technology domains. This structure of institutes reflects the overall research potential of Jordan. During the last five years, 14722 articles have been contributed by these institutes which had received 120928 citations with an average citation of 8.21 per article. There is a continuous growth of articles and citations received. The Jordanian public universities are highly productive as compared to private universities and other research institutes. The first five top universities produce about 76% of total articles and the University of Jordan and Jordan University of Science and Technology together constitutes about 50% of Jordanian research output. This is because the public universities in Jordan are established way back as early as 1970s which helped these universities to develop better infrastructure for undertaking the research and developmental activities as compared to the recent ones. So far as the journals are concerned, Jordanian authors have used 4767 journals for their publications and of which majority of them are from countries like USA, UK, Pakistan, Malaysia, etc. indicating that the Jordanian researchers prefer to publish their research findings from

international publishers. The number of articles published in local journals is more but their citations are very less as compared to non local journals which avert the perception that a large number of articles of a journal are getting maximum number of citations does not seem fit here as many highly cited journals are having lesser number of research articles. The use of well known foreign journals for publications may be associated with the high reputation and quality research which is represented by the citations of the articles received during the last five years. A total of 120928 citations have been received by 14722 articles with an average of 8.21 per article. As far as the Jordanian authors are concerned, there were 110965 author occurrences and a total of 42699 authors who have contributed their research output with a trend of occupying the top ranks by the authors of highly productive universities like that of Jordan University of Science and Technology and University of Jordan. The Jordanian authors prefer multi-authorship pattern of research and more collaboration rather than an individual contribution which is an important trend of research in Jordan, as 2208 articles are written by single and 12514 by multiple authors. So far as the stronger and weaker subject areas in Jordan are concerned, medicine, engineering, computer sciences emerged as the stronger areas of research while as the economics, econometrics and finance, neuroscience, veterinary, decision sciences, etc. as weaker areas of interest among the authors of Jordan. For country's collaboration, Jordan has widely collaborated USA and Saudi Arabia at the top, followed by UK, UAE, Germany and Malaysia and the less favourable collaboration was witnessed by Afghanistan, Albania, Argentina, Bangladesh, Botswana, Indonesia, etc. So far as the highly cited articles are concerned, the major research projects funded by Bill & Melinda Gates Foundation as Global Burden of Disease (GBD) study followed by global collaborative projects on obesity and high body-mass index (BMI) and the associated disease burden at the global level coupled with the publication in highly impact journals are responsible for high citation counts of these articles. The Jordanian research in the RSPY represents mostly the newer references which may be the result of stronger areas of research like medicine, computer sciences, engineering that needs newer ideas and innovation in every passing day.

Conclusion

The Jordanian research performance is promising as compared to the other countries in the Middle East leaving Saudi Arabia, Lebanon and Egypt aside. Its research reflects the growth of higher education and the governmental priorities in the kingdom. It performs well in the field of medicine, computer sciences, engineering, mathematics, with continuous increase in the number of research publications and citations. The earlier established universities are leading the show with their authors as top contributors of Jordanian research. It represents more collaboration and multiple authorship trends with research publications in high quality non-local journals of international repute. The strong collaboration with USA, Saudi Arabia, UK, UAE, Germany, and Malaysia has proved useful for Jordan in terms of citations received in their publications. The single author publications have been very less represented in Jordanian research. The Jordanian authors have used local journals also but their citations are very less as compared to non-local journals. Some of the Jordanian articles are highly cited which are the results of highly collaborative research projects at the international level. The overall research performance of Jordan seems strong in light of other Middle East countries however, compared with the other developing and developed countries it lags both in number as well as in quality of research which the higher education council of Jordan should focus and prioritise in its future policies.

References:

- Glänzel, W. (2003). *Bibliometrics as a Research Field: A course on theory and application of bibliometric indicators*. Course Handouts.
- Raan, A.F.J. van (2003). The use of bibliometric analysis in research performance assessment and monitoring of interdisciplinary scientific developments. *Technikfolgenabschätzung – Theorie und Praxis Nr. 1, 12. Jg., März 2003*.
- Waltman, L & Ed Noyons (2018). *Bibliometrics for Research Management and Research Evaluation: A Brief Introduction*
- Asad Abdi, Norisma Idris, Alguliyev, Rasim M., Aliguliyev, Ramiz. M. (2018). Bibliometric Analysis of IP&M Journal (1980–2015). *Journal of Scientometric Research*, 7(1), pp.54-62. DOI: 10.5530/jscires.7.1.8

- Hervé Rostaing (2003). Basic principles of bibliometrics. Application to Research Development. The competitive intelligence and industrial vision in the 21st century, Shanghai Institute of Technology, Shanghai, China.
- Suleiman, R.J., Sarhan, A. A., Tawalbeh., S.A., & Ahmed, M. H. (2016). Jordanian Intellectual Production from 2002 – 2011 : A Bibliometric Analysis. *Information and Knowledge Management*, 6 (2), 11–16.
- Hayajneh, W. A., Hayajneh, R. A., & Miqdady, M. S. (2010). A bibliometric analysis of PubMed-published Jordanian literature in the twentieth century. *Jordan Medical Journal*, 44(2), 152–158.
- Zyoud, S. H., Al-Jabi, S. W., Sweileh, W. M., & Awang, R. (2014). A bibliometric analysis of toxicology research productivity in Middle Eastern Arab countries during a 10-year period (2003-2012). *Health Research Policy and Systems*, 12(1). <https://doi.org/10.1186/1478-4505-12-4>
- Zyoud, S. H., Al-Jabi, S. W., & Sweileh, W. M. (2015). Scientific publications from Arab world in leading journals of Integrative and Complementary Medicine: A bibliometric analysis. *BMC Complementary and Alternative Medicine*, 15(1), 1–10. <https://doi.org/10.1186/s12906-015-0840-z>
- Kaba, A., & Ramaiah, C. K. (2019). Bibliometric analysis of research output on the internet of things in the Arab world. *DESIDOC Journal of Library and Information Technology*, 39(5), 222–229. <https://doi.org/10.14429/djlit.39.5.14303>
- AlRyalat, et.al. (2019). The impact of the open-access status on journal indices: Oncology journals. *Journal of Gastrointestinal Oncology*, 10(4), 777–782. <https://doi.org/10.21037/jgo.2019.02.13>
- UNESCO Institute for Statistics. (2005). What do bibliometric indicators tell us about world scientific output? *UIS Bulletin on Science and Technology Statistics*, (2), 1–6.
- Chahrour, et.al. (2020). A Bibliometric Analysis of COVID-19 Research Activity: A Call for Increased Output. *Cureus*, 12 (3), 1–8. <https://doi.org/10.7759/cureus.7357>
- Khamees, N.et.al. (2019). Gastroenterology and Hepatology Research Output in the 20th Century: A Bibliometric Study. *Journal of Gastroenterology and Hepatology Research*, 8 (3), 2903-2906. <https://doi.org/10.17554/j.issn.2224-3992.2019.08.824>
- Dardas, L. A., Sawair, F. A., F., Nabolsi, M., & Simmons, L. A. (2018). Nursing research in the Arab Region : A bibliometric analysis. *International Journal of Nursing Practice*, 1–11. <https://doi.org/10.1111/ijn.12716>
- Sweileh, W. M. (2018). Bibliometric analysis of peer-reviewed literature on Syrian refugees and displaced people (2011 – 2017). *Conflict and Health*, 12:43, pp.10–13. <https://doi.org/10.1186/s13031-018-0179-4>

- Zeinoun, P., Akl, E. A., Maalouf, F. T., & Meho, L. I. (2020). The Arab Region ' s Contribution to Global Mental Health Research (2009 – 2018): A Bibliometric Analysis. *Systematic Review*, 11 (March), 1–11. <https://doi.org/10.3389/fpsyt.2020.00182>
- Hassona, Y., & Qutachi, T. (2019). A bibliometric analysis of the most cited articles about squamous cell carcinoma of the mouth, lips, and oropharynx. *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*, 128 (1), 25–32. <https://doi.org/10.1016/j.oooo.2019.01.076>
- Valera-gran, D. et.al. (2020). Bibliometric Analysis of Research on Telomere Length in Children: A Review of Scientific Literature. *International Journal of Environmental Research and Public Health*, 17, 4593. Doi: 10.3390/ijerph17124593.
- Sweileh, W. M. (2017). Bibliometric analysis of medicine – related publications on refugees, asylum-seekers, and internally displaced people : 2000 – 2015. *BMC International Health and Human Rights* (2017) 17:7, pp.1–11. <https://doi.org/10.1186/s12914-017-0116-4>
- Sweileh, W. M.,et.al. (2014). Research Output from Palestine (1995–2012): A Bibliometric Study. *International Information & Library Review*. 46: 99–112. <https://doi.org/10.1080/10572317.2014.943070>
- Sweileh, W. M.et.al. (2019). Nursing and midwifery research activity in Arab countries from 1950 to 2017. *BMC Health Services Research* 19:340, pp. 1–11. <https://doi.org/10.1186/s12913-019-4178-y>
- Uzun, A. (1996). A Bibliometric Analysis of Physics Publications from Middle Eastern Countries. *Scientometrics*, 36(2), 259–269.
- Zyoud, SH. H., et.al. (2017). A bibliometric-based evaluation on environmental research in the Arab world. *International Journal of Environmental Science and Technology*, 14(4), 689–706. <https://doi.org/10.1007/s13762-016-1180-3>
- Ministry of Higher Education (2020). Higher education system in Jordan. Retrieved 25 July, 2020 from <http://www.mohe.gov.jo/en/pages/default.aspx>
- Report of EU on overview of the higher education system (2017). Overview of the Higher Education System. Retrieved from https://eacea.ec.europa.eu/sites/eacea-site/files/countryfiches_jordan_2017.pdf
- SPHERE Consortium EU (2020). Higher Education in Jordan. Retrieved from <http://supporthere.org/page/higher-education-jordan>
- Mahafzah, A (2017). Higher education in Jordan: history, present status and future. *QS Asia News Network*. Retrieved from <https://qswownews.com/higher-education-in-jordan>.