Bibliometric Analysis and Predictors of Citations for Publications of a Higher Institution

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Abstracts: Purpose: This study aims to depict the productivity and impact of publications affiliated with Jordan University of Science and Technology (JUST), and to identify bibliometric factors associated with the number of citations. Methods: Using keywords and identification numbers, Scopus and Web of Science were searched for all publications affiliated with JUST from 1987-2022. The retrieved data was imported, cleaned, visualized, and analyzed using stataIC 16, Excel 395 software, and VOSviewer software. The bibliometric analyses were conducted for types of publications, year of publications, type of journals, faculties, departments, faculty members, and most cited publications. Networking analyses were also conducted for international collaboration and keyword analysis using VOSviewer. Univariable and multivariable Poisson regression models were conducted to estimate the impact of several bibliometric factors on citation numbers. Results: A total of 16,830 publications were affiliated with JUST and published between 1986 and 2022. The total number of citations was 330,046. The average citation per publication was 19.6 and the institutional h-index was 165. Most publications were original articles (81.8%) and 71.7% were published in traditional (non-open) journals. Publication and citation numbers increased steadily, until 2013, and then exponentially, afterward. The Faculty of Engineering had the highest number of total publications (4,593), while the Faculty of Medicine had the highest number of total citations (148,384). Professor Yousef S. Khader ranks first as JUST's influential faculty with 640 publications and 110,777 citations. Factors contributing to higher incidence rate for citations include years since publication, indexing in Scopus and WoS, reviews, publication in open-access journals, and collaboration. Network analysis revealed significant clusters of authors and keywords, with strong connections to the United States and Saudi Arabia. Conclusion: The productivity nd impact of JUST publications have improved annually for all faculties and departments. However, this improvement seems to be limited and can be explained by several factors. Further improvements in research productivity and impact are needed by implementing relevant strategies such as collaboration and interdisciplinary research, publishing in high-impact journals, considering open-access publishing, considering the potential societal impact of research, increasing visibility and reputation through appropriate affiliations, publishing review articles, and monitoring research output over time.

Keywords: Bibliometric, Scientometric, Citation Predictors, Scopus, Web of Science, Jordan University of Science and Technology.

1. INTRODUCTION

Bibliometric analysis is a data-driven method used to analyze and quantify literature output and trends [1, 2]. It can help researchers gain a comprehensive overview, identify knowledge gaps, generate new ideas, and contextualize their contributions [3]. Bibliometrics is also a powerful method for evaluating the research performance of academic institutions such as universities and research organizations [4, 5]. Additionally, the integration of scientometric analysis can reveal relationships and gain insights into collaboration patterns between research constituents, which offers valuable insights into the bibliometric and intellectual landscape of higher educational institutions [6]. By regularly assessing their research output through bibliometric and scientometric analysis, academic institutions can evaluate their performance and impact, and make informed decisions on new research strategies [7]. Bibliometrics is also important for researchers and academic organizations as they are often used to make funding choices, hiring decisions, and promotions [8].

Several studies have demonstrated various factors influencing the number of citations. A review conducted in 2016 reported a total of 28 factors affecting the number of citations. These factors were categorized into a) paper-related factors, b) journal-related factors, and c) author-related factors [9]. Paper-related factors include high-quality [10], study subjects and field of discipline, and study design. For example, analytic chemistry, organic chemistry, and physical chemistry gain more citations than those on biochemistry in chemistry papers [11]. This may explain the

variation in the citation number by the faculties and faculty members. In addition, randomized control trials and review papers receive more citations than research designs [12].

Further, studies in different disciplines published in open-access journals receive more citations than papers published in non-open-access journals [13, 14]. Research papers published in high-impact factor journals receive more citations than those published in low-impact factor journals [15]. The number of authors, fields of authors, and authors from diverse disciplines positively influenced the number of citations [16]. Different source of databases also influence the number of citations, for example, the publication indexed in Google Scholar receive more citations than in Web of Science (WOS) and Scopus [17].

To date, evaluations of the research performance of universities in developing countries such as Jordan are limited. In addition, knowledge about the factors associated with the number of citations for such universities is limited. Therefore, this study aimed to depict the productivity and impact of publications affiliated with JUST and to identify bibliometric factors associated with their number of citations.

2. METHODS

Study Design and Setting

This was an advanced retrospective and bibliometric analysis of all publications with at least one author affiliated with JUST. Data were extracted from the Scopus and Web of Science (WoS) databases.

JUST is a prestigious academic institution located in Al-Ramtha, northern Jordan. It established in 1986 and had since grown to become one of the top universities in Jordan and the Middle East, with almost 30,000 undergraduate students in 46 programs. JUST has 12 faculties and 62 academic departments, including the King Abdullah University Hospital, which is a teaching hospital on the JUST campus. The university also has a faculty of 1,749 academic staff. In the 2022 world university ranking, JUST was ranked 501-600 overall, 161st in the Best Global Universities for Clinical Medicine, 24th in the Arab Region Rankings, and 90th for young universities [18].

Search Strategy

We searched Scopus and Web of Science (WoS) databases using relevant affiliation keywords and affiliation IDs associated with JUST. In Scopus, two affiliation IDs were identified for JUST: affiliation ID 60051534 for "Jordan University of Science and Technology" and affiliation ID 60199630 for the "Faculty of Medicine JUST." In WoS, all potential organization names of JUST were considered. The search strategy encompassed all languages, publication dates, and study types (Table 1).

Table 1: The search strategy.

Database	Search strategy
Scopus	AFFIL("jordan university of science and technology" OR "jordan univ. of sci. and technology" OR "jordan univ. of sci./technol." OR "jordan university and science & technology" OR "Jordan University of Science and Technology JUST" OR "Jordan Univ. of Science and Technology" OR "jordanian university of science and technology" OR "Jordan Univ. of Science and/Technology" OR "Jordan university of science & technology" OR "Jordan University Science and Technology") OR AFFIL("JUST University") AND AFFIL(jordan OR irbid) OR AFFIL("JUST") AND AFFIL(jordan OR irbid) OR AF-ID("Jordan University of Science and Technology" 60051534) OR AF-ID("Faculty of Medicine Jordan University of Science and Technology" 60199630)
WoS	OG=("jordan university of science and technology" OR "jordan univ. of sci. and technology" OR "jordan univ. of sci./technol." OR "jordan university and science & technology" OR "Jordan University of Science and Technology JUST" OR "Jordan Univ. of Science and Technology" OR "jordanian university of science and technology" OR "Jordan Univ. of Science and/Technology" OR "JUST University" OR Jordan OR irbid OR "Jordan university of science & technology" OR "Jordan University Science and Technology").

Data collection and manipulation

The retrieved publications with their essential variables (title, authors, affiliations, document type, journal, DOI, abstract, publication year, organization, number of citations, keywords, open access status, and funding details) were exported as two comma-separated values (CSV) files from both databases and then were merged into one dataset. Duplicate publications were identified and removed by comparing titles and DOIs. To ascertain JUST authors and their respective affiliations (department and faculty), the affiliation variable was split into separate variables, each containing the affiliation details of one author. Text mining techniques were then employed to extract author names, departments, and faculties associated with JUST, whenever specified. The Scopus author ID was also utilized to identify JUST authors when applicable.

Bibliometric and statistical analyses

Several metrics were estimated for all constitutes of JUST, including types of publication, year of publication, type of journal, faculties, department, faculty members, best publications, and journals. these metrics included the total publications (TP), sole-authored articles (SA), co-authored articles (CA), number of contributing authors (NCA), annual collaboration index (ACI), number of cited publications (NCP), total citations (TC), average citations (AC), citations per cited publication (C/CP), proportion of cited publications (PCP), collaboration index (CI), collaboration coefficient (CC), h-index, g-index, m-index, i10-index, number of active years of publication (NAY), and productivity per active year (PAY).

To identify factors associated with the number of citations received by publications, Poisson regression models were employed. Univariable and multivariable Poisson regression models were used to evaluate the impact of various variables (such as years since publication, databases, publication type, journal type (traditional vs. open access), number of authors, and faculty characteristics) on citation count. The results were presented as unadjusted and adjusted incidence risk ratios (IRR). In the multivariable model, the presence of Professor Khader was included as a covariate to account for global studies with extreme citation values. All data cleaning and analyses were performed using Excel and Stata statistical software (StataCorp, version 16.1, College Station, Texas, USA).

Visualization of Similarities

A CSV sheet was imported into the Visualization of Similarities Viewer (VOSviewer, v.1.6.18) software to analyze and visualize associations between authors, countries, and terms used in the publications [19]. The relationship was demonstrated as a network visualization mapping". To identify significant themes and temporal trends, co-occurrence analysis was performed on author keywords that occurred more than ten times in JUST publications. Network relationships among underlying research themes were examined, excluding country and regional names to focus on scientific topics and keywords. Normalization based on association strength minimized redundancy among comparable terms with similar meanings.

3. RESULTS

Identified publications of JUST

Our search strategy identified a total of 15,951 publications in Scopus and 12,170 publications in WoS. After removing 11,261 duplicates, a total of 16,832 unique publications with at least one author affiliated with JUST in both databases were included (Figure 1).
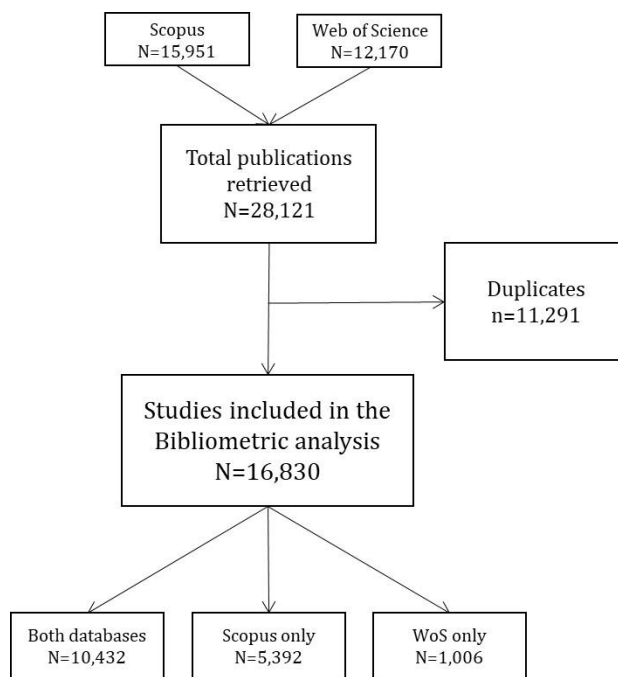
Figure 1: Flowchart of database data collection (October 2022).

The types and citations of JUST publications

Table 2 presents the total publications and citations by types of publication and types of journals. Most publications were original articles (82.1%), followed by conference papers (12.1%) and reviews (3.3%). A total of (71.7%) of publications were published in traditional journals (non-open access) and (28.3%) were published in open-access journals. Most publications in open-access journals were original articles (88.6%), followed by reviews (4.6%), and conference papers (4.1%). Overall, JUST publications (n=16,830) were cited 330,046 times, giving a citation average of 19.6 citations per publication. Although most publications were published in traditional journals (71.7%), the total citations (TC) for the publications in traditional journals (173,233) were slightly higher than for publications published in open journals (156,813).

Table 2: Total JUST publications and citations by the type of publication and across traditional and open journals.

	Total		Traditional		Open	
	Publications n (%)	Citations n (%)	Publications n (%)	Citations n (%)	Publications n (%)	Citations n (%)
Articles	13,814 (82.1)	299,459 (90.7)	9,592 (79.5)	154,401 (89.1)	4,222 (88.6)	145,058 (92.5)
Review	558 (3.3)	16,714 (5.1)	337 (2.8)	7,528 (4.3)	221 (4.6)	9,186 (5.9)
Conference paper	2,035 (12.1)	12,193 (3.7)	1,841 (15.3)	9,948 (5.7)	194 (4.1)	2,245 (1.4)
Book	104 (0.6)	453 (0.1)	101 (0.8)	445 (0.3)	3 (0.1)	8 (0)
Others	319 (1.9)	1,227 (0.4)	196 (1.6)	911 (0.5)	123 (2.6)	316 (0.2)
Total	16,830	330,046	12,067 (71.7)	173,233 (53.1)	4,763 (28.3)	156,813 (46.9)

Table 3 shows the results of a bibliometric analysis of all publications from JUST, categorized by journal type. According to the data, open journals have almost twice the number of contributing authors (co-authors) (80,405) than traditional journals (41,454), indicating a higher level of collaboration. This is also evident in the open journals having a higher annual collaboration index (15.9), collaboration index (0.003), and collaboration coefficient (0.94) compared to traditional journals. It's interesting to note that open journals have a lower h-index (117) than traditional journals (127), but a higher g-index (355 versus 185).

Table 3: The results of bibliometric analysis of total JUST publications and by the types of journals.

Metrics	All publications	Traditional Journals	Open Journals
Total publications	16,830	12,067	4,763
Productivity per active year	467.5	335.2	139.5
Total Citations	330,046	173,233	156,813
Average citations	19.6%	14.4%	32.9%
Number of cited publications	13,420	9,755	3,668
Citations per cited publication	24.60	17.8	42.8
h-index	165	127	117
g-index	393	185	355
Sole-authored publications	2,432	1,920	512
Co-authored publications	14,398	10,147	4,251
Number of contributing authors	121,859	41,454	80,405
Annual collaboration index	6.24	2.4	15.9
Collaboration index	7.44	3.43	16.88
Collaboration coefficient	0.86	0.71	0.94

Annual trend of publications and citations of JUST

Figure 2 shows the total number of publications and citations by the year of publication. The total publications and citations have steadily increased annually until the year of 2013. After that, the number of JUST publications and citations exponentially increased. The number of JUST publications in open-access journals remained remarkably lower than those in traditional journals and steadily increased until the year 2017 before exponentially increasing and exceeding the number of publications in traditional journals in 2020 and 2021. There was a spike in the citations between 2014 and 2020 with maximum citations for studies published in 2017(n=38,821). This spike is reflected by the citations of the studies published in open-access journals. However, the citations of studies published in traditional journals remained consistent from 2005 to 2018.
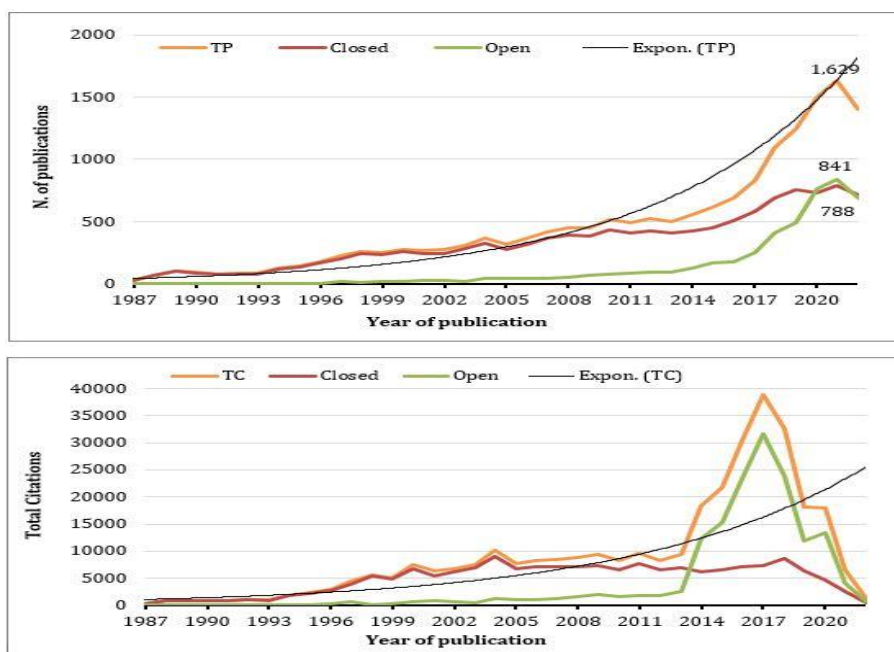

Figure 2: JUST publication and citations over the years of publication: 1987–2021. Note TP: Total publications, TC: Total citations.

Table 4 shows the bibliometrics metrics of JUST publications by year of publications. All bibliometrics had improved over the years correspondingly to the total publications and citations. The citation average ranges between 4.0 in 2021 and 46.6 in 2017. The sole-authored publications were 2,432 and ranged between 13 in 1987 and 185 in 2019. The co-authored publications were 14,398 ranging between 16 in 1987 and 1,478 in 2021. The NCA was 1211,859 and ranged between 57 in 1987 and 19,353 in 2020. In addition, the ACI was 6.24 and ranged between 0.97 for publications in 1987 and 14.83 for publications in 2017. The CC was 0.86 and ranged between 0.49 for studies published in 1987 and 0.94 for studies published in 2017.

A total of 13,420 publications had been cited and 3,410 publications had not been cited yet. The NCP ranged between 24 publications in 1987 and 1,205 publications in 2020. Finally, the h-index and g-index for all JUST publications were 165 and 393, respectively, and ranged between 9 and 17, respectively, for publications in 1987 and 56 and 163, respectively for publications in 2018.

Table 4: Bibliometrics by the year of publication for total JUST publications.

Year	TP	TC	AC	NCP	CCP	h	g	SA	CA	NCA	ACI	CI	CC
1987	30	304	10.4	24	12.6	9	17	13	16	57	0.97	0.80	0.49
1988	67	798	11.9	53	33.3	14	25	22	45	144	1.15	0.79	0.53
1989	103	893	8.7	85	37.2	18	29	33	70	231	1.24	0.83	0.55
1990	92	913	9.9	73	38.0	17	26	29	63	197	1.14	0.79	0.53
1991	80	886	11.1	69	36.9	18	25	18	62	215	1.69	0.86	0.63
1992	84	1,077	12.8	71	44.9	17	29	29	55	218	1.60	0.85	0.61
1993	86	1,018	11.8	75	42.4	16	28	33	53	213	1.48	0.87	0.60
1994	126	1,826	14.5	108	76.1	22	38	44	82	285	1.26	0.86	0.56
1995	143	2,285	16.0	121	95.2	23	44	50	93	341	1.38	0.85	0.58
1996	178	2,866	16.1	148	119.4	29	46	26	152	506	1.84	0.83	0.65
1997	226	4,461	19.7	192	185.9	34	58	59	167	578	1.56	0.85	0.61
1998	257	5,625	21.9	231	234.4	41	67	41	216	732	1.85	0.90	0.65
1999	253	5,075	20.1	222	211.5	37	59	46	207	702	1.77	0.88	0.64
2000	279	7,464	26.8	253	311.0	42	74	57	222	715	1.56	0.91	0.61
2001	269	6,292	23.4	238	262.2	41	66	68	201	692	1.57	0.88	0.61
2002	276	6,728	24.4	246	280.3	45	70	71	205	717	1.60	0.89	0.62
2003	306	7,464	24.4	280	311.0	44	75	69	237	766	1.50	0.92	0.60
2004	368	10,200	27.7	327	425.0	50	83	68	300	952	1.59	0.89	0.61
2005	320	7,773	24.3	285	323.9	48	72	73	247	935	1.92	0.89	0.66
2006	366	8,251	22.5	332	343.8	45	72	72	294	1,066	1.91	0.91	0.66
2007	420	8,392	20.0	355	349.7	43	74	72	348	1,399	2.33	0.85	0.70
2008	448	8,879	19.8	386	370.0	46	76	51	397	1,577	2.52	0.86	0.72
2009	454	9,330	20.6	399	388.8	50	73	64	390	1,583	2.49	0.88	0.71
2010	513	8,216	16.0	442	342.3	43	63	71	442	1,826	2.56	0.86	0.72
2011	495	9,511	19.2	428	396.3	49	70	47	448	1,794	2.62	0.86	0.72
2012	521	8,272	15.9	443	344.7	45	67	58	463	1,949	2.74	0.85	0.73
2013	503	9,473	18.8	452	394.7	43	76	52	451	1,907	2.79	0.90	0.74
2014	554	18,353	33.1	480	764.7	44	124	72	482	3,441	5.21	0.87	0.84
2015	618	21,811	35.3	559	908.8	47	135	72	546	5,709	8.24	0.90	0.89
2016	692	30,301	43.8	620	1,262.5	50	164	84	608	9,556	12.81	0.90	0.93
2017	833	38,821	46.6	729	1,617.5	52	187	111	722	13,190	14.83	0.88	0.94
2018	1,092	32,532	29.8	973	1,355.5	56	163	151	941	16,353	13.98	0.89	0.93
2019	1,246	18,213	14.6	1,022	758.9	44	111	185	1,061	11,277	8.05	0.82	0.89
2020	1,500	17,952	12.0	1,205	748.0	49	107	136	1,364	19,353	11.9	0.80	0.92
2021	1,629	6,504	4.0	1,098	271.0	29	49	151	1,478	12,858	6.89	0.67	0.87
2022	1,403	1,287	0.9	396	53.6	11	20	134	1,269	7,823	4.58	0.28	0.82
Total	16,830	330,046	19.6	13,420	24.60	165	393	2,432	14,398	121,859	6.24	7.24	0.86

Notes: TP = total number of JUST publications; SA = Sole-authored publications, CA = Co-authored publications, NCA = Number of contributing authors, ACI = Annual collaboration index (calculated as NCA/TP − 1), NCP = Number of cited publications, TC = Total citations, AC = Average Citations, CCP = Citations per cited publication, CI=Collaboration index, CC= Collaboration coefficient, h = h-index, g = g-index.

Bibliometrics of the faculties and departments of JUST

Most of the JUST publications (n=13,895, 82.6%) had an affiliation with one faculty at JUST, while 2,459 (14.6%) publications had an affiliation with two faculties, 422 (2.5%) publications had an affiliation with three faculties, 51 (0.3%) had an affiliation with four faculties, and 3 publications had affiliation with 5 faculties of JUST.

Table 5 shows the publications and citations of the faculties of JUST by type of publication and journals. The original articles were the most frequent type of publication and had the highest number of citations for all faculties. However, most publications of the Faculty of Computer and Information Technology were conference papers (47.6%) with (37.6%) citations. Followed by the Faculty of Engineering (14.3%) and the Faculty of Medicine (5.9%). The Faculty of Medicine had the highest number of reviews (5.7%), followed by the Faculty of Engineering (1.9%). Most publications for all faculties of JUST were published in traditional journals. However, 44.4% of the publications of the Faculty of Medicine were published in open-access journals, followed by the Faculty of Pharmacy (41.5%), and the Faculty of Applied Medical Sciences (39.6%). **Table 5**: The citations of the faculties of JUST by the type of publication. TP= Total publications, TC= Total citation

Faculty		Total	Article N (%)	Review N (%)	Conference N (%)	Book N (%)	Others N (%)	Open N (%)	Traditional N (%)
Medicine	TP	3,971	3,371 (84.9)	226 (5.7)	235 (5.9)	13 (0.3)	126 (3.2)	1,763 (44.4)	2,208 (55.6)
	TC	148,384	139,393 (93.9)	8,131 (5.5)	474 (0.3)	9 (0.01)	377 (0.3)	122,277 (82.4)	26,107 (17.6)
Dentistry	TP	950	849 (89.8)	39 (4.1)	36 (3.8)	2 (0.2)	24 (2.5)	273 (28.7)	677 (71.3)
	TC	18,593	16,863 (90.7)	1,475 (7.9)	175 (0.9)	0 (0.0)	80 (0.4)	3,291 (17.7)	15,302 (82.3)
Pharmacy	TP	1,773	1,604 (90.5)	81 (4.8)	54 (3.05)	7 (0.39)	27 (1.52)	735 (41.5)	994 (58.3)
	TC	21,315	19,427 (91.1)	1,743 (8.2)	62 (0.3)	22 (0.1)	61 (0.3)	8,011 (37.6)	13,304 (62.4)
Nursing	TP	779	696 (89.4)	41 (5.26)	23 (3.0)	4 (0.51)	15 (1.9)	286 (36.1)	493 (63.3)
	TC	8,257	7,442 (90.1)	680 (8.2)	40 (0.5)	14 (0.2)	81 (1.0)	2,035 (24.7)	6,222 (75.4)
Applied Medical Sciences	TP	1,279	1,136 (88.8)	60 (4.7)	61 (4.8)	2 (0.16)	20 (1.6)	507 (39.6)	772 (60.4)
	TC	14,723	13,343 (90.6)	1,150 (7.8)	120 (0.8)	0 (0.0)	110 (0.8)	6,425 (43.6)	8,298 (56.4)
Science and Arts	TP	2,800	2,538 (90.6)	69 (2.5)	154 (5.5)	12 (0.4)	27 (0.96)	872 (31.1)	1,928 (68.9)
	TC	32,876	30,766 (93.6)	1,424 (4.3)	488 (1.5)	92 (0.3)	106 (0.3)	9,801 (29.8)	23,075 (70.2)
Engineering	TP	4,593	3,767 (82.0)	89 (1.9)	656 (14.3)	25 (0.5)	56 (1.2)	662 (14.4)	3,931 (85.6)
	TC	73,265	67,368 (92.0)	3,197 (4.4)	2,224 (3.0)	65 (0.1)	411 (0.6)	7,478 (10.2)	65,787 (89.8)
Veterinary Medicine	TP	682	626 (91.8)	17 (2.5)	23 (3.4)	5 (0.7)	11 (1.6)	227 (33.3)	455 (66.7)
	TC	8,627	8,263 (95.8)	268 (3.11)	58 (0.7)	13 (0.2)	25 (0.3)	2,750 (31.9)	5,877 (68.1)
Agriculture	TP	1,260	1,172 (93.0)	33 (2.6)	30 (2.4)	15 (1.19)	10 (0.8)	342 (27.1)	918 (72.9)
	TC	23,748	22,550 (95.0)	786 (3.3)	266 (1.1)	111 (0.5)	35 (0.2)	4,488 (18.9)	19,260 (81.1)
Computer and IT	TP	1,926	911 (47.3)	19 (1.0)	917 (47.6)	27 (1.4)	52 (2.7)	283 (14.7)	1,643 (85.3)
	TC	24,742	15,141 (61.2)	96 (0.4)	9,294 (37.6)	125 (0.5)	86 (0.4)	4,076 (16.5)	20,666 (83.5)
Architecture and Design	TP	205	178 (86.8)	0	21 (10.2)	5 (2.4)	1 (0.5)	69 (33.4)	136 (66.3)
	TC	1,941	1,827 (94.0)	0 (0.0)	76 (4.0)	38 (2.0)	0 (0.0)	451 (23.2)	1,490 (76.8)
Nanotechnology	TP	38	36 (94.7)	0	1 (2.6)	0	1 (2.6)	6 (15.8)	32 (84.2)
	TC	121	119 (98.4)	0 (0.0)	2 (1.7)	0 (0.0)	0 (0.0)	12 (10.0)	109 (90.1)

Table 6 represents the bibliometrics analysis for all publications of the faculties of JUST. The average citation (AC) per publication was highest for the Faculty of Medicine (37.4), followed by the Faculty of Dentistry (19.6), and the Faculty of Agriculture (18.9). While the most impactful faculties were the Faculty of Medicine (h-index=114, h5-index=62, g-index=352), followed by the Faculty of Engineering (h-index=108, h5-index=40, g-index=160), and the Faculty of Computer and Information Technology (h-index=72, 27, g-index=105). The bibliometrics for the departments of the faculties of JUST are presented in Table 7.

Table 6: Bibliometrics for the faculties of JUST

Faculty	TP	TC	AC	SA	CA	NCA	ACI	NCP	CCP	PCP	CI	CC	NAY	PAY	h5	h	g
Medicine	3,971	148,384	37.4	202	3,769	100,574	24.3	2,971	1.5	0.75	25.33	0.96	36	110.3	62	114	352
Dentistry	950	18,593	19.6	87	863	3,680	2.9	818	5.1	0.86	3.87	0.74	34	27.9	20	62	83
Pharmacy	1,773	21,315	12.0	33	1,740	8,828	4.0	1,452	2.4	0.82	4.98	0.80	36	49.3	27	57	83
Nursing	779	8,257	10.6	43	736	3,505	3.5	619	2.4	0.79	4.50	0.78	29	26.7	19	39	60
Applied Medical Sciences	1,279	14,723	11.5	55	1,224	8,316	5.5	1,019	1.8	0.80	6.50	0.85	36	35.5	22	50	77
Science and Arts	2,800	32,876	11.7	270	2,530	13,402	3.8	2,260	2.5	0.81	4.79	0.79	36	77.8	33	65	98
Engineering	4,593	73,265	16.0	605	3,988	13,713	2.0	3,723	5.3	0.81	2.99	0.67	36	127.6	40	108	160
Agriculture	1,260	23,748	18.9	81	1,179	7,087	4.6	1,125	3.4	0.89	5.62	0.82	36	35.0	25	65	99
Veterinary Medicine	682	8,627	12.7	62	620	3,381	4.0	590	2.6	0.87	4.96	0.80	35	19.5	16	42	61
Computer and IT	1,926	24,742	12.9	91	1,835	6,842	2.6	1,512	3.6	0.79	3.55	0.72	31	62.1	27	72	105
Architecture and Design	205	1,941	9.5	33	172	603	1.9	150	3.2	0.73	2.94	0.66	29	7.1	11	22	38
Nanotechnology	38	121	3.2	-	38	167	3.4	25	0.7	0.66	4.39	0.77	7	5.4	6	7	8

Notes: TP = Total number of JUST publications, TC = Total citations, AC = Average Citations, SA = Sole-authored publications, CA = Co-authored publications, NCA = Number of contributing authors, ACI = Annual collaboration index (calculated as NCA/TP − 1), NCP = Number of cited publications, CCP = Citations per cited publication, PCP= Proportion of cited publication, CI=Collaboration index, CC= Collaboration coefficient, NAY= Number of active years of publication, PAY = Productivity per active year, h5= h5-index, h = h-index, g = g-index, m= m-index, and i10= i-index.

Table 7: The bibliometrics for the departments of JUST

Department	TP	TC	AC	SA	CA	NCA	ACI	NCP	CCP	PCP	CI	CC	NAY	PAY	h5	h	g
Medicine																	
Accident and Emergency Medicine	39	171	4.4	-	39	237	5.1	23	7.4	0.6	6.08	0.8	9	4.3	4	6	12
Anatomy	191	1,383	7.2	23	168	806	3.2	144	9.6	0.8	4.22	0.8	30	6.4	9	18	28
Anesthesia and Recovery	61	237	3.9	2	59	332	4.4	43	5.5	0.7	5.44	0.8	17	3.6	6	8	12
Dermatology	58	565	9.7	3	55	295	4.1	49	11.5	0.8	5.09	0.8	19	3.1	6	15	21
Diagnostic Radiology and Nuclear Medicine	241	2,686	11.2	4	237	1,303	4.4	172	15.6	0.7	5.41	0.8	24	10.0	13	25	46
General Surgery and Urology	439	4219	9.6	19	420	2,444	4.6	339	12.5	0.8	5.57	0.8	34	12.9	11	32	47
Health Management and Policy	67	250	3.7	1	66	389	4.8	46	5.4	0.7	5.81	0.8	12	5.6	7	8	12
Internal Medicine	381	3,368	8.8	14	367	4,421	10.6	264	12.8	0.7	11.60	0.9	32	11.9	16	27	42
Legal Medicine, Toxicology, and Forensic Medicine	61	477	7.8	4	57	250	3.1	48	9.9	0.8	4.10	0.8	21	2.9	5	12	19
Neurology	145	1,292	8.9	2	143	932	5.4	88	14.7	0.6	6.43	0.8	20	7.3	10	16	33
Neurosciences	192	1,667	8.7	3	189	1,109	4.8	128	13.0	0.7	5.78	0.8	20	9.6	10	20	34
Neurosurgery	89	751	8.4	8	81	412	3.6	61	12.3	0.7	4.63	0.8	19	4.7	4	15	25
Obstetrics and Gynecology	305	3,531	11.6	13	292	1,487	3.9	251	14.1	0.8	4.88	0.8	30	10.2	12	31	45
Pathology and Microbiology	377	4,333	11.5	9	368	2,120	4.6	292	14.8	0.8	5.62	0.8	33	11.4	11	32	47
Pediatrics and Neonatology	428	6,556	15.3	20	408	14,266	32.3	340	19.3	0.8	33.33	1.0	32	13.4	15	41	66
Pharmacology	227	2,229	9.8	1	226	1,379	5.1	169	13.2	0.7	6.07	0.8	32	7.1	14	25	38
Physiology and Biochemistry	267	3,535	13.2	10	257	115	0.6	218	16.2	0.8	0.43	1.3	34	7.9	16	29	48
Psychiatry	29	211	7.3	-	29	197	5.8	25	8.4	0.9	6.79	0.9	9	3.2	7	8	13

Public Health and Community Medicine	1,014	116741	115.1	11	1,003	72,155	70.2	827	141.2	0.8	71.16	1.0	33	30.7	56	97	337
Special Surgery	305	3,569	11.7	19	286	1,617	4.3	222	16.1	0.7	5.30	0.8	31	9.8	10	25	52
KAUH	532	5,057	9.5	18	514	3,023	4.7	407	12.4	0.8	5.68	0.8	27	19.7		33	48
Dentistry																	
Conservative Dentistry	165	4,081	24.7	3	162	620	2.8	150	27.2	0.9	3.76	0.7	25	6.6	13	41	56
Oral Medicine and Oral Surgery	244	4,605	18.9	15	229	879	2.6	214	21.5	0.9	3.60	0.7	30	8.1	11	36	54
Preventive Dentistry	350	6,305	18.0	25	325	1,526	3.4	307	20.5	0.9	4.36	0.8	29	12.1	11	45	59
Prosthodontics	163	2,361	14.5	16	147	583	2.6	135	17.5	0.8	3.58	0.7	28	5.8	12	28	40
Pharmacy																	
Clinical Pharmacy	1,033	11,561	11.2	8	1,025	5,342	4.2	825	14.0	0.8	5.17	0.8	20	51.6	24	49	69
Medicinal Chemistry and Pharmacognosy	405	5,946	14.7	5	400	2,170	4.4	348	17.1	0.9	5.36	0.8	34	11.9	16	34	58
Pharmaceutical Technology	382	5,018	13.1	12	370	1,623	3.3	327	15.4	0.9	4.25	0.8	35	10.9	16	34	50
Nursing																	
Adult Health Nursing	251	2,394	9.5	12	239	1,256	4.0	186	12.9	0.7	5.00	0.8	22	11.4	12	24	40
Community and Mental Health Nursing	299	3,311	11.1	10	289	1,314	3.4	247	13.4	0.8	4.39	0.8	25	12.0	13	28	45
Maternal and Child Health Nursing	278	2,643	9.5	17	261	1,142	3.1	228	11.6	0.8	4.11	0.8	22	12.6	13	28	37
Midwifery	85	688	8.1	4	81	367	3.3	70	9.8	0.8	4.32	0.8	15	5.7	8	12	21
Applied Medical Sciences																	
Allied Medical Sciences	349	3383	9.7	15	334	1,926	4.5	273	12.4	0.8	9.85	0.8	36	9.7	12	28	42
Applied Dental Sciences	57	637	11.2	1	56	249	3.4	44	14.5	0.8	9.85	0.8	15	3.8	7	14	23
Medical Laboratory Sciences	606	7,769	12.8	33	573	3163	4.2	513	15.1	0.9	9.85	0.8	33	18.4	18	39	62
Rehabilitation Science	381	3,811	10.0	5	376	3,751	8.9	276	13.8	0.7	9.85	0.9	19	20.1	14	28	49
Science and Arts																	
Biotechnology and Genetic Eng	845	11,088	13.1	29	816	4,391	4.2	702	15.8	0.8	5.20	0.8	34	24.9	20	45	65
Chemistry	553	7,748	14.0	39	514	2,320	3.2	465	16.7	0.8	4.20	0.8	35	15.8	15	40	66
English for Applied Studies	92	714	7.8	40	52	188	1.0	76	9.4	0.8	2.04	0.5	26	3.5	4	15	21
Humanities	39	333	8.5	6	33	127	2.3	33	10.1	0.9	3.26	0.7	18	2.8	6	11	16
Mathematics and Statistics	750	6,955	9.3	126	624	2,321	2.1	568	12.2	0.8	3.09	0.7	32	23.4	26	39	53
Physics	571	6,576	11.5	28	543	4,208	6.4	461	14.3	0.8	7.37	0.9	32	17.8	17	35	61
Engineering																	
Aeronautical Engineering	117	1,261	10.8	5	112	373	2.2	94	13.4	0.8	3.19	0.7	22	5.3	11	20	32
Biomedical Engineering	306	5,400	17.7	31	275	3,101	9.1	230	23.5	0.8	10.13	0.9	27	11.3	22	36	65
Chemical Engineering	616	17,652	28.7	50	566	2,068	2.4	561	31.5	0.9	3.36	0.7	36	17.1	18	60	108
Civil Engineering	1,248	18,908	15.2	148	1,100	3,545	1.8	1001	18.9	0.8	2.84	0.7	36	34.7	20	61	99
Electrical Engineering	977	10,042	10.3	192	785	2,565	1.6	745	13.5	0.8	2.63	0.6	36	27.1	16	42	72
Industrial Engineering	340	3,952	11.6	27	313	1,098	2.2	263	15.0	0.8	3.23	0.7	25	13.6	12	33	51
Mechanical Engineering	1,159	20,178	17.4	146	1,013	3,348	1.9	970	20.8	0.8	2.89	0.7	36	32.2	29	64	97

	TP	TC	AC	SA	CA	NCA	ACI	NCP	CCP	PCP	CI	CC	NAY	PAY	h5	h	g
Nuclear Engineering	59	368	6.2	1	58	222	2.8	41	9.0	0.7	3.76	0.7	13	4.5	6	10	16
Biosystems Engineering	40	1,241	31.0	7	33	113	1.8	36	34.5	0.9	2.83	0.7	10	4.0	2	15	35
Agriculture																	
Animal Production	251	3,642	14.5	10	241	989	2.9	229	15.9	0.9	3.94	0.8	34	7.4	9	30	45
Natural Resources and Environment	255	5,128	20.1	6	249	1,407	4.5	230	22.3	0.9	5.52	0.8	32	8.0	11	38	60
Nutrition and Food Technology	481	8,070	16.8	13	468	4,140	7.6	436	18.5	0.9	8.61	0.9	34	14.2	23	44	62
Agriculture Eng.	52	2,104	40.5	9	43	130	1.5	43	48.9	0.8	2.50	0.6	8	6.5	1	22	45
Plant Production	312	6,529	20.9	37	275	1,126	2.6	276	23.7	0.9	3.61	0.7	32	9.8	10	38	69
Computer and IT																	
Computer Engineering	550	6,900	12.6	22	528	1,848	2.4	448	15.4	0.8	3.36	0.7	28	19.6	15	40	66
Computer Information Systems	464	7,593	16.4	23	441	1,575	2.4	369	20.6	0.8	3.39	0.7	23	20.2	31	46	71
Computer Science	914	12,572	13.8	22	892	3,543	2.9	726	17.3	0.8	3.88	0.7	28	32.6	34	54	83
Network Engineering and Security	369	4,123	11.2	10	359	1,246	2.4	292	14.1	0.8	3.38	0.7	24	15.4	13	29	54
Software Engineering	262	4,076	15.6	23	239	886	2.4	211	19.3	0.8	3.38	0.7	18	14.6	21	33	55
Cyber Security	2	2	1.0	-	2	6	2.0	2	1.0	1.0	3.00	0.7	2	1.0	1	1	1
Architecture and Design																	
Architecture	205	1,941	9.5	33	172	603	1.9	163	11.9	0.8	2.94	0.7	23	8.9	11	19	36
Design and Visual Communication	10	11	1.1	2	8	25	1.5	6	1.8	0.6	2.50	0.6	4	2.5	2	2	2
City Planning and Design	46	271	5.9		46	191	3.2	34	8.0	0.7	4.15	0.8	14	3.3	6	8	14
Veterinary Medicine																	
Basic Medical Veterinary Sciences	249	3,134	12.6	13	236	1,300	4.2	212	14.8	0.9	5.22	0.8	31	8.0	11	28	45
Clinical Veterinary Medical Sciences	270	2,895	10.7	28	242	1,189	3.4	241	12.0	0.9	4.40	0.8	30	9.0	6	27	40
Pathology and Public Health	268	3,198	11.9	12	256	1,247	3.7	230	13.9	0.9	4.65	0.8	31	8.6	12	28	42
Nanotechnology																	
Nanotechnology	38	121	3.18	-	38	167	3.39	13	9.31	0.34	4.39	0.7	7	5.4	6	6	8

Notes: TP = Total number of JUST publications, TC = Total citations, AC = Average Citations, SA = Sole-authored publications, CA = Co-authored publications, NCA = Number of contributing authors, ACI = Annual collaboration index (calculated as NCA/TP − 1), NCP = Number of cited publications, CCP = Citations per cited publication, PCP= Proportion of cited publication, CI=Collaboration index, CC= Collaboration coefficient, NAY= Number of active years of publication, PAY = Productivity per active year, h5= h5-index, h = h-index, g = g-index.

The bibliometrics of the faculty members of JUST

Table 8 represents the 50 most prolific authors among the faculty members of JUST, arranged by the total publications. The median number of authors were three (IQR=2-5, range=1-2660). A total of 1,502 (8.9%) publications were sole-authored. While the median number of authors affiliated with JUST was 2 (IQR=1-3, range=1-18). The first authors of 11,800 (70.1%) publications were affiliated with JUST with total citations of 159,116. While the first authors of 5,030 publications affiliated with an institution other than JUST with total citations of 170,920.

A total of 906 faculty members were included in the analysis. They were working and affiliated with JUST at the time of conducting their studies as presented on the official website of JUST. The total publications of all included authors ranged between 1 and 640 publications showing average publications per faculty member of 24.0. The total citations of all included authors ranged between 0 and 110,777 citations showing an average citation per faculty member of 443. Only 22 (2.4%) authors had published more than 100 publications and 60 (6.6%) authors had more than 1000 citations at the time of searching the databases. On the other hand, a total of 299 (33.0%) authors had ten publications or less, while 103 (11.4%) authors had 10 citations or less, and 339 (44.0%) authors had 100 citations or less. The h-index among the faculty members of JUST ranged between 0 and 93.

Table 8: Top 50 prolific Faculty members of JUST.

R	Author	TP	TC	AC	SA	CA	NCA	CI	CC	ACI	NAY	PAY	NCP	CCP	PCP	h	h5
1	**Yousef S. Khader**	640	110,777	173	4	636	64,236	100.37	1.0	99	20	32	511	217	0.80	93	53
2	**Karem H. Al-Zoubi**	423	5,276	12	-	423	2,104	4.97	0.8	4	17	25	358	15	0.85	35	18
3	**Omar F. Khabour**	295	4,059	14	-	295	1,445	4.90	0.8	4	17	17	249	16	0.84	31	16
4	**Yaser I. Jararweh**	285	5,704	20	1	284	1,306	4.58	0.8	4	12	24	250	23	0.88	41	28
5	**Mohammad A. Al-Nimr**	274	5,882	21	17	257	728	2.66	0.6	2	34	8	255	23	0.93	39	14
6	**Mahmoud A. Alshbool**	210	4,850	23	-	210	995	4.74	0.8	4	11	19	184	26	0.88	35	19
7	**Sayer I. Al-Azzam**	155	1,674	11	-	155	908	5.86	0.8	5	16	10	128	13	0.83	18	10
8	**Tareq M. Osaili**	154	2,650	17	1	153	1,111	7.21	0.9	6	17	9	132	20	0.86	29	18
9	**Zuhair S. Amr**	137	1,110	8	1	136	593	4.33	0.8	3	28	5	115	10	0.84	18	6
10	**Nihad I. Dib**	132	1,807	14	6	126	397	3.01	0.7	2	27	5	120	15	0.91	23	6
11	**Marwan T. Alquran**	129	2,171	17	6	123	438	3.40	0.7	2	13	10	118	18	0.91	29	18
12	**Muneer O. Bani Yasin**	128	1,936	15	-	128	493	3.85	0.7	3	14	9	114	17	0.8	20	9
13	**Kamel M. Al-Khaled**	128	1,620	13	15	113	583	4.55	0.8	4	19	7	108	15	0.84	26	15
14	**Shadi A. Aljawarneh**	121	3,335	28	8	113	400	3.31	0.7	2	8	15	115	29	0.95	32	25
15	**Taha M. Rababah**	118	2,413	20	-	118	774	6.56	0.8	6	18	7	111	22	0.94	26	9
16	**Rajai Z. Al Rousan**	117	1,031	9	37	80	265	2.26	0.6	1	14	8	89	12	0.76	17	12
17	**Anwar M. Batieha**	117	12,908	110	2	115	10,219	87.34	1.0	86	28	4	105	123	0.90	33	12
18	**Tareq L. Mukattash**	113	987	9	-	113	785	6.95	0.9	6	12	9	93	11	0.82	16	9
19	**Mohammad Y. El-Khateeb**	110	1,383	13	4	106	567	5.15	0.8	4	22	5	99	14	0.90	20	4
20	**Laith N. Al-Eitan**	105	559	5	1	104	546	5.20	0.8	4	10	11	82	7	0.78	10	11
21	**Anas A. Al-Nabulsi**	103	1,584	15	-	103	740	7.18	0.9	6	15	7	89	18	0.86	23	15
22	**Zouhair O. Amarin**	102	1,571	15	3	99	477	4.68	0.8	4	20	5	88	18	0.86	24	2
23	**Nizar M. Mhaidat**	97	1,325	14	1	96	544	5.61	0.8	5	15	6	87	15	0.90	21	6
24	**Muhammad H. Alu"Datt**	94	1,537	16	-	94	686	7.30	0.9	6	14	7	89	17	0.95	22	8
25	**Zuhair A. Bani Ismail**	93	633	7	6	87	430	4.62	0.8	4	17	5	83	8	0.89	12	5
26	**Borhan Aldeen A. Albiss**	92	1,569	17	1	91	453	4.92	0.8	4	22	4	77	20	0.84	17	8
27	**Khalil I. Ereifej**	91	1,849	20	5	86	511	5.62	0.8	5	25	4	87	21	0.96	22	3
28	**Khalid I. El-Salem**	91	1,078	12	1	90	598	6.57	0.8	6	17	5	59	18	0.65	14	8
29	**Anan S. Jarab**	86	748	9	-	86	475	5.52	0.8	5	12	7	69	11	0.80	13	9
30	**Rami H. Haddad**	80	1,453	18	3	77	206	2.58	0.6	2	22	4	69	21	0.86	23	6

		TP	TC	AC	SA	CA	NCA	ACI	NCP	CCP	PCP	CI	CC	NAY	PAY	h5	h
31	Khalid A. Kheirallah	80	785	10	-	80	623	7.79	0.9	7	11	7	58	14	0.73	16	11
32	Mohammed T. Hayajneh	77	1,223	16	3	74	219	2.84	0.6	2	21	4	62	20	0.81	16	8
33	Mahmoud M. Alomari	70	1,478	21	-	70	2,058	29.40	1.0	28	15	5	61	24	0.87	17	8
34	Ahmad A. Omari	70	638	9	1	69	357	5.10	0.8	4	13	5	57	11	0.81	14	12
35	Wail E. Mardini	69	513	7	-	69	277	4.01	0.8	3	14	5	56	9	0.81	11	8
36	Mamoun F. Al-Mistarihi	69	508	7	4	65	221	3.20	0.7	2	15	5	53	10	0.77	11	6
37	Yousef S. Najjar	68	1,176	17	8	60	151	2.22	0.5	1	23	3	61	19	0.90	16	6
38	Mohammad Z. Allouh	68	430	6	3	65	340	5.00	0.8	4	15	5	49	9	0.72	12	6
39	Tamam M. El-Elimat	68	1,250	18	-	68	457	6.72	0.9	6	17	4	58	22	0.85	15	10
40	Mahmoud A. Alfaqih	67	626	9	-	67	437	6.52	0.8	6	7	10	50	13	0.75	12	12
41	Sawsan H. Abuhammad	67	369	6	8	59	268	4.00	0.8	3	5	13	50	7	0.75	11	11
42	Mohammad N. Alhamad	66	1,224	19	2	64	469	7.11	0.9	6	16	4	61	20	0.92	20	8
43	Marya M. Obeidat	66	477	7	-	66	308	4.67	0.8	4	20	3	56	9	0.85	13	6
44	Belal S. Obeidat	65	662	10	6	59	276	4.25	0.8	3	16	4	58	11	0.89	16	6
45	Nasr N. Alrabadi	64	188	3	-	64	417	6.52	0.8	6	5	13	40	5	0.63	8	8
46	Rehab M. Duwairi	63	939	15	7	56	195	3.10	0.7	2	19	3	44	21	0.70	18	5
47	Mohammad A. Alsmirat	63	676	11	-	63	267	4.24	0.8	3	9	7	50	14	0.79	14	7
48	Samer H. Al Ghour	63	263	4	25	38	124	1.97	0.5	1	16	4	43	6	0.68	6	6
49	Mohammad-Ali H. Al-Omari	63	906	14	2	61	319	5.06	0.8	4	19	3	52	17	0.83	15	5
50	Nehad M. Ayoub	61	938	15	2	59	481	7.89	0.9	7	14	4	47	20	0.77	18	9

Notes: TP = Total number of JUST publications, TC = Total citations, AC = Average Citations, SA = Sole-authored publications, CA = Co-authored publications, NCA = Number of contributing authors, ACI = Annual collaboration index, NCP = Number of cited publications, CCP = Citations per cited publication, PCP= Proportion of cited publication, CI=Collaboration index, CC= Collaboration coefficient, NAY= Number of active years of publication, PAY = Productivity per active year, h5= h5-index, h = h-index.

Figure 3 compares the citations of JUST over the years for publication with and without the contribution of Professor Khader.
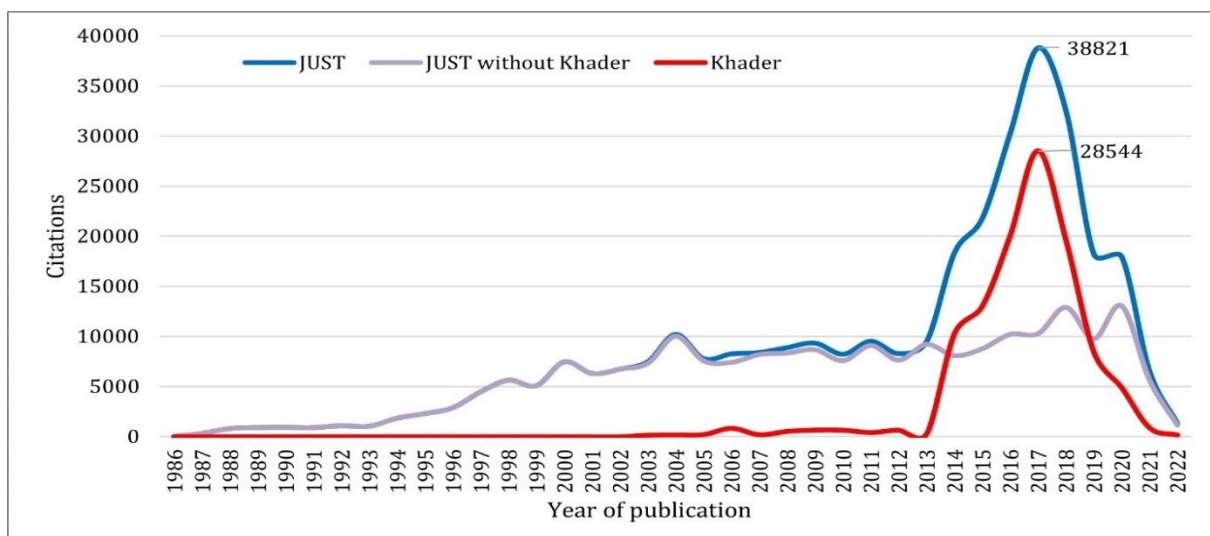
Figure 3: the citation of JUST for publications with and without Professor Khader.

The Most Cited Articles from JUST

Among the 100 most cited publications of JUST, 64 publications were global articles that the first author was not from JUST. The total citation of these global articles was 101,545 citations representing 30.8% of total JUST citations. Most of these global studies were published in the Lancet (n=46), followed by JAMA (n=4). Professor Khader has contributed to 61 studies that likely make him the most impactful among the faculty members of JUST. The most cited (7,768 citations) global article was "Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: A systematic analysis for the Global Burden of Disease Study 2013" published in The Lancet 2014, in which Professor Khader was the only author affiliated with JUST.

Table 9 provides the top 20 most influential publications. These publications represent nearly 2.8% of the total citations of JUST (9,353 of 330,046). The first author of 13 publications affiliated with the Faculty of Engineering. The top-cited publications (TC=627 citations) were authored by Professor Mohammed H. Al-Saleh from the Department of Chemical Engineering, followed by the work of Majid M. Khodier (TC=569 citations) from the Department of Electrical Engineering, and the study conducted by Professor Fawzi A. Banat from the Department of Civil Engineering.

Table 9: The top 20 cited articles published as JUST was affiliation of the first author.

Title	TC	NCA	Year	Journal	Author(s)	Department
EMI shielding effectiveness of carbon based nanostructured polymeric materials: A comparative study	627	3	2013	Carbon	Mohammed H. Al-Saleh	Chemical Engineering
Linear array geometry synthesis with minimum sidelobe level and null control using particle swarm optimization	569	2	2005	IEEE Transactions on Antennas and Propagation	Majid M. Khodier	Electrical Engineering
Adsorption of phenol by bentonite	492	4	2000	Environmental Pollution	Fawzi A. Banat	Civil Engineering
Removal of heavy metals from wastewater by membrane processes: A comparative study	450	2	2004	Desalination	Qdais H.A.;	Civil Engineering
Causes of construction delay: Traditional contracts	441	2	2002	International Journal of Project Management	Odeh, A.M.	Civil Engineering
Soil thermal conductivity: Effects of density, moisture, salt concentration, and organic matter	404	2	2000	Soil Science Society of America Journal	Nidal H. Abu-Hamdeh	Agriculture
The nature of halogenâ⁻ Halogen synthons: Crystallographic and theoretical studies	378	4	2006	Chemistry - A European Journal	Firas F. Awwadi	Chemistry
Developing a green building assessment tool for developing countries - Case of Jordan	356	2	2009	Building and Environment	Hikmat H. Ali	Architecture
Experimental evaluation of the transesterification of waste palm oil into biodiesel	353	2	2002	Bioresource Technology	Mohamad I. Al-Widyan	Mechanical Engineering
Anomaly-based intrusion detection system through feature selection analysis and building hybrid efficient model	348	3	2018	Journal of Computational Science	Shadi A. Aljawarneh	Network Engineering and Security
Solar thermal desalination technologies	338	2	2008	Desalination	Hazim M. Qiblawey	Chemical Engineering
Evaluation of the use of raw and activated date pits as potential adsorbents for dye containing waters	326	3	2003	Process Biochemistry	Fawzi Banat	Chemical Engineering
Review of the mechanical properties of carbon nanofiber/polymer composites	318	2	2011	Composites Part A: Applied Science and Manufacturing	Mohammed H. Al-Saleh	Chemical Engineering
Short-term prediction of traffic volume in urban arterials	317	3	1995	Journal of Transportation Engineering	Mohammad M. Hamed	Civil Engineering

Long term effect of wastewater irrigation of forage crops on soil and plant quality parameters	299	3	2007	Desalination	Munir M. Rusan	Plant Production
Job stress, job performance, and social support among hospital nurses	294	1	2004	Journal of Nursing Scholarship	Raeda F. AbuAlRub	Community and Mental Health Nursing
Removal of nickel ions from water by multi-walled carbon nanotubes	292	2	2007	Journal of Hazardous Materials	Munther Issa Kandah	Chemical Engineering
Analysis of pedestrians' behavior at pedestrian crossings	280	1	2001	Safety Science	Mohammed Hamed	Civil Engineering
Inhibition of acidic corrosion of pure aluminum by some organic compounds	277	2	2004	Corrosion Science	Maayta, A.K.	Chemistry
Periodontal status of diabetics compared with nondiabetics: A meta-analysis	276	5	2006	Journal of Diabetes and its Complications	Yousef S. Khader	Medicinal Chemistry and Pharmacognosy

Notes: TC = Total citations, NCA = Number of contributing authors.

Most Prolific Journals

Table 10 (in Apendix1) lists the most prolific journals. The "Saudi Medical Journal" ranked first (TP=125 publications), followed by "Jordan Journal of Civil Engineering" (TP=89) and "Heliyon" (TP=86). In terms of TC and AC, The "Lancet" (TC=72,769, AC=1,399.4), the "Desalination" (TC=4,197, AC=93.3), and "Energy Conversion and Management" (TC=2,326, AC=40.1) take the first three ranks. "The Lancet" had the leading and highest collaborative index (CI: 13.02). Although the "International Journal of Electronics Reemerges" has the highest NAY (NAY: 29), "Procedia Manufacturing" was the most productive journal in the one year of publishing (PAY: 23).

Table 10: Bibliometric analysis of most prolific journals.

Journal	TP	TC	AC	SA	CA	NCA	ACI	NAY	PAY
Saudi medical journal	150	1,228	8.2	40	110	437	1.9	25	6.0
Jordan journal of civil engineering	89	362	4.1	13	76	225	1.5	16	5.6
Heliyon	86	533	6.2	7	79	330	2.8	4	21.5
Annals of medicine and surgery	84	405	4.8	1	83	469	4.6	5	16.8
Jordan medical journal	68	112	1.6	6	62	262	2.9	15	4.5
International Journal of Electrical and Computer Engineering	61	172	2.8	8	53	173	1.8	5	12.2
Plos one	60	1,216	20.3	3	57	670	10.2	13	4.6
Energy conversion and management	58	2,326	40.1	15	43	165	1.8	22	2.6
Eastern mediterranean health journal	57	768	13.5	5	52	218	2.8	25	2.3
Construction and Building Materials	56	1543	27.6	5	51	146	1.6	16	3.5
Small ruminant research	55	918	16.7	9	46	192	2.5	23	2.4
The lancet	52	72,769	1,399.4	2	50	35,217	676.3	9	5.8
International Journal of Electronics	51	204	4.0	11	40	114	1.2	29	1.8
International Journal of Clinical Practice	48	277	5.8	3	45	263	4.5	4	12.0
Desalination	45	4,197	93.3	4	41	142	2.2	19	2.4
Veterinary world	44	235	5.3	3	41	177	3.0	7	6.3
JMIR Public Health and Surveillance	41	347	8.5	0	41	291	6.1	4	10.3
Energy	41	1,235	30.1	8	33	103	1.5	22	1.9
American Journal of Case Reports	41	64	1.6	0	41	177	3.3	11	3.7
Tropical Animal Health and Production	40	434	10.9	3	37	150	2.7	20	2.0

Notes: TP = Total number of JUST publications, TC = Total citations, AC = Average Citations, SA = Sole-authored articles, CA = Co-authored articles, NCA = Number of contributing authors, ACI = Annual collaboration index (calculated as NCA/TP − 1), CC= Collaboration coefficient, NAY= Number of active years of publication, and PAY = Productivity per active year.

Bibliometric network analysis

Co-authorship authors network

Figure 4 shows the VOSviewer network of author co-authorship collaboration pattern. A total of 24,332 authors were identified. Of those, 100 (0.41%) met the threshold of having published 42 publications on the topic and being cited 0 times, and those who were not connected to other authors in the network were excluded. The size of the circles indicates the number of publications, while the lines between the authors signify their collaboration. The colors denote the collaboration clusters. In the collaboration network, 20 clusters were identified. The three most impactful researchers were Yousef S. Khader, Karem H. Al-Zoubi, and Omar F. Khabour.
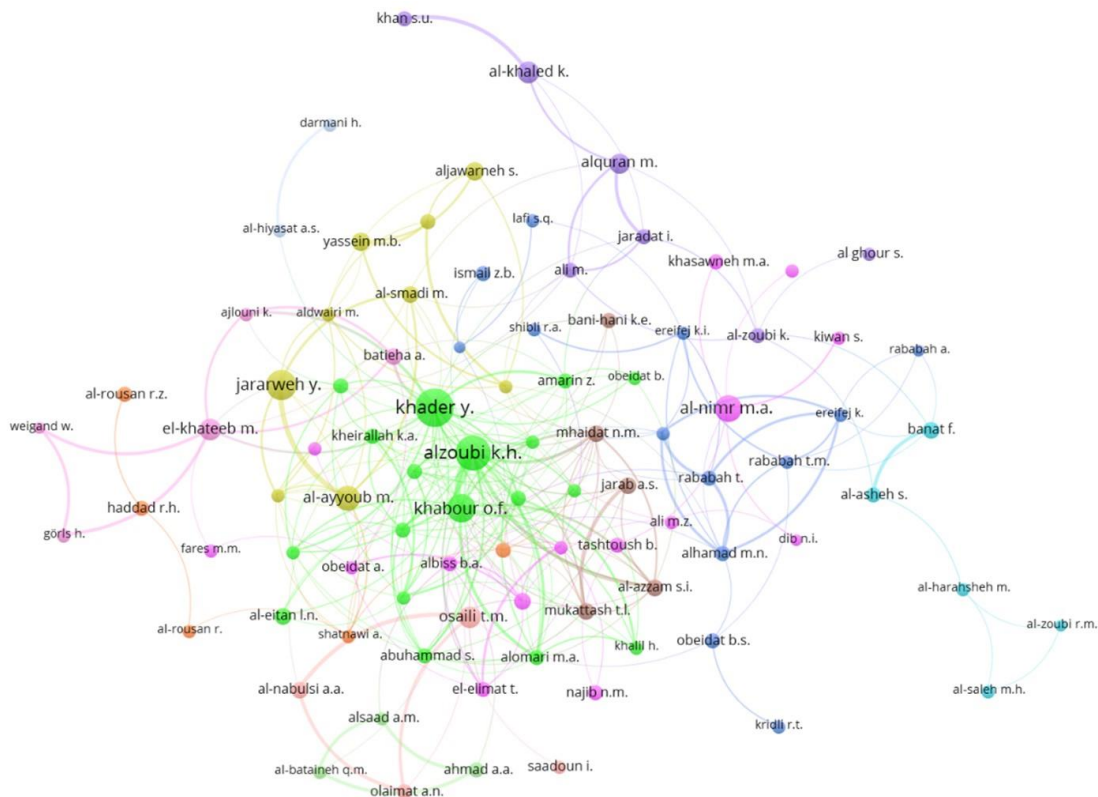
Figure 4: VOSviewer network of author co-authorship map weighted by number of publications. Because some names may overlap, others may not be shown.

Co-authorship countries network

Figure 5 illustrates the collaboration of co-authorship of JUST publications. Node sizes reflect article output, while line thickness and distance indicate the level of collaboration. When at least five publications are cited at least 0 times, 82 (24.5%) countries were identified, and meet the thresholds. five clusters emerge. The strong collaboration was the United States which has the highest number of totals like strength (4,038), followed by Saudi Arabia (2,433), and the United Arab Emirates (2,142). Clusters connected by these links are related. Countries close in proximity reveal strong relationships, while distant countries lack sufficient relationships and collaborations.
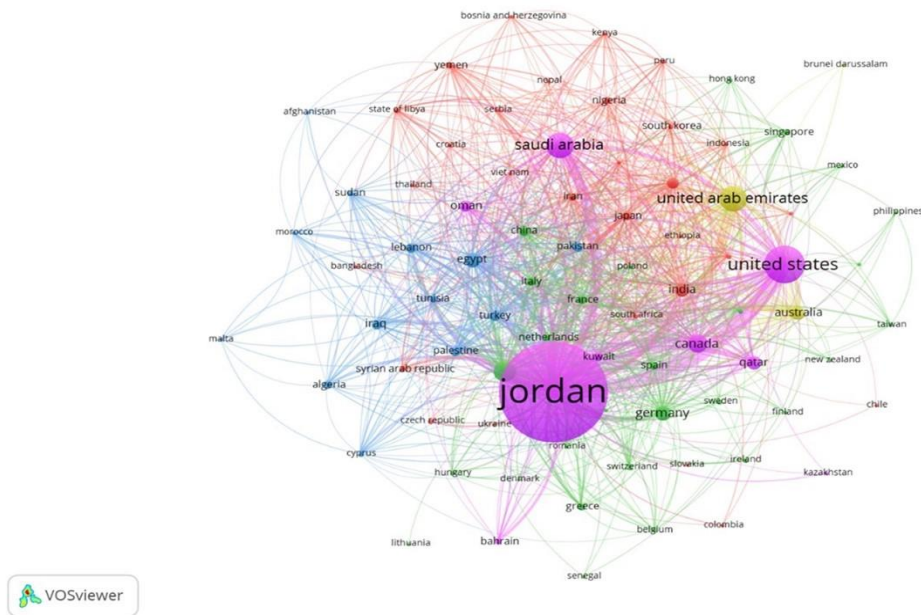
Figure 5: VOSviewer network of country co-authorship map, weighted by the total link strength.

Co-occurrence of Keyword Analysis

Figure 6 shows the co-occurrence analysis of keywords that revealed significant topics and trends in JUST publications. A total of 96 keywords were selected out of 33,161. The keywords "COVID-19", followed by "knowledge", and "machine learning" were the most occurring keywords, occurring 1,173 and 274 times, respectively, indicating the relevance and focus of research in these areas.
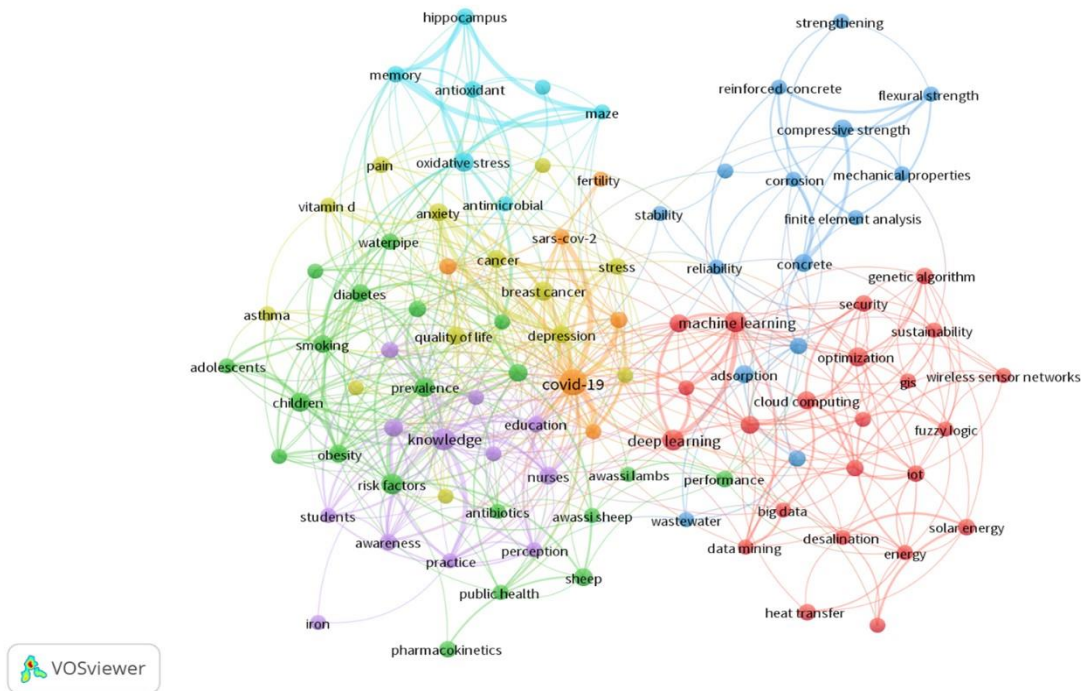
Figure 6: VOSviewer network of author keyword co-occurrence map weighted by occurrence.

Bibliometric factors associated with the number of citations.

The results of the Poisson regression models are presented in Table 11. In the univariable analysis, the rate ratio for citations would be expected to increase by a factor of 1.012 (95% CI, 1.012-1.013) for each year increase since publication, and by 1.002 (95% CI,1.002-1.002) for each increase in the number of contributing authors. However, the rate ratio for citations would be expected to decrease by a factor of 0.999 (95% CI, 0.999-0.999) for each increase in the number of authors affiliated with JUST. Compared to studies that were affiliated with one JUST faculty, studies affiliated with two or more JUST faculties are expected to have a lower rate ratio for citations. Among all JUST faculty, only the Faculty of Medicine had a greater rate for citations by a factor of 2.645 (95%CI ,2.627-2.663), compared to other JUST faculties.

Compared to studies identified only in the Scopus database, the publications identified only in the WoS database are expected to have a rate 0.846 times lower for citations, and publications identified in both databases are expected to have a rate of 1.349 times greater for citations. In addition, publications published in open-access journals compared to traditional journals are expected to have a rate of 2.293 times greater for citations. Compared to original articles, review articles were the only type of publication that had a greater rate for citations by a factor of 1.416 (95% CI ,0.831-0.861). The results above had minimally changed when adjusting for all variables in the multivariable models (Table 11).

Table 11: Factors associated with the number of citations for JUST publications using Poisson regression.

	Univariable regression	Multivariable model (including Khader)	Multivariable model (excluding Khader)
	Unadjusted IRR	Adjusted IRR	Adjusted IRR
Years since publication	1.012 (1.012-1.013)	1.056 (1.056-1.057)	1.049 (1.048-1.049)
Database			
Scopus	Reference	Reference	Reference
WoS	0.846 (0.831-0.861)	0.640 (0.627-0.652)	0.190 (0.185-0.194)
Both (Scopus & WoS)	1.349 (1.339-1.360)	1.226 (1.216-1.236)	1.222 (1.212-1.232)
Type of publication			
Article	Reference	Reference	Reference
Review	1.416 (1.395-1.437)	1.209 (1.191-1.227)	1.160 (1.143-1.178)
Book	0.201 (0.184-0.221)	0.379 (0.345-0.416)	0.328 (0.299-0.360)
Conference paper	0.277 (0.272-0.282)	0.423 (0.414-0.431)	0.453 (0.444-0.462)
Others	0.178 (0.168-0.188)	0.107 (0.101-0.113)	0.080 (0.076-0.085)
Open-access journal	2.293 (2.278-2.309)	1.557 (1.542-1.571)	1.894 (1.877-1.910)
Khader. Y	12.78 (12.688-12.873)	9.076 (8.960-9.194)	--
Number of authors	1.002 (1.002-1.002)	1.002 (1.002-1.002)	1.003 (1.003-1.003)
No of JUST authors	0.999 (0.999-0.999)	0.998 (0.998-0.998)	0.997 (0.997-0.997)
1st author of JUST	0.397 (0.394-0.399)	0.574 (0.569-0.578)	0.452 (0.449-0.456)
No of Faculties			
1	Reference	Reference	Reference
2	0.684 (0.677-0.692)	0.993 (0.925-1.065)	0.943 (0.879-1.011)
3	0.610 (0.594-0.627)	1.138 (0.988-1.312)	1.236 (1.073-1.423)
4	0.475 (0.435-0.518)	1.583 (1.263-1.985)	1.893 (1.510-2.371)
5	0.449 (0.310-0.650)	3.589 (2.259-5.702)	2.465 (1.552-3.914)
Faculty at JUST			
Medicine	2.645 (2.627-2.663)	0.667 (0.622-0.715)	1.510 (1.409-1.619)
Dentistry	0.998 (0.983-1.013)	0.951 (0.886-1.021)	0.940 (0.876-1.009)
Pharmacy	0.586 (0.578-0.595)	0.739 (0.689-0.793)	0.591 (0.551-0.634)

Nursing	0.529 (0.517-0.540)	0.661 (0.615-0.711)	0.623 (0.579-0.669)
Applied Medical Sciences	0.568 (0.558-0.577)	0.693 (0.645-0.745)	0.607 (0.565-0.652)
Science and Arts	0.554 (0.548-0.561)	0.712 (0.664-0.764)	0.603 (0.562-0.647)
Engineering	0.760 (0.754-0.766)	0.924 (0.862-0.990)	0.840 (0.783-0.900)
Computer and IT	0.636 (0.622-0.649)	0.732 (0.681-0.787)	0.543 (0.505-0.583)
Agriculture	0.627 (0.619-0.635)	1.433 (1.335-1.537)	1.161 (1.082-1.245)
Veterinary Medicine	0.958 (0.946-0.971)	0.994 (0.927-1.067)	0.905 (0.843-0.970)
Architecture and Design	0.480 (0.459-0.502)	0.685 (0.631-0.744)	0.613 (0.565-0.666)
Nanotechnology	0.162 (0.136-0.194)	0.390 (0.322-0.473)	0.373 (0.308-0.452)

DISCUSSION

Our advanced bibliometric and scientometric analyses of research of a higher education institute for JUST From 1987 to 2022 have several significant findings. Most publications were original articles and were published in traditional journals. The publication and citation numbers increased steadily, until 2013, and then exponentially afterwards. The faculty of engineering had the highest total publications, while the faculty of medicine had the highest number of citations, indicating a higher impact. Professor Yousef S. Khader ranked first as JUST's influential faculty. The strongest collaborations were with the United States and Saudi Arabia. Factors contributing to higher incidence rate for citations include years since publication, indexing in Scopus and WoS, reviews, publication in open-access journals, and collaboration.

The large number of publications affiliated with JUST demonstrates the institution's commitment to scientific research and its potential to make significant contributions to various fields. These results may also provide a benchmark for JUST to compare its research output with other institutions and identify areas where further investment or collaboration may be necessary. Moreover, it provides insight into the level of interest and impact of various journals in different fields.

The study found that the total citation count for papers published in traditional journals was only slightly higher at 53.1% compared to 46.9% for those published in open journals. Despite traditional publications still having more numbers, the results suggest that open publications are becoming increasingly significant in scientific communication. One possible explanation could be the unrestricted access provided by these journals, allowing a wider audience to read and cite these articles [20, 21]. The study has found that open-access publications have higher citation rates compared to traditional publications [22-24]. Accordingly, institutional leadership at JUST should consider coverage for publication fees at open-access journals to increase visibility and improve citation scores. This is critical in empowering JUST to have a higher impact at the regional and global levels. Understanding the limited resources of universities when it comes to funding research, one can recommend that more money should be allocated to publishing research that has the potential for higher citation and includes global affiliation from authors in developed countries. Restricting authors to only those at JUST may be an indicator of lower citation and lower institutional impact.

It is crucial to mention that the affiliation with JUST was written inconsistently among the studies. This created challenges to identify the exact affiliation with JUST. Standardization of affiliation in terms of clearly stating the department, faculty, and university may have produced more finetuned results that actually reflect a clearer picture of the citation and publication scores. Authors are then advised to clearly state their affiliation details in full and to seek taking the lead in publishing research of global impact. On the other hand, academic regulations for promotion should be finetuned to support not only the number of publications but also citation scores and global affiliation with academics from developed countries. This will increase productivity and ensure a better impact of publications from JUST.

The number of faculty members in each faculty is likely associated with their productivity over the years. However, faculties with lower productivity such as the Faculty of Nursing and Veterinary should focus on enhancing their

productivity. In addition, the exponential increase in the last seven years can also be associated with the availability of open-access journals. Open-access journals may speed up publication and have lower barriers to entry for authors. The findings of this study recommend JUST monitoring the progress of the faculties over time and identifying trends in research output. It is the responsibility of the faculty of research to report on research grants secured by faculty members and to ensure that their research activities have a global impact. Adopting an institutional agenda that fits global needs can facilitate productivity and improve citation scores.

Even though there are more publications affiliated with JUST, they have received fewer citations (159,116) compared to publications affiliated with other institutions (170,920). This could mean that while JUST produces a lot of research, their publications and topics may not have as much impact or influence as shown by the lower citation count. As a result, we recommend that JUST investigate current and trending topics. It is possible that the quality of publications from JUST may be lower due to the use of cross-sectional and survey studies from international universities. To address this, JUST should consider investing in more citable study designs such as randomized control studies, experiments, meta-analyses, systematic reviews, and review articles. Studies have shown that review articles tend to receive more citations than original research papers [12, 25]. To further increase the citation of publications from JUST, we suggest collaborating with more international authors and making a JUST member the first author. Studies have indicated that articles with international co-authors receive more citations than those without [26-28].

The analysis revealed that Professor Yousef S. Khader was the most productive and influential faculty member at JUST. These findings indicate that Professor Khader's contributions have had a significant impact on JUST's research output and impact. This study's findings are consistent with a recent study that highlights the top 2% of researchers worldwide for the year 2023, among them was Professor Yousef S. Khader, and others were mentioned within the prolific authors of the faculty members of JUST [29]. Khader's improved performance relates to effective collaboration and the global approach utilized in his publications. This is a case study that should be further investigated to attest to the need to provide opportunities to junior researchers when establishing their line of research.

Research collaboration is led by the United States and Saudi Arabia. Their strong collaboration is primarily due to their leading institutions, the Lancet and Saudi Medical Journal. Both countries have large populations, with 333 million and 36 million in 2022, respectively [30]. Saudi Arabia has invested extensively in the necessary resources for medical and scientific research over the years. It has also rapidly become a major player in scientific research, as research and development is one of the main pillars of the Saudi Vision 2030, which has a specific goal of having at least five Saudi universities among the top 200 in the world by 2030 [31, 32]. The United States is also a leading contributor to scientific research [33]. The exchange of staff between these universities and JUST may be an asset to further develop publication productivity and citation scores. More research opportunities should be established to house collaborative research that can address regional and global research questions.

Identifying the most frequently occurring keywords can provide insights into current trends and areas of research focus. It can also guide researchers in selecting areas to investigate and direct their efforts toward addressing important research gaps. This role should be activated through the faculty of research and faculty of graduate studies where a clear agenda and support should be created to focus on areas of global interest and higher citation.

The major limitation of the study was that several authors did not mention the faculty or the department that they were affiliated with. This may limit our findings as not all publications have been assigned to a faculty or a department in our analysis. Further, our results are only applicable to JUST and not to other institutions. While the results may be utilized from different national and regional academic institutions, the generalizability is limited. Our results may not also be comparable to other academic institutions as JUST houses both engineering and health sciences schools and is not merely focused on one dimension of science. Still, our results provide global lessons to increase visibility and reputation and to attract more funding and collaborations.

CONCLUSION AND RECOMMENDATIONS

In conclusion, the bibliometric study of JUST's academic research shows that there has been an improvement in productivity and impact over time, but there is still room for further improvement to compete with other universities. The study provides insights into the most productive authors, influential topics, and the intellectual structure of the field. To enhance total citations, JUST may consider focusing on factors associated with higher citations such as publishing in journals indexed in both Scopus and WoS, covering article processing fees for Open Access journals, and producing review articles. The study's results can inform researchers about strategies for disseminating research findings and increasing their impact.

This study provides recommendations for researchers at JUST and other institutions, including supporting collaboration and interdisciplinary research, publishing in high-impact journals, considering open-access publishing, considering the potential societal impact of research, increasing visibility and reputation through appropriate affiliations, publishing review articles, and monitoring research output over time. These recommendations aim to increase the visibility and impact of JUST's research and improve its competitiveness with other institutions.

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