Qualitative and Quantitative Methods in Libraries (QQML) 13,1:59-82, 2024

Scientometric sketch of Nobel laureate in chemistry Prof. Jennifer Doudna with emphasis on collaboration pattern and keyword analysis

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Abstract: Prof. Jennifer Doudna is an eminent Biochemist who contributed immensely to the area of gene editing for which she was awarded the Nobel Prize in Chemistry in 2020. The study investigates and analyses Doudna's contributions and scientific productivity in peer-reviewed Scopus-indexed sources. She had 315 publications during 1987-2020 in Genetics and related fields. Of the total papers she had written and published, 94.29% are multi-authored. Doudna was the primary author in 7.07% of publications whereas she was claimed to be the secondary author in 92.93% of papers. The majority of her publications were in journals from the USA followed by UK and Germany. The most active researchers in the research team of Jennifer were Zhou Kaihong, Ma Enbo, Nogales Eva, Cate Jamie, and Sternberg, Samuel H. Her fifty-percentile age is found to be 26 years. The publication data set is tested with Bradford's law which was found to be negative. She utilized 63 means of communication i.e., journals where she published at least three papers. The highest impact factor journal in which she published a decent number of papers (27) in *Nature*. As depicted in the keyword analysis, her research core area was related to genetics, the CRISPR CAS system, endonuclease, and gene editing.

Received: 13.8.2022 Accepted: 12.3.2024 ISSN 2241-1925

Keywords: Scientometric Profile, Collaboration, Jennifer Doudna, Noble laureate, Scopus

1. Introduction

Scientometrics is an efficient practice applied to assess the performance of a researcher quantitatively. Preparation of a scientometric portrait of a scientist/researcher involves a very careful investigation of his/her work dealing with both quantitative and qualitative aspects of the publications. Scientific publications form a basis for measuring the research productivity of an individual researcher as the prolificity and influence of a scientist depend on the sustainability of his/her publications (Price 1986). Historically speaking, there are a lot of studies that used the term "Scientometric Portrait" specifically of Nobel laureates. Like Cawkell and Garfield 1980; Gupta 1983; Kademani, Kalyane, and Kedamani 1994; Kalyane and Sen 1996; Kalyane and Kademani 1997; Kademani, Kalyane, and Jange 1999; Kademani, Kalyane and Kumar 2002; Kademani, Kalyane, Kumar and Mohan 2005. Besides this, a large number of studies have been conducted to sketch a scientometric portrait of researchers from various disciplines and organizations as well. These studies used performance measurement indicators to sketch the publication profile of a Nobel laureate using performance analysis metrics (traditional metrics) only. While in this study, there is an attempt to sketch a scientometric portrait of Jennifer Doudna, Nobel Prize winner (shared) in Chemistry in 2020 with an analysis of trending topics and research hot spots using an enriched bibliometric network analysis technique in addition to an analysis of her scientific publications with performance and citation-related metrics. Moreover, the depth analysis of year-wise trends of papers (Table 1) also is not encountered in many of the previous studies. This fulfills the research gap and makes this study different from the previous studies.

1.1 About Prof. Jennifer Doudna

Jennifer Doudna, born in 1964, was an American biochemist who pioneered CRISPR gene editing and made several fundamental contributions to biochemistry and genetics. Doudna has been serving at the University of California, Berkeley, the U.S. since 2002. She is among the handful of women who have gained name and fame working for science. As per a declaration of the United Nations, the decade of 1975 to 1985 has been declared as a Decade of Women. Just after 2 years of this decade, Doudna had her first publication in 1987 at the age of 23. She is a pioneer in CRISPR gene editing and also made significant contributions in the field of fundamental biochemistry and genetics. She has been working at the affiliation of the University of California, Berkeley in the Department of Molecular and Cell Biology. She is an alumnus of Harvard Medical School. She was awarded the prestigious Noble Prize in Chemistry for 2020 for her contribution to the development of a method for genome editing which she shared with Emmanuelle Charpentier, who is a microbiologist and biochemist.

2. Objectives

This study is an attempt to document the research productivity of Jennifer Doudna quantitively and qualitatively based on:

i. Analysis of research publications chronologically
ii. Authorship patterns
iii. Collaboration dynamics
iv. Channels of Communication
v. Bradford’s Law
vi. Highly Cited papers and
vii. Analysis of Keywords in Doudna’s publications.

3. Methodology

At the preliminary stage, in the basic search box, the search was conducted entering the last name, first name, and affiliation of Jennifer Doudna (JD) and it presented 315 document search results as on 28th August, 2021. Bibliographic Scopus profile of JD popped-up. This bibliographic information of publications from 1987 to 2020 served as the source of data for analysis. The data is downloaded in CSV format. Later a comprehensive bibliography of JD was prepared based on several bibliographic indicators. MS Excel was used for preparing figures and analysis. For the presentation of high-frequency keywords, Biblioshiny (Aria and Cuccurullo 2017) was used.

RQ.1 What is the pattern of chronological growth in JD's publications?

RQ.2 Do multi-authored papers are the majority of single-authored papers?

RQ.3 What is the behavior of collaboration in her research profile?

RQ. 4 What are the channels of scholarly communication used? Which of the papers are having high citations?

RQ. 5 Does the dataset fit into the author productivity law of Bradford?

RQ. 6 What are the trending areas of research in her profile?

If bibliographic and citation details of all related papers are extracted for analysis then the findings of the study will be more relevant which will improve the accuracy and precision of the results. The database, Scopus will provide articles that are inclusively incorporated from all research platforms like prominent journals on the subject that will meet the requirements of the study. A total of 315 documents are found in the preliminary search. The data is further filtered to include articles in the final printed stage only but not those which are in press. Using a complex screening method which is the requirement of this study was developed so that the final research corpus has high-quality articles particularly related to the research areas of JD topic which highlight the trends and importance.

The second phase of the study is mining the data exported in the CSV format into the VOSviewer 1.6.15 (developed by Leiden University's Centre for Science and Technology Studies in Leiden, Netherlands) was used to develop the co-authorship networks of the units – authors and countries. Moreover, the visualization of the co-occurrence of author keywords is done following a certain algorithm. Performance analysis tools, science mapping techniques, and network analysis techniques are used to identify the research performance and visualization. Performance-and-citation-related metrics such as h-index, number of publications, total citations, and CPP are used to identify the prominent authors, institutes and journals favored. The clustering technique is used to identify the keywords in a common theme. Biblioshiny was used to visualize the research hot spots and trending topics in the area using a specific algorithm. The biblioshiny web interface from the RStudio was also used for network analysis in general and visualization in particular. A set of programming codes are utilized in the R-console to get into the web interface of the Biblioshiny. These are as follows:

R-command in Console	**Result Display**
>library (bibliometrix)	To start with the biblioshiny web interface please digit: biblioshiny ()
>biblioshiny ()	Let's to the biblioshiny web interface through the default browser

The final stage (i.e., interpretation of results and finding the research limitations) is highlighted from the outcomes and key results obtained in the previous stages. The paper is further extended to discover the future research directions from exclusive outcomes of the scientometric analysis.

4. Analysis and Results

4.1 Analysis of Research Publications Chronologically

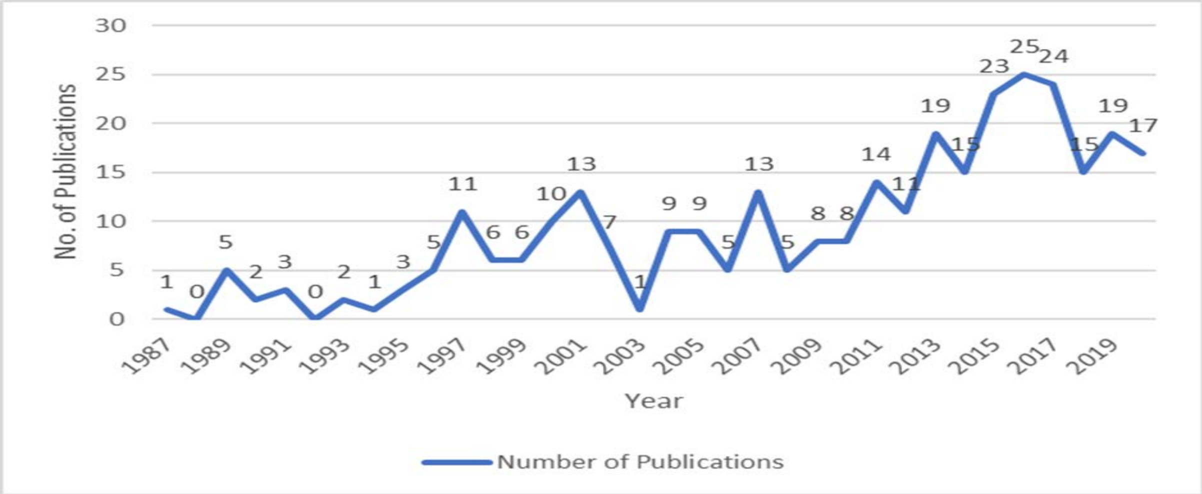

Figure 1. Chronological distribution of JD's publications

As observed from the Scopus database, a total of 315 publications till 2020 in the name of Jennifer Doudna under the affiliation the of University of California, Berkeley was seen to be indexed. The growth in publication as observed from the Figure 1 is non-linear and the highest number of publications was observed in the year 2016 (25 publications) followed by 2017 (24 publications). Publications in 2016 are multi-authored, and she is reported to be the secondary author in all publications whereas in 2017 one publication is single-authored and the remaining 23 are multi-authored and again she turned out to be the secondary author (Table 1). The chronological distribution of the papers along with the collaborative pattern is presented in Table 1. As per the Scopus profile, her first paper was published in 1987 at the age of 23. Analysis of the quinquennial distribution of her papers with her productivity age depicts that she had 11 papers during the first two quinquennia which reached its peak in the 6th quinquennium, i.e., 2012-16 with 93 papers. This was preceded by 48 papers in the previous quinquennium i.e., the 5th quinquennium followed by 75 papers in the 7th quinquennial period. There are 45 papers on average per quinquennium. It is clear that her research activity gained momentum from 2011 onwards at the age of 47 years and it is consistent till the last year of study i.e., 2020. Of the total 315 papers, 297 papers are multi-authored papers, i.e., 94.29%. Maximum single-authored papers i.e., 5 out of 18 belong to the 3rd and 7th quinquennium namely, 1997-2001 and 2017-2020 at the age of 33-37 and 53-56 years respectively. Of all the quinquennia, the 3rd quinquennium has the maximum number of main authored papers i.e., 8 followed by Q1 and Q6 with 7 main authored papers each. Her fifty percent productivity life is 26 years, i.e., the 48th year of her life. The trends based on quinquennial in JD's all papers (single and multi-authored), the cumulative number of papers, and collaborative coefficients are shown in Figure 2. Again, Table 2 shows there are 1393 co-authors in JD's papers.

Table 1. Year-wise authorship trends of papers by Jennifer Doudna

Quinquennium	Year	Number of Authors						Publications		Total	CC	Age of JD
		One	Two	Three	Four	Five	>Five	Main	Coauthor			
Q1	1987				1			1		1	1	23
	1988											24
	1989		3	2				4	1	5	1	25
	1990				1	1		1	1	2	1	26
	1991			1	1		1	1	2	3	1	27
Q2	1992											28
	1993			1	1			2		2	1	29
	1994	1						1		1	0	30
	1995	1	1	1				3		3	0.67	31
	1996		2				3		5	5	1	32
Q3	1997	2	6	3				4	7	11	0.82	33
	1998	1	1	3			1	1	5	6	0.83	34
	1999	1	1	2		1	1	1	5	6	0.83	35
	2000	1	4	2		2	1	1	9	10	0.9	36
	2001		6	2	3	1	1	1	12	13	1	37
	2002		6			1		2	5	7	1	38
	2003		1						1	1	1	39

Q4	2004		5	1		2	1	1	8	9	1	40
	2005	1	3	1	2	1	1	2	7	9	0.89	41
	2006		2	1		1	1		5	5	1	42
Q5	2007	1	4	3	3		2	1	12	13	0.92	43
	2008		2		1	1	1		5	5	1	44
	2009		3	2			3		8	8	1	45
	2010		2	2	1	3			8	8	1	46
	2011			4		1	9		14	14	1	47
Q6	2012		2	4	2	1	2		11	11	1	48
	2013		5	1	1	3	9		19	19	1	49
	2014		2	3	2	1	7	2	13	15	1	50
	2015	4	5		2	3	9	5	18	23	0.83	51
	2016		3	2	1	7	12		25	25	1	52
Q7	2017	1	2	2	1	4	14	1	23	24	0.96	53
	2018		2	3		3	7		15	15	1	54
	2019	3				2	14	3	16	19	0.84	55
	2020	1	2				14	1	16	17	0.94	56

Total 18 75 46 23 38 115 39
276 315

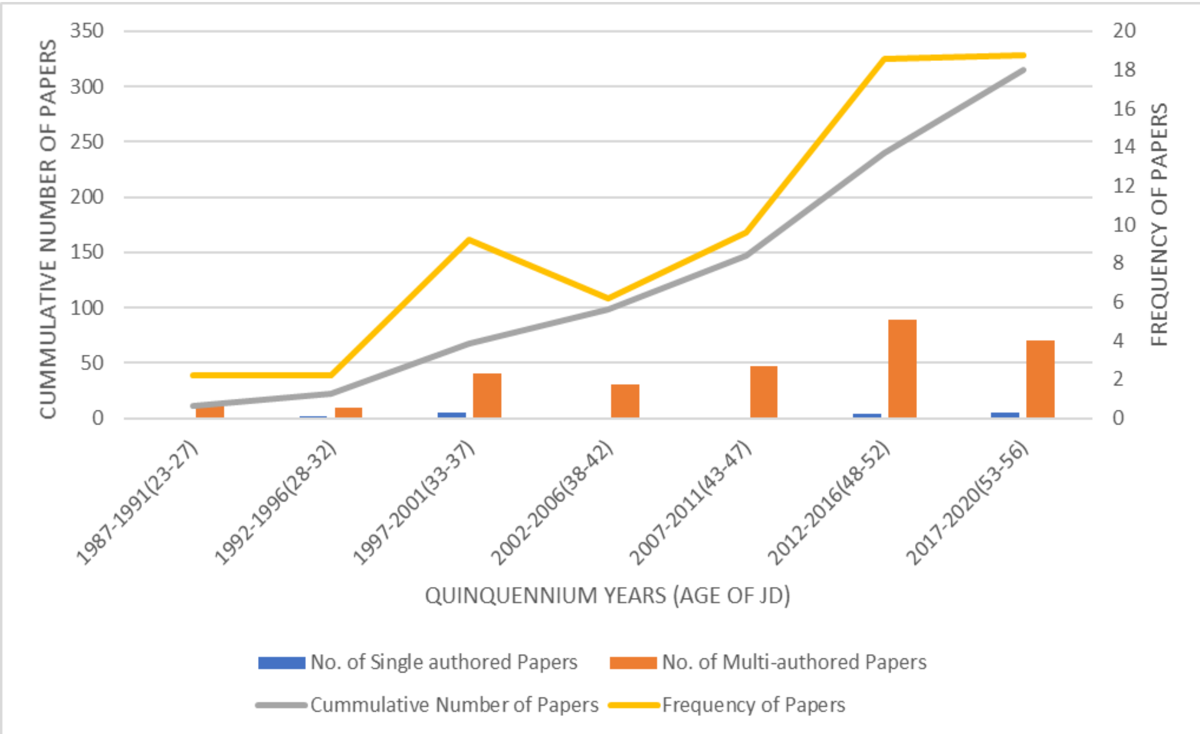

Figure 2. Publication Productivity of Jennifer Doudna

Table 2. Distribution of papers of JD by number of authors

No. of authors	No. of papers	Percent of papers	Number of authors	Percent of authors
One	18	5.71	18	1.29
Two	75	23.81	150	10.78
Three	46	14.6	138	9.91
Four	23	7.30	92	6.60
Five	38	12.06	190	13.63
More than 5	115	36.51	805	57.79
Total	315	100	1393	100

4.2 Analysis of Collaboration behavior of JD with co-authors

The research team of JD is found to be with 150 collaborators in total. The total number of multi-authored papers is found to be 297 which is 94.29% of the cumulative publications. The authors in the top 10 have 177 publications in total which is 63.9% of the multi-authored papers (277). The average number of authors per paper is found to be 2.1. Table 3 presents authors with a minimum of 5 or more 5 papers in collaboration with JD and the top 50 authors who have collaborated with J.D. Out of the total authors, a maximum number of papers are with Zhou, Kaihong (30, 9.52% share in cumulative publications), who shares the same affiliation with JD. This is followed by MA and Enbo of the same institute (20,6.35% share). Nogales, Eva from the California Institute for quantitative biosciences is placed at the third rank (19, 6.03% share).

Of the total number of co-authors, Table 3 presents the top 50 authors with at least 5 or more papers, 12 papers collaborating with the same affiliation of JD i.e., the University of California. This is followed by a collaboration with the

California Institute for Quantitative Biosciences, the U.S. with 4 publications in the top 50 list. She collaborated with 150 authors to produce 297 papers. She was the primary author in 21 (7.07%) publications and the secondary author in 276 (92.93%) papers.

Table 3. Prominent Authors in JD's Publications with ≥5 papers

SL. No.	Name of Author	Affiliation	Total Papers	SL. No.	Name of Author	Affiliation	Total Papers
1	Zhou, Kaihong	University of California, Berkeley, U.S.	30	26	Nuñez, James K.	University of California, San Francisco, U.S.	7
2	Ma, Enbo	University of California, Berkeley, U.S.	20	27	Mortimer, Stefanie A.W.	Guardant Health, Redwood City, U.S.	7
3	Nogales, Eva	California Institute for Quantitative Biosciences, U.S.	19	28	Arkin, Adam Paul	University of California, Berkeley, U.S.	7
4	Cate, Jamie	California Institute for Quantitative Biosciences, U.S.	19	29	Kidwell, Mary Anne	University of California, Berkeley, U.S.	7
5	Sternberg, Samuel H.	Columbia University, New York	17	30	Floor, Stephen N.	University of California, San Francisco, U.S.	7
6	Knott, Gavin J.	Monash University, Australia	17	31	O'Connell, Mitchell R.	University of Rochester School of Medicine and Dentistry, Rochester, U.S.	7
7	Harrington, Lucas B.	University of California, Berkeley, U.S.	16	32	Tsuchida, Connor A.	University of California, Berkeley, U.S.	7
8	Jinek, Martin	University of Zurich, Switzerland	16	33	Oakes, Benjamin L.	Scribe Therapeutics, Almeda, U.S.	6
9	Chen, Janice S.	California Institute for Quantitative Biosciences, U.S.	12	34	Ke, Ailong	Cornell University, Itchaca, U.S.	6
10	Szostak, Jack W.	Massachusetts General Hospital, Boston, U.S.	11	35	Liu, David R.	Harvard Faculty of Arts and Sciences, Cambridge, U.S.	6

11	Fellmann, Christof	Gladstone Institutes, San Francisco, U.S.	10	36	Heck, Albert J.R.	Bijvoet Center for Biomolecular Research, Utrecht, Netherlands	6
12	Al-Shayeb, Basem	California Institute for Quantitative Biosciences, U.S.	10	37	Hamilton, Jennifer R.	University of California, Berkeley, U.S.	6
13	Ferré-D'Amaré, Adrian R.	National Heart, Lung and Blood Institute, Bethesda, U.S.	10	38	Bai, Yun	Shanghai Tech University, Shanghai, China	6
14	Wiedenheft, Blake	Montana State University, Bozeman, U.S.	10	39	East-Seletsky, Alexandra	Arrakis Therapeutics, Waltham, U.S.	6
15	Fraser, Christopher S.	University of California, Davis, U.S.	10	40	Kieft, Jeffrey S.	University of Colorado School of Medicine, Denver, U.S.	6
16	Taylor, David W.	The University of Texas at Austin, U.S.	10	41	Burstein, David	The George S. Wise Faculty of Life Sciences, Israel	6
17	Wright, Addison V.	University of California, Berkeley, U.S.	9	42	Lin, Steven	National Taiwan University, Taipei, Taiwan	6
18	Liu, Junjie	Peking University, Beijing, China	9	43	Noland, Cameron L.	Genentech Incorporated, San Francisco, U.S.	6
19	Doherty, Elizabeth A.	Yale University, New Haven, U.S.	9	44	Barendregt, Arjan	Bijvoet Center for Biomolecular Research, Utrecht, Netherlands	6
20	Kranzusch, Philip J.	Dana-Farber Cancer Institute, Boston, U.S.	9	45	Kornfeld, Jack E.	Geisel School of Medicine at Dartmouth, Hanover, U.S.	5
21	Jiang, Fuguo	University of Texas Health Science Center at Houston, U.S.	9	46	Haurwitz, Rachel E.	Caribou Biosciences Inc., Berkeley, U.S.	5
22	Banfield, Jillian F.	Dept. of ENVSc., Policy and Management,	9	47	Lee, Amy Si Ying	Dana-Farber Cancer Institute, Boston, U.S.	5

		Berkeley, U.S.					
23	Staahl, Brett T.	Scribe Therapeutics, Almeda, U.S.	9	48	Corn, Jacob E.	ETH Zurich, Switzerland	5
24	MacRae, Ian J.	Scripps Research Institute, San Diego, U.S.	8	49	Hershey, John W.B.	University of California, Davis, U.S.	5
25	Batey, Robert T.	University of Colorado, Boulder, U.S.	8	50	Coyle, Scott M.	University of Wisconsin, Madison, U.S.	5

4.3 Preferred Channels of Communication

Table 4. Journal Preference of JD

Rank	**Journal**	**N**	**Cumulative**	**Period of Journal Usage FPY-LPY**	**TY**	**Country**
1.	Science	31	31	1989-2020	32	U.S.
2.	Nature	27	58	1989-2020	32	U.K.
2.	Proceedings of the National Academy of Sciences of the United States of America	27	85	1989-2020		
3.	Molecular Cell	21	106	2005-2020	16	U.S.
4.	Nature Structural and Molecular Biology	15	121	2005-2019	15	Germany
5.	RNA	14	135	1995-2013	19	U.S.
6.	Cell	13	148	2002-2019	18	U.S.
7.	Nature Biotechnology	11	159	2012-2020	9	Germany
7.	Nucleic Acids Research	11	170	1996-2020	25	U.K.
8.	eLife	10	180	2013-2020	8	U.K.
9.	Journal of Molecular Biology	9	189	1990-2012	23	U.K.
10.	Current Opinion in Structural Biology	8	197	1997-2015	19	U.K.
11.	Biochemistry	7	204	1993-2010	18	U.S.
11.	Nature Communications	7	211	2016-2019	4	Germany
12.	Nature Structural Biology	6	217	1997-2002	6	Germany
12.	Structure	6	223	1994-2011	18	U.S.
13.	ACS Chemical Biology	5	228	2006-2018	13	U.S.
13.	Cell Reports	5	233	2013-2018	6	U.S.
13.	PLoS One	5	238	2010-2017	8	U.S.
14.	Cold Spring Harbor Symposia on Quantitative Biology	4	242	1987-2019	33	U.S.
14.	Journal of Biological Chemistry	4	246	2004-2020	17	U.S.

14.	Journal of the American Chemical Society	4	250	2001-2018	18	U.S.
14.	Trends in Biochemical Sciences	4	254	1997-2015	19	U.K.
15.	Methods in Molecular Biology	3	257	1997-1997	1	U.K.
15.	Molecular and Cellular Biology	3	260	1989-2009	21	U.S.
15.	Nature Chemical Biology	3	263	2005-2005	1	Germany
15.	Science Advances	3	266	2017-2017	1	U.S.
28.	11 journals 2 papers and 27 journals with 1 paper each	49	315			

FPY = First Publishing Year LPY= Last Publishing Year
TY= Total Years

Table 4 lists some channels where JD has published at least 3 papers. In total, Doudna used 63 channels to communicate her 315 research papers. The top 10 journals as ranked in the list have 189 papers in total, which accounts for a 60% share in cumulative publications (315). She published 31 papers in *Science* during 1989-2020, 27 papers each in *Nature* and *Proceedings of the National Academy of Sciences of the United States of America* during 1989-2020, 21 papers in *Molecular Cell* during 2005-20. In Nature Structural and Molecular Biology, she has 15 articles during 2005-19. 14 articles in *RNA* and 13 articles in *Cell* during 1995-2013 and 2002-19 respectively. 11 articles each were published in *Nature Biotechnology* and *Nucleic Acids Research* during 2012-20 and 1996-2020 respectively. She has published 10 articles during 2013-20 in *eLife.* Out of the total channels, the highest impact factor journal where she published 27 papers is *Nature* followed by *Science,* where she published 31 papers. Majority of her publications were in journals from the US, U.K. and Germany.

4.4 Analysis of Keywords

The target of keyword analysis is to investigate the developing trends and hot spot areas of research and it is one of the significant approaches to trace the scientific progress. Frequently appearing keywords can reveal the trending categories along with the progress of R&D activities in any discipline (Wu *et al.* 2021). The analysis of occurrence of the keywords in multiple documents helps to find research trends in broad prospects and to assess the impact on other subjects too (Gupta *et al.* 2021). In another study, Kostoff *et al.* 1997 stated that impact of research can be assessed by analyzing the occurrence of keywords in the titles of scholarly communications by a researcher. Figure 3 depicts textual data about keywords that appear in the data set coherently. This figure shows keywords with maximum frequencies which appears in publications of JD, but not their co-occurrences or networks. The frequency of occurrences is directly proportional to the font size of the words in the figure. More is the font size of the words; more is the frequency of occurrence and vice-versa. The top 50 highly occurring keywords in the papers of JD are listed in Table 6. The top-ranking keywords with frequencies in parenthesis are Gene Editing (80), CRISPR CAS System (78), DNA (46), Article (45), Genetics (43), non-human (43), Priority Journal (41), Human (39). The occurrence of these keywords in her paper implies the area of interest of JD is Genetics and related fields.

Table 6. Keywords with high frequency of occurrence

Keyword	**Frequency**	**Keyword**	**Frequency**
Gene Editing	80	Enzyme activity	15
CRISPR CAS System	78	Bacteriophage	14
DNA	46	Clustered regularly interspaced short palindromic repeats	14
Article	45	CRISPR-associated proteins	14
Genetics	43	Genetic engineering	14
Non-human	43	CRISPR-associated protein 9	13
Priority Journal	41	CRISPR associated endonuclease cas9	13
Human	39	Gene expression	13
Metabolism	37	Unclassified drug	13
RNA	32	Bacterial protein	12
Humans	31	Bacterial proteins	11
DNA cleavage	26	Cryoelectron	11

		microscopy	
Controlled study	25	Double stranded DNA	11
Chemistry	24	Enzymology	11
Guide RNA	24	Bacterial genome	10
Clustered regularly interspaced short palindromic repeat	23	Phylogeny	10
CRISPR associated protein	22	Protein	10
Procedures	22	Animal	9
Genome	21	Animals	9
RNA guide	19	Bacteriophages	9
Escherichia coli	18	Electroporation	9
Human cell	16	Human genome	9
Streptococcus pyogenes	16	Review	9
CRISPR-CAS9 system	15		
Endonuclease	15		
Endonucleases	15		

Figure 3. Word Cloud of Keyword Co-occurrences

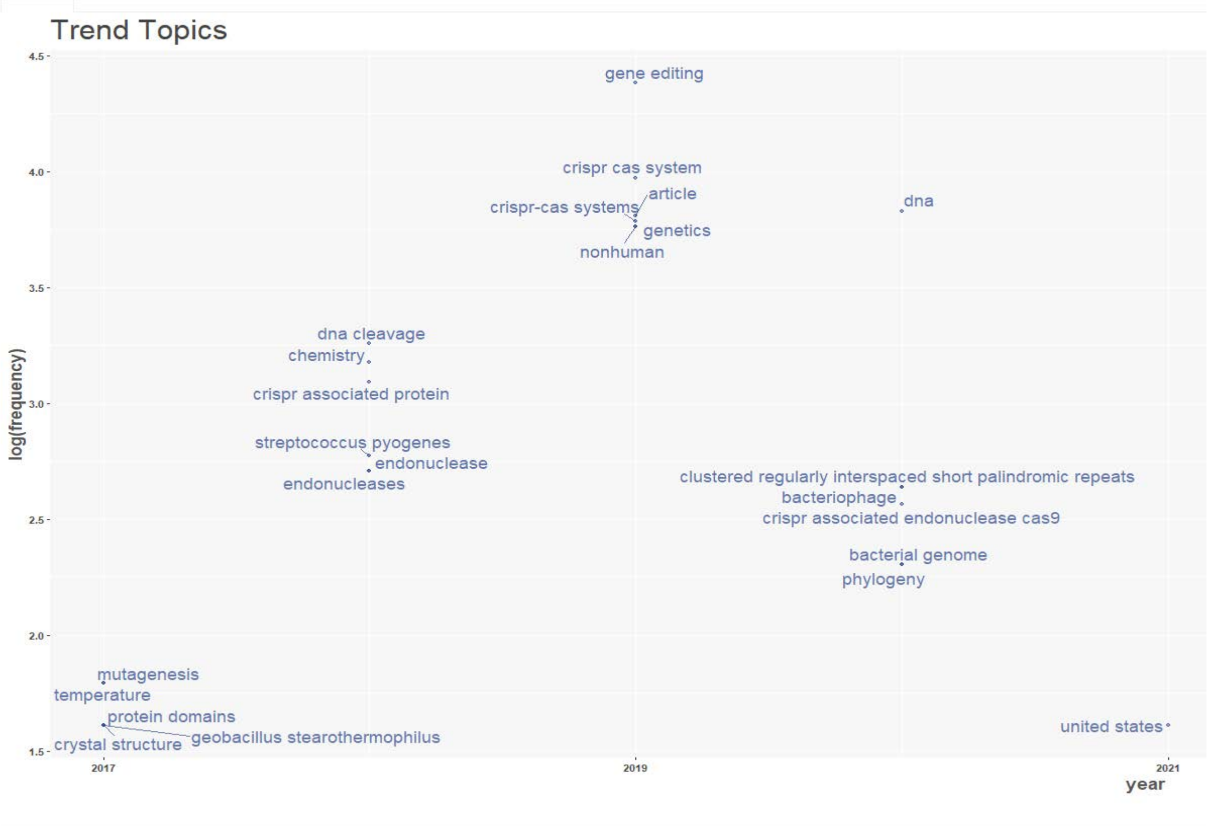

Figure 4. Trending topics of research of JD (presents data from 2017 onwards till date)

The analysis of trending topics in research publications of JD is done from 2017 onwards till date. From figure 4, it is quite clear that the areas of research in 2017 are reflected from the most prominent keywords like “temperature”, “mutagenesis”, “protein domains”, “crystal structure”, “Geobacillus stearothermophilus”. In 2018, the prominent keywords are “DNA Cleavage”, “Crispr Associated Protein”, “endonuclease”, “endonucleases”. In 2019, “gene editing”, the highest frequently occurring keyword is prominent. Besides, “genetics”, “nonhuman”, “CRISPR CAS system” are also observed. In 2020, “Phylogeny”, “bacterial genome”, “CRISPR Associated Endonuclease” occurred maximum number of times.

4.5 Highly Cited Papers

The 315 papers authored and co-authored by JD received citations in the range 1-7438 since their publication. The cumulative citations received by all papers are 53483 with 169.79 citations per paper. Of the 315 papers, 197 were in citation range 1-100, 60 papers are in the citation range 101-200, 23 papers are in citation range 201-300, 11 papers are in the citation range 301-400, 17 papers are in the range 401-1000, 6 papers are in the citation range 1001-3000 and 1 paper has received citations in the range 3001-8000. The top 10 highly cited papers are listed in Table 7 which received 20884 citations in total (39.05% share in cumulative citations and citations per paper of 20.89). Majority of the highly cited papers (4 out of 10) are published in the reputed journal *Science*, followed by *Nature* and *Cell* (2 out of 10), *eLife* and *Nature Biotechnology* (Journal with the highest impact factor in the list of 54.91) has 1 article each in the list. These papers are published during 1996 to 2018.

Table 7. Top 10 highly cited papers

Title of the paper	**Journal**	**JIF* (2020/2021)**	**Year**	**TC****
A programmable dual-RNA-guided DNA endonuclease in adaptive bacterial immunity	Science	47.79	2012	7438
The new frontier of genome engineering with CRISPR-Cas9	Science	47.79	2014	2868

Repurposing CRISPR as an RNA-γuided platform for sequence-specific control of gene expression	Cell	41.58	2013	2470
XCRISPR-mediated modular RNA-guided regulation of transcription in eukaryotes	Cell	41.58	2013	1875
RNA-programmed genome editing in human cells	eLife	8.14	2013	1310
RNA-guided genetic silencing systems in bacteria and archaea	Nature	49.96	2012	1168
Crystal structure of a group I ribozyme domain: Principles of RNA packing	Science	47.79	1996	1142
DNA interrogation by the CRISPR RNA-guided endonuclease Cas9	Nature	49.96	2014	973
High-throughput profiling of off-target DNA cleavage reveals RNA-programmed Cas9 nuclease specificity	Nature Biotechnology	54.91	2013	933
CRISPR-Cas12a target binding unleashes indiscriminate single-stranded DNase activity	Science	47.79	2018	707

5. Discussion

Willium Stockley, a Noble Laureate, first observed to be keeping interest in measuring research productivity among researchers in a group by evaluating their publications and indicated scientific publications as a basis of measuring research output (Stockley 1957). Performance of an individual scientist if documented quantitatively has wide contribution in the field of Scientometrics (Hazarika *et al.* 2010). Scientometric profile depicts the social behavior of a researcher working in a particular discipline analyzing the collaboration dynamism of the scientist/ researcher. Scientometric studies are of real value for science history researchers, science policy makers, biography makers of scientists, R&D administrators, documentation officers, young scientists, bibliometricians, information scientists, research institutions and also science journalists (Munnoli and Kalyane 2003). Large number of studies have already been published on scientometric portrait of noble laureates (Kedamani *et al.* 2001), scientists from various backgrounds (Parvathamma and Gobbur 2008; Sinha and Ullah 1993) as well as organizations (Nandi and Bandopadhyay 2009; Swarna *et al.* 2002). These studies indicated the emergence of an interdisciplinary, multidisciplinary and trans disciplinary area which specializes studies on individual scientists and institutions. Jennifer Doudna has made exemplary contribution on gene editing. Her research emerged with exceptional publications in the time when women were not allowed to step out of their house especially in India.

Bibliometric analysis that differs from systematic reviews is an efficient tool for briefing the present status and prediction of future progress in the frontiers of knowledge in any domain of research (Grant and Booth 2009; Moller and Myles 2016). So, using different performance measurement indicators, the pattern of research, collaboration, growth of publications and analysis of keywords were performed. In any form of Bibliometric study, analysis of keywords reveals hot spot areas of research and progress of a research topic (Donthu *et al.* 2021). In case of preparation of scientometric profile, analysis of keywords in general provides the area of interest of the scholar and analysis of trending topics in particular gives information on chronological distribution of the areas of interest which generates quite interesting information. Scientometric profile of a scientist facilitates quantitative analysis and graphical presentation of publication output of a scientists providing an easy and clear perception about the his or her work. In turn, it plays an important role in dissemination of information to a scientist who is having interest to know about the number of papers published and also the research trends followed in his or her career (Sangam *et al.* 2006).

6. Conclusion

It is really a great achievement of Jennifer Doudna that she began her research career at the age of 23 years by publishing article as a principal author in prestigious journal *Cold Spring Harbor Symposia on Quantitative Biology* (Scopus coverage from 1950). Her publication output was found to be very consistent throughout her scientific career examined for this study. The share in collaborative research work is found to be very high as she had 150 co-authors during the period of 34 years of her research career. She initiated extensive research on "gene editing" techniques. Among the innumerable awards, she received the illustrious Nobel Prize in Chemistry at the age of 56 years. Hence, she is considered to be a role model for new generation scientists especially women to pursue her footsteps in discovering nature through scientific findings/studies. This study enables bibliometricians to compare how bibliometric profile of a scientist and a Noble Prize Winner (specifically in Chemistry) differs from those in other subjects. Moreover, it will be interesting if an attempt would be made to prepare citation maps analyzing synchronous and diachronous self-citation rate, sociological aspects and more extensive insights on collaboration pattern and detailed citation pattern as well as authorship credit of Doudna's publication.

7. Limitations of the study

This study is confined to analysis of scientific publications of Jennifer Doudna with citation and publication related metrics only. The study has never applied enriched bibliometric techniques like cluster and network analysis, visualization, analysis of co-authorship of authors, countries, journals, and co-citation. Moreover, the study lacks to provide the intellectual structure and collaboration network of the scientist with her peers.

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