



# Authorship Pattern and Collaborative Research Trends in Journal of Artificial Intelligence Research (JAIR)

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**Abstract:** *The prime objective of this Research oriented paper is to conduct a bibliometric analysis of Journal of Artificial Intelligence Research (JAIR), a premier open access, peer-reviewed journal on the web since its inception in the year 1993. It is published by Artificial Intelligence Access Foundation, whose purpose is to facilitate the dissemination of scientific result to the global Artificial Intelligence (AI) community. This bibliometric study is to explore the recent trends of publication in JAIR regarding the Authorship Pattern and Collaborative Research activities of 30 volumes (3 volumes were published in each year and this study is covering all the volumes ranging from (vol. no. 46-75) consisting of 760 articles contributed by 2633 authors which were published in the 10 year period in between 2013 to 2022. Out of 760 articles, only 39 articles were written by single author and the rest 721 articles were contributed by more than one author. This study clearly manifests that multiple Authorship Patterns are dominant but single author's contribution are also exists in every year. The most scholarly articles were written by 3 authors i.e., 226 (29.73%) articles followed by 2 authored paper i.e., 197 (25.92% articles). The degree of collaboration ranges from 0.89 to 0.98 and the average degree of collaboration is determined as 0.94.*

**Keywords:** *Authorship Pattern, Degree of collaboration, Journal of Artificial Intelligence Research (JAIR), Artificial Intelligence (AI), Bibliometric study*

## Introduction

Bibliometric study is one of the prime tools which have an extensive application based on quantitative analysis as well as the use of mathematical and statistical techniques of any research oriented work for identifying the research trends of that particular discipline. Authorship study is also a type of bibliometric analysis that focuses on the patterns and characteristics of authorship in scholarly publication. This includes analyzing the number of author per publication, author collaboration, author productivity etc. In modern times, we notice that the most of the research oriented assignments have been contributed by more than one author due to the overall growth of Information and Communication Technology (ICT) worldwide. Writing of articles with co-authorship is one of the indicators of reliability in scholarly articles. The main reason for collaborative research can be attributed to the interdisciplinary nature of investigation, escalating cost of instrumentation, Laboratory facilities and common interest of the researches in the same field. So the main advantages of scientific collaboration are accessing the various ideas and sources, exchange of information, learning new skills, more efficiency and higher quality of results and improve the quality of articles. In this paper, the bibliometric analysis is done on JAIR, a peer-reviewed research oriented journal for investigating about the Authorship Pattern and Collaborative Research trends in recent years covering the periods of 10 years from 2013-2022.

## About the Journal of Artificial Intelligence Research (JAIR)

The Journal of Artificial Intelligence Research (JAIR) first published in August, 1993 by Artificial Intelligence Access Foundation, a non-profit charitable organization. The main objective of this organization is to facilitate on the internet for free distribution of scientific results covering all the areas of Artificial Intelligence. The printed volumes are also available. Now this journal publishes 3 volumes in a year. In its website ([www.jair.org](http://www.jair.org)), all the past volumes since 1993 are available on the web. This journal is one of the first and premier and leading open access peer-reviewed journal of Artificial Intelligence on the web. Publications under JAIR include refereed research articles, survey articles, technical notes etc Artificial Intelligence. It is indexed by INSPEC, SCI and MathSciNet. The impact factor of JAIR is 2.441 (2019). Since its appearance in the year 1993, JAIR had a major impact on the field and it has been continuously ranked as one of the top journals covering all the arena of Artificial Intelligence.

## Literature Review

It was found that various studies were conducted on authorship pattern and collaborative research and published in various journals in different disciplines. Some of the literatures on were reviewed and mentioned before the current study.

**Saha, M. (2019)** conducted a bibliometric analysis on Authorship Pattern and Collaborative research work in Journal of Drug Research in Ayurvedic Sciences to explore the trends of publications of scholarly articles of JDRAS between the period of 2000-2011.

**Yadav, S. K., & et al (2019)** conducted a study on evaluation of authorship and collaboration pattern in SRELS Journal of Information Management during 2008-2017.

**Garg, K.C., Anjana A.K. (2014)** analyses 605 papers published in the Journal of Intellectual Property Rights during 1996-2012.

**Tunga, S.K. (2014)** conducted a citation study on authorship pattern and degree of collaboration in journal articles of 80 doctoral dissertations of Bidhan Chandra Krishi Viswavidyalaya and Uttar Banga Krishi Viswavidyalaya, West Bengal during 1991-2010.

**Chandran, V. (2013)** investigates the bibliometric analysis of Journal of Intellectual Property Rights (JIPR) for selected six years between 2007 and 2012.

**Thavamani K. and Velmurugan C, (2013)** explores the publication trends of scholarly papers in Annals of Library and Information Studies published from New Delhi.

**Amsaveni, N., et al (2013)** did the study of the authorship pattern and collaborative research in bioinformatics. The study found that the rate of increased in multiple authorship pattern mottled considerably with subject area.

**Thanuskodi, S. (2011)** conducted a bibliometric analysis of the journal titled "Library Herald" for the period between 2006 to 2010.

The review of the above shows that studies on authorship pattern and collaborative research trends of publications performing bibliometric analysis have been done in various journals. Similar studies in the Journal of Artificial Intelligence Research (JAIR) were not conducted. So, it is more meaningful to conduct this type of study to understand the research trends of publications in this field.

## Objective of the study

The primary objectives of this study are to understand the growth of JAIR and the contributor's research output during the period 2013-2022. The specific objectives are

- To know the year wise growth of publications
- To examine the period and volume wise authorship pattern
- To find out the degree of collaboration.

- To scrutinize the single and multi authorship paper of JAIR.
- To study the authors productivity.

## Methodology

For this research paper, the data are collected from JAIR website (www.jair.org) covering the period of 10 years from 2013-2022. JAIR publishes 3 volumes in each year and from the above selected 10 years, all the 30 volumes (volume no 46-75) consisting 760 articles are considered in this bibliometric study. At first all the articles and relevant data like total articles per year, number of authorship, single and multiple authored papers etc. are noted and downloaded in my personal laptop . Thereafter these collected data are examined and analyzed with the help of Ms-Excel software. Then the data were compiled, organized, tabulated and analyzed to examine the various aspects relating to authorship pattern, author's productivity, degree of collaboration etc. and presented with the help of using simple arithmetic and statistical method of respective equation for obtaining of the desired result.

## Limitations

This bibliometric study is not considered the broader view of collaboration like consultation in composing article content, articles that deals with co-operative works but written by only one author etc. The only consideration is solely for the joint authorship of the articles. Moreover this work collects the relevant data from the journal website (www.jair.org). So these data are collected from secondary sources of information. So the conclusive outcomes of this study is fully depends on the online JAIR websites. On the other hand in this research study, the period is considered for the latest 10 years (2013-2022) in order to simplifying the calculation, analyzing the data. Hence the coming results of this study will obviously not to throws the light in a comprehensive manner but these conclusive results gives us a correct indicator relating about the trends of authorship pattern and collaborative research this scholarly JAIR in coming days.

## Result and Discussion

**Table 1: Year wise Distribution**

Sl. no	Year	Volume	No. of Articles	% of Records
1	2013	46-48	61	8.02
2	2014	49-51	68	9.44
3	2015	52-54	48	6.31
4	2016	55-57	65	8.55
5	2017	58-60	68	8.94
6	2018	61-63	69	9.07
7	2019	64-66	75	9.86
8	2020	67-69	84	11.05
9	2021	70-72	104	13.68
10	2022	73-75	118	15.52
<b>Total</b>			<b>760</b>	<b>100</b>

Table-1 shows the year wise volume numbers and total number of scholarly journal articles published in JAIR during the period 2013-2022. There are total 760 articles published during this study period. It is depicted that maximum 118 (15.52%) articles were published in the year 2022 followed by 104 (13.68%) articles in the year 2021 which is marked as the second highest publication. The lowest publication has been counted in the year 2015 with 48 (6.31%) articles. It is also noticed that JAIR is publishing 3 volumes in each year. It is also observed that the number of articles published is steadily growing in the last half of this study period i.e. 450 ((59.21%) articles

were published in between 2018 to 2022 as compared to the period of the first half i.e.310 (40.79%) articles published in between the period from 2013 -2017.

**Table 2: Author Pattern**

Sl. no	No. of Authors	Total No. of Contributions	% of Records
1	Single Author	39	5.13
2	Two Authors	197	25.92
3	Three Authors	226	29.73
4	Four Authors	161	21.18
5	Five Authors	61	8.02
6	Six Authors	40	5.26
7	Seven Authors	18	2.36
8	Eight Authors	8	1.05
9	Nine Authors	3	0.39
10	More than Nine authors	7 ( 2 articles by 11Authors, 1 article each by 12, 13, 15, 18 & 36 Authors)	0.92
<b>Total</b>		<b>760</b>	<b>100</b>

In table-2, it is revealed that majority of scholarly articles were written by more than one author. Out of 760 contributions, only 39 articles (5.13%) were written by single author and the rest 721 (94.87%) were written by multi -author collaboration. The highest number of contribution is 226 articles (29.73%) which were written by jointly by 3 authors followed by 197 articles (25.92%) and 161 (21.18%) articles contributed by 2 and 4 authors respectively. The least contribution is 1 (0.13%) article each which was written jointly with the collaboration by 12, 13, 15, 18 and 36 authors respectively.

**Table 3: Period/ Volume wise Authorship Pattern**

Sl. no	Year	Vol.	Number of Author/Authors										Total	% of Records
			1	2	3	4	5	6	7	8	9	more than 9		
1	2013	46-48	2	21	17	11	5	3	2	0	0	0	61	8.02
2	2014	49-51	4	21	23	14	3	0	3	0	0	0	68	9.44
3	2015	52-54	5	12	20	6	4	1	0	0	0	0	48	6.31
4	2016	55-57	1	20	24	12	3	2	0	1	1	1	65	8.55
5	2017	58-60	4	24	18	15	5	2	0	0	0	0	68	8.94
6	2018	61-63	5	19	18	11	10	2	3	1	0	0	69	9.07
7	2019	64-66	5	20	23	14	11	1	0	1	0	0	75	9.86
8	2020	67-69	4	20	21	23	6	6	0	4	0	0	84	11.05
9	2021	70-72	4	21	33	22	5	11	4	0	1	3	104	13.68
10	2022	73-75	5	19	29	33	9	12	6	1	1	3	118	15.52
<b>Total</b>			<b>39</b>	<b>197</b>	<b>226</b>	<b>161</b>	<b>61</b>	<b>40</b>	<b>18</b>	<b>8</b>	<b>3</b>	<b>7 *</b>	<b>760</b>	<b>100</b>
Percentage (%)			5.1	25.9	29.7	21.1	8.0	5.2	2.3	1.0	0.3	0.9		

\*In more than 9 authors, 2 articles by 11Authors, 1 article each by 12, 13, 15, 18 & 36 Authors

The table-3 presents the volume and year wise authorship pattern of contributions. It is noticed that out of 39 contributions of single author, the highest number of contributions is 5 (12.82%) which were published in the years of 2015 (volume no. 52 - 54), 2018 (volume no. 61-63), 2019 (volume no. 64-66) and 2022 (volume no. 73-75). On the other hand, the lowest number of contribution was written by single author is 1(2.56%) article in the year 2016 (volume no. 55-57). It is evident from the table-3, multi authored contributions are dominated over the single

author. During the study period, there was total publishing articles in JAIR were 760 articles, and out of 760 articles, only 39 (5.13%) contributed by single author where as 721 (94.87%) articles were written by joint authorship. It is also evident from this table, maximum articles were written by 3 author's collaboration i.e. 226 (29.73%) articles, followed by 2 authors contributions i.e. 197 (25.92%) articles in between 2013-2022. There is 1 (0.13%) research oriented paper contributed with the collaboration with 12,13,15,18 and 36 authors each in the year 2016, 2021 and 2022 and this is the least contribution in regard to the multiple authorship collaboration. In the year 2022 (volume no. 73-75) the highest number of contributions is 118 (15.52%) articles, followed by 104 (13.68%) articles published in the year 2021. Out of 226 articles, 33 (14.60%) articles in 2021 (Vol. 70-72), is the highest one in between 3 authored papers.

**Table-4: Author Productivity**

Sl. no	Year	Total no of Articles	No. of Authors	AAPP*	Productivity per Year
1	2013	61	196	3.21	0.31
2	2014	68	207	3.04	0.32
3	2015	48	139	2.89	0.48
4	2016	65	218	3.35	0.29
5	2017	68	203	2.98	0.33
6	2018	69	232	3.36	0.29
7	2019	75	239	3.18	0.31
8	2020	84	297	3.53	0.28
9	2021	104	423	4.06	0.24
10	2022	118	479	4.05	0.24
<b>Total</b>		<b>760</b>	<b>2633</b>	<b>3.36</b>	<b>0.30</b>

\*average authors per paper (AAPP) = number of authors/number of papers.

Productivity per author = number of papers/number of authors.

It is evident from the table no-4 that the total average number of authors per paper is 3.36 and the average productivity per author is 0.30. The highest author productivity is 479 (4.05) in the year 2022.

**Table 5: Year wise single and Multiple Authored papers**

Sl. no	Year	Single Authored		Multi Authored		Total	% of Records
		Papers	%	Papers	%		
1	2013	2	5.12	59	8.18	61	8.02
2	2014	4	10.25	64	8.87	68	9.44
3	2015	5	12.82	43	5.96	48	6.31
4	2016	1	2.56	64	8.87	65	8.55
5	2017	4	10.25	64	8.87	68	8.94
6	2018	5	12.82	64	8.87	69	9.07
7	2019	5	12.82	70	9.70	75	9.86
8	2020	4	10.25	80	11.09	84	11.05
9	2021	4	10.25	100	13.86	104	13.68
10	2022	5	12.82	113	15.67	118	15.52
<b>Total</b>		<b>39</b>	<b>100</b>	<b>721</b>	<b>100</b>	<b>760</b>	<b>100</b>

The table-5 represents the details about the single and multi authorship contributions. A total of 39 (5.13%) contributions out of 760 research oriented papers have been written by single author and the rest i.e. 721 (94.87%) articles contributed by multiple authors collaboration.

**Table 6: Degree of Collaboration**

Sl no	Year	Single Authored Paper (Ns)	Multiple Authored Papers (Nm)	Total (Ns + Nm)	Degree of Collaboration
1	2013	2	59	61	0.96
2	2014	4	64	68	0.94
3	2015	5	43	48	0.89
4	2016	1	64	65	0.98
5	2017	4	64	68	0.94
6	2018	5	64	69	0.92
7	2019	5	70	75	0.93
8	2020	4	80	84	0.95
9	2021	4	100	104	0.96
10	2022	5	113	118	0.95
<b>Total</b>		<b>39</b>	<b>721</b>	<b>760</b>	<b>0.94</b>

Table-6 represents itself about the details of degree of collaboration. The degree of collaboration is one of the most crucial and essential factor of any research arena of the bibliometric study. This table indicates the trends in single and joint authorship during the study period span of 10 years from 2013-2022. The degree of collaboration ranges from 0.89 to 0.98 and the average degree of collaboration is 0.94. The degree of collaboration is formulated by using the following technique (K.Subramanyam, 1982)

The formula is where

C = Degree of Collaboration

$$C = \frac{N_m}{N_m + N_s}$$

Nm = Number of multiple authors

$$C = \frac{721}{721 + 39}$$

Ns = Number of single author

In the present study, the value of C is

$$C = 0.94$$

As a result, the degree of collaboration in JAIR is 0.94, which clearly indicates that the multiple authors' contribution is dominated over the single author contributions.

### Conclusion

The trend towards the collaborative research can be seen during the study period 2013-2022 in JAIR. The year wise distribution of total 760 articles were written by the 2633 authors in 30 volumes (volume no.46-75) published in this period. The maximum number of articles published i.e. 118 (15.52%) in the year 2022 (volume no. 73-75) and the minimum number of articles published i.e., 48 (6.31%) articles in the year 2015 (volume no. 52-54). In the authorship pattern, out of 760 articles, only 39 (5.13%) articles were contributed by single author and the rest i.e., 721 (94.87%) articles were written by multi authors. The publication papers in JAIR for the period of first 5 years (i.e. 2013-2017) is 310 (40.79%), where as growth of publication articles for the last 5 years (i.e. 2018-2022) is 450 (59.21%) articles. The maximum articles i.e., 226 articles out of 760 are contributed by 3 (29.73%) authors followed by 197 (25.92%) articles are with 2 authors. That means of about 30% and 26% of 3 authored and 2 authored papers respectively i.e. these two types authors papers covers more than 50% contributions during the study periods of 10 years ranging from 2013 to 2022. So authorship pattern obviously tilt towards the collaborative research work particularly in science and technology sector. The total average number of authors per paper is 3.36

and the average productivity per author is 0.30. The degree of collaboration ranges from 0.89 to 0.98 and the average degree of collaboration is 0.94 during this period. The result has vastly adhered to the multi authorship type of collaboration (of about 94%) as compared to the individual contribution (of about 6%). So scientific collaboration in research is increasing rapidly and this would lead to writing the article with joint collaboration on this research oriented work. It is also noticed that one of the paper was written by 36 authors side by side some of the papers were written by 11, 12, 13, 15 and 18 authors in JAIR. All these occurrences clearly indicate that since its inception the majority of joint authorship work and high degree of collaboration in JAIR prevails in this bibliometric study. It also reveals that team research is to be predominant over the single author's contribution and this trend will be continued in future also.

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