

# Autism Research Collaboration: A Scientometric study

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## ABSTRACT

The present study focus on the year wise growth rate, Relative growth rate and doubling time and Authorship pattern in autism research for the period of 2013-2022. Authorship pattern included frequency of authorship, degree of collaboration, rate of single authorship and Co-authorship index. Degree of collaboration indicates that multiple authorship dominates with increase in DC over the years. RGR and DT show slight fluctuation during the period of study. RSA decreased during the study period and highest CAI is for more than five authors. The present situation compels on the researchers to go for collaboration in research, thus resulting in the shift from solo research to team research. Multiple authorship indicates development of a subject and a tendency of inter institutional, inter disciplinary and collaborative study.

**Keywords:** Relative growth rate (RGR), Doubling time (DT), Degree of collaboration (DC), Rate of single authorship (RSA), Co-authorship index (CAI)

## 1. INTRODUCTION

The productivity of authors in the context of Research and Development is normally measured in terms of scientific and technical output. The principle means of author's communication is the publication process, which allows authors to verify the reliability of information, to acquire and sense of relative importance of a contribution, and to obtain critical response to work. Correspondingly, it is through publications that authors receive professional recognition and esteem, as well as promotions, advancements, and funding to future research work.

Autism is a neurological disorder that causes complex developmental delays, including marked impairments in social interactions, communication, and behaviours that restrict leisure and daily activities (Ashmun & Fenton, n.d.)<sup>1</sup>. Autism is a diverse disorder. The initial signs of autism, which typically appear in the first three years of

life, are typically recitations of passages or the alphabet by the kid's parents, who often grow concerned when their child does not use words to communicate. (Catherine, 2020).<sup>2</sup>

The intensity of autistic symptoms varies from person to person and might include intellectual incapacity, sensory abnormalities, repetitive movements, and difficulties with communication and social interactions.

(Nature,2020)<sup>3</sup>. Children with autism may rely more on physical

Feedback than visual cues when performing tasks (Nature, 2009)<sup>4</sup>

In actuality, neurological and genetic factors have been implicated in its etiology. Despite its genetic foundation, Autism is primarily diagnosed by looking at behavioral indications including communication, imaginative capacity, social interaction and repetitive habits among others. (Chakrabarti et al.,2009)<sup>5</sup>.

Compared to the general population, adults with autism and intellectual disabilities are more likely to develop adult health disorders such as obesity, hypertension, and diabetes. (Croen et al., 2015).<sup>6</sup>

## 1.2 SCIENTOMETRICS

The term "scientometrics" was first used in Russian in 1969, described it as the quantitative examination of different types of intelligence processes in the advancement of science. The term, which was coined in 1978 and has gained widespread recognition thanks to the magazine *Scientometrics*, refers to the quantitative aspects and traits of science and scientific study. It has established a permanent field. Scientometrics is a field of study that employs mathematical techniques to measure scientific research persons and accomplishments in order to shed light on the process of scientific advancement and to offer a scientific foundation for scientific management and decision-making. Qiu, J., Zhao et al., 2017<sup>7</sup>. The present study tries to analyses the authorship pattern, year wise growth in autism literature, to find out Relative growth rate and doubling time of autism research publications during the period of 2013-2022 for a period of 10 years.

## 2. REVIEW OF LITERATURE

Thangaraj and Ramalingam, 2023<sup>8</sup> made an effort to investigate the authoring trends on various disability from 2006 to 2020. Using social network analysis and 27708 records, it demonstrated the growth rate of research collaboration in much disability. The study's observations of growth rate, relative growth rate, and doubling time highlight the fact that author collaboration is predominate and that there was no steady pace of augmentation in the research area.

Hosamani and Krishnamurthy, 2023<sup>9</sup> looked at the authorship trends in the field of endocrinology from 1992 to 2021 based on the output of literature research as shown in the Web of Science (WoS) database. Many scientometric elements were examined in the inquiry, such as the degree of collaboration, authorship pattern, collaborative index, and highly productive Indian institutions. The performance of India in producing endocrinology publications was assessed in this study. 9812 data were analyzed using an MS-Excel spreadsheet and the VOS viewer program. It was discovered that the degree of cooperation pointed to an expanding trend in the sector. 5.38 was the collaborative index rating for the general level.

Chithiraivel.S, Jeyshankar , R, and Sivasekaran, K, 2020<sup>10</sup> carried out a study based on articles indexed in the Web of Science Core Collection between 1998 and 2017, the current analysis examined authorship patterns in the Eosinophilia literature. Twelve hundred and eighteen researchers have contributed in total. More than 1,797 journals have published articles on Eosinophilia. The analysis's findings demonstrated that, with a maximum record of 1625 articles generated by four writers, an author's productivity examines the general pattern in understanding the scientific research process across all scientific disciplines. It was observed that there were both rising and downward trends in the level of collaboration. Time series analysis for individual researchers, a summary of co-authorship, research efficiency and ranking, a presentation of the co-authorship network, and an analysis of group author contributions were all included in this study. Reeja, and Senthilkumaran, P 2018<sup>12</sup> analyses the growth and development of Autism research in world based on the publication output from 2002-2016 using SCOPUS database. India secured 16 positions with 538 papers. Autism research output is highly scattered both in terms of the subfields as well as the publishing county.

### 3. OBJECTIVES:

The Main objective of the study is to present the growth of autism literature published during 2013 to 2022. This study attempts to

1. Find out the year wise distribution of autism research for the period of 2013-2022.
2. Analyse relative growth rate (RGR) and doubling time (DT) of autism research.
3. Evaluate the authorship pattern and frequency of authorship in autism research
4. Find out Rate of single authorship (RSA), Degree of collaboration (DC) and Co-authorship Index (CAI) in Autism research for 2013-2022.

### 4. METHODOLOGY

The data for the study was collected from Scopus database for a period of 10 years from 2013-2022 using the keyword “autism”. The Data is used to find the authorship pattern and measures of authorship, RGR, DT, DC, Rate of Single Authorship and CAI.

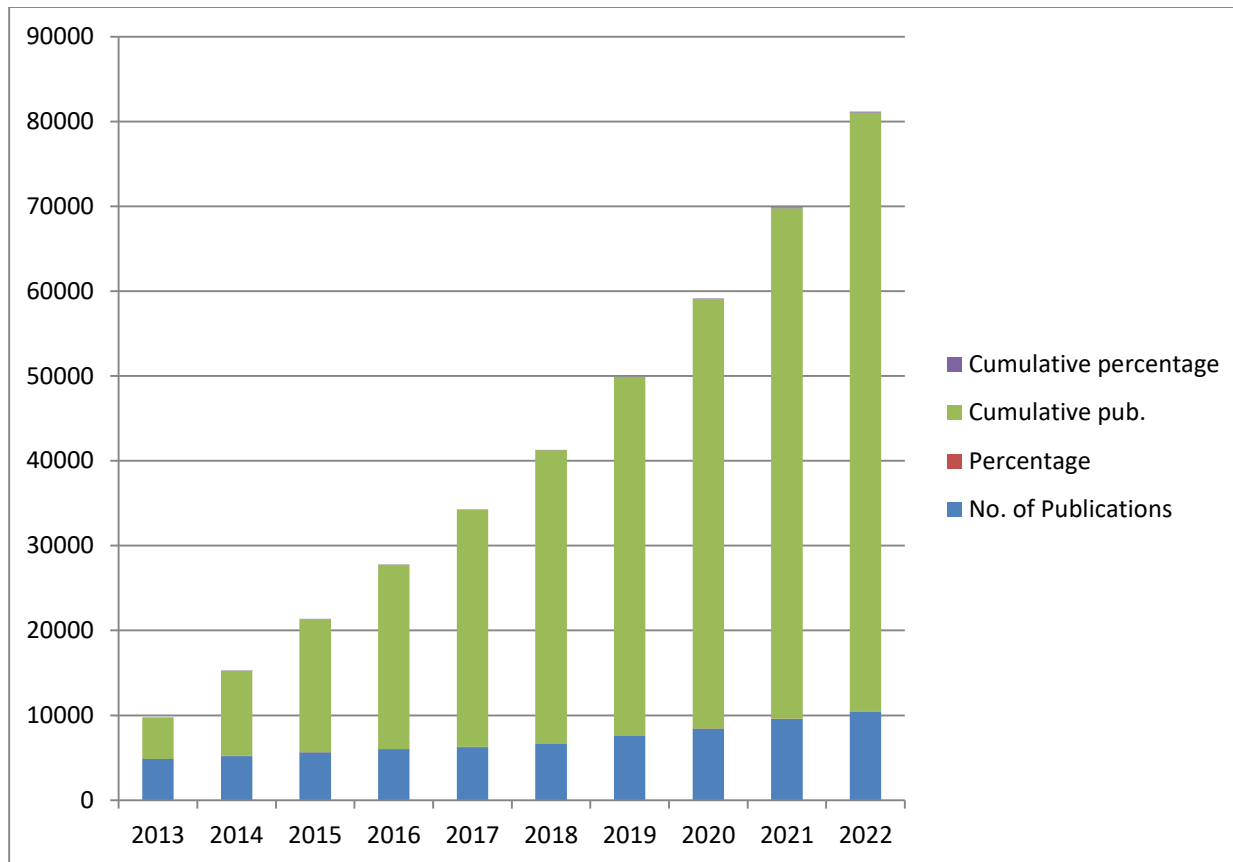
## 5. RESULTS AND DISCUSSION

### 5.1 Year wise productivity

Table-1 shows the year wise productivity of autism research for the period of 2013-2022. The lowest rate of autism research publication is in 2013 with 4852 (6.87%), in 2014 is 5209 (7.38%), in 2015 it is 5643 (7.99%), the highest productivity is in 2022 with 10423 (14.76%). Year wise publications and its percentage, cumulative publications and its percentage is shown in Table -1. Graphical representation of autism research publications is presented through Fig. 1.

**Table 1: Year wise output of Publications on Autism Research**

Sl. No.	Year	No. of Publications	Percentage	Cumulative pub.	Cumulative percentage
1	2013	4852	6.87	4852	6.87
2	2014	5209	7.38	10061	14.25
3	2015	5643	7.99	15704	22.24
4	2016	6011	8.51	21715	30.75
5	2017	6263	8.87	27978	39.62
6	2018	6634	9.40	34612	49.02
7	2019	7576	10.73	42188	59.75
8	2020	8424	11.93	50612	71.68
9	2021	9576	13.56	60188	85.24
10	2022	10423	14.76	70611	100
<b>Total</b>		<b>70611</b>	<b>100</b>	<b>-</b>	<b>-</b>



**Fig. 1 Year wise productivity**

**5.2 Relative Growth Rate and Doubling Time on Autism Research Output**

The below table reveals that the rate of growth of autism research literature is calculated by using Relative Growth rates (RGR) and Doubling time (DT) for the publications during the period of study. Table -2 presents the RGR and DT of total research output in autism research publications. The RGR value for the year 2013 is 8.49 and the value for the year 2014 is 0.07. The result shows that the value was not in standard position; it has been fluctuating. The Doubling Time (DT) value for the year 2013 is 4.96 and the value for the final year 2022 is 8.67. It is explored that the doubling time value also been dilemma values during the period of study in autism research domain. RGR and DT are graphically represented through graph in Fig. 2.

**Table 2: Relative Growth Rate and Doubling Time on Autism Research Output**

Year	N. of Pub.	Cumulative	W1	W2	RGR	DT
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2013	4852	4852	--	8.49	8.49	4.96
2014	5209	10061	8.49	8.56	0.07	9.9
2015	5643	15704	8.56	8.64	0.08	8.66
2016	6011	21715	8.64	8.70	0.06	11.56
2017	6263	27978	8.70	8.74	0.04	17.33
2018	6634	34612	8.74	8.80	0.06	11.56
2019	7576	42188	8.80	8.93	0.13	5.33
2020	8424	50612	8.93	9.04	0.11	6.3
2021	9576	60188	9.04	9.17	0.13	5.33
2022	10423	70611	9.17	9.25	0.08	8.67

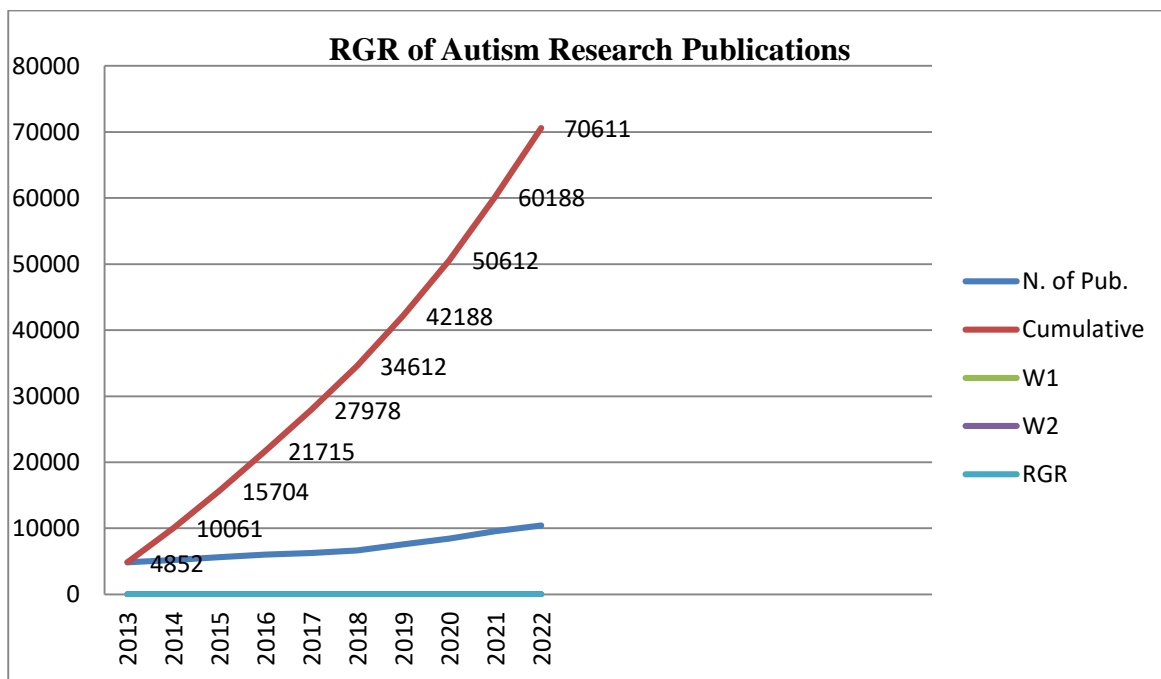


Fig.2 RGR of autism research publications

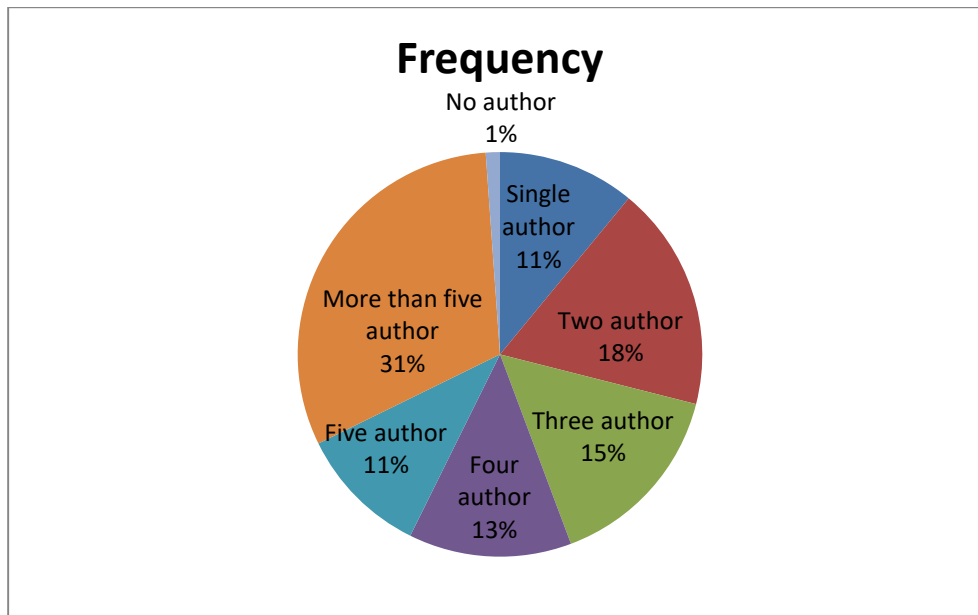
### 5.3 Frequency of Authorship Pattern

The table- 3 and Fig. 3 show the frequency of authorship pattern on autism research during the period of study from 2013 to 2022. It is stated that more than five authored papers occupies as more predominant position with 21983 (31.13%) publications. Two authored communications are occupied as second place with 12693 (17.98%) records. Three authored articles are in the third rank with 10834 (15.34%) research productivity in autism research. Single authored papers are ranked as fourth place with 7750 (10.98%) contributions. Four authored articles are placed as fifth place with 9192 (13.02%) articles. Five authored papers are occupied as

sixth place with 7361 (10.42%) publications. Anonymous authored papers are placed in the least place with 798 (1.13%) records in autism research productivity during the period of present study

**Table 3: Frequency of Authorship Pattern on Autism Research**

Sl. No.	Author Pattern	Frequency	Percentage
1	Single author	7750	10.98
2	Two author	12693	17.98
3	Three author	10834	15.34
4	Four author	9192	13.02
5	Five author	7361	10.42
6	More than five author	21983	31.13
7	Anonymous	798	1.13
Total		70611	100



**Fig.3 Authorship frequency in Autism research publications**

Multiple authorship indicates development of a subject and a tendency of inter institutional and inter disciplinary study.

**5.4 Year wise Authorship pattern**

The table- 4 shows the authorship pattern in autism research during the period of study from 2013 to 2022. It is noted that more than five authors are produced 3031(29.07%) publications in the year 2022 with more predominant place; single authors have been published only 737 (7.08%) records, at the same time 94 (0.90%), unknown authored publications also identified in autism research, followed by 2908 (30.37%) papers published in 2021 with second place, single authored papers 761 (7.95%) and unknown authored articles 99 (1.03%) in 2021, 2783 (33.04%) papers are published in 2020 with third place. Single authored papers are 822 (9.76%) and unknown authored articles are 93 (1.10%) in 2020, 2453 (32.38%) articles are published in 2019 with fourth rank. Single authored papers are 788 (10.40%) and unknown authored articles are 79 (1.04%) in 2019, 2183 (32.91%) articles are published in 2018 with fifth rank. Single authored papers are 753 (11.34%) and unknown authored articles are 78 (1.18%) in 2018, From Table 5.4 it is clearly evident that multi authorship is dominating over single authorship pattern in autism research publications during the period of 2013-2022.

**Table 4 : Year wise Authorship Pattern on Autism Research**

<b>Year</b>	<b>No author</b>	<b>Single author</b>	<b>Two author</b>	<b>Three author</b>	<b>Four author</b>	<b>Five author</b>	<b>More than five author</b>	<b>Total Publications</b>
2013	68 1.40%	775 15.97%	610 12.57%	782 16.13%	620 12.78%	450 9.27%	1547 31.88 %	4852
2014	65 1.25%	750 14.40%	735 14.11%	823 15.80%	669 12.84%	551 10.58%	1616 31.02%	5209
2015	63 1.12%	800 14.18%	1007 17.85%	820 14.52%	726 12.87%	529 9.37%	1698 30.09%	5643
2016	73 1.21%	815 13.56%	1049 17.45%	836 13.91%	784 13.04%	720 11.98%	1734 28.85%	6011
2017	86 1.37%	749 11.96%	1267 20.23%	865 13.82%	760 12.13%	506 8.08%	2030 32.41%	6263
2018	78 1.18%	753 11.34%	1332 20.08%	849 12.80%	749 11.29%	690 10.40%	2183 32.91%	6634
2019	79 1.04%	788 10.40%	1548 20.43%	1182 15.60%	805 10.63%	721 9.52%	2453 32.38%	7576
2020	93 1.10%	822 9.76%	1438 17.07%	1190 14.12%	1281 15.21%	817 9.70%	2783 33.04%	8424
2021	99 1.03%	761 7.95%	1553 16.22%	1521 15.88%	1417 14.80%	1317 13.75%	2908 30.37%	9576
2022	94 0.90%	737 7.08%	2154 20.67%	1966 18.86%	1381 13.25%	1060 10.17%	3031 29.07%	10423
	798	7750	12693	10834	9192	7361	21983	70611



### 5.5 Degree of Collaboration

The Subramanyam (1983)<sup>11</sup> formula was used to develop the Degree Collaboration (DC) proxy measure for research collaboration among the contributors. This measure is the ratio of collaborative contributions to the total number of research contributors published in the discipline within a specific time frame. Mathematically it can be referred to as,

$$DC = N_m / (N_m + N_s) \text{ or,}$$

$$DC = 62063 / (62063 + 7750) =$$

$$62063 / 69813 = 0.89$$

Where  $N_m$  refers to collaborative communications

$N_s$  indicates the number of single-authored communications

Table-5 indicates the collaboration scenario of the contributors of the autism research output from 2013 to 2022. Out of a total of 70611 publications, about 87.89% collaborated by multiple authors ranging from two to five plus co-authored contributions and rests were non collaborative. The table also explores the degree of collaboration of the autism research output from 2013 to 2022. The average degree of collaboration is impressive 0.89.

**Table 5: Degree of Collaboration on Autism Research**

Year	Total No. of publications	Single author	Multiple author	DC
2013	4852	775	4009	0.84
2014	5209	750	4394	0.85
2015	5643	800	4780	0.86
2016	6011	815	5123	0.86
2017	6263	749	5428	0.88
2018	6634	753	5803	0.89
2019	7576	788	6709	0.89
2020	8424	822	7509	0.90
2021	9576	761	8716	0.92
2022	10423	737	9592	0.93
Total	70611	7750 (10.98%)	62063 (87.89%)	-

**5.6 Rate of single authorship (RSA)**

Table- 6 indicates the rate of single authorship on autism research productivity from 2013 to 2022. In 2013, RSA is 0.16, further RSA decreased from 2014-2022 (0.14 to 0.07). The lowest RSA shows in 0.07 and the highest RSA is being in 2013 (0.16)

**Table 6: Rate of single authorship on Autism Research**

<b>Year</b>	<b>Total publications</b>	<b>Single author</b>	<b>RSA</b>
2013	4852	775	0.16
2014	5209	750	0.14
2015	5643	800	0.14
2016	6011	815	0.14
2017	6263	749	0.12
2018	6634	753	0.11
2019	7576	788	0.10
2020	8424	822	0.10
2021	9576	761	0.08
2022	10423	737	0.07
	70611	7750	

**5.7 Co-Authorship Index (CAI)**

The table -7 explores that in 2013 a total of 4852 publications were published in the field of autism research with 775 single-authored papers (CAI is 115), 610 two authored papers (CAI 75) and more than two authored published 3399 papers (CAI is 400). In 2014 a total of 5209 articles were published in autism research with 750 single-authored papers (CAI is 103), 735 two authored papers (CAI is 84) and more than two authored published 3659 papers (CAI is 409). In 2015 a total of 5643 articles were published in autism research with 800 single authored papers (CAI 102), 1017 two authored papers (CAI is 107) and more than two authored published 3773 papers (CAI is 386). In 2016 a total of 6011 articles were published in autism research with 815 single-authored papers (CAI 97), 1049 two authored papers (CAI is 104) and more than two authored published 4074 papers (CAI is 404). It is highlighted that in 2020, a total of 8424 articles were published in autism research with 822 single-authored papers with predominant place, but the CAI is only 70, 1438 two authored papers (CAI is 102) and more than two authored published 6071 papers CAI is 414. It indicates that total of 7750 articles were produced by the single authored publications and total CAI is 835, 12693 papers were published by two authored communications and CAI is 1055, and 49370 papers were produced by more than two authors and CAI is 4027 during the ten years study period from 2013 to 2022 in autism research.

**Table 7: Co-Authorship Index on Autism Research Publications**

Year	Total publications	Single author	CAI	2 author	CAI	3 author	CAI	4 author	CAI	5 author	CAI	More than 5 authors	CAI
2013	4852	775	115	610	75	782	103	620	97	450	91	1547	109
2014	5209	750	103	735	84	823	101	669	98	551	104	1616	106
2015	5643	800	102	1007	107	820	93	726	98	529	92	1698	103
2016	6011	815	97	1049	104	836	89	784	99	720	117	1734	99
2017	6263	749	86	1267	121	865	88	760	93	506	79	2030	111
2018	6634	753	81	1332	120	849	82	749	86	690	102	2183	113
2019	7576	788	74	1548	122	1182	100	805	81	721	93	2453	111
2020	8424	822	70	1438	102	1190	90	1281	116	817	95	2783	113
2021	9576	761	57	1553	97	1521	102	1417	113	1317	135	2908	104
2022	10423	737	50	2154	123	1966	121	1381	101	1060	100	3031	99
Total	70611	7750	835	12693	1055	10834	969	9192	982	7361	1008	21983	1068

**6. CONCLUSION**

The present era is witnessing the practice of collaboration which is spreading very fast owing to the globalization of research. Study concluded that the year wise productivity of autism research publications during the period shows an increasing trend. The rate of growth is assessed by calculating the relative growth rate and doubling time. The study shows that both RGR and DT values are not in a standard position and is fluctuating. This study indicates the collaboration scenario of the contributors of the autism research output from 2013 to 2022. Out of a total of 70611 publications, about 87.89% collaborated by multiple authors ranging from two to five plus co-authored contributions and rests were non collaborative. The average degree of collaboration is impressive 0.89. The study concluded that multiple authorship is dominating. The days of individual research are gone. The present situation compels on the researchers to go for collaboration in research, thus resulting in the shift from solo research to team research. Multiple authorship indicates development of a subject and a tendency of inter institutional, inter disciplinary and collaborative study. This study suggested that essential studies should be conducted in other sub-fields of autism in order to identify the intensify of collaboration.

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