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Research Article

SCIENTOMETRIC ANALYSIS OF RESEARCH PUBLICATIONS ON TOXICOLOGY

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ABSTRACT

This paper examines on scientometric analysis of research publications on toxicology, the data that have been accessed from the Web of Science database; the study period is from 2011 to 2020; with 3480 records have retrieved for the study. Objectives of the study; to find out year-wise publications on toxicology research, to examine authorship patterns, to find out the top twenty authors contributions, to find out top twenty institutions that contributed to toxicology research, to find top twenty sources contributions, to identify top twenty countries contributed on toxicology research. The study reveals that, year publications on toxicology research show an increase and decrease trend, the document type wise research publications on toxicology, Articles has first place with 1177 records, Meeting Abstracts has second place, Review Articles has third place with 627 records. The authors wise contributions, totally 12080 authors were contributions, Hoeng J, has first position, Peitsch M C, has second, Martin F, has a third contributions and so on, out of 3480 publications, 97.99 per cent of papers has been published in the English language, totally of 891 sources were published 3480 records on toxicology research, total of 113 countries were contributed to toxicology research, among the countries, the United States of America has the first position with 44.48 per cent contributions, Germany has second position with 10.20 per cent, England has third position with 9.17 per cent. Totally of 113 countries were contributed to toxicology research, out of 113 countries the United States of America has the first position, Germany has second position, England has third position and India has eighteenth place contributions.

Keywords: Scientometric, Toxicology, Chemical Toxicology, Ethnopharmacology, Pharmacology.

INTRODUCTION

Toxicology is a multidisciplinary science that has grown and expanded by borrowing data from several different areas. It comprises knowledge and methods from basic sciences such as medicine, epidemiology, pharmacy, and even some engineering areas (Costa.S, Teixeira.J.P, 2014). Toxicology is the study of harmful effects of agents on people, animals, and other living organisms (Borghoff. S J, 2005). The study of toxicology serves society in many ways, not only to protect humans and the environment from the deleterious effects of toxicants, but also to facilitate the development of more selective toxicants such as anticancer and other clinical drugs, pesticides, and so forth (Hodgson. E, 2010). Environmental toxicology is concerned primarily with the movement and impact of toxicants and their metabolites in the environment, in food chains, and upon the structure and function of biological systems. The biological systems include any living systems such as human and other mammals, plants, other organisms, and their habitats (Tetsuo Satoh, Salmaan H. Inayat-Hussain). Toxicology is the analysis and identification of poisons and drugs in the body (Britannica, The Editors of Encyclopedia, 2020). Toxicological research and testing helps us to live safely and to derive benefit from natural and synthetic substances while avoiding harm (The Society of Toxicology, 1999). Toxicology research is in particular demand, as a substantial part of the total burden of disease in industrialized countries has been attributed to environmental factors, including chemicals (Pruss-Ustun A, Vickers C, Haefliger P, et al. 2011). Toxicology research and the dissemination of results through toxicology journals provide ample support for decision making on preventing toxic hazards (Grandjean.P 2015). These scientometric studies help to identify publications on toxicology research.

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METHODOLOGY

The data have been collected from the Web of Science database; the search string was used 'toxicology' in the Title search box, field was used, and the time span field was select from 2011 to 2020. A total of 3480 records were retrieved, the data downloaded and analyzed using MS office-Excel as per objectives of the present study.

Relative Growth Rate (RGT) and Doubling Time (DT)

The relative growth rate is the increase in the number of publications/pages per unit of time. Here, one year is taken as the unit of time. The mean relative growth rate R (1-2) over a specified period of interval can be calculated from the following equation suggested by Mahapatra (1985).

$$R(1-2) = \frac{W2 - W1}{T2 - T1}$$

Where,

R = Mean relative growth rate over the specific period of interval;
W1 = log w1 (Natural log of initial number of publications/ pages);
W2 = log w2 (Natural log of initial number of publications/pages);
T2-T1 = Unit difference between the initial time and final time.

Therefore,

R (a) = Relative growth rate per unit of publications per unit of time (year)
R (p) = Relative growth rate per unit of pages per unit of time (year)

Doubling Time (DT)

A direct equivalence exists between the relative growth rate and doubling time. If the number of publications/pages of a subject

doubles during a given period, then the difference between the logarithms of the numbers at the beginning and at the end of the period must be the logarithms of the number 2. This difference has a value of 0.693. Thus, the corresponding doubling time for publication and pages can be calculated by the following formula:

$$\text{Doubling time (Dt)} \quad \frac{0.693}{R}$$

Therefore,

$$\text{Doubling time for publications Dt (a)} \quad \frac{0.693}{R(a)}$$

Objectives

The following objectives are framed for the present study;

- To find out year wise publications on toxicology research
- To identify document types wise research publications on toxicology
- To examine authorship pattern on toxicology research
- To find out top twenty authors toxicology research
- To find out top twenty institutions contributed on toxicology research
- To find top twenty sources contributions on toxicology research
- To identify top twenty countries contributed on toxicology research

ANALYSIS AND INTERPRETATION

Table 1 year wise publications on toxicology research

Sl. No.	Publication Years	No. of Records	Percentages
1	2011	340	9.77
2	2012	316	9.08
3	2013	312	8.97
4	2014	332	9.54
5	2015	315	9.05
6	2016	384	11.03
7	2017	371	10.66
8	2018	338	9.71
9	2019	391	11.24
10	2020	381	10.95
	Total	3480	100.00

Table 1 show that the year wise publications on toxicology research during from 2011 to 2020, totally 3480 publications were published during the study period, out of 3480 publications, in the year 2019 has 11.24 per cent publications, in the year 2016 has 11.03 per cent, in the year 2020 have published 10.95 per cent, followed by in the year 2017 has 10.66 per cent, in the year 2011 has 9.77 per cent, in the year 2018 have published 9.17 per cent, 2014 have 9.54 per cent, in the year 2012 have 9.08 per cent, in the year 2015 have published 9.05 per cent, in the year 2013 have published 8.97 per cent publication. It found that the year publications on toxicology research show an increase and decrease trend.

Table 2 Relative Growth Rate and Doubling Time of toxicology research

Sl. No.	Years	No. of Records	Cumulative	W1	W2	W2 - W1(Ra)	Mean (Ra) W2-W1	Doubling Time	Mean Dt (a)
1	2011	340	340		5.82				
2	2012	316	656	5.82	5.75	-0.07		-9.90	
3	2013	312	968	5.75	5.74	-0.01		-69.30	
4	2014	332	1300	5.74	5.8	0.06		11.55	
5	2015	315	1615	5.8	5.75	-0.05	-0.01	-13.86	-20.38
6	2016	384	1999	5.75	5.95	0.2		3.47	
7	2017	371	2370	5.95	5.91	-0.04		-17.33	
8	2018	338	2708	5.91	5.82	-0.09		-7.70	
9	2019	391	3099	5.82	5.96	0.14		4.95	
10	2020	381	3480	5.96	5.94	-0.02	0.03	-34.65	-10.25
	Total	**3480**					**0.01**		**-15.31**

Table 2 shows that Relative Growth Rate and Doubling Time of toxicology research, the value of average relative growth rate of publications [R(a)] increased from 5.82 to 594 during 2011 to 2020 and the corresponding mean doubling time [Dt(a)] for the period decreasing from 9-9 to -34.65.

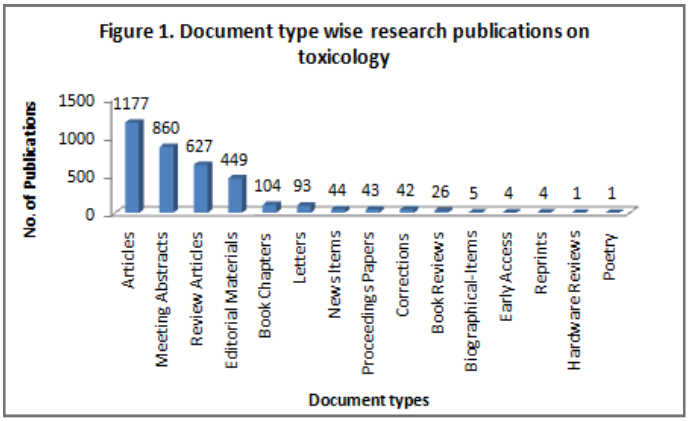

Figure 1, shows that document type wise research publications on toxicology, in the form of Articles 1177 records, Meeting Abstracts is 860 records, Review Articles has 627 records, Editorial Materials is 449 records, Book Chapters is 104 records, Letters is 93 records, News Items is 44 records, Proceedings Papers is 43 records, Corrections is 42 records, Book Reviews is 26 records, Biographical-Items is 5 records, Early Access, Reprints is records respectively, Hardware Reviews, Poetry is 1 respectively. It found that, majority of the records were published in article, Meeting Abstracts is second place, Review Articles has third place with 627 records.

Table 3 top twenty authors contributed on toxicology research

Sl. No.	Authors	No. of Records	% of 3480
1	Hoeng J	63	1.81
2	Peitsch M C	51	1.47
3	Martin F	40	1.15
4	Leroy P	38	1.09
5	Ivanov NV	32	0.92
6	Guedj E	31	0.89
7	Hartung T	31	0.89
8	Titz B	26	0.75
9	De Voogt P	25	0.72
10	Elamin A	25	0.72
11	Frentzel S	23	0.66
12	Sewer A	23	0.66
13	Vanscheeuwijck P	21	0.60
14	Schlage WK	20	0.58
15	Mathis C	19	0.55
16	Whitacre DM	18	0.52
17	Brent J	17	0.49
18	Trivedi K	17	0.49
19	Vuillaume G	17	0.49
20	Busardo FP	16	0.46

Table 3 shows that top twenty authors contributed on toxicology research, Totally 12080 authors have contributed to toxicology research from 2011 to 2020, among the 12080 authors top twenty authors have listed in table 3. out of 3480 records Hoeng J, has first position with 63 publications, Peitsch M C, has second place with 51 contributions, Martin F, has a third place with 40 contributions, Leroy P, has fourth place with 38 contributions, Ivanov NV, has fifth place with 32 contributions, Guedj E, Hartung T, has sixth and seventh place with 31 contributions respectively, Titz B, has eighth place with 26 contributions, De Voogt P, Elamin A, has ninth and tenth place with 25 contributions respectively, Frentzel S, Sewer A, has eleventh and twelfth place with 23 contributions respectively, Vanscheeuwijck P, has thirteenth place with 21 contributions, Schlage WK, has fourteenth place with 20 contributions, Mathis C, has fifteenth place with 19 contributions, Whitacre DM, has sixteenth place 18 contributions, Brent J, Trivedi K, Vuillaume G has seventeenth, eighteenth, nineteenth place with 17 contributions respectively, Busardo FP, has twentieth place with 16 contributions.

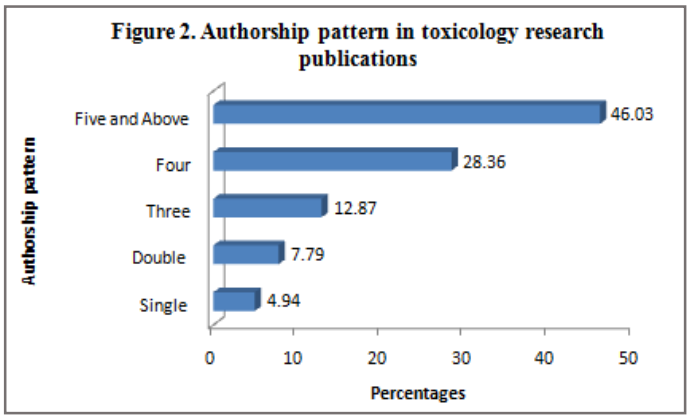

Figure 2 shows the authorship pattern on toxicology research publications, among the 12080 authors, single-author contributions is 4.94 per cent, double authors contributions 7.79 per cent, three authors contributions are 12.87 per cent, four authors contributions 28.36 per cent, and five and above contributions are 46.03 per cent. Single-author contributions less compared with multi authorship pattern.

Table 4 language wise research performance on toxicology

Sl. No.	Languages	No. of Records	% of 3480
1	English	3410	97.99
2	French	22	0.63
3	German	17	0.49
4	Spanish	10	0.29
5	Hungarian	4	0.12
6	Japanese	4	0.12
7	Chinese	3	0.09
8	Czech	3	0.09
9	Polish	3	0.09
10	Portuguese	2	0.06
11	Icelandic	1	0.03
12	Turkish	1	0.03
	Total	**3480**	**100.00**

Table 4 shows that the language wise research performance on toxicology, out of 3480 publications, 97.99 per cent of papers has been published in the English language, followed by 0.63 per cent in French, 0.49 per cent in German, 0.29 per cent in Spanish, 0.12 per cent in Hungarian and Japanese respectively, 0.09 per cent in Chinese, Czech, and Polish respectively, 0.06 per cent in Portuguese, 0.03 per cent in Icelandic and Turkish language respectively.

Table 5 top twenty institutions contributed on toxicology research

Sl. No.	Institutions (Affiliations)	No. of Records	% of 3480
1	United States Environmental Protection Agency	122	3.51
2	National Institutes of Health Nih USA	115	3.31
3	University of California System	106	3.05
4	National Institute of Environmental Health Sciences NIEHS	91	2.62
5	US Food Drug Administration FDA	75	2.16
6	Philip Morris International INC	65	1.87
7	AstraZeneca	54	1.55
8	Johns Hopkins University	53	1.52
9	PFIZER	52	1.49
10	University of North Carolina	47	1.35
11	Harvard University	45	1.29
12	Covance	43	1.24
13	State University System of Florida	41	1.18
14	Bristol Myers Squibb	38	1.09
15	Netherlands National Institute for Public Health the Environment	37	1.06
16	University of Texas System	37	1.06
17	Roche Holding	36	1.03
18	Chinese Academy of Sciences	35	1.01
19	Johns Hopkins Bloomberg School of Public Health	35	1.01
20	University of Colorado System	35	1.01

Table 5 shows that top twenty institutions contributed on toxicology, totally Institutions 3418 were contributed on toxicology research from 2011 to 2020, out of 3418 institutions, the United States Environmental Protection Agency has occupied first place with 3.51 per cent, followed by the National Institutes of Health Nih – USA, which has 3.31 per cent with the second place, University of California System has third place with 3.05 per cent contributions, National Institute of Environmental Health Sciences (NIEHS} has fourth place with 2.62 per cent contributions, US Food Drug Administration FDA has fifth place with 2.16 per cent contributions, Philip Morris International INC has sixth place with 1.87 per cent contributions, AstraZeneca has seventh place with 1.55 per cent contributions, Johns Hopkins University has eighth place with 1.52 per cent contributions, PFIZER has ninth place with 1.49 per cent contributions, University of North Carolina has tenth place with 1.35 per cent contributions, Harvard University has eleventh place with 1.29 per cent contributions, Covance has twelfth place with 1.24 per cent contributions, State University System of Florida has the thirteenth place with 1.18 per cent contributions, Bristol Myers Squibb has the fourteenth place with 1.09 per cent contributions, and Netherlands National Institute for Public Health the Environment, University of Texas System has occupied fifteenth and sixteenth place respectively, Roche Holding has occupied seventeenth place with 1.03 per cent contributions, Chinese Academy of Sciences, Johns Hopkins Bloomberg School of Public Health, University of Colorado System has an eighteenth, nineteenth, and twentieth place with 1.01 per cent respectively,

Table 6 top twenty sources contributed on toxicology research

Sl. No.	Sources	No. of Records	% of 3480
1	Toxicology Letters	230	6.61
2	Clinical Toxicology	168	4.83
3	Abstracts of Papers of the American Chemical Society	96	2.76
4	Toxicological Sciences	88	2.53
5	International Journal of Toxicology	79	2.27
6	Reviews of Environmental Contamination and Toxicology	77	2.21
7	Archives of Toxicology	66	1.90
8	Chemical Research in Toxicology	61	1.75
9	Food and Chemical Toxicology	61	1.75
10	Environmental and Molecular Mutagenesis	60	1.72
11	Regulatory Toxicology and Pharmacology	56	1.61
12	Toxicologic Pathology	48	1.38
13	Altex Alternatives To animal Experimentation	37	1.06
14	Basic Clinical Pharmacology Toxicology	37	1.06
15	Journal of Pharmacological and Toxicological Methods	37	1.06
16	Journal of Analytical Toxicology	34	0.98
17	Naunyn Schmiedebergs Archives of Pharmacology	32	0.92
18	Environmental Toxicology and Chemistry	30	0.86
19	Inhalation Toxicology	30	0.86
20	journal of Ethno pharmacology	29	0.83

Table 6 shows that top twenty sources contributed to toxicology research, totally of 891 sources were published 3480 records on toxicology research. Out of 891 sources, the top twenty sources are listed in this table 8, among the twenty sources, Toxicology Letters has occupied first place with 6.61 per cent, Clinical Toxicology has second place with 4.83 per cent, Abstracts of Papers of the American Chemical Society has a third place with 2.76 per cent, followed by Toxicological Sciences has fourth place with 2.53 per cent, International Journal of Toxicology has fifth place with 2.27 per cent, Reviews of Environmental Contamination and Toxicology has sixth place with 2.21 per cent, Archives of Toxicology has seventh place with 1.90 per cent, Chemical Research in Toxicology, Food and Chemical Toxicology has eighth and ninth place with 1.75 per cent respectively, Environmental and Molecular Mutagenesis has tenth place with 1.72 per cent, Regulatory Toxicology and Pharmacology has eleventh place with 1.61 per cent, Toxicologic Pathology has twelfth place with 1.38 per cent, Altex Alternatives To animal Experimentation, Basic Clinical Pharmacology Toxicology, Journal of Pharmacological and Toxicological Methods has thirteenth, fourteenth and fifteenth place with 1.06 per cent respectively, Journal of Analytical Toxicology has sixteenth place with 0.98 per cent, Naunyn Schmiedebergs Archives of Pharmacology has seventeenth place with 0.92 per cent, Environmental Toxicology and Chemistry, Inhalation Toxicology has eighteenth and nineteenth place with 0.86 per cent respectively, journal of Ethno pharmacology has place with 0.83 per cent.

Table 7 top twenty countries contributed on toxicology research

Sl. No.	Countries/Regions	No. of Records	% of 3480
1	United States of America	1548	44.48
2	Germany	355	10.20
3	England	319	9.17
4	Peoples R China	269	7.73
5	Switzerland	179	5.14
6	France	156	4.48
7	Netherlands	151	4.34
8	Italy	147	4.22
9	Canada	146	4.20
10	Australia	89	2.56
11	Belgium	85	2.44
12	Spain	82	2.36
13	Sweden	82	2.36
14	Brazil	72	2.07
15	Japan	67	1.93
16	Denmark	65	1.87
17	Scotland	64	1.84
18	India	52	1.49
19	South Korea	41	1.18
20	Finland	40	1.15

Table 7 shows that the top twenty countries contributed to toxicology research publications, a total of 113 countries were contributed to toxicology research, in table 7 shows that out of 113 countries top 20 countries were listed. Among the top 20 countries, the United States of America has the first position with 44.48 per cent contributions, Germany has second position with 10.20 per cent, England has third position with 9.17 per cent, followed by Peoples R China has fourth place with 7.73 per cent contributions, Switzerland has fifth place with 5.14 per cent contributions, France has sixth place with 4.48 per cent contributions, Netherlands has seventh place with 4.34 per cent contributions, Italy has eighth place with 4.22 per cent contributions, Canada has ninth place with 4.20 per cent contributions, Australia has tenth place with 2.56 per cent contributions, Belgium has eleventh place with 2.44 per cent contributions, Spain, Sweden has twelfth and thirteenth place with 2.36 per cent respectively, Brazil has fourteenth place with 2.07 per cent contributions, Japan has fifteenth place with 1.93 per cent contributions, Denmark has sixteenth place with 1.87 per cent contributions, Scotland has seventeenth place with 1.84 per cent contributions, India has eighteenth place with1.49per cent contributions, South Korea has nineteenth place with 1.18 per cent contributions, Finland has twentieth place with 1.15 per cent contributions.

CONCLUSION

Conclude from the study, the year-wise publications on toxicology research, a total of 3480 publications were published during the study period, which shows an increase and decrease trend. The document type wise research publications on toxicology, in the form of Articles 1177 records, Meeting Abstracts is 860 records, the Review Articles has 627 records. Out of 12080 authors Hoeng J, has the first position with 63 publications, Peitsch MC, has second place with 51 contributions, Martin F, has the third place with 40 contributions, In this study, authorship on multi authorship pattern is more compared with Single-author contributions. Out of 3480 publications, 97.99 per cent of papers have been published in the English language, out of 3418 institutions, the United States Environmental Protection Agency has occupied first place with 3.51 per cent, total of 891 sources was published 3480 records on toxicology research, among the twenty sources, Toxicology Letters has occupied first place with 6.61 per cent, Clinical Toxicology has second place with 4.83 per cent, Abstracts of Papers of the American Chemical Society have third place. Among the top 20 countries that contributed to toxicology research, the United States of America has the first position, Germany has the second position, England has the third position, and India has the eighteenth position.

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