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LEPTOSPIROSIS RESEARCH PUBLICATIONS IN INDIA: A CITATION ANALYSIS (1999-2012)

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ABSTRACT

The study was to perform a scientometric analysis of all leptospirosis research publications by Indian scientists. A total of 202 publications were published by the Global scientists in leptospirosis during 1999-2012 which received 2569 citations. The average number of publications per year was 14.42%. It states that globally 0.51 percents of articles were from single authors, followed by 99.48% authors by double authors. 0.005 percent of collaborative authors' articles published during the study periods. The highest number of publications 32 was published in 2008. Madras Veterinary College topped the list with 16 publications which received LCS 12, GCS 48. India is top producing country with 195 publications (96.5%, TLCS 223 TGCS 953). The parameters studied include growth of publications and citations, relative growth rate and doubling time, national and international collaboration, highly productive institutions, highly productive authors, highly preferred journals and highly cited publications.

Key Words: *Scientometric study, Protocol, Switching, Networking, bibliometric study, Citation analysis*

Abbreviations: *TLCS-Total Local Citation Score, TGCS-Total Global Citation Score, TCR-Total Cited Reference, UAE-united Arab Emirates, DT- Doubling time. RGR -Relative growth rate, MPLS- Multi Protocol Label Switching*

INTRODUCTION

The SCI database has been recognized as the most authoritative scientometric analysis tool and as a useful supplementary tool in the evaluation of scientific research. In many countries, institutions and researchers are using this data for research performance evaluation. A citation is a reference to a book, article, web page, or other published item (Machado and Raymundo, 2007) analyzed the theme "bibliometric studies" published on five Brazilian journals, from 1990 to 2005, particularly the aspects of geographic origin, chronological evolution and thematic orientation. The methodology used was the quantitative-description analysis. The citation analysis thematic, one of the styles of bibliometric studies, is what promotes Brazilian studies on this area since the beginning of the 21st century. Rao *et al.*, (2008) has analyzed the data on distributions of multiple authors in two journals namely, JASIST and Scientometrics (Raja *et al.*, 2011). Scientometric analysis of 380 papers were published by the scientists in the field of Gender in thyroid cancer during 1991-2010. It also analyses various other features of publications output such as modes of communication, areas of research priority, research quality, nature of collaboration, and institutional productivity and citation. Raja, S.; Ramkumar, P ⁴ (2012) discussed the growth of Global literature in nuclear crisis deposition and make the quantitative assessment of the research in terms of year-wise research output, geographical distribution of research output, nature of collaboration, characteristics of highly productive institution and the channel of communication used by the scientists.

Statement of the Problem

The study pointing out of analyzing the research output performance of leptospirosis in Indian perspective. In academic and scientific work, publication is the means of communicating research, primarily for recognition and reward and central social process in the Universities. Hence publication is a social norm in a public sense and serves as a tool for the betterment of the individuals. After the

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publication, it can be called as research and can be fixed or judged and acknowledged by the scientists in the society.

Scope of the Study

The study is to find out the information about the recent communication trends in the advancement of the field of Multidisciplinary subject a citation analysis “Leptospirosis” and for this purpose, the study is based on articles in journals, authors published the books and papers published in conference proceedings published on Leptospirosis subject from 1999 to 2012 Using statistical techniques like histogram charts, bar charts etc, these will be used to interpret the data.

Limitations of the Study

- The study undertaken is limited to 14 years, i.e. 1999-2012.
- In this study we did not include the citation analysis on patents.

Data Collection

The publication of leptospirosis are mostly in the form of primary Journals, Notes, Letters, and reviews, Editorial-materials, Meeting-abstracts, Bibliographic-items and Discussions. The research papers published by web of science in the field of Science and Technology covered and index database were taken as the prime source for the present study. Finally the cards were arranged in different ways with a view to identify the research performance of faculty Members.

RESULTS AND DISCUSSION

Authorship Pattern

Table 6.1 shows the number of authors and their corresponding publications. Lotka's Law, an inverse, square law, is used to find authors productivity patterns. It states that globally 0.51 percents of articles were from single authors, followed by 4.98% authors by double authors etc. There is general decrease in performance among a body of authors following $1:n^2$. This ratio shows that some produce much more than the average. According to Lotka's law of scientific productivity, only 5.82 percent of the authors in a field will produce more than 10 articles. The general form of Lotka's law can be expressed as: $y = c/x^n$. The results depict that majority of papers are Multi authored. It clearly brings out collaborative research in the field It clearly brings out multi investigation is high compare than individual research in the field of leptospirosis.

Table 6.1: Authorship Pattern

S. No.	No of Author	Contribution	Cumulative	Percentage (%)
1	Single Authors	5	5	0.51975052
2	Double Authors	48	53	4.98960499
3	Three Authors	84	137	8.731808732
4	Four Authors	192	329	19.95841996
5	Five Authors	160	489	16.63201663
6	Six Authors	198	687	20.58212058
7	Seven Authors	98	785	10.18711019
8	Eight Authors	64	849	6.652806653
9	Nine Authors	27	876	2.806652807
10	Ten Authors	30	906	3.118503119
11	More than 10 authors	56	962	5.821205821
-	Total	962	-	100

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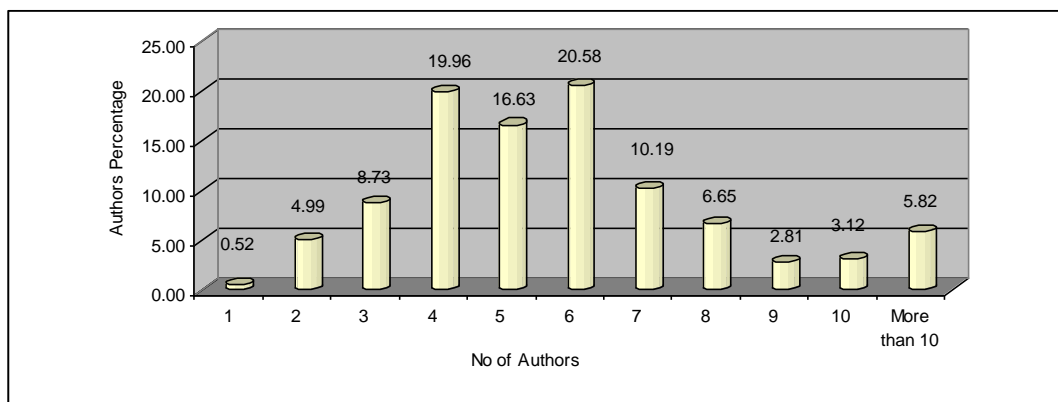


Figure 1

Degree of Collaboration

The authorship pattern analyzed to determine the percentage of single and multi-authorship is denoted in table 6.2. The extent of collaboration in research can be measured with the help of multi-authored papers using the formula given by Subramaniam (1982)

Degree of collaboration $C = \frac{N_m}{N_m + N_s}$

C = Degree of collaboration

N_m = Number of Multiple authors

N_s = Number of Single authors

Based on this study, the result of the degree of collaboration $C = 0.005$, i.e., 0.005 percent of collaborative authors' articles published during the study periods. Individual contribution is just 0.51 percents in the field of Leptospirosis research output. Multi author's contribution is 99.48 percents of the Leptospirosis research output. The study interpreted that multi author contributed papers maintained the high profile among Leptospirosis research scientists.

Table 6.2 Shows Authorship Pattern of Degree of collaboration

S. No	Authors	Contribution	Cumulative	Percentage (%)
1	Single	5	5	0.51975052
2	Multi	957	962	99.48024948
	Total	962	-	100
Degree of Collaboration				0.005197505

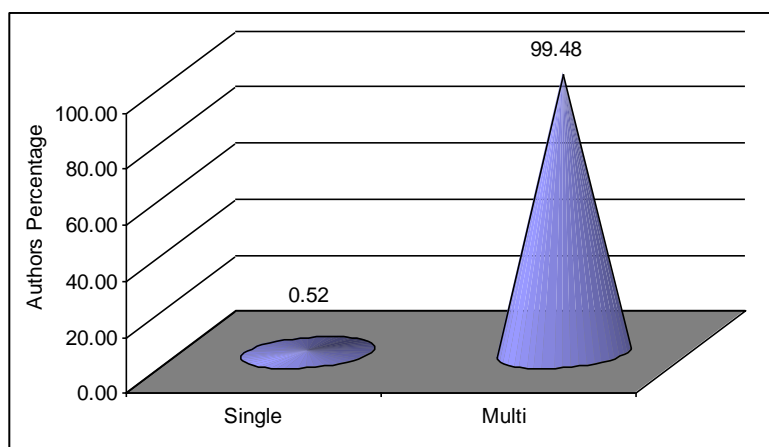


Figure- 2

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Relative Growth Rate and Doubling Time

Relative Growth Rate (RGR) is the increase in number of publications per unit of time. There exists a direct relation between the relative growth rate and the doubling time. The relative growth rate and doubling time of publications have been presented in Table 6.3. Figure 2 indicates the value of an average RGR of publications which decreased from 1.79 in 1999 to 0.03 in 2012. Simultaneously, the values of doubling time (Dt) of publications increased from 0.38 in 1999 to 22.98 in 2012.

Table 6.3: Relative Growth Rate and Doubling Time

Year	No. of Records	Cumulative	W1	W2	RGR	Doubling Time
1999	6	6	0	1.791759469	1.791759	0.386770664
2000	9	15	1.791759469	2.708050201	0.916291	0.756310171
2001	9	24	2.708050201	3.17805383	0.470004	1.4744567
2002	8	32	3.17805383	3.465735903	0.287682	2.408909231
2003	11	43	3.465735903	3.761200116	0.295464	2.345461717
2004	18	61	3.761200116	4.110873864	0.349674	1.981847373
2005	13	74	4.110873864	4.304065093	0.193191	3.587119371
2006	8	82	4.304065093	4.406719247	0.102654	6.750822764
2007	16	98	4.406719247	4.584967479	0.178248	3.887836612
2008	32	130	4.584967479	4.86753445	0.282567	2.452515931
2009	19	149	4.86753445	5.003946306	0.136412	5.080203605
2010	26	175	5.003946306	5.164785974	0.16084	4.308638588
2011	21	196	5.164785974	5.278114659	0.113329	6.114956669
2012	6	202	5.278114659	5.308267697	0.030153	22.98275869

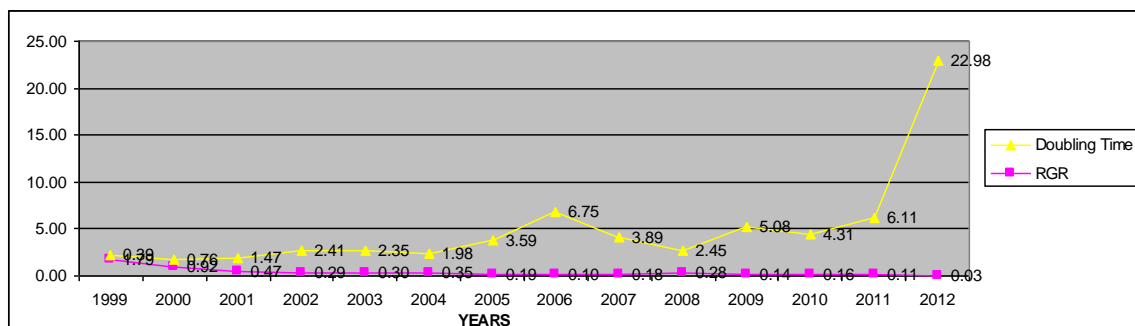


Figure- 3

Author's wise document distribution

The most productive author is Vijayachari P with 30 papers dealing with leptospirosis and each 14.9 % TLCS 109, TGCS 320, TLCR 76 of all papers published in this research field. The authors of the seminal publication on leptospirosis given Table 6.4 Sehgal SC 27 (13.4%), TLCS 114, TGCS 293, TLCR 62 and Sugunan AP 24(11.9%), TLCS 92, TGCS 283, TLCR 64, appear on rank 2 and 3, respectively. It can be clearly visualized from the below table.

Table 6. 4: Author's wise document distribution

S. No.	Author	Records	Percent	TLCS	TLCS/t	TLCSx	TGCS	TGCS/t	TLCR	TLCSb	TLCSe
1	Vijayachari P	30	14.9	109	10.09	34	320	35.34	76	32	3
2	Sehgal SC	27	13.4	114	10.65	37	293	28.98	62	33	8
3	Sugunan AP	24	11.9	92	8.48	32	283	31.60	64	26	5
4	Natarajaseenivasan K	19	9.4	22	2.69	8	73	10.71	48	7	-

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5	Ramadass P	13	6.4	13	1.60	4	48	6.54	11	1	-
6	Sharma S	13	6.4	41	3.96	13	123	13.51	40	10	0
7	Hartskeerl RA	10	5.0	30	2.88	9	142	17.33	13	12	0
8	Meenambigai TV	10	5.0	2	0.37	1	2	0.37	2	1	-
9	Srivastava SK	10	5.0	4	0.57	1	13	2.12	11	0	-
10	Govindarajan R	9	4.5	2	0.37	1	2	0.37	2	1	-
11	Jayakumar V	9	4.5	2	0.37	1	2	0.37	1	1	-
12	Ahmed N	7	3.5	1	0.11	0	52	9.78	8	0	-
13	Roy S	7	3.5	11	1.42	2	45	6.54	23	3	-
14	Rathinam SR	6	3.0	9	1.15	3	49	5.83	9	2	-
15	Senthilkumar TMA	6	3.0	2	0.37	1	7	1.50	8	1	-
16	Bharadwaj R	5	2.5	9	0.95	6	50	5.45	13	1	4
17	Manohar BM	5	2.5	1	0.20	1	1	0.20	2	-	-
18	Ratnam S	5	2.5	6	0.54	3	16	1.79	4	2	1
19	Subathra M	5	2.5	1	0.20	1	6	1.33	8	-	-
20	Amutha R	4	2.0	4	0.57	1	12	1.79	4	0	2

Journal wise document distribution

The most productive Journal is Indian Journal of Medical Research and Indian Veterinary Journal with each 22 papers dealing with leptospirosis 10.9%, TCLS 51, TGCS 142, TCR 33 and 10.9%, TCLS 13, TGCS 18, TCR 3 of all papers published in this research field. The journal of the seminal publication on leptospirosis given table 6.5, Indian Journal of Animal Sciences, appear on rank 2 (6.9%), TCLS 2, TGCS 5, TCR 12 respectively.

Table 6. 5: Journal wise document distribution

S.No	Journal	Record s	Percent	TCLS	TCLS/t	TGCS	TGCS/t	TCR
1	Indian Journal of Medical Research	22	10.9	51	4.53	142	16.24	33
2	Indian Veterinary Journal	22	10.9	13	1.41	18	1.96	3
3	Indian Journal of Animal Sciences	14	6.9	2	0.21	5	0.58	12
4	Indian Journal of Medical Microbiology	6	3.0	4	0.85	12	2.60	3
5	Japanese Journal of Infectious Diseases	6	3.0	12	1.16	52	5.31	8
6	Journal of Medical Microbiology	6	3.0	17	1.70	47	4.80	13
7	National Medical Journal of India	6	3.0	18	1.65	41	4.07	16
8	Epidemiology and Infection	4	2.0	16	1.46	38	3.42	7
9	Indian Journal of Pathology And Microbiology	4	2.0	0	0.00	2	0.45	1
10	International Journal of Infectious Diseases	4	2.0	0	0.00	0	0.00	0
11	Journal of Postgraduate Medicine	4	2.0	5	0.83	15	2.83	2
12	Plos One	4	2.0	0	0.00	36	8.93	5
13	Tropical Doctor	4	2.0	0	0.00	1	0.09	2

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14	American Journal of Tropical Medicine and Hygiene	3	1.5	3	0.49	20	3.81	3
15	Annals of Tropical Medicine And Parasitology	3	1.5	2	0.28	9	1.36	9
16	Asian Pacific Journal of Tropical Medicine	3	1.5	1	0.50	1	0.50	4
17	Journal of Infection in Developing Countries	3	1.5	0	0.00	0	0.00	4
18	Archives of Disease in Childhood	2	1.0	4	0.40	30	3.20	3
19	Comparative Immunology Microbiology and Infectious Diseases	2	1.0	4	0.57	8	1.14	3
20	Current Microbiology	2	1.0	1	0.50	1	0.50	2

Word wise distribution of Documents

The high frequency keywords will enable us to understand the various aspects of leptospirosis under study. The high frequency keywords were: Leptospirosis 127 (62.9%, TCLS 174, TGCS 618), India 40 (19.8%, TCLS 49, TGCS 276), Leptospira 36 (17.8 %, TCLS 37 TGCS 206) and Evaluation 51 (8.9%, TCLS 29, TGCS 115). Analysis of the keywords appeared either on the title or assigned by the indexer or the author himself will help in knowing in which direction the knowledge grows.

Table 6. 6 Word wise distribution of Documents

S. No.	Word	Records	Percent	TLCS	TGCS
1	Leptospirosis	127	62.9	174	618
2	India	40	19.8	49	276
3	Leptospira	36	17.8	37	206
4	Evaluation	18	8.9	29	115
5	Acute	15	7.4	30	92
6	Andaman	15	7.4	39	109
7	Rapid	15	7.4	37	128
8	Based	14	6.9	17	63
9	Diagnosis	14	6.9	12	39
10	Seroprevalence	14	6.9	12	22
11	Infection	13	6.4	8	38
12	Islands	13	6.4	39	103
13	Serodiagnosis	13	6.4	27	91
14	Serovar	13	6.4	17	49
15	Clinical	12	5.9	7	65
16	Interrogans	12	5.9	12	31
17	Leptospiral	12	5.9	19	62
18	Test	12	5.9	20	67
19	ELISA	11	5.4	16	49
20	Recombinant	11	5.4	15	52

Year wise distribution of documents

During 1999 - 2012 a total of 202 publications were published in leptospirosis by India. The average Number of Publications produced per year was 14.42 %. The highest number of publications 32 was produced in 2008 Table 6.7 was given year wise growth and collaboration rate in leptospirosis. It can be

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clearly visualized from the table 6.7 that growth of the literature was very low during 1999. It Indicate that research in leptospirosis received a major impetus this period.

Table 6.7 Year wise distribution of documents

S.No.	Publication Year	Records	Percent	TLCS	TGCS
1	1999	6	3.0	43	129
2	2000	9	4.5	24	84
3	2001	9	4.5	30	98
4	2002	8	4.0	31	88
5	2003	11	5.4	22	78
6	2004	18	8.9	33	131
7	2005	13	6.4	16	72
8	2006	8	4.0	13	57
9	2007	16	7.9	6	32
10	2008	32	15.8	17	160
11	2009	19	9.4	3	38
12	2010	26	12.9	0	38
13	2011	21	10.4	2	22
14	2012	6	3.0	0	0

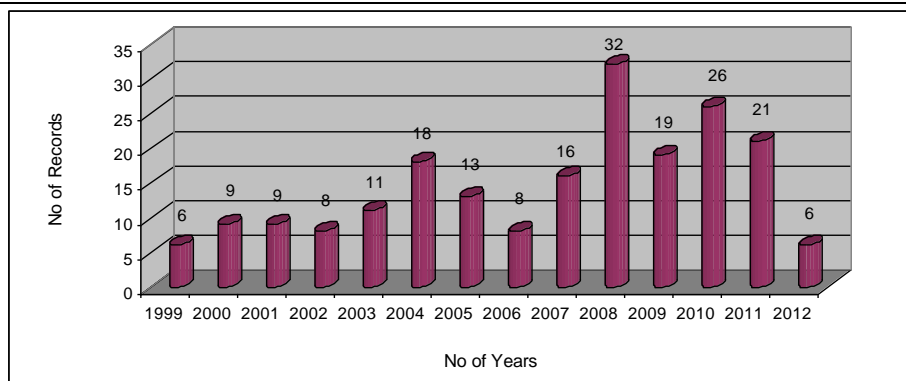


Figure 4

Source wise distribution documents

Leptospirosis Scientists communicated their research results through a variety of communication channels. Table – 6.8 provides the distribution of publications in various channels of communication. It was observed that 78.7 percent of the literature was published in Article followed by 18.4 percent in Letter, 5.9 percent in Meeting Abstract, 4.0 percent in Review and 3.0 percent in Editorial Material.

Table 6. 8: Source wise distribution documents

S. No.	Document Type	Records	Percent	TLCS	TGCS
1	Article	159	78.7	218	915
2	Letter	17	8.4	10	44
3	Meeting Abstract	12	5.9	0	0
4	Review	8	4.0	6	53
5	Editorial Material	6	3.0	6	15

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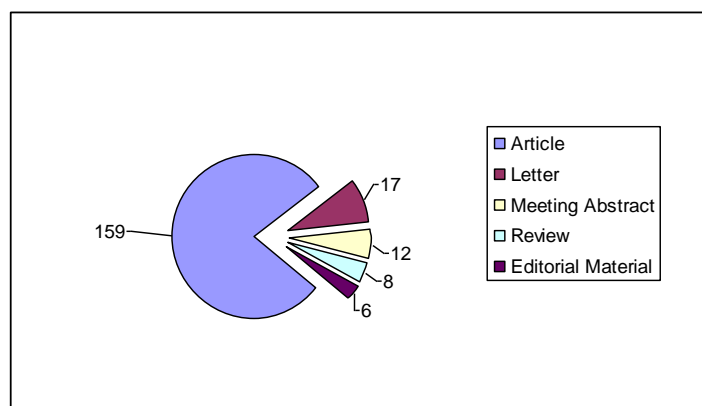


Figure 5

Institution wise distribution documents

There were 181 institutions involved in research activity in the field of Leptospirosis. Table-6.9 provides publication productivity of top 20 institutions. Madras Veterinary College topped the list with 16 publications (7.9 %, TLCS 12, TGCS 48) followed by Indian Veterinary Research Institute with 14 publications (6.9 %, TLCS 14, TGCS 52), respectively.

Table 6. 9: Institution wise distribution documents

S. No.	Institution	Records	Percent	TLCS	TGCS
1	Madras Veterinary College	16	7.9	12	48
2	Indian Veterinary Research Institute	14	6.9	14	52
3	Indian Council Medical Research	11	5.4	38	111
4	Bharathidasan University	8	4.0	1	10
5	Tamil Nadu Veterinary & Animal Science University	8	4.0	2	3
6	Postgraduate Institute Medical Education & Research	7	3.5	2	18
7	Regional Medical Research Center	7	3.5	37	93
8	Royal Tropical Institute	7	3.5	31	138
9	Center for Animal Health Studies	6	3.0	1	1
10	WHO	6	3.0	8	29
11	All India Institute Medical Science	5	2.5	4	29
12	Christian Medical College & Hospital	5	2.5	0	14
13	Aravind Eye Hospital	4	2.0	5	32
14	Byramjee Jeejeebhoy Medical College	4	2.0	9	48
15	Cornell University	4	2.0	5	60
16	Center Cellular & Molecular Biology	4	2.0	5	60
17	Center DNA Fingerprinting & Diagnost	4	2.0	1	40
18	National Leptospirosis Reference Center	4	2.0	14	37
19	W Bengal University Animal & Fishery Science	4	2.0	1	1
20	Aravind Medical Research Foundation	3	1.5	7	24

Country wise documents distribution

There were as many as 16 countries carrying out research in the field of Leptospirosis. Table 6.10 provides a list of collaboration countries whose research output is more than 50 publications. India is top producing country with 195 publications (96.5%, TLCS 223, TGCS 953) followed by USA with 15 publications (7.4%, TLCS 21 TGCS 221), Netherlands with 12 Publications (5.9%, TLCS 34, TGCS 182), respectively.

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Table 6.10: Country wise documents distribution

S. No.	Country	Records	Percent	TLCS	TGCS
1	India	195	96.5	223	953
2	USA	15	7.4	21	221
3	Netherlands	12	5.9	34	182
4	Australia	4	2.0	8	45
5	Unknown	4	2.0	8	18
6	Indonesia	2	1.0	8	50
7	Seychelles	2	1.0	10	62
8	Surinam	2	1.0	10	62
9	Barbados	1	0.5	5	46
10	Brazil	1	0.5	0	2
11	Canada	1	0.5	0	2
12	Italy	1	0.5	0	4
13	Japan	1	0.5	5	46
14	Philippines	1	0.5	5	46
15	Russia	1	0.5	5	46
16	Spain	1	0.5	0	23

Cited reference wise documents distribution

The most cited reference is Levett PN, 2001, CLIN MICROBIOL REV, V14, P296, DOI 10.1128/CMR.14.2.296-326.2001 with 38 papers dealing with leptospirosis 18.8 % of all papers published in this research field. The cited reference of the seminal publication on leptospirosis given Table 6.11, appear on rank 2 & 3 SEHGAL SC, 1995, INDIAN J MED RES, V102, P9 and Faine S, 1999, LEPTOSPIRA LEPTOSPIR respectively. It can be clearly visualized from the table below

Cited reference wise documents distribution

S.No	Author / Year / Journal	Records	Percent
1	Levett PN, 2001, CLIN MICROBIOL REV, V14, P296, DOI 10.1128/CMR.14.2.296-326.2001	38	18.8
2	SEHGAL SC, 1995, INDIAN J MED RES, V102, P9	31	15.3
3	Faine S, 1999, LEPTOSPIRA LEPTOSPIR	28	13.9
4	TERPSTRA WJ, 1985, J GEN MICROBIOL, V131, P377	27	13.4
5	Gussenhoven GC, 1997, J CLIN MICROBIOL, V35, P92	21	10.4
6	Flannery B, 2001, J CLIN MICROBIOL, V39, P3303, DOI 10.1128/JCM.39.9.3303-3310.2001	19	9.4
7	Singh SS, 1999, INDIAN J MED RES, V109, P94	19	9.4
8	COLE JR, 1973, APPL MICROBIOL, V25, P976	18	8.9
9	Bharti AR, 2003, LANCET INFECT DIS, V3, P757, DOI 10.1016/S1473-3099(03)00830-2	17	8.4
10	Haake DA, 2000, INFECT IMMUN, V68, P2276, DOI 10.1128/IAI.68.4.2276-2285.2000	16	7.9
11	FARR RW, 1995, CLIN INFECT DIS, V21, P1	15	7.4
12	Murhekar MV, 1998, INDIAN J MED RES, V107, P218	15	7.4
13	Sehgal SC, 1999, T ROY SOC TROP MED H, V93, P161, DOI 10.1016/S0035-9203(99)90293-6	13	6.4
14	BOOM R, 1990, J CLIN MICROBIOL, V28, P495	12	5.9
15	Brenner DJ, 1999, INT J SYST BACTERIOL, V49, P839	12	5.9
16	GRAVEKAMP C, 1993, J GEN MICROBIOL, V139, P1691	12	5.9
17	Ko AI, 1999, LANCET, V354, P820, DOI 10.1016/S0140-12	12	5.9

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18	Muthusethupathi M A, 1995, J Assoc Physicians India, V43, P456	11	5.4
19	Ribotta MJ, 2000, CAN J VET RES, V64, P32	11	5.4
20	ADLER B, 1980, J CLIN MICROBIOL, V11, P452	10	5.0

CONCLUSION

This paper has analyzed 202 publications on leptospirosis and cited in the web of science database during 1999-2012. It states that 0.51 percents of articles were from single authors. 0.005 percent of collaborative authors' articles published during the study periods. Individual contribution is just 0.51 percents in the field of Leptospirosis research output. Multi author's contribution is 99.48 percents output. The most productive author is Vijayachari P with 30 papers dealing with leptospirosis of all papers published in this research field and most productive Journal is Indian Journal of Medical Research with 22 papers dealing with leptospirosis 10.9 %, TCLS 51, TGCS 142, TLCR 33 in this research field. The high frequency keywords were "Leptospirosis" 127 (62.9%, TCLS 174, TGCS 618). The highest number of publications 32 were produced in 2008 and very low during 1999. Madras Veterinary College topped the list compare to other institution. Indian is top producing country with 195 publications (96.5%, TLCS 223, TGCS 953). The most cited reference is Levett PN, 2001, Clinical Microbiology Review, V14, P296, DOI 10.1128/CMR.14.2.296-326.2001. Scientometric studies enable the science policy makers and administrators to understand and grasp the growth, development and impact of research.

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