

Trends in the Growth of Literature on Hepatitis(1984-2003) : Quantitative Analysis

간염에 관한 문헌의 증가추세(1984-2003): 계량적 분석

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초 록

이 논문에서는 1984년부터 2003년까지 200년에 걸쳐 MEDLINE과 CINAHL, IPA 등 3개 서지데이터베이스에 수록된 간염에 관한 분야의 문헌의 증가추세를 계량과학적으로 분석하였다. 이 기간 동안 MEDLINE은 최대인 75,750건의 레코드를 수록하였으며, CINAHL, IPA의 순이었다. 특정지식영역의 연간문헌증가율은 동일하지 않으며, 연간증가율을 측정하기 위해서는 RGR을 적용하는 것이 아주 적합한 것으로 나타났다. RGR은 감소추세를 보였는데, 다만 1985년과 1997년에 성장률에서 약간의 변동이 있었다. 대학과 기업, 연구기관들은 RGR 및 Dt와 관련한 성과에서 성장추세와 감소추세, 변동추세 등의 결과에서 혼재된 양상을 보여주었다. 간염연구는 논문수와 페이지수의 측면에서 연단위로 RGR과 Dt를 산정했을 때는 다양한 양상을 보여주었다.

주제어: 계량과학-간염, RGR-간염, Dt-간염, 계량정보학-간염, 간염-계량과학, MEDLINE, CINAHL, IPA

ABSTRACT

This paper presents a scientometric analysis of the growth of literature output in the field of Hepatitis covered in three bibliographic databases namely MEDLINE, CINAHL and IPA. The literature covered in three databases for the period 1984-2003 was considered. MEDLINE covered the maximum of 75750 records during the study period 1984 to 2003. This is followed by CINAHL and IPA databases. It is found that the annual growth rate of literature in a particular field of knowledge will not be uniform and in order to measure the rate of growth from year after year, the application of RGR is quite appropriate. The RGR has shown a decreasing trend, with a slight fluctuation of growth rate for the years 1985 and 1997. The output by colleges, universities, corporate sector and research institutions with reference to RGR and Dt has shown mixed results such as increasing trend, decreasing trend and fluctuation trend. Hepatitis research indicates a different picture when the RGR and Dt were calculated by year-wise both in terms of number of papers and number of pages.

Key Words: Scientometrics-Hepatis, RGR-Hepatis, Dt-Hepatis, Informetrics-Hepatis, Hepatis-Scientometric Analysis, MEDLINE, CINAHL, IPA

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I. Introduction

This study was aimed to examine quantitatively the growth of literature in the field of 'Hepatitis' with the help of bibliographic databases namely MEDLINE, CINAHL and IPA. One of the most obvious features of science in recent years has been its rate of growth. Scientific growth has involved not only increase in manpower and finance but also in literature growth.¹⁾ The flood of papers represents one aspect of the general growth of scientific communication. Wooster(1970)²⁾ has estimated the number of journals that existed in the world at any one time, where as some estimates of the number of papers published annually at various times was done by Vickery(1968)³⁾ and Martyn(1973).⁴⁾ Gottschalk and Desmond(1963)⁵⁾ have also estimated the number of scientific and technical journals existed in the World. Growth studies in other scientific areas included the work of Baker(1976)⁶⁾ in chemistry, Conard(1957)⁷⁾ in biology, May(1966)⁸⁾ and Lamb(1971)⁹⁾ in mathematics, Sengupta(1973) in microbiology,¹⁰⁾ physiology,¹¹⁾ and biochemistry.¹²⁾

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- 1) Mahapatra, M.(1985). On the Validity of the theory of Exponential Growth of Scientific Literature, Proceedings of the 15th IASLIC Conference, Bangalore, pp.61-70.
 - 2) Wooster, H. "The future of scientific publishing - or, what will scientists be doing for Brownic points?" *Journal of Washington Academy of Sciences*, Vol.60(1970), pp.41-50.
 - 3) Vickery, B. C. "Statistics of scientific and technical articles," *Journal of Documentation*, Vol.24(1968), pp.192-196.
 - 4) Martyn, J. "Secondary services and the rising tide of paper," *Library Trends*, Vol.22(1973), pp.9-17.
 - 5) Gottschalk, C. M. and Desmond, W. F. "Worldwide census of Science and Technology serials," *American Documentation*, Vol.14(1963), pp.188-194.
 - 6) Baker, D. "Recent trends in the growth of chemical literature," *Chemical and Engineering news*, Vol.54(1976), pp.23-27.
 - 7) Conard, G. M. "Growth of biological literature and the future of biological abstracts," *Federal Proceedings*, Vol.16(1957), pp.711-715.
 - 8) May, K. O. "Quantitative growth of the mathematical literature," *Science*, Vol.154(1966), pp.1672-1673.
 - 9) Lamb, G. H. "The coincidence of quality and quantity in the literature of mathematics(Ph. D. dissertation, Case Western Reserve University)," *Dissertation Abstracts International*, Vol.32, 06-A(1971), pp.33-40.
 - 10) Sengupta, I. N. "Recent growth of the literature of biochemistry and changes of ranking of periodicals," *Journal of Documentation*, Vol.29(1973), pp.192-211.
 - 11) Sengupta, I. N. "Choosing physiology journals: A recent study of the growth of its literature," *Annals of Library Science and Documentation*, Vol.20(1974), pp.39-57.
 - 12) Sengupta, I. N. "Choosing microbiology journals: Study of the growth of literature in the field," *Annals of Library Science and Documentation*, Vol.21(1975), pp.39-57.

II. LITERATURE REVIEW

The growth of literature and its doubling time results in the field of Science and Technology¹³⁾ and Biological science literature in India during the period 1965-1989¹⁴⁾ has been analysed by Maheswarappa and Ningoji(1992 and 1993) with exponential, logistic and linear patterns of analysis and found that none of the patterns has been followed in the output. Aleixandre et al.(1995)¹⁵⁾ have conducted a study of the Spanish publications on AIDS, covering 2013 items, of which 1821 journal papers and 192 books. Their study confirmed exponential growth of publication since 1983 and the growth was similar to the trend observed in other countries. Parallelism was detected between growth in the number of publications and in the number of journals publishing on subject and the growth in the number of institutions, which collaborate, and the growing trend of reported cases in Spain. Ramesh Babu and Nandini Muthusamy(1998)¹⁶⁾ has conducted a bibliometric study of the articles published in the "International Library Review" during 1987-1991. Narendra Kumar and Ramesh Babu(1999)¹⁷⁾ analysed the literature published in ILA bulletin during the year 1986-1996 discussing authorship pattern, citation pattern, subject covered, ranking of the contributors, nature of contributions, bibliographic forms, of cited documents etc. Bhagavathi Sudha and Ramesh Babu(2000)¹⁸⁾ analysed the Indian contributions on 'Information Technology' covered in the "*Indian Library and Information Science Literature*" during the period 1990-1993, with respect to degree of collaboration, bibliographic forms, sub-fields of information technology etc. Karki, Garg, and Sharma(2000)¹⁹⁾ examined the

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- 13) Maheswarappa, B. S. and Ningoji, M. M. "Growth of literature in the field of Science and Technology in India," *International Information Communication and Education*, Vol.11, No.2, pp.186-197.
- 14) Maheswarappa, B. S. and Ningoji, M. M. "A study of the growth of Biological Science Literature in India from 1965-1989," *ILA Bulletin*, Vol.29, No.1-2, pp.47-57.
- 15) Alexandre, R. et al. "10 Years of Literature on AIDS(1983-1992): Bibliometric Analysis," *Enfermedades Infecciosas y Microbiologia Clinica*, Vol.13(1995), pp.338-344.
- 16) Ramesh Babu, B and Nandini Muthuswamy, "International Library Review(1987-1991): a bibliometric study, In: H.R. Chopra U.C. Sharma and M.K. Srivastava(ed)," *Library Science and its facets*, Vol.1(New Delhi: ESS ESS Publications, 1998), pp.249-263.
- 17) Narendra Kumar, A.M. and Ramesh Babu, B. ILA Bulletin(1986-1996): an analytical study. In: *Readings in Library and Information Science* (S.P. Sood festschrift) (Jaipur: Raj Publishing House, 1999), pp.237-256.
- 18) Bhagavathi, Sudha and Ramesh Babu, B. Indian Literature on Information Technology: A bibliographic study. In: *Trends in library and information science* (Essays in honour of Prof. G. D. Bhargava) (New Delhi: Gyan Publishing House, 2000), pp.273-286.
- 19) Karki, M. M. S., Garg, K. C. and Sharma, P. "Activity and Growth of Organic Chemistry Research in India During 1971-1989," *Scientometrics*, Vol.49(2000), pp.279-88.

research productivity on Indian Organic Chemistry during the period 1971-1989 using *Chemical Abstracts*. They attempted to quantify the national contribution to world efforts and identified areas of relative strength and weakness and also modelled the growth of Indian Organic Chemistry to world Organic Chemistry output as a whole, and in subfields, where the AI(Activity Index) for the world and India were similar. An attempt was made by Macias-Chapula(2000)²⁰⁾ to identify the patterns of the growth in AIDS literature, as well as the types of documents published, authorship pattern, institutional affiliations of authors, and subject content. The Indian output on Air Pollution research covered in *E-CD* was analysed quantitatively by Parameswaran, Ramesh Babu and Gopalakrishnan(2003).²¹⁾ The various bibliometric indicators have been used in the analysis, with regard to the authorship pattern, Relative Growth Rate, Doubling time, and Ranking of core journals, and core research institutions in India. Ramakrishnan and Rajendran(2004)²²⁾ analysed the literature on Hepatitis B. For this purpose, three journals namely *Journal of Virology*, *Journal of Medical Virology* and *Gastroenterology* for a period of five years(1997-2001) have been considered, with citation counting and compared the coverage in three databases viz. *MEDLINE*, *CINAHL* and *IPA*. Rajendran, Ramesh Babu and Gopalakrishnan(2005)²³⁾ analysed the global output of "fiber optics" research. Articles covered in the *Ei-Tech Index* database for the period 1999-2003 have been studied in terms of Growth of literature by year wise, country wise, authorship pattern, bibliographic forms, ranking of core journals and nature of research.

III. HEPATITIS

According to Stedman's medical dictionary "*Hepatitis is an inflammation of liver, due*

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- 20) Macias-Chapula CA. AIDS in Haiti: a bibliometric analysis. *Bull Med Libr Assoc* 2000, Vol.88, No.1, pp.56-61.
- 21) Parameswaran R, Ramesh Babu B and Gopalakrishnan S(2003). Quantitative Analysis of Air Pollution Research output from India during 1993-1998 paper presented in 9th ISSI Conference held at Beijing, China during August 25-29, 2003.
- 22) Ramakrishnan, J and Rajendran, P.(2004). Mapping the Literature of Hepatitis B. In: *Information and Knowledge Management in Health Sciences: Newer Perspectives*, MLAI 2004 National Convention held at Dr.ALM Post Graduate Institute of Basic Medical Sciences, Chennai, pp.216-224.
- 23) Rajendran, P, Ramesh Babu, B and Gopalakrishnan, S. Bibliometric Analysis of "Fiber Optics" literature. *Annals of Library and Information Studies*, Vol.52, No.3(2005), pp.82-85.

*usually to viral infection but sometimes to toxic agents. Previously endemic throughout much of the developing world, viral hepatitis now ranks as a major public health problem in industrialized nations. The 3 most common type of viral hepatitis(A, B, and C) affects millions worldwide*²⁴⁾

Hepatitis is a disease as old as the Greek and Roman hills. Hippocrates was the first to note the occurrence of jaundice epidemics - the telltale yellowing of the skin that heralds the fact that the liver can no longer properly cleanse the blood.²⁵⁾

Vaccines have been available for almost 20 years; however the disease still remains, many factors contributing to the failure to control hepatitis B, including the limited nature of the Vaccination programs implemented initially.²⁶⁾

For the past 25 years, worldwide clinicians, epidemiologists, microbiologists, pathologists, molecular biologists and other basic scientists have contributed immensely to the knowledge on Hepatitis.

A large number of articles, papers, reports and so on are being published on research work in Hepatitis. Since there is a continuous generation of information in this field, it is warranted to study quantitatively the output of literature by applying Scientometric tools/ indicators. The study of this nature would benefit to identify the growth rate of literature in the field of Hepatitis.

IV. OBJECTIVES OF THE PAPER

1. To examine the year wise growth of Hepatitis literature output.
2. To analyse the Indian literature on "Hepatitis".
3. To study the Hepatitis literature output by Colleges and Universities, Corporate Sector and Research Institutions.
4. To quantify the Research output in Journal Articles in terms of total pages.

24) Stedman's Medical Dictionary. 27thed. 2000, Lippincott: Baltimore.

25) Turkington(Carlol) Hepatitis C: the silent Killer. 1998, Contemporary Books: Lincolnwood(Chicago).

26) Sarin, S.K and Singal A.K. Hepatitis B in India: Problems & Prevention. New Delhi: CBS Publishers & Distributors, 1996.

V. LIMITATION

This study is confined to the literature covered in MEDLINE, CINAHL and IPA bibliographic databases for the period 1984-2003.

VI. METHODOLOGY

The three databases namely MEDLINE(Medical Literature Analysis and Retrieval Systems Online) CD-ROM, CINAHL(Cumulative Index to Nursing and Allied Health Literature) CD-ROM and IPA(International Pharmaceutical Abstract) CD-ROM, for the purpose of data collection on Hepatitis research. MEDLINE CD-ROM, the world leading international bibliographic database produced by the National Library of Medicine of United States, has been used. It deals with the biomedical literature, containing references to articles from more than 4800 journals²⁷⁾ which cover from 1966 to present. The CINAHL CD-ROM database is the only compact disc designed specifically to meet the information needs of nurses and allied health professionals. It covers records from 1982 to the current period.²⁸⁾ IPA CD-ROM began in 1964as a print service and become computerised in 1970 which includes Clinical and Technical Drug Information, Pharmacy practice, Pharmaceutical education, and Legal aspects of pharmacy and Drugs covering over 850 journals.²⁹⁾ In order to limit the chance of missing related articles, it is thought just and necessary to cover more than one database and therefore MEDLINE, CINAHL and IPA databases have been taken into consideration for searching in order to achieve a comprehensive coverage of Hepatitis in literature for the analysis. The data thus collected from the source databases on the literary production of 'Hepatitis' for the period 1984-2003 has been analysed by using bibliometric indicators such as Relative Growth Rate(RGR) and Doubling Time(Dt).

27) <http://www.nlm.nih.gov/pubs/factsheets/medline.html>

28) <http://www.cinahl.com/prodsvcs/cinahlddbbody.htm>

29) <http://library.dialog.com/bluesheets/html/bl0074.html>.

VII. Concept of Relative Growth Rate(RGR) and Doubling Time(Dt)

1. Relative Growth Rate(RGR)

The Relative Growth Rate(RGR) is the increase in number of articles/pages per unit of time. This definition is derived from the definition of relative growth rates in the study of growth analysis of individual plants and effectively applied in the field of Botany,³⁰⁾ which in turn, had its origin from the study of the rate of interest in the financial investment.³¹⁾ The mean Relative Growth Rate(R) over the specific period of interval can be calculated from the following equation:

$${}_{1-2}\bar{R} = \frac{\text{Log}_e {}_2W - \text{log}_e {}_1W}{{}_2T - {}_1T}$$

whereas

${}_{1-2}\bar{R}$ = mean relative growth rate over the specific period of interval

$\text{log}_e {}_1W$ = log of initial number of articles/pages

$\text{log}_e {}_2W$ = log of final number of articles/pages after a specific period of interval

${}_2T - {}_1T$ = the unit difference between the initial time and the final time

The year can be taken here as the unit of time. The RGR for both articles and pages can be calculated separately.

Therefore

$1 - {}_2\bar{R}$ (aa-1 year-1) can represent the mean relative growth rate per unit of articles per unit of year over a specific period of interval.

and

$1 - {}_2\bar{R}$ (pp-1 year-1) can represent the mean relative growth rate per unit of pages per unit of year over a specific period of interval.

30) Hunt, R. *Plant growth analysis* (London: Edward Arnold, 1978).

31) Blackman, V. H. "The compound interest law and plant Growth," *Annals of Botany*, Vol.33(1919), pp.353-360.

2. Doubling Time(Dt)

There exists a direct equivalence between the relative growth rate and the doubling time.³²⁾ If the number of articles/pages of a subject doubles during a given period then the difference between the logarithms of numbers at the beginning and end of this period must be logarithms of number 2. If natural logarithm is used this difference has a value of 0.693. Thus the corresponding doubling time for each specific period of interval and for both articles and pages can be calculated by the formula:

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

Therefore,

$$\text{Doubling time for articles Dt(a)} = \frac{0.693}{1 - 2 \bar{R} \text{ (aa-1 year-1)}}$$

and

$$\text{Doubling time for pages Dt(p)} = \frac{0.693}{1 - 2 \bar{R} \text{ (pp-1 year-1)}}$$

VIII. ANALYSIS AND DISCUSSION

1. QUANTUM OF HEPATITIS RESEARCH PRODUCTIVITY

The research productivity on 'Hepatitis' covered in those databases is shown in Table 1. It is observed that 0.97% of the records on 'Hepatitis' are covered in the total output of MEDLINE database. This is followed by 0.61% and 0.66% of total output covered in CINAHL and IPA respectively. This shows that MEDLINE is the largest database covered on the subject of 'Hepatitis'.

32) Mahapatra, M.(1985). *op. cit.*, 61-70.

Table 1. Quantum of Literature published in Hepatitis on Database wise

S.No.	Databases	Total No. of Records	Records on Hepatitis	%
1	MEDLINE	7806245	75750	0.97%
2	CINAHL	818447	5006	0.61%
3	IPA	279447	1861	0.66%
	Total	8904139	82617	0.92%

2. ELIMINATION OF DUPLICATE RECORDS AMONG THE THREE DATABASES

It is observed that there are duplication of literature covered among databases, which do not lead to correct assessment of the research productivity while examining the literary production of a subject. Therefore to gauge the quantum of literature productivity of a particular subject has been decided to eliminate the duplicate records in the source databases and arrive at the data which has been considered for the purpose of analysis. The data in Table 2 shows that the extent of duplicate records is about 4% (3305) of total productivity covered in the three databases. Therefore the analysis in the subsequent tables, is based on the total of 79312 records covered in the three databases after the elimination of duplicate records.

Table 2. Total No. of records after removing duplicate records among three databases

Total No. of records		Total No. of duplicate records		Total No. of records after removed duplicate records	
No.	(%)	No.	(%)	No.	(%)
82617	100	3305	4%	79312	96%

3. QUANTUM OF LITERATURE PUBLISHED ON HEPATITIS DURING 1984-2003

After the elimination of duplicate records, the literature has been classified in Table 3 according to year of publication. It is found that there is a gradual growth of literature in the subject of study by year after year. The year 2002 has marked a maximum of 7.59% out of total productivity in the study period.

Table 3. Quantum of Literature published in Hepatitis by year wise

S.No.	Year	Frequency	%	Cumulative %
1	1984	2538	3.20	
2	1985	2516	3.17	6.37
3	1986	2566	3.24	9.61
4	1987	2715	3.42	13.03
5	1988	2679	3.38	16.41
6	1989	2993	3.77	20.18
7	1990	3382	4.26	24.45
8	1991	3543	4.47	28.91
9	1992	3919	4.94	33.85
10	1993	3976	5.01	38.87
11	1994	4084	5.15	44.02
12	1995	4584	5.78	49.80
13	1996	4311	5.44	55.23
14	1997	4458	5.62	60.85
15	1998	4697	5.92	66.78
16	1999	5083	6.41	73.18
17	2000	5440	6.86	80.04
18	2001	5560	7.01	87.05
19	2002	6019	7.59	94.64
20	2003	4249	5.36	100.00
Total		79312	100.00	

4. RELATIVE GROWTH RATE(RGR) AND DOUBLING TIME(Dt)

The analysis of data on the literary output in Hepatitis has been done with parameters such as Relative Growth Rate(RGR) and Doubling Time(Dt).

(1) RGR and Dt for Hepatitis Research Output by year wise

It is seen from Table 4 that there is fluctuation in RGR by year wise. The RGR has been decreasing from 1985(0.69) to 1997(0.09) in the span of 13 years. Again it increased to 0.10 in 1998 and decreased in 2001(0.08). Thus the RGR by year wise revealed a fluctuation trend(Figure 1).

The Doubling Time(Dt) has also shown fluctuation when calculated by year wise. Normally the doubling time always be in increasing trend. The data in table 4 reveals fluctuation in different years. The Dt increases from 1.01 in the year 1985 to 1997(7.34) in

the time span of 13 years. Then it decreased to 7.12 in 1998 and increased from 1999(7.79) to 2001(8.40) (Figure 2).

Table 4. RGR and Dt for Hepatitis Research Output by Year-wise

Year	Quantum of Output	Cumulative Total of Output	W_1	W_2	$1-2\bar{R}^{(aa^{-1}year^{-1})}$ RGR	Dt(a)
1985	2516	2538	7.84	8.53	0.69	1.01
1986	2566	5054	8.53	8.94	0.41	1.70
1987	2715	7620	8.94	9.24	0.30	2.28
1988	2679	13014	9.24	9.47	0.23	2.96
1989	2993	16007	9.47	9.68	0.21	3.29
1990	3382	19389	9.68	9.87	0.19	3.60
1991	3543	22932	9.87	10.04	0.17	4.07
1992	3919	26851	10.04	10.20	0.16	4.38
1993	3976	30827	10.2	10.34	0.14	5.09
1994	4084	34911	10.34	10.46	0.12	5.75
1995	4584	39495	10.46	10.58	0.12	5.59
1996	4311	43806	10.58	10.69	0.11	6.44
1997	4458	48264	10.69	10.78	0.09	7.34
1998	4697	52961	10.78	10.88	0.10	7.12
1999	5083	58044	10.88	10.97	0.09	7.79
2000	5440	63484	10.97	11.06	0.09	7.83
2001	5560	69044	11.06	11.14	0.08	8.40
2002	6019	75063	11.14	11.23	0.09	8.05
2003	4249	79312	11.23	11.28	0.05	13.55

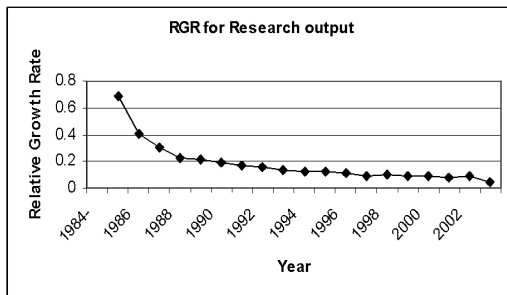


Figure 1. Relative Growth Rate for Research Output Vs. Year

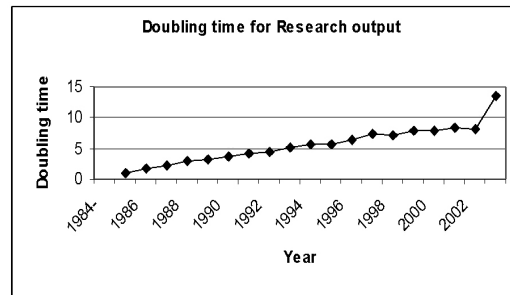


Figure 2. Doubling time for Research output Vs. Year

(2) RGR and Dt for Hepatitis Research Output in India by Year Wise

It was thought appropriate to calculate and analyse the RGR and Dt for Indian output on Hepatitis research. Accordingly the data has been analysed and presented in Table 5. It is found from Table 5 that the year wise calculation of RGR and Dt for Indian output has shown fluctuation trends throughout the study period. The RGR has been decreased from 1985(0.77) to 1991(0.16). In 1992 it has been enhanced to 0.18, and since then there is fluctuation up to 2003(0.04)(Figure 3).

The Dt also fluctuated from year after year. The Dt increased from 0.90 in 1985 to 4.33 in 1991 and it has gone down to 3.85 in 1992. Since then, there is fluctuation by year after year(Figure 4).

Table 5. RGR and Dt for Hepatitis Research out put in India

Year	Quantum of Output	Cumulative Total of Output	W ₁	W ₂	$1-2^{\overline{RGR}^{(a \cdot year^{-1})}}$ RGR	Dt(a)
1984	29	29		3.37		
1985	34	63	3.37	4.14	0.77	0.90
1986	32	95	4.14	4.55	0.41	1.69
1987	35	130	4.55	4.87	0.32	2.17
1988	42	172	4.87	5.15	0.28	2.48
1989	38	210	5.15	5.35	0.2	3.47
1990	43	253	5.35	5.53	0.18	3.85
1991	44	297	5.53	5.69	0.16	4.33
1992	57	354	5.69	5.87	0.18	3.85
1993	38	392	5.87	5.97	0.1	6.93
1994	51	443	5.97	6.09	0.12	5.77
1995	28	471	6.09	6.15	0.06	11.55
1996	43	514	6.15	6.24	0.09	7.70
1997	41	555	6.24	6.32	0.08	8.66
1998	63	618	6.32	6.43	0.11	6.30
1999	67	685	6.43	6.53	0.1	6.93
2000	78	763	6.53	6.64	0.11	6.30
2001	65	828	6.64	6.72	0.08	8.66
2002	81	909	6.72	6.81	0.09	7.70
2003	38	947	6.81	6.85	0.04	17.33

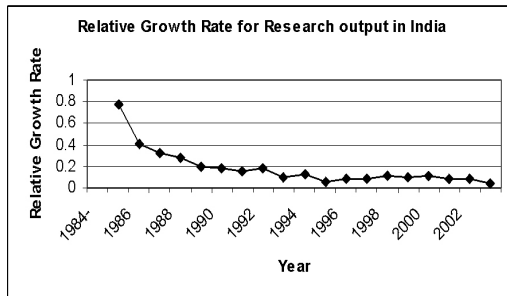


Figure 3. Relative Growth Rate for Hepatitis Research out put in India

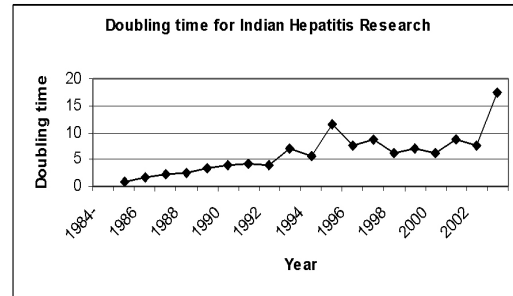


Figure 4. Doubling time for Hepatitis Research out put in India

(3) RGR and Dt for Hepatitis Research Output by Colleges and Universities by Year Wise

The year wise analysis of RGR and Dt for the Hepatitis out put by Colleges and Universities is shown in Table 6. A decreasing trend has been noticed for RGR except for the year 2002(Figure 5).

Table 6. RGR and Dt for Hepatitis Research in Colleges and Universities

Year	Quantum of Output	Cumulative Total of Output	W ₁	W ₂	$1-2\bar{R}^{(aa^{-1} \text{ year}^{-1})}$ RGR	Dt(a)
1984	1679	1679		7.43		
1985	1784	3463	7.43	8.15	0.72	0.96
1986	1728	5191	8.15	8.55	0.40	1.71
1987	1705	6896	8.55	8.84	0.29	2.40
1988	2039	8935	8.84	9.10	0.26	2.69
1989	2132	11067	9.10	9.31	0.21	3.27
1990	2563	13630	9.31	9.52	0.21	3.30
1991	2512	16142	9.52	9.69	0.17	4.10
1992	2678	18820	9.69	9.84	0.15	4.54
1993	2866	21686	9.84	9.98	0.14	4.80
1994	2924	24610	9.98	10.11	0.13	5.29
1995	3337	27947	10.11	10.24	0.13	5.41
1996	3246	31193	10.24	10.35	0.11	6.42
1997	3197	34390	10.35	10.45	0.10	7.25
1998	3312	37702	10.45	10.54	0.09	7.92
1999	3627	41329	10.54	10.63	0.09	7.76
2000	3714	45043	10.63	10.72	0.09	8.12
2001	4164	49207	10.72	10.80	0.08	8.27
2002	5185	54392	10.80	10.90	0.10	6.67
2003	3755	58147	10.90	10.97	0.07	9.80

The Dt increased from 0.96 in 1985 to 1998(7.92) and decreased in 1999(7.76) and then enhanced up to 2001. But the year 2002(6.67) shows a declining trend. In other words, the RGR and Dt results for 2002 year has shown fluctuation trend(Figure 6).

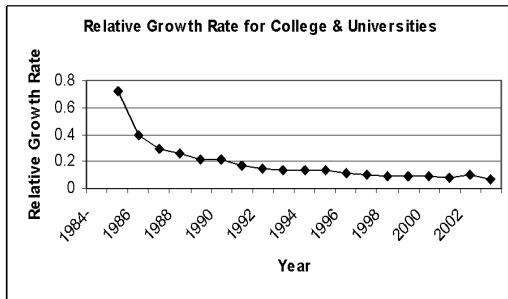


Figure 5. Relative Growth Rate for Hepatitis Research in College and Universities

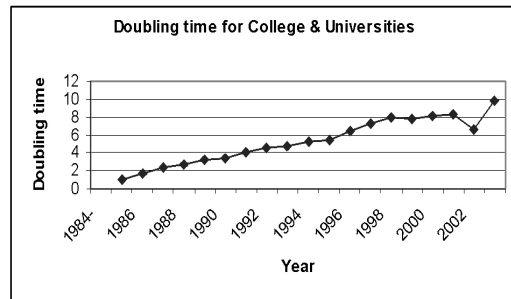


Figure 6. Doubling time for Hepatitis Research in College and Universities

(4) RGR and Dt for Hepatitis Research Output by Corporate Sector by Year Wise

It is noticed from Table 7 that the RGR and Dt for the year wise analysis shows fluctuation trends through out the study period by the Corporate Sector(Figures 7 and 8).

Table 7. RGR and Dt for Hepatitis Research in Corporate Sector

Year	Quantum of Output	Cumulative Total of Output	W ₁	W ₂	$1-2^{\frac{1}{RGR}}$ RGR	Dt(a)
1984	819	819		6.71		
1985	658	1477	6.71	7.30	0.59	1.18
1986	768	2245	7.30	7.72	0.42	1.66
1987	766	3011	7.72	8.01	0.29	2.39
1988	517	3528	8.01	8.17	0.16	4.37
1989	725	4253	8.17	8.36	0.19	3.74
1990	733	4986	8.36	8.51	0.15	4.49
1991	894	5880	8.51	8.68	0.17	4.09
1992	1018	6898	8.68	8.84	0.16	4.36
1993	909	7807	8.84	8.96	0.12	5.64
1994	954	8761	8.96	9.08	0.12	5.87
1995	1017	9778	9.08	9.19	0.11	6.42
1996	865	10643	9.19	9.27	0.08	8.38
1997	1030	11673	9.27	9.37	0.10	7.29

1998	1102	12775	9.37	9.46	0.09	8.13
1999	1211	13986	9.46	9.55	0.09	8.08
2000	1368	15354	9.55	9.64	0.09	7.78
2001	1152	16506	9.64	9.71	0.07	9.70
2002	660	17166	9.71	9.75	0.04	17.03
2003	379	17545	9.75	9.77	0.02	30.77

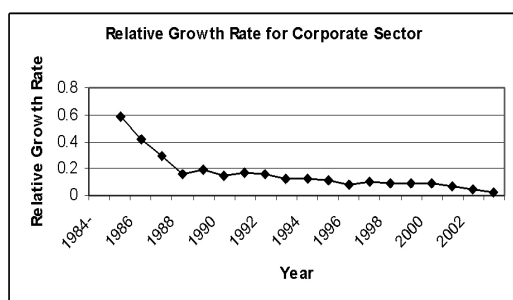


Figure 7. Relative Growth Rate for Hepatitis Research in Corporate Sector

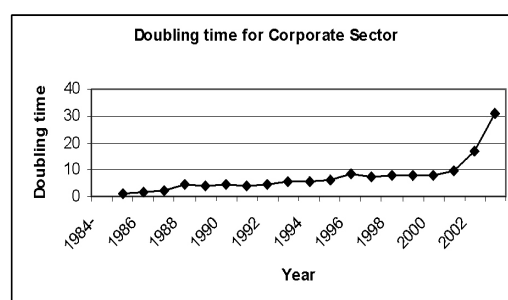


Figure 8. Doubling time for Hepatitis Research in Corporate Sector

(5) RGR and Dt for Hepatitis Research Output by Research Institutions by Year Wise

The data in Table 8 reveals the fluctuation trend in RGR by year wise through out the study period(Figure 9).

A similar trend is also noticed in the Dt through out the study period(Figure 10).

Table 8. RGR and Dt for Hepatitis in Research Institutions

Year	Quantum of Output	Cumulative Total of Output	W ₁	W ₂	$1-2^{\overline{R}(\text{aa}^{-1} \text{year}^{-1})}$ RGR	Dt(a)
1984	21	21		3.04		
1985	41	62	3.04	4.13	1.09	0.64
1986	29	91	4.13	4.51	0.38	1.82
1987	149	240	4.51	5.48	0.97	0.71
1988	78	318	5.48	5.76	0.28	2.46
1989	84	402	5.76	6.00	0.24	2.93
1990	45	447	6.00	6.10	0.10	6.76
1991	105	552	6.10	6.31	0.21	3.25
1992	170	722	6.31	6.58	0.27	2.55
1993	157	879	6.58	6.78	0.20	3.49

1994	175	1054	6.78	6.96	0.18	3.84
1995	188	1242	6.96	7.12	0.16	4.21
1996	161	1403	7.12	7.25	0.13	5.48
1997	209	1612	7.25	7.39	0.14	5.12
1998	240	1852	7.39	7.52	0.13	5.17
1999	208	2060	7.52	7.63	0.11	6.27
2000	293	2353	7.63	7.76	0.13	5.19
2001	198	2551	7.76	7.84	0.08	8.23
2002	102	2653	7.84	7.88	0.04	15.95
2003	72	2725	7.88	7.91	0.03	22.93

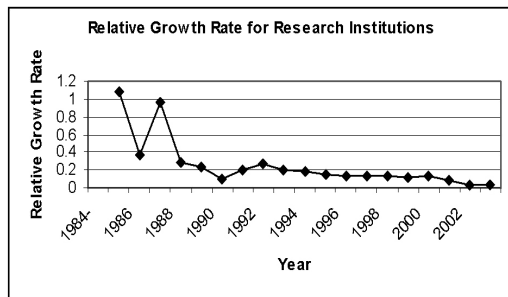


Figure 9. Relative Growth Rate for Hepatitis in Research Institutions

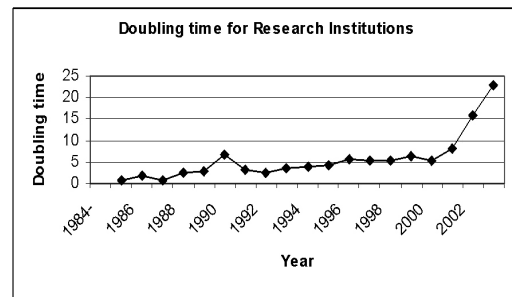


Figure 10. Doubling time for Hepatitis in Research Institutions

(6) RGR and Dt for Hepatitis Research Output in Journal Articles by Year Wise

The year wise RGR and Dt for journal articles is presented in Table 9. It is noticed that there is a decreasing trend in the year wise RGR of journal articles in the field of Hepatitis research output. The RGR in the year 1985 is 0.68 which has been gradually decreased to 0.05 in 2003(Figure 11).

Similarly the Dt for journal articles has shown an increasing trend. The Dt for the year 1985 was 1.03 and enhanced gradually to 13.90 in 2003(Figure 12).

Table 9. RGR and Dt for Journal Articles in Hepatitis Research

Year	Quantum of Output	Cumulative Total of Output	W ₁	W ₂	$1-2^{\bar{R}(aa^{-1} year^{-1})}$ RGR	Dt(a)
1984	2278	2278		7.73		
1985	2193	4471	7.73	8.41	0.68	1.03
1986	2268	6739	8.41	8.82	0.41	1.71
1987	2433	9172	8.82	9.12	0.30	2.28

1988	2388	11560	9.12	9.36	0.24	2.95
1989	2636	14196	9.36	9.56	0.20	3.45
1990	2930	17126	9.56	9.75	0.19	3.68
1991	2974	20100	9.75	9.91	0.16	4.37
1992	3219	23319	9.91	10.06	0.15	4.71
1993	3294	26613	10.06	10.19	0.13	5.37
1994	3308	29921	10.19	10.31	0.12	5.96
1995	3718	33639	10.31	10.42	0.11	6.11
1996	3546	37185	10.42	10.52	0.10	6.69
1997	3654	40839	10.52	10.62	0.10	7.12
1998	3853	44692	10.62	10.71	0.09	7.92
1999	4247	48939	10.71	10.80	0.09	7.85
2000	4462	53401	10.80	10.89	0.09	8.10
2001	4628	58029	10.89	10.97	0.08	8.81
2002	4355	62384	10.97	11.04	0.07	9.75
2003	3119	65503	11.04	11.09	0.05	13.90

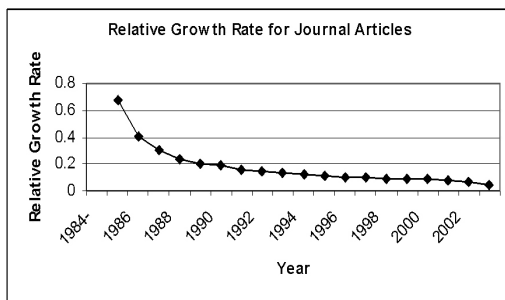


Figure 11. Relative Growth Rate for Journal Articles in Hepatitis Research

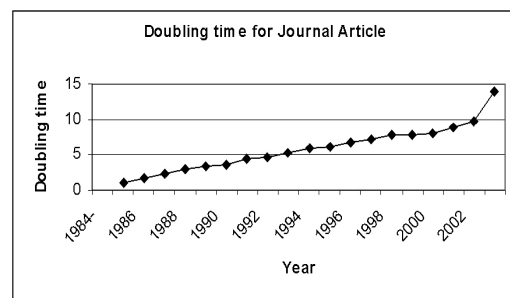


Figure 12. Doubling time for Journal Articles in Hepatitis Research

(7) RGR and Dt for Total pages in Hepatitis Research

The year wise calculation of RGR and Dt for the total pages in Hepatitis research has been presented in the Table 10. It is seen from the Table 10 that there is a decreasing trend in RGR by year after year. It was 0.67 in the year 1985 and since then it gradually decreasing and in 2003 it was 0.05(Figure 13).

Similarly Dt also shows an increasing trend. It was 1.03 in 1985 and increasing gradually to 12.67 for the year 2003(Figure 14).

Table 10. RGR and Dt for Total pages in Hepatitis Research

Year	Quantum of Output	Cumulative Total of Output	W ₁	W ₂	$1 - 2\bar{R}^{(pp^{-1} \text{ year}^{-1})}$ RGR	Dt(p)
1984	14948	14948		9.61		
1985	14288	29236	9.61	10.28	0.67	1.03
1986	14772	44008	10.28	10.69	0.41	1.68
1987	15193	59201	10.69	10.99	0.30	2.32
1988	14760	73961	10.99	11.21	0.22	3.13
1989	16069	90030	11.21	11.41	0.20	3.50
1990	18560	108590	11.41	11.60	0.19	3.74
1991	19151	127741	11.60	11.76	0.16	4.39
1992	20067	147808	11.76	11.90	0.14	4.82
1993	21782	169590	11.90	12.04	0.14	4.91
1994	21957	191547	12.04	12.16	0.12	5.64
1995	25217	216764	12.16	12.29	0.13	5.48
1996	24293	241057	12.29	12.39	0.10	6.74
1997	25425	266482	12.39	12.49	0.10	6.72
1998	26942	293424	12.49	12.59	0.10	6.97
1999	30294	323718	12.59	12.69	0.10	7.10
2000	34830	358548	12.69	12.79	0.10	6.94
2001	32595	391143	12.79	12.88	0.09	7.98
2002	36266	427409	12.88	12.97	0.09	8.11
2003	26066	453475	12.97	13.02	0.05	12.67

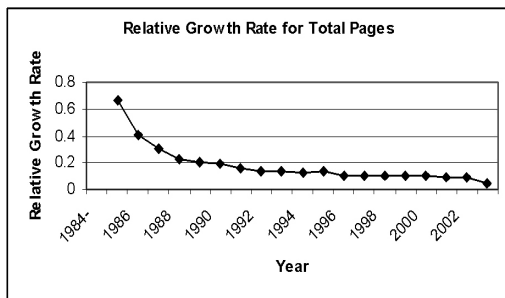


Figure 13. Relative Growth Rate for Total pages in Hepatitis Research

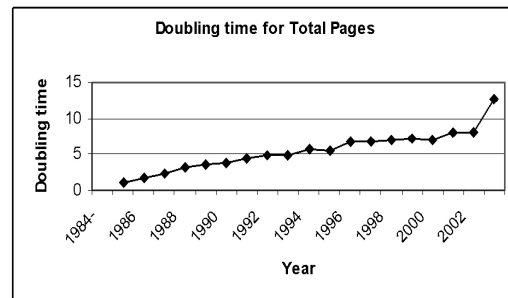


Figure 14. Doubling time for Total pages in Hepatitis Research

(8) RGR and Dt for Journal article pages in Hepatitis research

It was observed from the Table 11 that year wise calculation of RGR for journal article pages is in decreasing trend from 0.67 in the 1985 to 0.05 in 2003, of course, there are little

fluctuations in the year 1997(Figure 15).

Similarly the Dt also shows fluctuation trends. The Dt for 1985 was 1.04 and increased up to 7.33 in the year 1997. In the year 1998 it decreased to 7.06 and 6.58 in 2000 and since then it shows an increasing trend(Figure 16).

Table 11. R and Dt for Journal Articles pages in Hepatitis Research

Year	Quantum of Output	Cumulative Total of Output	W ₁	W ₂	$1 - 2\bar{R}^{(pp^{-1} \text{ year}^{-1})}$ RGR	Dt(p)
1984	14218	14218		9.56		
1985	13389	27607	9.56	10.23	0.67	1.04
1986	13822	41429	10.23	10.63	0.40	1.73
1987	14474	55903	10.63	10.93	0.30	2.30
1988	13975	69878	10.93	11.15	0.22	3.09
1989	15084	84962	11.15	11.35	0.20	3.47
1990	17176	102138	11.35	11.53	0.18	3.76
1991	17470	119608	11.53	11.69	0.16	4.28
1992	18193	137801	11.69	11.83	0.14	4.83
1993	19716	157517	11.83	11.97	0.14	5.05
1994	19743	177260	11.97	12.09	0.12	6.01
1995	22236	199496	12.09	12.20	0.11	6.10
1996	21741	221237	12.20	12.31	0.11	6.48
1997	22683	243920	12.31	12.40	0.09	7.33
1998	23940	267860	12.40	12.50	0.10	7.06
1999	27103	294963	12.50	12.59	0.09	7.33
2000	31241	326204	12.59	12.70	0.11	6.58
2001	29030	355234	12.70	12.78	0.08	8.61
2002	29169	384403	12.78	12.86	0.08	8.72
2003	21414	405817	12.86	12.91	0.05	12.92

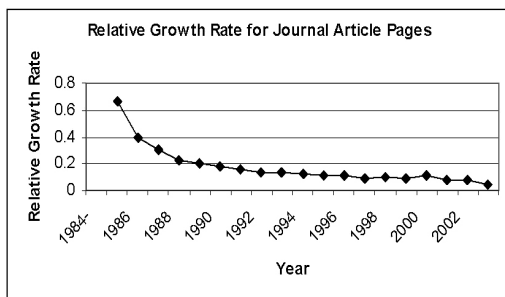


Figure 15. Relative Growth Rate for Journal Articles pages in Hepatitis Research

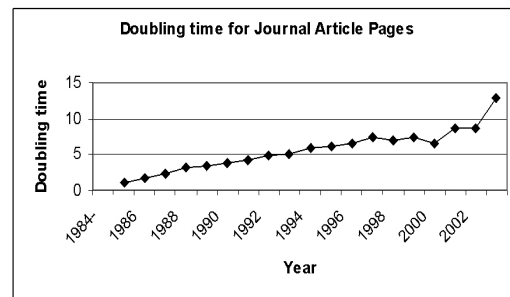


Figure 16. Doubling time for Journal Articles pages in Hepatitis Research

IX. Conclusion

There exists fluctuations in Relative Growth Rate and Doubling Time for research productivity from year after year throughout the study period. The Relative Growth Rate and Doubling Time for Indian output on Hepatitis also shows the fluctuation trends throughout the study period. The Relative Growth Rate for Hepatitis research by “colleges and universities” shows decreasing trend and increasing trend for Doubling time, whereas the output by “corporate sector” and “research institutions” have shown fluctuation trends for both Relative Growth Rate and Doubling time. The Relative Growth Rate for the Journal articles output has shown decreasing trends and on the other hand, Doubling Time is in increasing trend. The Relative Growth Rate for the total pages and journal article pages in Hepatitis research is in decreasing trend whereas Doubling Time is in increasing trend. It was found throughout the study period that, wherever the Relative Growth Rate is at higher rate, the Doubling Time is lower.