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Growth of Literature on Oncology: A Scientometric Analysis

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***Abstract** - The growth rate of literature on oncology from 2010 to 2019 in which a total of 1275877 research papers is analyzed. A scientometric technique is one of the most prominent dimension tools to recognize and ascertain the growth of publications in the scientific disciplines. The study evaluated various scientometric dimensions i.e. the year-wise distribution of records, annual growth rate, compound annual growth rate, authorship pattern, and found that a maximum of 143481 papers was published in 2018. The annual growth rate was registered in the year 2014 and in the same year, 4.447 CAGR was recorded. The relative growth rate is decreasing and the doubling time is increasing during the study period. The authorship pattern reveals that 93.66% of the papers collaborated paper. The study found that the growth of literature in oncology research is in increasing trend.*

Keywords: Scientometric, Oncology, PubMed, Authorship Pattern

Introduction

Cancer is the world's second-largest reason for death and is known for an approximate 9.6 million people dead in 2018. Around 1 in 6 deaths were due to cancer globally. Many research results revealed that about 70 percent of deaths occur in low and middle-income nations. The common types of cancers are lung cancer, colorectal cancer, prostate cancer, stomach cancer, breast cancer, skin cancer. The main reasons for cancer are the habit of tobacco use, unhealthy diet, alcohol use, and physical inactivity are the major risk factors. Cancer is a broader term for a wide range of diseases that can affect any part of the body. The rapid development of abnormal cells that expand throughout their natural limits, which can then invade adjacent parts of the body and spread to other organs, is one distinguishing characteristic of cancer. The latter phase is referred to as cancerous growth. Metastases are a significant reason for cancer death. Oncology is a field of medicine that is concerned with cancer prohibitions, treatment, and care. An oncologist is medical fractioned practicing oncology (Tanriverdi, 2013). Many international organizations like the American Cancer Society, Canadian Cancer Society Cancer Research UK, National Cancer Society are actively engaged in cancer research. Because of advanced screening, testing tools, and treatment options with cancer treatment, cancer survival has substantially improved over the past few years.

Scientometric is an empirical field and plenty of research is being undertaken for numerical analysis of a given subject's different aspects of literature. It is a subdivision of information science that quantitatively analyzes published information based on aspects of bibliographic data. In recent decades the scientometric studies have obtained tremendous attention and have been widely applied to assess the scientist's research success and the development of different science disciplines (Verma and Shukla, 2019). Scientometric may also be used in recognizing new areas of study. Therefore, the current study has been undertaken to know the growth of literature, annual growth rate, compound annual growth rate, and collaborative research in oncology literature.

Objectives

- To evaluate the year-wise growth of publications in the field of oncology;
- To determine Relative Growth Rate and Doubling Time of literature in oncology;
- To examine the nature of the authorship pattern in the field of oncology;

Methodology

The present study is appertaining to analyze the growth of literature in the field of "Oncology" by scientometric indices. To achieve the data for the predefined objectives, a Pubmed core collection database was used to extract publications, using the search string "Oncology" from 2010 to 2019 i.e. for ten years. A total of 1275877 records were considered for the study. Further, the downloaded data saved as .csv files, which were later entered into the MS Excel spreadsheet, and the resultant data were tabulated. This amounts to publications from the year 2010 to 2019, a total of 10 years. The following scientometric indices were used to analyze the data.

- Annual Ratio of Growth
- Relative Growth rate and doubling time
- Annual Growth Rate of Publications
- Compound Annual Growth Rate
- Authorship Pattern

Literature Review

There were several scientometric studies at the global level have been carried out on different disciplines. The researches associated with different disciplines such as Raja, Ramkumar and Viji (2011) conducted a scientometric study based on the Web of Science database on gender in worldwide thyroid cancer from 1991 to 2010. The highest number of papers was published in the year 2006 and 2007 correspondingly and the USA, Italy, and Japan countries were contributed to a maximum number of publications among the most productive countries. Among the top 20 most productive institutions NCI was in the first position by contributing the highest number of research papers on thyroid cancer. Grant Lewison and Philip Roe (2012) evaluated the citation study of Indian cancer research from 1990 to 2010. For their study, the data has been retrieved from the web of science citation database for analysis. The study revealed that the Council of Scientific and Industrial Research was the main organization by contributing research publications on Indian cancer. Shao et al. (2013) analyzed the scientometric indicators on oncology research from 2001 to 2010 for ten years by using a web of science database. The study pointed out that the citation frequency of the United States is high among the total citation frequency. The University of Texas has occupying first place in most cited institutions in oncology. Gupta et al (2014) evaluated

1141 Indian publications in cervical cancer research from 2003 to 2012 indexed in the Scopus database. The result revealed that the growth of publications was in increasing trend recording an annual average growth rate of 13.05%. In terms of global publication share, India has secured 13th rank among the top 15 contributing countries. Gupta, Gupta, and Ahmed (2016) have examined 5189 Indian publications on breast cancer research indexed in the Scopus database from 2005 to 2014. They found that the annual growth rate of publication is 21.94% and the highest numbers of publications were published by the USA, UK, China. India has secured 12th rank by publishing 2.55% of share at the global level. In terms of Indian research performance, half the total publications were contributed by Maharashtra, Tamil Nadu, and Karnataka states researchers. Padmamma and Walmiki (2016) have studied 3197 publications to analyze the growth of publications in Uterus Cancer from 2006 to 2016. The study also examined the authorship pattern, international collaboration, ranking of journals, etc. The study found that there was a fluctuation in terms of the growth of publication during the study. A study was done by Sadik Batcha (2018) aimed to study oral cancer research contribution in India. In this study, he analyzed the Indian institution's research contribution, the most preferred journal by the researchers, and examined the journal citations which were published by the researchers. The study found that the growth of publications was increasing trend over the years, USA was the most productive country furthermore Tata Memorial Hospital Mumbai produced most publications in oral cancer research. Shilpa et al (2019) studied the growth of literature on Leukemia research from 2009 to 2018 based on the Web of Science database. The study evaluated the research trend, communication channels preferred by researchers, international collaboration, most prolific authors, and most productive journals in Leukemia research. The study found that the highest number 16794 of publications were published in the year 2016. The majority of the researchers prefer to publish their research articles in journals. In terms of international collaboration, the United States of America was in first place contributing the highest number of publications in Leukemia research. The highest number of publications were contributed by more than 4 authors and the Indian author named Bakhshi was in the first place by publishing 121 publications during the study. The study revealed that the growth of publications in Leukemia research was in increasing trend during the study. Arun and Santhosh Kumar (2020) conducted a study on Gravity research from 2015 to 2019. The study aimed to identify the research trend, ranking of prolific authors, relative growth rate and doubling time, etc. The study depicts that majority of the publications were published in the year 2018. The RGR was decreasing and DT was increasing during the period. In terms of most prolific authors Sharif, M was the most prolific author by contributing the highest number of publications in the gravity field. They conclude that the growth of publications in gravity research was in a rising trend during the period.

Data Analysis and Interpretation

World research output in Oncology research

World research output is an indicator of year-wise publication in the Oncology literature. Table 1 illustrates the year-wise world research output from 2010 to 2019. The publication output in oncology research expanded from 100829 (7.90%) in 2010 to 143481 (11.25%) in 2018. Out of a total of 1275877 publications, maximum of 143481 (11.25%) were recorded in the year 2018, followed by 141037 (11.05%) were published in the year 2016 and a minimum of 100829 (7.90%) publications were published in the year 2010. It can be found that there is an increasing trend during the year except in 2019.

Table - 1: World research output in Oncology research

| Years | Number of Publications | Percentage |
|--------------|------------------------|------------|
| 2010 | 100829 | 7.90 |
| 2011 | 106527 | 8.35 |
| 2012 | 116051 | 9.10 |
| 2013 | 122867 | 9.63 |
| 2014 | 134037 | 10.51 |
| 2015 | 139899 | 10.96 |
| 2016 | 141037 | 11.05 |
| 2017 | 140768 | 11.03 |
| 2018 | 143481 | 11.25 |
| 2019 | 130381 | 10.22 |
| Total | 1275877 | 100 |

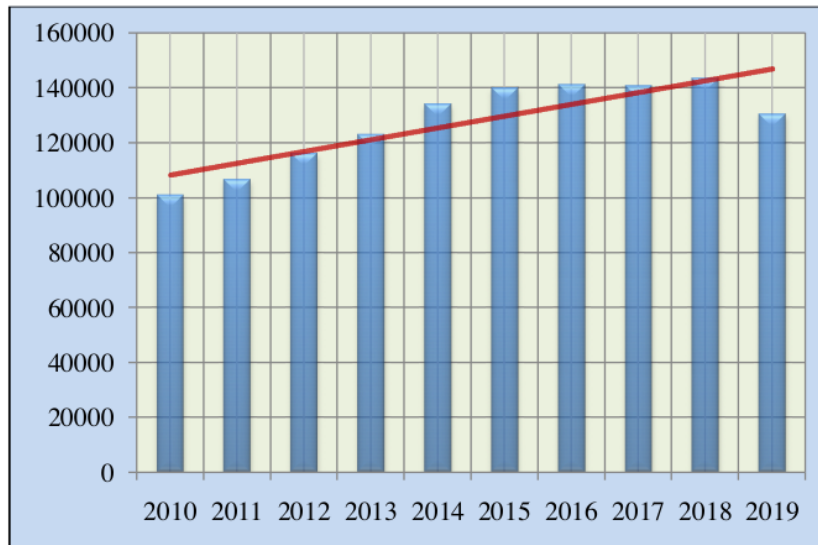


Figure – 1: World research output and Linear growth

Annual Ratio of Growth (ARoG)

T

he annual distribution and growth pattern of publications during the period of 2010 to 2019 are given in Table 2. The annual ratio of growth has been calculated with the current year's publications divided by the previous year's publications. The ratio of growth with the base year 2015 has been calculated and the same is shown in Table2.

It is identified from the table2 that in the year 2010 the total number of publications in oncology is 100829. In the year 2019, it increased to 130381. During the period the annual ratio of growth ranges between 0.91 and 1.09. There exist study growths in the publications. The annual ratio of growth thus calculated with the base year 2015 shows that there is a study growth during the last five years. It ranges between 0.93 and 1.03.

Table - 2: Annual Ratio of Growth of Oncology

| Year | Number of Publications | Percentage | Cumulative Papers | Cumulative Percentage | ARoG | ARoG with Base Year 2015 |
|--------------|------------------------|------------|-------------------|-----------------------|------|--------------------------|
| 2010 | 100829 | 7.90 | 100829 | 7.90 | 1.07 | 0.72 |
| 2011 | 106527 | 8.35 | 207356 | 16.25 | 1.06 | 0.76 |
| 2012 | 116051 | 9.10 | 323407 | 25.35 | 1.09 | 0.83 |
| 2013 | 122867 | 9.63 | 446274 | 34.98 | 1.06 | 0.88 |
| 2014 | 134037 | 10.51 | 580311 | 45.48 | 1.09 | 0.96 |
| 2015 | 139899 | 10.96 | 720210 | 56.45 | 1.04 | 1.00 |
| 2016 | 141037 | 11.05 | 861247 | 67.50 | 1.01 | 1.01 |
| 2017 | 140768 | 11.03 | 1002015 | 78.54 | 1.00 | 1.01 |
| 2018 | 143481 | 11.25 | 1145496 | 89.78 | 1.02 | 1.03 |
| 2019 | 130381 | 10.22 | 1275877 | 100 | 0.91 | 0.93 |
| Total | 1275877 | 100 | | | | |

Relative Growth Rate and Doubling Time

RGR means the increase in the number of publications per unit of time. It is also called the exponential growth rate or continuous growth rate concerning scientific literature publication. Further, the mean RGR of publications over a specific period can be calculated by using the formula. The growth rate of all publication has been measured based on RGR and Dt model, the particular model is developed by Mahapatra in 1985 (Mahapatra, 1985)

The formula which is used to calculate the relative growth rate and doubling time are:

$$RGR = \frac{W_2 - W_1}{T_2 - T_1}$$

Where,

RGR = Growth Rate over the specific period of the interval,

W1 = Log_e (natural log of the initial number of contributions)

W2 = Log_e (natural log of the final number of contributions)

T1 = The unit of initial time

T2 = The unit of final time (Shilpa and Padmamma, 2020)

The doubling time is the given period required for a quantity to double in size or value. It is directly related to RGR, where RGR is constant. The quantity undergoes exponential growth and has a constant doubling time or period which can be calculated directly from the growth rate. So the Doubling time is calculated by using the Formula;

$$Doubling\ Time(Dt) = \frac{0.693}{R}$$

Where,

R= Growth rate

Here Dt(P) is the average doubling time of articles (Arun Kumara and Santhosh Kumar, 2020).

Table 3 depicts the relative growth rate and doubling time of publication on oncology from 2010 to 2019. It indicates that the RGR was decreased from 0.72 in the year 2011 to 0.11 in the year 2019. The mean relative growth rate for the first four years (2010 to 2013) is 0.37. For the next three years (2014 to 2016) the growth rate was decreased slightly to 0.22. Further, again it decreased to 0.13 during the year 2017 to 2019. It is evident that during the

period 2010 to 2013 the relative growth rate was high compared to 2014 to 2016, 2017 to 2019.

The doubling time was increased from 0.96 in the year 2011 to 6.43 in the year 2019. The mean doubling time for the first four years (2010 to 2019) was 1.17 and it was increased to 3.24 in the second three years (2014 to 2016). In the last three years (2017 to 2019) it has increased to 5.39. It is observed from the table that the relative growth rate has decreased and the doubling time has increased during the study.

Table - 3: Relative Growth Rate and Doubling Time

| Year | Number of Publications | Cumulative Publications | Cumulative Percentage | W1 | W2 | RGR | Mean RGR | DT | Mean DT |
|--------------|------------------------|-------------------------|-----------------------|-------|-------|------|----------|------|---------|
| 2010 | 100829 | 100829 | 7.90 | | 11.52 | | 0.37 | | 1.17 |
| 2011 | 106527 | 207356 | 16.25 | 11.52 | 12.24 | 0.72 | | 0.96 | |
| 2012 | 116051 | 323407 | 25.35 | 12.24 | 12.69 | 0.44 | | 1.56 | |
| 2013 | 122867 | 446274 | 34.98 | 12.69 | 13.01 | 0.32 | | 2.15 | |
| 2014 | 134037 | 580311 | 45.48 | 13.01 | 13.27 | 0.26 | 0.22 | 2.64 | 3.24 |
| 2015 | 139899 | 720210 | 56.45 | 13.27 | 13.49 | 0.22 | | 3.21 | |
| 2016 | 141037 | 861247 | 67.50 | 13.49 | 13.67 | 0.18 | | 3.88 | |
| 2017 | 140768 | 1002015 | 78.54 | 13.67 | 13.82 | 0.15 | 0.13 | 4.58 | 5.39 |
| 2018 | 143481 | 1145496 | 89.78 | 13.82 | 13.95 | 0.13 | | 5.18 | |
| 2019 | 130381 | 1275877 | 100.00 | 13.95 | 14.06 | 0.11 | | 6.43 | |
| Total | 1275877 | | | | | | | | |

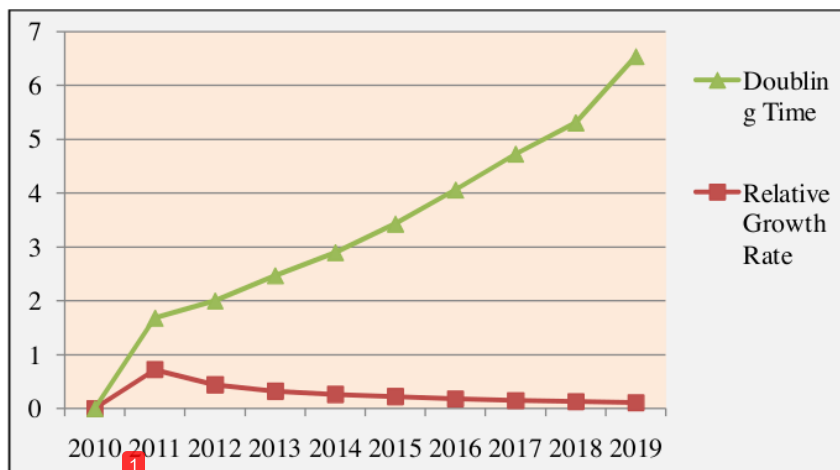


Figure - 2: Relative Growth Rate and Doubling Time

Annual growth rate of publications

Table 4 shows the annual growth rate (AGR) of the research result from the marked period of study in which the maximum annual growth rate was recorded in the year 2014 i.e. 9.091, followed by 8.940 in 2012. The annual growth rate is calculated on the formula suggested by Kumar and Kaliyaperumal, 2015 and mentioned below;

$$AGR = \frac{\text{End Value} - \text{First Value}}{\text{First Value}} \times 100$$

Table - 4: Annual Growth Rate of Publications

| Year | Number of Publications | Percentage | AGR |
|--------------|------------------------|------------|--------|
| 2010 | 100829 | 7.90 | 0.000 |
| 2011 | 106527 | 8.35 | 5.651 |
| 2012 | 116051 | 9.10 | 8.940 |
| 2013 | 122867 | 9.63 | 5.873 |
| 2014 | 134037 | 10.51 | 9.091 |
| 2015 | 139899 | 10.96 | 4.373 |
| 2016 | 141037 | 11.05 | 0.813 |
| 2017 | 140768 | 11.03 | -0.191 |
| 2018 | 143481 | 11.25 | 1.927 |
| 2019 | 130381 | 10.22 | -9.130 |
| Total | 1275877 | 100 | |

The ratio of growth and Compound annual growth rate of publications

Table 5 describes the compound annual growth rate of publications on oncology literature during the period. The compound annual growth rate is measured by taking the nth root of the total percentage growth rate, where n is t number of years in the period being conscious (Subramanyam, 1983). It is found that the CAGR was recorded in the year 2014 with 9.091, followed by 8.940 in the year 2012. The compound annual growth rate was calculated by the following formula (Shukla, 2019).

$$CAGR = [(Ending\ Value / Beginning\ Value)^{1/n} - 1]$$

Table - 5: Ratio of Growth and Compound Annual Growth Rate of Publications

| Year | Number of Publications | Percentage | CAGR | CAGR % |
|--------------|------------------------|------------|--------|--------|
| 2010 | 100829 | 7.90 | 0.000 | 0 |
| 2011 | 106527 | 8.35 | 0.028 | 2.787 |
| 2012 | 116051 | 9.10 | 0.044 | 4.375 |
| 2013 | 122867 | 9.63 | 0.029 | 2.895 |
| 2014 | 134037 | 10.51 | 0.044 | 4.447 |
| 2015 | 139899 | 10.96 | 0.022 | 2.163 |
| 2016 | 141037 | 11.05 | 0.004 | 0.406 |
| 2017 | 140768 | 11.03 | -0.001 | -0.095 |
| 2018 | 143481 | 11.25 | 0.010 | 0.959 |
| 2019 | 130381 | 10.22 | -0.047 | -4.674 |
| Total | 1275877 | 100 | | |

Collaborative Research

Collaboration is research conducted through which individuals research mutually to a specific purpose to reach benefits. Collaboration allows individuals to research together to achieve a specified and regular purpose (Dillenburg, 1999). Table 6 shows that the majority (93.66%) of publications have been published in multi-authorship. It is seen that only 6.34% of the publications have been contributed by a single author, 8.88% of publications by two authors, 10.06% of contributions from three authors, and 10.86% publications were contributed by four authors. Further, 63.86% of publications were contributed by more than four authors. The most collaboration types are notably ten and above authors (20.08%), six authors (10.7%), four authors (10.86%), five authors (10.92%) respectively. Therefore there is a collaboration research trend.

Table - 6: Authorship Pattern

| Authorship | Frequency of Publications | Percentage | Cumulative Frequency of Publications | Percentage |
|---------------|---------------------------|------------|--------------------------------------|------------|
| Single Author | 80854 | 6.34 | 80854 | 6.34 |
| Two Authors | 113299 | 8.88 | 194153 | 15.22 |
| Three Authors | 128392 | 10.06 | 322545 | 25.28 |
| Four Authors | 138527 | 10.86 | 461072 | 36.14 |
| Five Authors | 139295 | 10.92 | 600367 | 47.06 |
| Six Authors | 136515 | 10.7 | 736882 | 57.75 |
| Seven Authors | 113678 | 8.91 | 850560 | 66.66 |
| Eight Authors | 95272 | 7.46 | 945832 | 74.13 |
| Nine Authors | 73804 | 5.79 | 1019636 | 79.92 |
| >Ten Authors | 256241 | 20.08 | 1275877 | 100 |
| Total | 1275877 | 100 | | |

Findings and Conclusion

Scientometric studies have developed a body of theoretical knowledge and a group of techniques and applications based on the distribution of bibliographic data. The wider application of Scientometric techniques is leading to the development of a new and more precise technique. Hopefully, the on-going theoretical work will point the way to more innovative techniques. The study examines the growth of publications, annual growth rate, compound annual growth rate, authorship pattern in oncology literature. The growth of publications was ranged from 7.90 in the year 2010 to 11.25 in the year 2018. In the year 2019, we can found a slight decrease in publications productivity. The study found that there is an increasing trend during the study.

The annual growth rate was ranged from 0.91 and 1.09 during the study. The relative growth rate was decreasing and doubling time was increasing from 2010 to 2019. The compound annual growth rate was registered in the year 2014 with 9.091, followed by 8.940 in the year 2012. The authorship pattern shows that 93.66% of the publications were contributed by more than two authors. Only 6.34% of the publications were contributed by a single author. This result shows the collaborative network is high in oncology literature.

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