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### Radiologic Clinics of North America; Bibliometric Spectrum of Publications from 2000 to 2019.

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# Radiologic Clinics of North America; Bibliometric Spectrum of Publications from 2000 to 2019.

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## ABSTRACT

**Aim:** The aim of this study is to present the bibliometric analysis of papers published in *Radiologic Clinic of North America (RCNA)* from 2000 to 2019.

**Design/Methodology:** The Elsevier's Scopus database was used as a source to retrieve the bibliographic records published from 2000 to 2019. The data was evaluated on the following parameters, growth of publications and their citation impact by year, most contributing institutions and countries, productive authors, authorship patterns, most-cited papers, frequently used keywords and flow of knowledge. Only original and review articles were used for analysis, other types of documents were excluded. Microsoft Excel, SPSS and VOSviewer software were used for data analysis.

**Results:** A fluctuation was detected in the number of publications. A total of 1,401 papers were selected, of whom 1,241 (88.57%) were review articles and 160 (11.42%) were research articles. The mean and standard deviation (SD) scores of papers were 70 and 6.15 respectively. All selected papers received 34,145 citations with a mean score of 24.37 citations per paper (SD 1019.55). The study found that all top-10 contributing institutions belonged to the USA and the USA was also found most productive country. Out of the ten-most productive authors, nine were affiliated with USA and two-author pattern found a most preferred pattern.

**Conclusion:** The finding of this study exposed that the USA is the most productive country in terms of authors, institutions and even in citing the literature of *RCNA*.

**Keywords;** Radiology, Bibliometric; Research productivity, Scopus

## INTRODUCTION

The research activities are imperious for the development of knowledge and sharing the findings with rest of the world is an integral part of the research cycle (Haq & Al Fouzan, 2017; Shehatta & Mahmood, 2016). Continuous research in radiological sciences has enhanced the current knowledge, to provide solutions to the problems and improve the process of medical practice (Aklhawtani, Kwee & Kwee, 2020; Mattar, Tilson & Sayed, 2013). Journals are considered a vital channel to publicize scholarly and scientific research. It is known as one of the best sources to disseminate the findings of the experiment, to validate one's research, and to amplify the worth of the author, affiliated institution and the country as well (Doloon, 2007; Tanveer, et al., 2020).

*Radiologic Clinics of North America (RCNA)* is a popular journal of Radiology. It was started in 1963 by W. B. Saunders from Philadelphia, United States with ISSN 0033-8389 (print), 1557-8275 (electronic). The frequency of *RCNA* has been bimonthly since January 1987. It provides a platform for radiologic science specialists to communicate their research among the larger scientific community to assist and improve the medical practice. Each issue brings a specialized theme of radiology under the editorial guidance of a particular subject specialist, and the celebrated radiologist and educationalist, Frank H. Miller is the consulting editor. It is indexed in all reputed global databases, like Web of Science, Scopus, PubMed, Embase and Radiological Association of North America. The impact factor of this journal in *Journal Citation Report-2019* of Web of Science is 2.042 and CiteScore in Elsevier's Scopus database is recorded 3.4. (<https://www.radiologic.theclinics.com/>).

There are 41,317 journals and source publications which are indexed in the Scopus database. The radiological journals are divided into three groups; health professions, medicine and physics & astronomy. In the first group of health professions, 65 journals are indexed in the subcategory of "radiological and ultrasound technology". The highest number of journals (n=447) are included in the second group, medicine under the subcategory of "radiology, nuclear medicine and imaging". The Elsevier's journal, *Medical Image Analysis* found on the first rank in both groups with 17.2 CiteScore. In the third group, physics and astronomy, 68 journals are indexed under the subcategory of "radiation" ([www.scopus.com](http://www.scopus.com)). According to Scimago Journal and Country Rank (SJR), a total global research output counted 58,807,729 from 1996 to 2019, the share of radiology, nuclear medicine and imaging has been found 833,056 that is 1.41% of the total research (Scimago, n.d.).

The *International Association of Scientific, Technical and Medical Publishers' (STM)* report of 2018 stated that there were about 42,500 active journals consisting of 78% in English and 22% in the non- English language, producing over 3 million papers per annum with a 3.5% increase of articles in every year. As the number of researchers are increasing, the growth of publications would reach 5% annually in the recent future. About one-third percent of the journals are open-accessed and China (19%) has overtaken the United States (18%) in production of the global scholarly literature. (Johnson, Watkinson & Mabe, 2018. p. 5)

As the quantity of research has been increasing, the demand of evaluating research productivity has also been getting popularity (Javed, Ahmad & Khakro, 2020). Primarily, the library and information professionals have been actively involved in bibliometric and scientometric studies, but the subject specialists of different branches of knowledge are also conducting these studies to determine the quantitative and qualitative aspects of publications (Alhibshi et al., 2020).

The term bibliometric is coined by Alan Prichard (1969). This technique has been used to evaluate the performance of research (Hood & Wilson, 2003). The similar term scientometrics has also been applied to research growth, Hood & Concepcion, (2001) affirmed that this procedure has been utilized for analyzing and measuring the state of scientific and scholarly disciplines and their growth.

The bibliometric method is the application of mathematics and statistics on publications to determine and quantify the various parameters of printed work, e. g., the growth of publications by year, segregation of papers by subjects, finding out the preferred sources of publications, authorship and collaboration pattern and citations analysis, etc. (Baladi, et al., 2018). The science of bibliometrics was earlier known as the statistical bibliography and a pioneer study was done by Cole and Eales (1917) to estimate the literature on comparative anatomy published in books and journals from 1543 to 1860. The second work was conducted by Hulme (1923) on the area of

history of science and Gross and Gross (1927) measured the publication output of chemical society from 1871-1925.

The findings of bibliometrics studies are used for several purposes, the statistical layout helps to formulate strategy, revisit the previous plan and provide justification of financial grant (Haq, Elahi & Dana. 2019). This research paper aimed to present the qualitative and quantitative bibliometric characteristics of papers published in *RCNA* for a period of 20 years (2000-2019).

## LITERATURE REVIEW

A review of the relevant studies supports to establish the theoretical framework of the research and to set up the connection for previous research with the present study. As 30% of the total global research output is related to health sciences (Johnson, Watkinson & Mabe, 2018) and the estimated share of radiology sciences counted 1.41% of the total (Scimago, n.d.). Numerous bibliometrics studies have been conducted on the medical and allied health specialties including radiology sciences around the globe.

A recent bibliometric study on a single radiology journal was conducted on the comparative analysis of citations received by open-access and subscription access articles published in the *European Radiology* from 2015 to 2017. Out of 500 articles, 86 articles were open access while 414 were subscription access. The study found the open access articles are significantly more cited as compared to subscription access articles (Alkhawtani, Kwee, & Kwee, 2020).

A 2019 bibliometric study on the research output of *Insights into Imaging* was conducted into two databases. This journal was indexed in the Scopus (since 2012) and the Emerging Source Citation Index (ESCI) of Web of Science (since 2015) databases. There were 474 papers indexed in the Scopus and 292 in ESCI. Amongst the most prolific author, institution and country, Tonolini stand out on the top as the most productive author with 20 papers, European Society of Radiology produced 25 papers and the most of papers (n=92) were contributed by Italy. The editorial board members contributed 47% of the documents and the highest number of papers was written on magnetic resonance imaging (n=154). There was an average of 9.06 and 4.03 citations per papers in the Scopus and ESCI respectively (Valderrama-Zurián, Castelló-Cogollo, & Aleixandre-Benavent, 2019).

Mattar, Tilson and Sayed (2013) presented the bibliometric analysis of 2,329 papers published in *Radiologic Technology* from 1963-2011, a maximum No. of papers (n=84) were published in the year 1997 and minimum no. of papers (n=37) were published in 1992. The bulk of papers (73%) consisted of original research articles. Dowd SB emerged as a productive author with 53 articles, his productive period contained 19 years. The majority of papers were written on a subcategory of radiology, nuclear medicine and medical imaging (35%), followed by clinical medical topics (14%), social sciences (11%) and educational research (8%).

Shekhani et al. (2017) evaluated the attributes of 703 articles published in six impact factor journals of radiology during the first six months of 2004 to determine citations influence. Maximum 30% of the articles were published in *Radiology*, then *AJR* and *European Radiology*, 34% of the articles used the retrospective followed by prospective (23%) study design. The majority of articles (37%) were produced by the authors belong to North America, followed by Europe (36%) and one percent of the articles were contributed by Saudi Arabia. The articles were classified into nine groups based on modality, the highest, 30% of the papers related to MRI, followed by CT (23%), interventional radiology (11%) and ultrasound (6%). The citation analysis revealed that the median number of citations got by each paper was 32 and the interquartile range was found 16-60. Further, the study concluded that the statistical significance of citation-counts

depended on various factors such as study finding mentioned in the title, the study universe, radiology authors, abstract word and character count.

Brinjikji, et al. (2013) assessed the bibliometric indicators of 100 most-cited articles on imaging as reflected in the Scopus database. These selected articles were published from 1973 to 2006 and 87% have been published after 1990. These articles received the citation range from 624 to 6447, with a median range of 938 citations. The bulk of articles were related to neuroimaging (58%) and imaging modality analysis stated that 69% of the articles were about to MR imaging. The maximum (n=22) articles were published in the journal named, *NeuroImage*, most of the articles contributed by USA (n=46) followed by UK (n=25) and 75% of the article belonged to a preclinical type.

Pagni, et al., (2014) examined the 100 highly-cited papers of radiology based on the Web of Science database, published between the intervals of 1967-2006. These papers were published in nine journals with a range of citations from 422-7506 and 59 articles published in *Radiology*. The median range of authors was found five and 61 articles were contributed by the USA, followed by Germany and Italy. The share of prospective and retrospective studies was 54 and 46 respectively. MRI has been found the top preference (n=31) in radiology techniques. The top three journals, *Radiology*, *Journal of Nuclear Medicine* and *American Journal of Roentgenology* contained 85% of the articles. One-fourth of the articles were published from 1986 to 1990 and the highest numbers of citations were found from 2006 to 2010.

Yoon, et al., (2013) scrutinized the 100 top-cited articles on radiology, published in eight journals based on the data available in Science Citation Index Expanded during 1939 to 2006 with the mean of 644.3 citations per article. Sixty-seven percent of the papers consisted of research articles, more than three-fourth (78%) of the articles published after 1979, and 57% of the papers were produced by the USA. Interventional radiology was the preferred sub-category, followed by neuroradiology and breast imaging.

Rosenkrantz et al., (2016) investigated the most-cited articles on machine learning within radiology journals. The study selected 25 impact factor journals on general radiology and the articles published during 2012 and 2013 were examined, top 10% highly-cited articles of each journal were included in the analysis and the Bayesian binary regression model was resulted to be the best performing model.

Dolan, et al., (2015) analyzed the 100 top-cited articles on radiology of trauma. The data for the study was downloaded from the Web of Science database. The selected articles received the citations from 82 to 252 and the maximum articles (n=45) were published in the decade of the 1990s. These articles published in 24 journals and *Radiology* was in the top (n=31) and articles had a mean of five authors per paper. In the analysis of the most preferred sub-category of radiology, 67 & 48 articles were found on computed tomography (CT) and neuroradiology.

Miguel-Dasit, et al., (2008) investigated the 332 PubMed indexed articles on MR radiological produced by Spanish authors from 2001 to 2007 that published in 101 journals. Almost one-third (n=101; 32%) of the articles published in non-radiology journals and the highest number of articles (n=51; 15%) were published in *Radiología*, and neuroradiology was found the hot area of research (n=139; 42%).

Snaith (2013) analyzed the 835 papers published in four radiology journals from 2004-2011, 53% of the papers were published in *radiography* and 36% of the total papers were contributed by a single author pattern. The authors of the United Kingdom contributed highest number of papers (n=32%), followed by Australia and Canada. Almost 49% of the papers stand out as research articles and 51% of the articles fall in clinical practice topics.

## RESEARCH METHODOLOGY

The current retrospective study was conducted to examine the bibliometric attributes of articles published in RCNA from 2000-2019. The data was taken from Elsevier's Scopus database in October 2020. We used the name of the journal in the main search box and selected the option of source publication in the subsequent box, the desired period was mentioned. A total of 1,619 documents were found, only 1,401 documents consisted of articles and reviews were selected for data analysis. The following query was used to get the targeted data.

“SRCTITLE ( *radiologic* AND *clinics* AND *of* AND *north* AND *america* ) AND DOCTYPE ( *ar* OR *re* ) AND PUBYEAR > 1999 AND PUBYEAR < 2020”

The data were analyzed in Microsoft Excel and distributed by year with the number of publications vs citations, the number of citations were calculated to determine its impact, most contributing institutions, productive countries, prolific authors and ten most-cited papers were highlighted, the correlation of authorship pattern and citations were measured by SPSS. All the results were presented in graphic and tabular form and VOSviewer software was used to illustrate the co-authors' clusters and frequently used co-occurrence of keywords.

The study is exempted from institutional review board approval because the electric data was used which is available online, and no human or animal data was used.

## LIMITATIONS

The study was limited to original and review articles published during 20 years in RCNA and indexed in the Scopus database. Two hundred and eighteen (n=218) documents consisted of editorials (n=169), notes (n=46), erratum (n=4) and conference paper (n=1) were excluded from the study, because these documents types rarely received any citation. The only editorial received some citations (n=46), these citations have also been excluded. The citations and the data related to the flow of knowledge were also taken from the Scopus database.

## RESULTS

Table-1 and Figure-1 display the number of papers published and the number of citations received by these papers in RCNA from 2000 to 2019. A total of 1,401 papers were published in RCNA for 20 years, mean score was recorded 70 papers per year (standard deviation, 6.15). The fluctuation has been observed in the number of publications. A maximum of 78 papers was published in 2002 and 2012 while minimum of 56 papers have published in the year 2006. All these papers received 34,145 citations with an average of 24.37 citations per paper (standard deviation, 1019.55). The older documents received more citations as compared to the latest, that's why the documents published in the year 2000 got maximum citation impact (51.09). A total of 675 papers (48.17%) were published in the first decade (2000-2009) and these papers received 24,636 (72%) citations.

The analysis of document types reveal that the majority of the documents were published as review articles (n=1241; 88.57%) followed research articles (n=160; 11.42%). The impact of citations found higher to research articles as compared to review articles, 160 research articles received 5,956 citations (37.22) and 1,241 review articles got 28,189 citations (22.71).

**Table-1; Distribution of papers and citations by year**

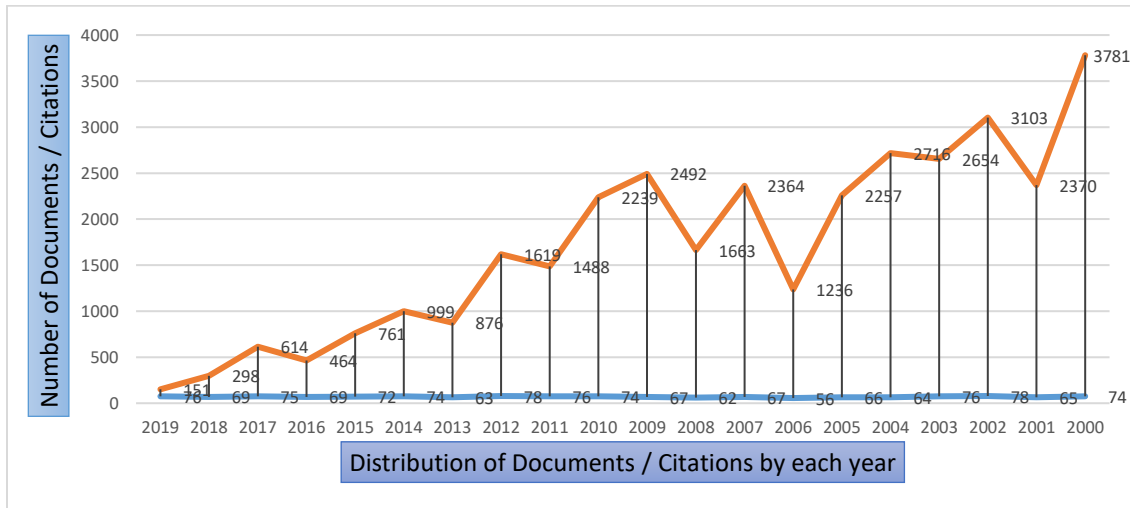
Year	Publications	Citations	ACPP*
2019	76	151	1.99
2018	69	298	4.32
2017	75	614	8.19
2016	69	464	6.72
2015	72	761	10.57
2014	74	999	13.50
2013	63	876	13.90
2012	78	1619	20.76
2011	76	1488	19.58
2010	74	2239	30.26
2009	67	2492	37.19
2008	62	1663	26.82
2007	67	2364	35.28
2006	56	1236	22.07
2005	66	2257	34.20
2004	64	2716	42.44
2003	76	2654	34.92
2002	78	3103	39.78
2001	65	2370	36.46
2000	74	3781	51.09
	1401	34145	24.37

\*ACPP = Average citations per paper

The data about the distribution of papers by contributing institutions was limited to 160 institutions which contributed more than three papers each. More than half (n=93; 58%) of the institutions contributed four to nine papers each. Forty-nine institutions (30.65%) contributed from 10 to 20 papers each and only 25 institutions contributed more than 20 papers each. Table-2 illustrated the top-10 contributing institutions. The authors affiliated with Harvard Medical School contributed maximum of 123 papers (8.77%) in 20 years. Harvard Medical School has been the only institution which contributed more than 100 papers, whereas Massachusetts General Hospital and the University of California, San Francisco produced 72 and 48 papers respectively. Interestingly, all top-10 most contributing institutions belonged to the United States and they contributed more than one-third of the total papers (n=499; 35.61%).

The authors belong to 39 countries who contributed their papers in RCNA, 24 countries contributed one to nine papers each and 15 countries have produced more than 10 papers each (Figure-2). The authors of the United States produced the maximum documents (n=1,194; 85.22%), followed by Canada, Italy, Germany, United Kingdom and France. Figure-2 demonstrated the top-15 countries that contributed more than nine articles each.

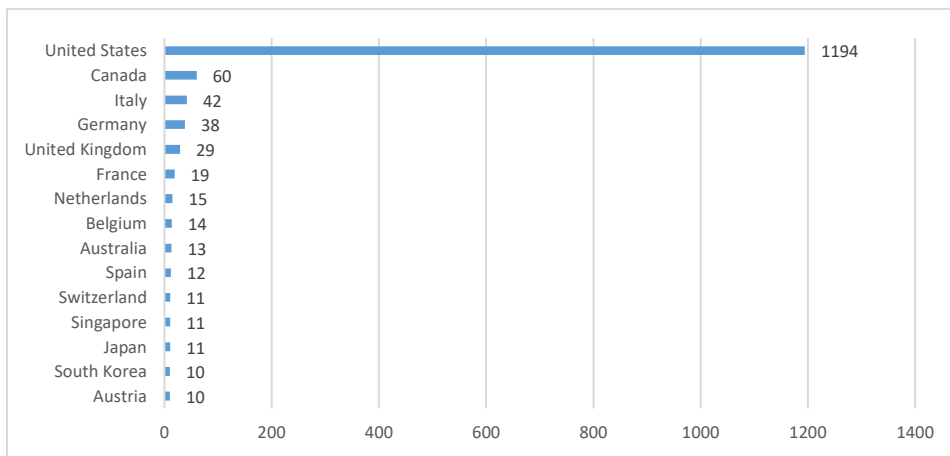
**Figure-1; Distribution of documents and number of citations by year**



**Table-2; Top-10 most contributing institutions in RCNA (2000-2019)**

Rank	Contributing institutions	Documents
1.	Harvard Medical School	123
2.	Massachusetts General Hospital	72
3.	University of California, San Francisco	48
4.	Children's Hospital Boston	41
5.	Brigham and Women's Hospital	40
6.	Memorial Sloan-Kettering Cancer Center	38
7.	University of Texas MD Anderson Cancer Center	36
8.	Mayo Clinic	35
9.	Hospital of the University of Pennsylvania	35
10.	Weill Cornell Medicine	31

**Figure-2; Distribution of papers by contributing countries**



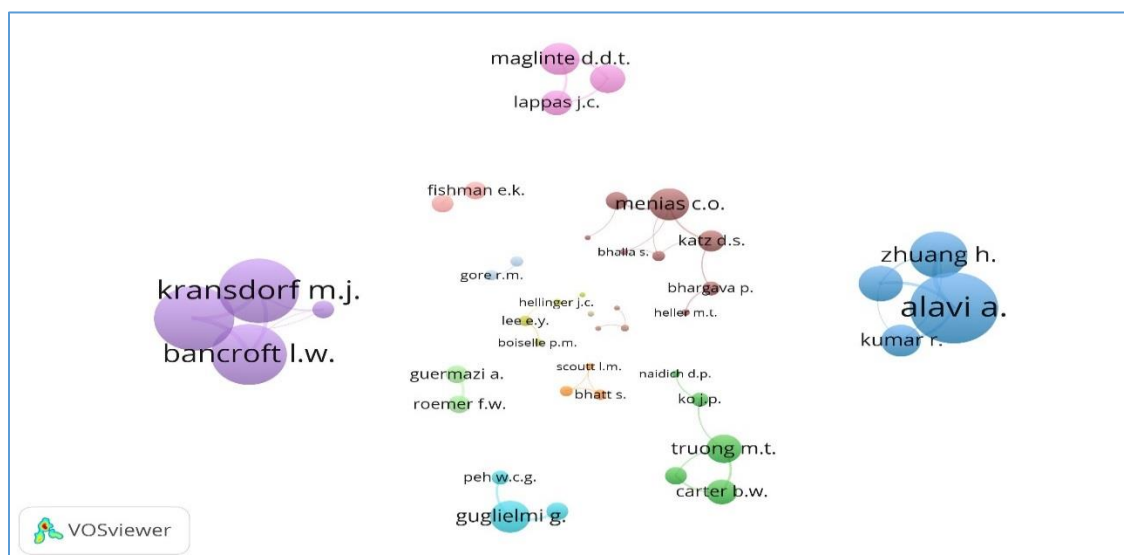


The data about the productive authors has been limited to 159 authors who contributed papers ranges from 3 to 26. Table-3 demonstrates the names, affiliation and number of papers of the 10 most productive authors. Except, Guglielmi, G., all top authors belong to United States. Lee, E. Y. of Harvard Medical School, found a most prolific author with 26 papers, followed by Alavi, A. of Hospital of the University of Pennsylvania, with 21 papers. The VOSviewer Software identified the 2,678 authors, and 55 authors collaborated with each other consisted of 24 clusters (Figure-3).

**Table-3; Top-10 most productive authors in RCNA (2000-2019)**

S. No.	Author	Affiliation	Documents
1.	Lee, E.Y.	Harvard Medical School, USA	26
2.	Alavi, A.	Hospital of University of Pennsylvania, USA	21
3.	Guglielmi, G.	Università degli Studi di Foggia, Italy	17
4.	Bancroft, L.W.	University of Virginia, USA	12
5.	Fishman, E.K.	Johns Hopkins Hospital, USA	12
6.	Menias, C.O.	Mayo Clinic, Scottsdale, AZ, USA	12
7.	Peterson, J.J.	Mayo Clinic Florida, USA	12
8.	Kransdorf, M.J.	Mayo Clinic, Phoenix, AZ, USA	10
9.	Miller, F.H.	Northwestern University Chicago, USA	10
10.	Sahani, D.V.	University of Washington, USA	9

**Figure-3; Eight clusters of authors contributed in RCNA**



A total of 3,813 authors include multiple counts contributed in 1400 articles with an average of 2.72 authors per article, one review paper has been published without the name of authors. The majority of the papers (n=1102; 79%) have been written by collaborative efforts, while 21% (n=298) of the papers were written by a single author. More than one-third (n=480; 34.26%) of the papers were contributed by the two-author pattern and this pattern was found as a most preferred authorship pattern. There were 92 papers with more than five-author collaboration, and these papers received the highest citations impact, 29.11 citations per paper, followed by a single-author pattern, received 27.83 citations per paper. Overall there is a strong correlation (0.985332)

that has been prevailed, as the number of authors increased, similarly the number of citations has also expanded (Table-4).

**Table-4; Comparison of authorship pattern and impact of citations**

Authorship Pattern	Number of Articles (%)	Citations	ACPP
Single-author	298 (21.27%)	8,292	27.83
Two-author	480 (34.26%)	11,416	23.78
Three-author	298 (21.27%)	6,494	21.79
Four-author	152 (10.85%)	3,329	21.90
Five-author	80 (5.71%)	1,889	23.61
Six and Above	92 (6.57%)	2,678	29.11

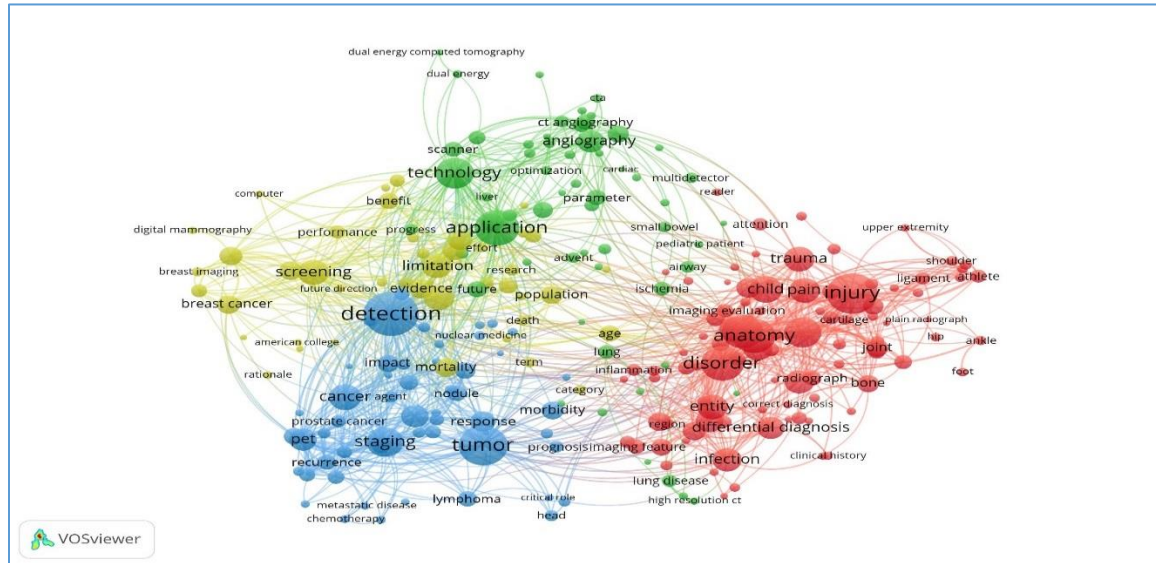
Table-5 presents the list of 10 most-cited papers. These papers received 2,612 citations with an average of 261.2 citations per paper. The list consisted of six review papers and four articles published from the year 2000 to 2009. Four papers were published in the year 2000, one each in 2002 & 2008 and two each in the years 2004 & 2009. The highly-cited paper, “Strategies for reducing radiation dose in CT” published in 2009 and received 511 citations with an average of 42.58 citations per year. A total of 37 authors contributed to the most-cited paper two papers contributed by single-author while eight papers were the result of collaborative research.

**Table-5; Top-10 most-cited papers of RCNA from 2000-2019 (TC=Total Citations)**

S.No.	Description of paper	Type	TC
1.	McCullough, C. H., Primak, A. N., Braun, N., Kofler, J., Yu, L., & Christner, J. (2009). Strategies for reducing radiation dose in CT. 47(1), 27-40.	Review	511
2.	Tabár, L., Vitak, B., Chen, H. H., Duffy, S. W., Yen, M. F., Chiang, C. F., ... & Smith, R. A. (2000). The Swedish Two-County Trial twenty years later: updated mortality results and new insights from long-term follow-up. 38(4), 625-651.	Article	397
3.	Felson, D. T. (2004). An update on the pathogenesis and epidemiology of osteoarthritis. 42(1), 1-9.	Review	380
4.	Smith, R. A., Duffy, S. W., Gabe, R., Tabar, L., Yen, A. M., & Chen, T. H. (2004). The randomized trials of breast cancer screening: what have we learned?. 42(5), 793-806.	Review	263
5.	Liberman, L. (2000). Clinical management issues in percutaneous core breast biopsy. 38(4), 791-807.	Article	228
6.	Liberman, L., & Menell, J. H. (2002). Breast imaging reporting and data system (BI-RADS). 40(3), 409-430.	Review	182
7.	Kyle, K. Y., & Hricak, H. (2000). Imaging prostate cancer. 38(1), 59-85.	Article	179
8.	Kurhanewicz, J., Vigneron, D. B., Males, R. G., Swanson, M. G., Kyle, K. Y., & Hricak, H. (2000). The prostate: MR imaging and spectroscopy: present and future. 38(1), 115-138.	Article	163
9.	Kambadakone, A. R., & Sahani, D. V. (2009). Body perfusion CT: technique, clinical applications, and advances. 47(1), 161-178.	Review	156
10.	Legiehn, G. M., & Heran, M. K. (2008). Venous malformations: classification, development, diagnosis, and interventional radiologic management. 46(3), 545-597.	Review	153

Amongst the frequently used keywords, the word “Human” comes the maximum 1,319 times, followed by Nuclear Magnetic Resonance Imaging (n=757), Diagnostic Imaging (n=701), Computer Assisted Tomography (n=653), Magnetic Resonance Imaging (n=464), and Tomography, X-Ray Computed (n=441). There are forty keywords used more than 100 times each. The VOSviewer software has been used to find out the co-occurrence of frequently used keywords. (Figure-4)

**Figure-4; Co-occurrence of keywords generated by VOSviewer software**



The examination of the citations (n=34,145) received by 1401 papers of RCNA (2000-2019), further exposed the flow of knowledge from RCNA to the other world. There are 36 journals cited more than 100 times and the researchers affiliated to 142 countries cited the papers published in RCNA during the targeted period. The papers published in RCNA have been more frequently cited by the *American Journal of Roentgenology* (n=761), followed by *Radiology* (n=448), *European Radiology* (n=421), *European Journal of Radiology* (n=387) and *Radiographics* (365). The authors who belonged to the United States have been mostly citing the literature of RCNA (n=11,988) followed by Italy (n=2,010), China (n=1,997), Germany (n=1,770), and United Kingdom (n=1,709) as shown in Table-3.

## DISCUSSION

*RCNA* is a celebrated journal in the field of radiology science, as its each number comprehensively covers the unique topic so every journal becomes a reference source of the specific category. A twenty-year dataset of *RCNA* was downloaded from the Scopus database. The study selected a sample of 1,401 citable documents to include articles and reviews. Although, the inconsistency was discovered in the number of papers per annum a mean ratio of 70 papers per annum was determined. The popularity of *RCNA* in the academic arena is reflected by the frequency of citations, a total of 34,145 citations with a mean of 27.37 citations/paper were received in the targeted period. Slightly less than half of the papers were published in the first decade (2000-2009) received 76% of the citations. This finding proves that the older documents got more citations as compared to the latest. The proportion of research articles was less than review articles, but the research articles received more attention from academics and scientists as per citations count is concerned. Conversely, a citation analysis on Saudi Medical Journal exposed that 7,483 documents gained 37,988 citations (5.07 cites/doc) from 1979 to 2018 and the

documents published before the year 2000 received less citations and maximum citations gained the documents published between 2000 to 2009. So we can say time and quality both are important factor for acquisition the citations (Tanveer, et al., 2020a).

**Table-6, Flow of knowledge (2000-2019)**

Journals that cited RCNA mostly	Citations	Radiologic Clinic of North America	Countries that cited RCNA mostly	Citations	
American Journal Of Roentgenology	761			United States	11,988
Radiology	448			Italy	2,010
European Radiology	421			China	1,997
European Journal Of Radiology	387			Germany	1,770
Radiographics	365			United Kingdom	1,709
Radiologic Clinics Of North America	350			Canada	1,196
Pediatric Radiology	221			South Korea	1,109
Clinical Radiology	216			France	1,095
Skeletal Radiology	216			Spain	906
Magnetic Resonance Imaging Clinics Of North America	195			Netherlands	792

The *RCNA* is publishing from the United States, and the dominance of the United States has been outclassed the rest of the world, amongst the ten most productive institutions, surprisingly all these institutions are geographically located in the United States, Harvard Medical School stand in forefront with more than 100 papers. The supremacy of indigenous researchers was confirmed that out of the 10 productive authors, nine were affiliated to the United States. The distribution of the papers by country shows that the majority (85%) of the total papers were contributed by the United States.

The majority of papers (79%) were the results of multi-author research while 21% of the papers were written by a single author. The ratio of a single author has been higher in article writing (35%) as compared to review (19%). The inspection of authorship pattern in *RCNA* exposed that the highest performance was shown by two-author pattern (n=480; 34.26%) and positive correlation was found in the number of authors and citation impact, papers produced by more than five authors collaboration received maximum citations and 10 most-cited papers received 2,612 citations. The analysis of the flow of knowledge from *RCNA* to the rest of the world has been based on the investigation of the citations received by 1,401 papers. More than one-third (35%) of the citations have been generated by indigenous researchers. The authors of radiology science affiliated with the United States are more inclined to cite the native literature. Similarly, the highest citations of *RCNA* were found in *American Journal of Roentgenology* (n=761) and *Radiology* (n=448), both journals are published in the United States.

Three bibliometric studies were found on the assessment of a single radiology journal. A study on the 500 articles of *European Radiology* published from 2015-2017, elucidated that open access articles have more citations as compared to subscription assess (Alkhawtani, Kwee & Kwee, 2020). Another paper provides the bibliometric snapshot of *Insights into Imaging*, 474 and 292 papers were indexed in the Scopus and ESCI respectively. The editorial board of the journals

contributed 47% of the papers and 9.06 citations per paper have been recorded in the Scopus (Valderrama-Zurián, Castelló-Cogollos, & Aleixandre-Benavent, 2019). The third study was conducted by Mattar, Tilson and Sayed (2013) on the 2,329 papers published in *Radiologic Technology* for 1963-2011, and the majority of papers (73%) were written as research articles. Conversely, our study on *RCNA* found that the share of research articles (11.42%) has been very small as compared to review articles (88.57).

Sekhani et al. (2017) carried out a study of six radiology journals, almost one-third of the total papers were published in *Radiology*, and the majority of research was produced by the authors geographically affiliated to North America. Snaith (2013) analyzed the four journals and stated that more than half of the papers were published in *radiography* and 36% were contributed by a single author. In our research, one-fifth of the papers were produced by a single author pattern. A study on MR radiology quantifying Spanish research on the PubMed database discovered that 32% of the selected articles were published in non-radiology journals (Miquel-Dasit, et al. 2008). These studies help to understand the historical progress in radiological sciences.

Five bibliometric studies elaborated on the various characteristics of most-cited papers on radiology and most of the highly cited papers were contributed by the United States. In Brinjikji et al., (2013), 46, out of 100 most-cited papers were written by the authors of the United States. This ratio was 61 in Pagni, et al., (2014) research and Yoon, et al., (2013) found the major share (57%) of American authors in 100 most-cited articles. In our study on *RCNA*, the United States outclassed the rest of the world.

## CONCLUSION

The dominance of the United States has been explicitly observed in the radiology science research through this bibliometric analysis. *RCNA* has a unique status, as its, each number exclusively dealt with a single and specific radiological category, so each copy is considered a useful reference source for a particular theme. The increasing number of citations has validated the prominent stature of the journal in the academic arena.

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