Bibliometric Analysis of Indian Journal of Nuclear Medicine (2014 - 2018)

P. Vijayakumar[1], G. Sivasubramaniyan[2] and M. Saraswati Rao[3]
[1&2]Assistant Librarian, [3]Professional Assistant
[1,2&3]Ananda Rangapillai Library, Pondicherry University, Puducherry, India
E-Mail: pvijai@gmail.com, sivas_prof_pu@yahoo.com, saraswati.manne@gmail.com

Abstract - **The study aims to analyze the published papers of the journal titled "Indian Journal of Nuclear Medicine" using various bibliometric parameters for the period from 2014 to 2018. The total number of documents was 513 downloaded from the Elsevier's Scopus bibliographic database. The analysis covers mainly annual growth of publication, citations, type of document, authorship pattern, the average number of references, top ten prolific authors/institutions, and keywords frequency, etc. The results reveal that an increasing trend has been found in the annual production of publications during the five years study period. The most productive year is 2017 with 114 (22.22%) and there is 4.93% of the average growth of publications identified. The highest citations is been received in the year 2014 with 195 (36.25%) and the majority of the researchers preferred document form has been articles with 400 (77.97%). The publications h-index value varies from 3-4 and the study also explains that "All India Institute of Medical Science (AIMS)" identified as the most productive institution with 79 (15.40%). Majority of the publications are 388 (75.63%) contributed by Indian authors followed by Turkey with 32 (6.24).**
Keywords: **Bibliometrics, Authorship Pattern, Scopus, Indian Journal of Nuclear Medicine**

I. INTRODUCTION

Bibliometrics is a systematic method of analysis used to quantitatively evaluate the research progress in various disciplines which based on published literature of an individual researcher, institutions, countries, and journals. Abdi *et al.,* (2018) stated that bibliometrics analysis are mainly applied to scientific fields based on different parameters of published papers like an author, subject, keywords, title and references etc. Application of this analysis has been seen in each and every walk of our social life i.e. to provide the toppers ranks and university rankings in the education sector and to identify eminent scientists or scholars in the field of science and technology. Bibliometrics is also considered as a standard tool to check the academic quality in terms of literature growth, authorship patterns, collaborations, and citations. These bibliometric tools have been effectively used not only in library and information profession but also used by most of the famous publishers in publication sector to provide the impact factor of journals, most cited papers, h-index, collaborations, etc. It also provides an idea to formulate a well-defined objective for doing high-quality research to find out which institutions or journals have high impact in the specific field of knowledge.

Nuclear medicine is a new branch of medicine which utilizes in radioactive substances in diagnosis, research and treatment and also important in the areas such as molecular imaging, cellular imaging, and tissue imaging.

Nuclear medicine is defined by Lioupis & Syrmos (2016) as: "the scientific and clinical discipline in which free radionuclide's and radionuclide compounds, redistributed in vivo or in vitro by physical or chemical mechanisms, are used for diagnostic, therapeutic or investigative purposes". Majority of the inventions are primarily published as a journal article. These journals are considered as a primary source of information to transmit knowledge for the development of research literature in any field of knowledge. Therefore, we have chosen this one of the prime journals in the nuclear medicine field titled 'Indian Journal of Nuclear Medicine' for this study.

Indian Journal of Nuclear Medicine (ISSN: Print -0972-3919, Online - 0974-0244) is the official publication of Society of Nuclear Medicine (SNM), India. The SNM, India was founded in 1967 with the main aim to promote help and encourage the development and advancement in the field of Nuclear Medicine as an area of specialization in India (http://snmindia.com/about_us/about-snmi.php). This is a quarterly journal which has recently completed its 33rd volume successfully in the year 2018 and articles are published under the terms and conditions of the Creative Commons Attribution License and the fields of study are "nuclear medicine, radiopharmaceutical chemistry, radiation biology, instrumentation physics and related fields including thyroidology" (http://www.ijnm.in/contributors.asp). It is being published uninterruptedly as well as its application of open access policy, journal ethics such as the "Committee on Publication Ethics" (COPE), "International Committee of Medical Journal Editors" (ICMJE) and "World Association of Medical Editors" (WAME), that set standards and provides guidelines for the best practices to select the manuscripts, and peer-reviewed process would be made and indexed in 9 databases such as EMBASE/ Excerpta Medica, Emerging Sources Citation Index, Indian Science Abstracts, IndMed, MedInd, PubMed Central, Scimago Journal Ranking, SCOPUS, Web of Science" (http://www.ijnm.in/aboutus.asp). Indexing the journal into one of these reputed databases will get high citations of the researches publication and it is also opened to a broad range of research community around the world. This study gives a broad overview of the journals from 2014 to 2018, a total of five year period, by application of the bibliometric tools to evaluate its performance.

II. LITERATURE REVIEW

Various studies were undertaken in the past and the results were also published dealing with the bibliometric analysis of journals, has been declared in the literature. Hosein & Abdiazar (2014) have identified the different bibliometric aspects of the global status of research in nuclear science & technology publications. They have selected a nuclear science related journal named "International Journal of Radiation Biology" for conducting study and data collected from the Web of Science bibliographic database during the years from 2001 to 2010. It was noticed that the USA acts as the central role in the collaboration network and Japanese researches had contributed more publications.

Singh (2012) has conducted a bibliometric analysis on LIBRI Journal for a period of 2001 to 2009. A total of 221 papers have been taken as a sample for study. The study shows the majority of the papers contributed by single authors and collaboration between authors are less. The analysis also stated that Indian researcher's contribution has been considerably less in foreign journals in the field of Library and Information Science. Garg (2014) has carried out an analysis of published articles in "Annals of Library and Information Studies (ALIS)" and "DESIDOC Journal of Library and Information Technology (DJLIT)" during 2010-2013. The study states that DJLIT published the number of papers and received more citations when compared to ALIS. The average citation per paper for two journals is almost the same. Vijayanathan (2014) has examined various parameters on published papers in the "Singapore Journal of Library and Information Management" between the years 2008-2012. The analysis is considered different aspects like distribution of articles, authorship patterns, the geographical distribution of papers and references. Majority of the contributors were from Singapore and an

average of 17 references have been given per paper. Around 48 per cent of papers published as journal articles and more than 65% of multi-authored publications identified during the study. Mamdapur *et al.,* (2019) have made an effort to analyze the "Journal of Horticultural Science and Biotechnology" by application of various bibliometric tools from 2007 to 2008. A total of 1059 research papers were published during the study period. Authorship patterns show 96.13% papers published with joint authors and the journals have got the highest references with 29,407 (87.64%) are the extremely utilized resources. Other studies on different journals have also been taken up by various authors however, none on Indian Journal of Nuclear Medicine.

III. OBJECTIVES OF THE STUDY

1. To examine year wise distribution of papers and citations
2. To show types of documents published
3. To examine year wise authorship pattern of papers
4. To examine the most prolific contributions of papers
5. To examine institution-wise distribution of papers
6. To show the most productive countries
7. To identify the most frequently occurred keywords

IV. MATERIALS AND METHODS

Data were extracted for a period of five years 2014 to 2018 from the Elsevier's Scopus bibliographic database. The basic search strategy was used for the collection of bibliographic details of the data as follows: "source title" = "Indian Journal of Nuclear Medicine" and "ISSN" = "0972-3919". A total of 513 records were downloaded in RIS and CSV file formats and exported into Bibexcel, Microsoft-Excel and VOS viewer software for analysis of data.

V. DATA ANALYSIS AND INTERPRETATION

TABLE I YEAR-WISE DISTRIBUTION OF PAPERS AND CITATIONS

Year	No. of Publications	Percentage	Growth Rate	Average Growth Rate %	Citation	Percentage	Average Citation Per Paper
2014	89	17.35	0	0	195	36.25	2.19
2015	99	19.30	10	11.24	170	31.60	1.72
2016	99	19.30	0	0	92	17.10	0.93
2017	114	22.22	15	15.15	64	11.90	0.56
2018	112	21.83	-2	-1.75	17	3.16	0.15
Total	513	100.00	23	24.63 (Avg. 4.93)	538	100	1.05

A. Year Wise Distribution of Publications

Table I how the number of published papers during the five years amounts to 513 in total. The year wise productivity, the published papers indicate that 2017 was the most productive year with 114 (22.22%) publications followed by 2018 with 112 (21.83%) publications, 2015 & 2016 with 99 (19.30%), 2014 with 89 (17.35%) publications and negative growth rate identified in the

year 2018. The analysis explains that there is 4.93% of the average growth of publications identified.

The published literature increased progressively year by year except in 2018. The highest citations received in the year 2014 with 195 (36.25%) followed by 170 (31.60%) in 2015 with and an average of 1.05% citations received per paper overall.
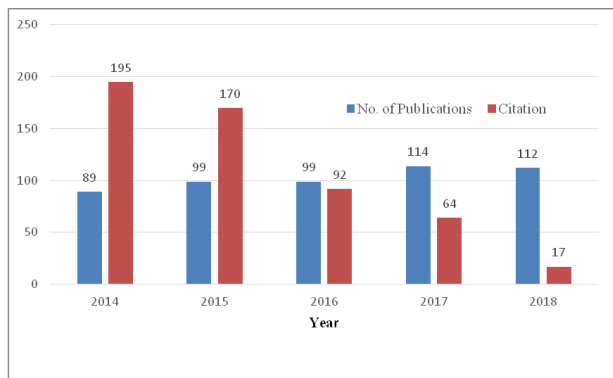
Fig. 1 Year-wise distribution of papers and citations

B. Year Wise Distribution of Document Types

Table II reveals the different forms of documents published in the "Indian Journal of Nuclear Medicine"

journal between the years 2014 and 2018. Majority of the researches preferred document type of the publication were articles (400, 77.97%) followed by Letter (55, 10.72%), Review (40, 7.80%), Editorial (9, 1.75%), Note (5, 0.97%) and Erratum (4, 0.78%).

TABLE II YEAR WISE DISTRIBUTION OF DOCUMENT TYPES

Document Type	2014	2015	2016	2017	2018	Total	Percentage
Article	67	83	67	93	90	400	77.97
Editorial	2	2	-	1	4	9	1.75
Erratum	-	-	2	-	2	4	0.78
Letter	14	6	11	14	10	55	10.72
Note	1	-	3	-	1	5	0.97
Review	5	8	16	6	5	40	7.80
Total	89	99	99	114	112	513	100

TABLE III YEAR-WISE AUTHORSHIP PATTERNS

Authors	2014	2015	2016	2017	2018	No. of Publications	Percentage	Total Authors
1	6	9	8	7	18	48	9.36	48
2	7	8	5	11	12	43	8.38	86
3	9	12	8	19	12	60	11.70	180
4	18	29	30	22	20	119	23.20	476
5	25	16	24	21	19	105	20.47	525
6	14	17	17	15	12	75	14.62	450
7	7	5	-	7	7	26	5.07	182
8	3	2	4	8	6	23	4.48	184
9	-	1	1	3	1	6	1.17	54
10 and above	-	-	2	1	5	8	0.97	80
Total Papers	89	99	99	114	112	513	100	-
Total Authors	401	419	445	519	481	-	-	2265
Average authors per papers	4.51	4.23	4.49	4.55	4.29	4.42 (=2265/513)	-	-
Single %	6.74	9.09	8.08	6.14	16.07	9.36	-	-
Joint %	93.26	90.91	91.92	93.86	83.93	90.64	-	-

C. Authorship Pattern of Papers

The year-wise authorship pattern has been calculated to find out the percentage of single, two, three and multiple authorship publications. As shown in table III and figure. 2, our study consists of 2265 authors in 513 research publications.
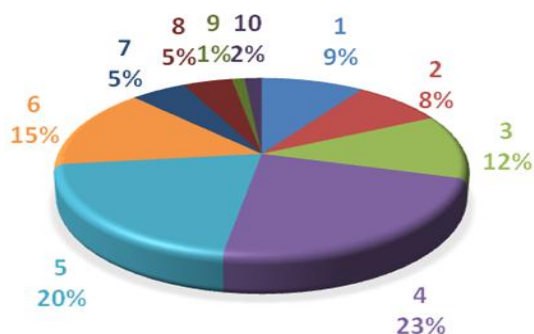

Fig. 2 Pie Diagram of Distribution of Authorship Patterns

The study exposes that during 2014 to 2018 the highest percentage of published papers are by multi-authors that too, four authors papers with 119 (23.20%), followed by papers with five authors 105 (20.47%), six authors 75 (14.62%). It means out of a total 513 publications 465 (90.64%) multi-authored publications and remaining 48 (9.36%) are single author contribution. It indicates that maximum works in this journal were in joint author works and four, five and six author's publication considerably more in numbers. This analysis represents single-authored publications gradually reduced and multi-authored publications progressively increased; it determines collaboration between the researches, and team-work. There by sharing of information has been increased more and more during 2014 and 2018. The average number of authors per paper is 4.42%, i.e. 2265 authors have written 513 papers.

Table IV is listed out top ten most productive authors out of a total of 2265 authors which is based on the number of

publications they have produced during the years 2014-2018. The study reveals that Bal. C who is the most productive author contributed the number of papers and received high citations (44 papers; 66 citations, 4 h-index) followed by M. Tripathi (32 papers; 31 citations, 3 h-index). The second highest citations are received by R. Kumar (31 papers; 61 citations; 4 h-index). The research

publications h-index values are varied from 3-4 for top ten authors and five authors (C. Bal, R. Kumar, B.R. Mittal, A. Bhattacharya, and P. Sharma) which is received the highest h-index: 4. The rest of the five authors have got the h-index: 3. The analysis also shows that the top three authors are from AIMS, New Delhi.

TABLE IV TOP TEN PROLIFIC AUTHORS WITH NUMBER OF PAPERS

Authors	Affiliation	No. of Publications	Percentage of Publications	Total Citations	Average Citations Per Item	h index
Bal, C.	All India Institute of Medical Sciences (AIMS), New Delhi	44	8.58	66	1.50	4
Tripathi, M.	AIMS, New Delhi	32	6.24	31	0.97	3
Kumar, R.	AIMS, New Delhi	31	6.04	61	1.97	4
Rangarajan, V.	Tata Memorial Hospital (TMH),	31	6.04	36	1.16	3
Shah, S.	TMH, Mumbai	30	5.85	36	1.20	3
Agrawal, A.	TMH, Mumbai	29	5.65	36	1.24	3
Mittal, B.R.	Postgraduate Institute of Medical Education and Research (PIMER), Chandigarh	27	5.26	30	1.11	4
Purandare, N.	Homi Bhabha National Institute, Mumbai	26	5.07	33	1.27	3
Bhattacharya, A.	PIMER, Chandigarh	25	4.87	44	1.76	4
Sharma, P.	Shri Guru Tegh Bahadur Khalsa College, New Delhi	20	3.90	51	2.55	4

TABLE V THE TOP TEN PROLIFIC INSTITUTIONS WITH NUMBER OF PAPERS

S. No.	Name of the Institution	No. of Publications	Percentage
1	All India Institute of Medical Sciences, New Delhi	79	15.40
2	Postgraduate Institute of Medical Education and Research, Chandigarh	48	9.36
3	Tata Memorial Hospital, Mumbai	42	8.19
4	Bhabha Atomic Research Centre, Maharashtra	14	2.73
5	Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow	11	2.14
6	Amrita Institute of Medical Sciences India, Kochi	10	1.95
7	Cancer Institute India, Chennai	10	1.95
8	Kovai Medical Center and Hospital, Coimbatore	9	1.75
9	Institute of Nuclear Medicine and Allied Sciences India, New Delhi	8	1.56
10	Sher-I-Kashmir Institute of Medical Sciences, Srinagar	8	1.56

Researches from a different organization like government institutions, research and development institutions, etc. are published their research publications in "Indian Journal of Nuclear Medicine".

Table V is listed out an author affiliation of the number of research published in the top ten institutions were taken for dialogue. The study explain that the most productive institutions identified with highest number of the publications are from "All India Institute of Medical Science" 79 (15.40%) located at New Delhi, followed by "Postgraduate Institute of Medical Education and Research", located at Chandigarh has contributed that is 48 (9.36%), Tata Memorial Hospital located in Mumbai has 42 papers (8.19%) and rest of the 7 institutions are produced research publication in the range between 14-8. The top ten institutions contributed 239 papers (46.58%)

which are almost half of the total research output of the journal.

This table also provides distribution of nuclear medicine associated publications, a total of ten institutions which are from India.

D. Geographical Distribution of Papers

Table VI shows the countries share of top ten published output of the journal "Indian Journal of Nuclear Medicine". Majority of the publications 388 (75.63%) has been produced by Indian authors followed by Turkey with 32 (6.24) and the United States has 22 (4.29%). The rest of the seven countries has contributions range from 15 – 4 publications respectively.

TABLE VI THE TOP TEN COUNTRIES WITH NUMBER OF PAPERS

S. No.	Country	No. of Publications	Percentage
1	India	388	75.63
2	Turkey	32	6.24
3	United States	22	4.29
4	Iran	15	2.92
5	United Kingdom	8	1.56
6	Italy	6	1.17
7	Egypt	5	0.97
8	Saudi Arabia	5	0.97
9	Spain	5	0.97
10	Kuwait	4	0.78

TABLE VII THE 10 TOP KEYWORDS WITH NUMBER OF PAPERS

S. No.	Keyword	No. of Papers	Percentage
1	Human	434	84.60
2	Article	353	68.81
3	Case Report	322	62.77
4	Adult	283	55.17
5	Male	231	45.03
6	Female	194	37.82
7	Fluorodeoxyglucose F 18	179	34.89
8	Computer Assisted Emission Tomography	144	28.07
9	Middle Aged	138	26.90
10	Human Tissue	117	22.81

E. Frequency of Keywords

Table VII shows the top ten keywords used in the research publications of the journal "Indian Journal of Nuclear Medicine" during the period of study from 2014-2018. The high-frequented keywords are "Human" which is topped with 434 (84.60%) publications followed by "article" has scored 353 publications. Keywords play a crucial role in the literature search. If we are providing the right keywords to the document only then, it will bring up the appropriate publications from a huge collection of documents. Keyword acts as 'key' to open your research paper able to search globally through online.
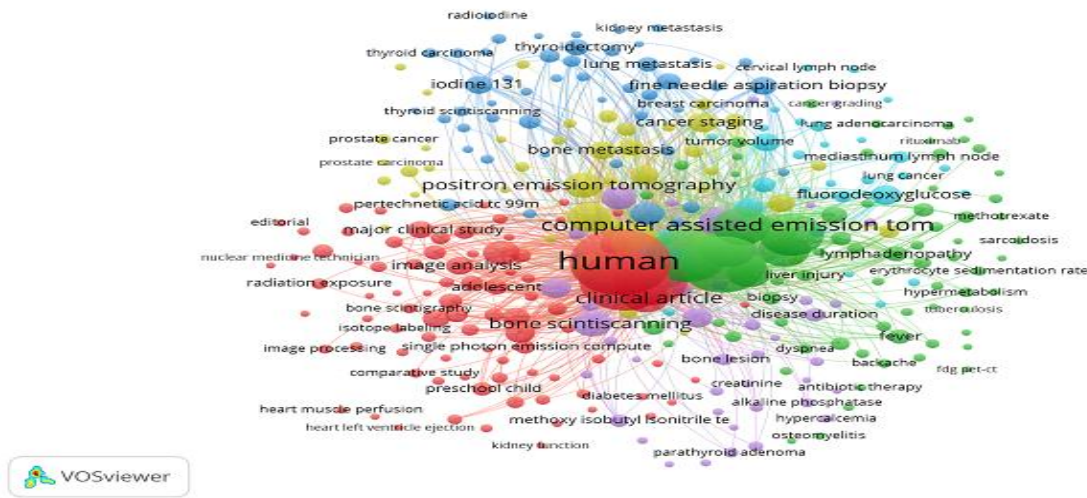

Fig. 3 Geographical distribution of papers

Fig. 4 Vos Viewer mapping of most frequent author keywords

TABLE VIII YEAR WISE DISTRIBUTION OF REFERENCES

S. No.	Year	Publications	Reference	Percentage
1	2014	89	1139	17.82
2	2015	99	1400	21.91
3	2016	99	1196	18.71
4	2017	114	1390	21.75
5	2018	112	1266	19.81
6	Grand Total	513	6391	100.00

F. Year Wise Distribution of References

Table VIII presents the information regarding the references providing at the end of the published papers in the "Indian Journal of Nuclear Medicine" journal during the study period from 2014 to 2018. A total of 6,391 references found in this five years period for 513 publications and average references per paper have been 12.45%. The highest number of references were appeared in the year 2015 with 1400 (21.91%) and followed by the year 2017 with 1390 (21.75%) and references average has been improved progressively from 2014 to 2018. It

indicates researchers are critically assessing the other published literature in the related field and provided the number of references for better understanding of their scholarly works.

VI. CONCLUSION

The study based on five years (2014 – 2018) research output of the "Indian Journal of Nuclear Medicine" and a total of 513 papers published. It is found that the most productive year was 2017 with 114 (22.22%) publications and there is 4.93% of the average growth of publications identified. The highest citations received in the year 2014 with 195 (36.25%). Majority of the researches preferred document type of the publication were articles with 400 (77.97%). The study reveals that Bal. C is most productive author contributed the highest number of papers and received high citations also (44 papers; 66 citations, 4 h-index). The publications h-index value varies from 3-4.

The study explains that "All India Institute of Medical Science (AIMS)" identified as the most productive institution with 79 (15.40%) and also shown that top three authors are from AIMS, New Delhi. The top ten prolific institutions contributed 239 papers (46.58%), which is almost half of the total research output of the journal and AIMS, New Delhi Tata Memorial Hospital, Mumbai and Postgraduate Institute of Medical Education and Research, Chandigarh has been played a vital role in the field of nuclear medicine through contributing highest share of research literature. This journal basically from India, so the majority of the publications 388 (75.63%) are contributed by Indian authors followed by Turkey with 32 (6.24). The high-frequency keyword was

"Human" which is topped with 434 (84.60%) and a total of 6,391 references found for 513 publications in this five years period of study with an average of 12.45% per paper.

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