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SCIENTOMETRIC ANALYSIS OF NEPHROLOGY RESEARCH IN INDIA: INSIGHTS FROM THE WEB OF SCIENCE DATABASE (1994–2023)

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ABSTRACT

The present study focuses on the research output performance on nephrology in India from 1994 to 2023 (30 years), using the Web of Science (WoS) database. The study depicts nephrology with special reference to Indian researchers achieving unanticipated milestones through significant contributions to the discipline while enhancing their prominence across the global research community. It also provides a comparative evaluation and performance of various scientometric indices, including the growth, global publications share, Contribution of major productive organizations & countries, contribution of different subject fields, Relative Growth Rate (RGR), Doubling Time (Dt.), Activity Index (AI), Publication Efficiency Index (PEI), Annual Growth Rate (AGR), Annual Ratio of Growth (ARoG), Compound Annual Growth Rate (CAGR), and collaboration from India and also attempt to explore the global trends in nephrology from different dimensions.

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INTRODUCTION

Nephrology, the medical specialty concerned with kidney function and diseases, has emerged as a critical field of study in response to the increasing global burden of Chronic Kidney Disease (CKD). CKD is now recognized as a significant public health concern, with the Global Burden of Disease Study (2020) identifying it as one of the leading contributors to morbidity and mortality worldwide. The disease is characterized by a progressive loss of kidney function, and its global rise is attributed to lifestyle factors, aging populations, and comorbid conditions such as diabetes and hypertension. In the Indian context, the prevalence of CKD has seen a marked escalation over the past decade. Several interrelated factors, most notably the rapid increase in non-communicable diseases like diabetes and hypertension, limited public awareness, insufficient early detection mechanisms, and inequities in healthcare access, have contributed to this surge (Anand et al., 2021). As a result, CKD now poses a major challenge to India's healthcare system, making nephrology research not only scientifically significant but also socially and economically imperative. Mapping and evaluating India's contributions to nephrology research can provide valuable insights into how the country addresses this health crisis. The scientometric analysis offers a robust, data-driven approach to assessing research performance by analyzing publication output, citation frequency, authorship trends,

and collaboration patterns (Velmurugan, 2017). Such studies make it possible to evaluate research growth, impact, and direction at national and institutional levels. Previous scientometric studies on Indian medical research in domains such as genetics (Nair & Raja, 2018), leishmaniasis (Ram, 2018), ophthalmology (Rezaei & Mohammad, 2018), lung cancer (Ramakrishnan et al., 2019), and orthopedics (Vaish et al., 2023) reveal a consistent upward trend in publication volumes. These studies also highlight persistent challenges, including limited international collaboration, underrepresentation in high-impact journals, and variations in research quality. Globally, the field of nephrology has also witnessed a surge in research output. For example, He et al. (2022) reported substantial growth in nephrotoxicity-related publications between 2011 and 2021, with contributions from 123 countries and an average annual publication rate exceeding 849 papers. Similarly, Zhou et al. (2022) emphasized the expanding research volume addressing antimicrobial resistance in nephrology-related areas. These studies underscore the importance of high-quality, collaborative, and policy-relevant research in combating renal health issues. Despite the upward trajectory, India's share in global nephrology research remains relatively modest compared to leading nations like the USA and China. This study aims to fill this gap by providing a comprehensive scientometric analysis of India's research contributions in nephrology. This study offers a nuanced understanding of India's position in the global nephrology research landscape by systematically examining publication trends, citation

impact, collaborative networks, and subject-wise research focus. Furthermore, the findings are intended to guide policymakers, research institutions, funding bodies, and individual scholars in identifying strategic areas for investment and improvement. Ultimately, enhancing India's research visibility and influence in nephrology is a scientific goal and a crucial step toward addressing the country's growing kidney health crisis.

METHODS AND MATERIALS

This study employs a scientometric approach to analyze the growth, impact, and collaboration patterns in nephrology research in India from 1994 to 2023. The Web of Science (WoS) database was the primary data source. A systematic search was conducted to identify relevant publications, ensuring that only research explicitly related to nephrology and affiliated with Indian institutions was included. A structured search query was formulated using Boolean operators to retrieve relevant data. The keywords used in the search included “Nephrology,” “Renal Disease,” and “Kidney Disorders,” with the geographical filter set to “India” under the affiliation field. The study considered articles, reviews, and conference proceedings indexed in the Science Citation Index Expanded (SCIE) and Emerging Sources Citation Index (ESCI). The time frame for data collection was set from 1994 to 2023, capturing nearly three decades of nephrology research output.

other databases such as Scopus and PubMed. Additionally, only English-language publications were considered, potentially overlooking significant research published in regional or non-English journals. However, these constraints do not diminish the study's significance, as it provides a robust and data-driven assessment of India's nephrology research landscape over the past three decades.

RESULTS AND DISCUSSION

Growth of Publications of the World & India in Nephrology Research in India: Table1 depicts the nephrology research output of the World and India, along with India's global publications share. India has produced 7,614 publications from 1994 to 2023. As per the Web of Science data, cumulative publications growth, the cumulative Nephrology research publications output of India had increased from 337 publications during 1994-1998 to 477 publications during 1999-2003, 1100 publications during 2004-2008, 1657 publications during 2009-2013, 1561 publications during 2014-2018 and 2482 publications during 2019-2023. The quantity of publications in India is gradually increasing year by year. The global publications share of India during 1994-2023 was 1.33 %, which has increased from 0.77% in 1994 to 2.25% in 2023. This analysis proves an increasing trend in Indian nephrology research. The global research output in nephrology research has increased from 57,967 in 1994 to 1998 to 1,29,295 in 2019-2023.

Table 1. Growth of publications of the world & India in nephrology research in India

Year	World (TP)	%	India (TP)	%	% Indian TP Share
1994	10643	1.86	82	1.08	0.77
1995	11947	2.08	70	0.92	0.59
1996	12490	2.18	53	0.70	0.42
1997	12574	2.19	65	0.85	0.52
1998	10313	1.80	67	0.88	0.65
1999	9805	1.71	87	1.14	0.89
2000	9225	1.61	73	0.96	0.79
2001	9773	1.70	97	1.27	0.99
2002	15026	2.62	102	1.34	0.68
2003	16211	2.83	118	1.55	0.73
2004	13903	2.42	124	1.63	0.89
2005	17829	3.11	216	2.84	1.21
2006	19044	3.32	268	3.52	1.41
2007	20908	3.64	248	3.26	1.19
2008	19573	3.41	244	3.20	1.25
2009	22201	3.87	247	3.24	1.11
2010	23677	4.13	332	4.36	1.40
2011	22424	3.91	297	3.90	1.32
2012	26418	4.60	369	4.85	1.40
2013	22858	3.98	412	5.41	1.80
2014	23157	4.04	353	4.64	1.52
2015	22780	3.97	309	4.06	1.36
2016	22711	3.96	324	4.26	1.43
2017	24854	4.33	281	3.69	1.13
2018	24082	4.20	294	3.86	1.22
2019	24040	4.19	361	4.74	1.50
2020	26047	4.54	494	6.49	1.90
2021	27937	4.87	523	6.87	1.87
2022	27436	4.78	567	7.45	2.07
2023	23835	4.15	537	7.05	2.25
1994-1998	57967	10.10	337	4.43	0.58
1999-2003	60040	10.47	477	6.26	0.79
2004-2008	91257	15.91	1100	14.45	1.21
2009-2013	117578	20.49	1657	21.76	1.41
2014-2018	117584	20.49	1561	20.50	1.33
2019-2023	129295	22.54	2482	32.60	1.92
Total	573721	100	7614	100	1.33

This search criteria yielded 7,614 publications. The Annual Growth Rate (AGR), Annual Ratio of Growth (ARoG), Publication Efficiency Index (PEI), and Activity Index (AI) have been calculated. Later, the data were analyzed to determine the objectives of the study. The bibliometric analysis was performed in Microsoft Excel and SPSS packages. The study is limited to publications indexed in the WoS database, which may exclude relevant nephrology research indexed in

The trend shows a steady and significant increase in publications. In the same manner, the Indian research output in nephrology has increased from 337 in 1994 to 1998 to 2,482 by 2019-2023.

The trend depicts the increasing steepness, reflecting that research output is growing faster than globally.

Relative Growth Rate and Doubling Time

Relative Growth Rate (GR) is the increase in the number of publications per unit time. The formula for calculating the mean R

$$R = \frac{W_2 - W_1}{T_2 - T_1} \text{ Where}$$

R = mean relative growth rate over the specific period of intervals;

W1 = number of publications;

W2 = number of publications;

T2–T1 = the unit difference between the initial and final time

This formula even holds good for the calculation of RGR subject-wise

Doubling Time (Dt): The doubling time is the period required for a quantity to double in size or value. This can be calculated by using the formula.

$$\text{Doubling time } Dt = 0.693/R$$

Here, Dt (P) = average doubling time of publications

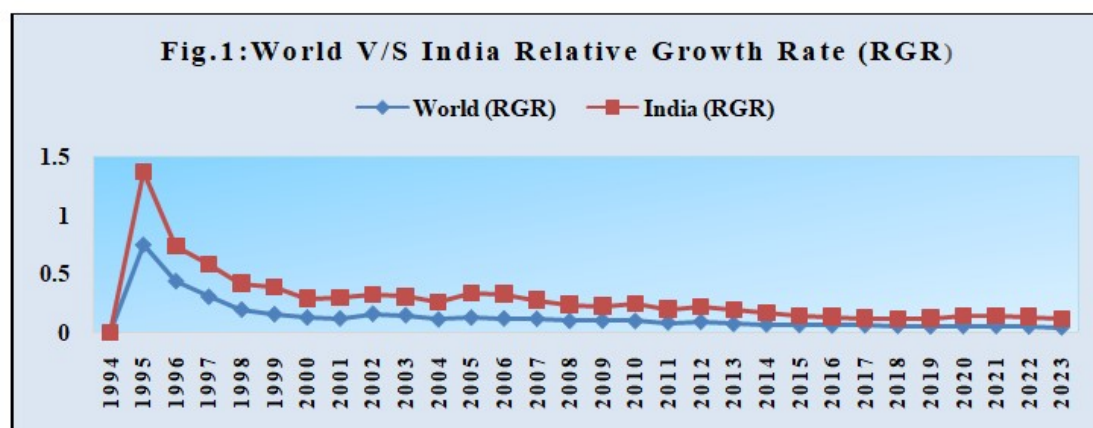
Table 2 reveals the total research output, growth rate, and doubling time of the world and India (thirty years). The table shows that the relative growth rate of world output decreases gradually from 0.75 to 0.04 over thirty years (1994-2023). The doubling time (Dt) increases from 0.92 to 16.33. The mean growth rate and doubling time for the world are 0.14 and 7.86, respectively. Indian output, as shown in Table 2, also decreases gradually from 0.62 to 0.07 during the period (1994-2023). The growth of significant scientific institutions, which led to increased scientific research, might cause this increase. Correspondingly, the doubling time increases from 1.12 to 9.48 in the same period. The mean growth rate and doubling time for Indian output are 0.16 and 5.92, respectively.

World Output Vs. Indian Output: Table 3 indicates the total publications of 7,614 by Indian scientists in nephrology between 1994 and 2023. The total publication output constituted about 1.33% of the global production. Here, the activity index (AI), suggested by frame and elaborated by Schubert, Braun, Garg, and Nagpaul, has been used to compare India's research performance. Activity Index (AI) for India has been calculated for different years to see how India's performance has gradually changed.

Table 2. World v/s india relative growth rate (rgr) and doubling time (dt.)

Year	World (TP)	India (TP)	World (RGR)	World (Dt.)	India (RGR)	India (Dt.)
1994	10643	82				
1995	11947	70	0.75	0.92	0.62	1.12
1996	12490	53	0.44	1.57	0.30	2.32
1997	12574	65	0.31	2.26	0.28	2.52
1998	10313	67	0.20	3.54	0.22	3.13
1999	9805	87	0.16	4.43	0.23	3.02
2000	9225	73	0.13	5.43	0.16	4.36
2001	9773	97	0.12	5.80	0.18	3.89
2002	15026	102	0.16	4.34	0.16	4.37
2003	16211	118	0.15	4.69	0.16	4.42
2004	13903	124	0.11	6.22	0.14	4.89
2005	17829	216	0.13	5.47	0.21	3.34
2006	19044	268	0.12	5.79	0.21	3.32
2007	20908	248	0.12	5.93	0.16	4.31
2008	19573	244	0.10	7.06	0.14	5.08
2009	22201	247	0.10	6.87	0.12	5.71
2010	23677	332	0.10	7.12	0.14	4.85
2011	22424	297	0.08	8.23	0.11	6.16
2012	26418	369	0.09	7.62	0.12	5.58
2013	22858	412	0.07	9.56	0.12	5.65
2014	23157	353	0.07	10.12	0.09	7.35
2015	22780	309	0.06	10.99	0.08	9.14
2016	22711	324	0.06	11.72	0.07	9.40
2017	24854	281	0.06	11.37	0.06	11.58
2018	24082	294	0.06	12.44	0.06	11.75
2019	24040	361	0.05	13.15	0.07	10.19
2020	26047	494	0.05	12.81	0.09	8.05
2021	27937	523	0.05	12.61	0.08	8.27
2022	27436	567	0.05	13.54	0.08	8.30
2023	23835	537	0.04	16.33	0.07	9.48
Total	573721	7614				
Mean Value			0.14	7.86	0.16	5.92

TP=Total Publications, RGR=Relative Growth Rate, Dt.= Doubling Time



For this, the author has used the Activity Index for thirty years. The Activity Index (AI) characterizes the relative research effort of a country in given subjects. It is defined as:



2011	22424	297	99.80
2012	26418	369	105.25
2013	22858	412	135.81
2014	23157	353	114.86
2015	22780	309	102.21
2016	22711	324	107.50
2017	24854	281	85.19
2018	24082	294	91.99
2019	24040	361	113.15
2020	26047	494	142.91
2021	27937	523	141.06
2022	27436	567	155.72
2023	23835	537	169.76
Total	573721	7614	Average AI (91.06)

TP=Total Publications, AI=Activity Index

Most Productive Countries in Nephrology Research in the World: Table 4 analyses the global nephrology in the most productive Countries from 1994 to 2023. The USA has contributed the highest number of publications, i.e., 170390 (29.70%), followed by Germany, which ranked second with 39665 (6.91%) publications, England ranked third with 35376 (6.17%) publications, Japan with 33222 (5.79%) and Italy with 31017 (5.58%) publications ranked fourth and fifth respectively followed by other countries.

Table 4. Most productive countries in nephrology research in the world

Sl. No.	Country	TP	TP%	Cum.Pub.	Cum.Pub.%
1	USA	170390	29.70	170390	29.70
2	Germany	39665	6.91	210055	36.61
3	England	35376	6.17	245431	42.78
4	Japan	33222	5.79	278653	48.57
5	Italy	32017	5.58	310670	54.15
6	France	25349	4.42	336019	58.57
7	Peoples R China	24520	4.27	360539	62.84
8	Canada	23474	4.09	384013	66.93
9	Spain	19813	3.45	403826	70.39
10	Australia	19382	3.38	423208	73.77
11	Netherlands	16886	2.94	440094	76.71
12	Turkey	14679	2.56	454773	79.27
13	South Korea	11971	2.09	466744	81.35
14	Belgium	9402	1.64	476146	82.99
15	Sweden	9187	1.60	485333	84.59
16	Brazil	8995	1.57	494328	86.16
17	Switzerland	8094	1.41	502422	87.57
18	India	7614	1.33	510036	88.90
19	Austria	7409	1.29	517445	90.19
20	Taiwan	6958	1.21	524403	91.40
21	Denmark	5559	0.97	529962	92.37
22	Greece	5512	0.96	535474	93.33
23	Poland	4807	0.84	540281	94.17
24	Israel	4202	0.73	544483	94.90
25	Egypt	4181	0.73	548664	95.63
26	Iran	4064	0.71	552728	96.34
27	Scotland	3687	0.64	556415	96.98
28	Portugal	3326	0.58	559741	97.56
29	Russia	2732	0.48	562473	98.04
30	Czech Republic	2705	0.47	565178	98.51

TP=Total Publications, Cum.Pub. = Cumulative Publications

Publication Efficiency Index (PEI) of Nephrology Research in India: Table 5 examines the relative research effort measured by the Publications Efficiency Index (PEI), based on the references appended to the research publications by the authors (Frame 1977).

$$PEI = \frac{TNCi/TNCt}{TNPi/TNPt}$$

TNCi = total number of citations in a year,

$$AI = \frac{\text{Given field's share in the country's publication output}}{\text{Given field's share in the world's publication output}}$$

AI= 100 indicates that the country's research effort in the field corresponds precisely to the world's average.

AI> 100 reflects higher activity than the world's average and

AI<100 indicates lower activity than the world's average.

$$AI = \frac{\text{India's output in a particular year/ Total Indian output}}{\text{World's output in a particular year/ total world's output}}$$

$$\text{Mathematically, AI} = \frac{nij/nio}{noj/noo} * 100$$

Where:
 nij= Indian output of papers in a particular field,
 nio= Total Indian output in all subjects,
 noj= World output of papers in a particular field and
 noo= Total World output on all subjects
 Here:
 nij= The Indian output in the year i;
 nio= The total Indian output;
 noj= the world output in the year i; and
 noo= The total world output.

Table 3 presents the results of India's AI in the field of nephrology over different years. The computed AI values above 100 represent the higher-than-average research efforts from 1994 to 2023. The years achieved in 2006, 2010, 2012-2016, and 2019-2023 have more than 100 AI values, and 1994-2005, 2007-2009, 2011, and 2017-2018 have achieved less than 100 AI values.

Table 3. World and India Research output in Nephrology research from 1994 to 2023

Year	World (TP)	India (TP)	AI-Index
1994	10643	82	58.05
1995	11947	70	44.15
1996	12490	53	31.97
1997	12574	65	38.95
1998	10313	67	48.95
1999	9805	87	66.86
2000	9225	73	59.63
2001	9773	97	74.79
2002	15026	102	51.15
2003	16211	118	54.85
2004	13903	124	67.20
2005	17829	216	91.29
2006	19044	268	106.04
2007	20908	248	89.38
2008	19573	244	93.93
2009	22201	247	83.83
2010	23677	332	105.66

TNCt = total number of citations for all the years,

TNPi = total number of publications in a year,

TNPt = total number of publications for all the years

If $PEI > 1$, it indicates that the impact of scientific publications in a given field by a particular country is more than the research energy dedicated to it during the period considered. Table 5 reveals that the value of the Publication Efficiency Index is greater than 1 ($PEI > 1$) from the years 1994,1996-1997,1999-2005, 2007-2011, 2015, and 2017-2018, which shows that the impact of publication and research efforts in Nephrology research is more significant. Also, the Publication Efficiency Index and Average Citation Per Paper were highest in 2004 with values of 2.162 and 26.84, respectively. In the years, i.e., 1995,1998, 2006, 2012-2014, 2016, and 2019-2023, Publication Efficiency Index values are less than 1 ($PEI < 1$). The average value of the Publication Efficiency Index is 1.189, and the Average Citation Per Paper is 14.76.

Table 5. Year-wise publication efficiency index (pei) of nephrology

Year	TP	TC	%	CPP	PEI
1994	82	1023	1.08	12.48	1.005
1995	70	705	0.75	10.07	0.811
1996	53	992	1.05	18.72	1.507
1997	65	975	1.03	15.00	1.208
1998	67	737	0.78	11.00	0.886
1999	87	1277	1.35	14.68	1.182
2000	73	1953	2.07	26.75	2.155
2001	97	2362	2.50	24.35	1.961
2002	102	2448	2.59	24.00	1.933
2003	118	2462	2.60	20.86	1.680
2004	124	3328	3.52	26.84	2.162
2005	216	4150	4.39	19.21	1.547
2006	268	2979	3.15	11.12	0.895
2007	248	4285	4.53	17.28	1.392
2008	244	4660	4.93	19.10	1.538
2009	247	4109	4.35	16.64	1.340
2010	332	6133	6.49	18.47	1.488
2011	297	4896	5.18	16.48	1.328
2012	369	3239	3.43	8.78	0.707
2013	412	4153	4.39	10.08	0.812
2014	353	3898	4.12	11.04	0.889
2015	309	4901	5.18	15.86	1.277
2016	324	3453	3.65	10.66	0.858
2017	281	3564	3.77	12.68	1.022
2018	294	3800	4.02	12.93	1.041
2019	361	3955	4.18	10.96	0.882
2020	494	4628	4.90	9.37	0.755
2021	523	4886	5.17	9.34	0.752
2022	567	3473	3.67	6.13	0.493
2023	537	1112	1.18	2.07	0.167
Total	7614	94536	100	12.42	35.674
Average	253.8	3151.2		14.76	1.189

TP=Total Publications, TC=Total Citations, CPP=Citations Per Paper, PEI=Publications Efficiency Index

Growth Ratios of Nephrology Research in India: Table 6 identifies the Annual Ratio of Growth (ARoG), Annual Growth Rate (AGR), and Compound Annual Growth Rate (CAGR) of Nephrology research in India from 1994 to 2023. Annual Growth Rate (AGR) provides the average growth in the number of publications over a period, calculated using the current and previous publications. The following can be calculated with this formula:

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

The Average Annual Growth Rate (AAGR) refers to the average increase in the number of publications over some time.The AAGR can be calculated using the formula mentioned below:

$$AAGR = (\text{Growth Rate}_1 + \text{Growth Rate}_2 + \dots + \text{Growth Rate}_n) \div n$$

Where,

AAGR Average Annual Growth Rate,
 AGR1= Annual Growth Rate in the 1st year,
 AGR2= Annual Growth Rate in the 2nd year,
 AGR3= Annual Growth Rate in the 3rd year,
 AGRN= Annual Growth Rate in the Nth year,
 n= Total Number of Years

Annual Ratio of Growth (ARoG) states the ratio between the number of current year publications and the number of previous year publications. The following can be calculated with this formula:

$$ARoG = \frac{\text{No. of Publications of Present Year}}{\text{No. of Publications of Prior Year}}$$

The Compound Annual Growth Rate (CAGR) is a metric that measures the average increase in the number of publications over a period of time. The following can be calculated with this formula:

$$CAGR = \left(\frac{\text{Ending Value}}{\text{Beginning Value}} \right)^{\frac{1}{n-1}} - 1$$

Table 6. Annual growth rate (AGR), annual ratio of growth (AROG), average annual growth rate (AAGR), compound annual growth rate (CAGR) of nephrology

Year	TP	Cum.Pub.	AGR	ARoG	AAGR	CAGR
1994	82	82				
1995	70	152	-14.63	0.85		
1996	53	205	-24.29	0.76		
1997	65	270	22.64	1.23		
1998	67	337	3.08	1.03		
1999	87	424	29.85	1.30		
2000	73	497	-16.09	0.84		
2001	97	594	32.88	1.33		
2002	102	696	5.15	1.05		
2003	118	814	15.69	1.16		
2004	124	938	5.08	1.05		
2005	216	1154	74.19	1.74		
2006	268	1422	24.07	1.24		
2007	248	1670	-7.46	0.93		
2008	244	1914	-1.61	0.98		
2009	247	2161	1.23	1.01	8.538	
2010	332	2493	34.41	1.34		
2011	297	2790	-10.54	0.89		
2012	369	3159	24.24	1.24		
2013	412	3571	11.65	1.12		
2014	353	3924	-14.32	0.86		
2015	309	4233	-12.46	0.88		
2016	324	4557	4.85	1.05		
2017	281	4838	-13.27	0.87		
2018	294	5132	4.63	1.05		
2019	361	5493	22.79	1.23		
2020	494	5987	36.84	1.37		
2021	523	6510	5.87	1.06		
2022	567	7077	8.41	1.08		
2023	537	7614	-5.29	0.95		
Total	7614		247.60	31.48		0.065%
Mean Value			8.54	1.09		(6.465)

TP=Total Publications, Cum.Pub.= Cumulative Publications, AGR=Annual Growth Rate, ARoG=Annual Ratio of Growth, AAGR= Average Annual Growth Rate, CAGR= Compound Annual Growth Rate

Table 7. Distribution of nephrology research from different sources

Sl.No.	Documents Types	TP	%	TC	%
1	Article	3,380	44.39	71274	75.39
2	Meeting Abstract	2,195	28.83	296	0.31
3	Letter	826	10.85	1537	1.63
4	Editorial Material	606	7.96	3484	3.69
5	Review Article	411	5.40	14879	15.74
6	Proceeding Paper	88	1.16	2341	2.48
7	Note	51	0.67	402	0.43
8	Correction	26	0.34	12	0.01
9	News Item	11	0.14	161	0.17
10	Early Access	10	0.13	6	0.01
11	Book Chapters	5	0.07	51	0.05
12	Discussion	1	0.01	55	0.06
13	Publication With Expression of Concern	1	0.01	14	0.01
14	Reprint	1	0.01	1	0.00
15	Retracted Publication	1	0.01	4	0.00
16	Withdrawn Publication	1	0.01	19	0.02
	Total	7,614	100	94536	100

TP=Total Publications, TC=Total Citations

Table 8. Highly productive was subject categories nephrology research in India

Sl. No.	Subject Categories	TP	TC	CPP	H-Index
1	Pediatrics	850	4897	5.76	35
2	Transplantation	687	4108	5.98	37
3	Obstetrics Gynecology	185	882	4.77	18
4	Andrology	145	4037	27.84	32
5	Oncology	91	1284	14.11	20
6	Hematology	45	791	17.58	15
7	Health Care Sciences Services	40	933	23.33	15
8	Endocrinology Metabolism	37	660	17.84	16
9	Nutrition Dietetics	23	621	27.00	13
10	Physiology	21	594	28.29	14

TP=Total Publications, TC=Total Citations, CPP=Citations Per Paper

Table 9. Most prolific journals in nephrology research in India

Sl. No.	Title of the Sources	TP	%	TC	%	CPP	Country	IF
1	Nephrology Dialysis Transplantation	677	8.89	4082	4.32	6.03	United Kingdom	4.8
2	Pediatric Nephrology	658	8.64	3508	3.71	5.33	USA	2.676
3	Journal of Endourology	546	7.17	6719	7.11	12.31	USA	2.9
4	Urology	530	6.96	5843	6.18	11.02	Netherlands	2.649
5	Nephrology	398	5.23	1569	1.66	3.94	USA	1.749
6	BJU International	328	4.31	5806	6.14	17.70	USA	5.969
7	International Journal of Urology	290	3.81	939	0.99	3.24	USA	2.6
8	Journal of Urology	276	3.62	5242	5.54	18.99	Netherlands	7.45
9	Renal Failure	216	2.84	3894	4.12	18.03	United Kingdom	3.1
10	European Urology	212	2.78	3807	4.03	17.96	Netherlands	25.3

TP=Total Publications, TC=Total Citations, CPP=Citations Per paper, IF=Impact Factor

However, AAGR is a linear measure or arithmetic mean of AGR, and CAGR is an average compounded growth rate over a period of time. Table 6 analyses the annual ratio of growth (ARoG), annual growth rate (AGR), and compound annual growth rate (CAGR) of nephrology from 1994 to 2023. The data shows that the maximum annual growth rate, i.e., 74.19, was recorded in 2005, and the minimum annual growth rate in 1996 (-24.29). The mean of AGR for the period of study is 8.54. The years 1995-1996, 2000, 2007-2008, 2011, 2014-2015, 2017, and 2023 have a negative growth rate. The reason for the fluctuation is that there is no constant growth in publications yearly. The ARoG is more than 1 in the years, i.e., 1997-1999, 2001-2006, 2009-2010, 2012-2013, 2016, and 2018-2022. The highest ARoG was in 2005 (1.74), and the lowest was in 1996 (0.76). The mean of ARoG for the period of study is 1.09. And the Compound Annual Growth Rate (CAGR) of the

Nephrology research in India is 0.0645 (6.645%). The compound annual growth rate compares the growth rate over a specified duration of time.

Distribution of Nephrology research from different sources: Table 7 indicates the document-wise output in Nephrology research through different communication channels. Journal Articles rank first with 3380 (44.39%) publications, followed by Meeting Abstract, which occupies the second place with 2195 (28.83%) publications, and Letters occupy third place with 826 (10.85%) publications. The remaining 1213 (15.93%) Editorial Material, Review Articles, Proceedings Papers, Notes, Corrections, News Items, etc.

Highly Productive WOS Subject Categories: Table 8 shows that the Web of Science database has various subject categories across all the disciplines to be assigned to individual articles.

Table 10. Highly productive institutions in the field of nephrology research

Sl. No.	Name of Organisation	TP	%	TC	%	CPP
1	All India Institute of Medical Sciences (AIIMS), New Delhi	906	11.90	16663	17.63	18.39
2	Post Graduate Institute of Medical Education Research (PGIMER), Chandigarh	650	8.54	9345	9.89	14.38
3	Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, Uttar Pradesh	544	7.14	8754	9.26	16.09
4	King George S Medical University, Lucknow, Uttar Pradesh	363	4.77	1900	2.01	5.23
5	Muljibhai Patel Urological Hospital, Nadiad, Gujarat	283	3.72	6614	7.00	23.37
6	Manipal Academy of Higher Education (MAHE), Manipal, Karnataka	253	3.32	4818	5.10	19.04
7	Christian Medical College Hospital (CMCH), Vellore, Tamil Nadu	244	3.20	2901	3.07	11.89
8	George Institute for Global Health, Punjagutta, Hyderabad,	129	1.69	4597	4.86	35.64
9	The Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry	120	1.58	886	0.94	7.38
10	Kasturba Medical College, Manipal, Mangaluru	116	1.52	731	0.77	6.30

TP=Total Publications, TC=Total Citations, CPP=Citations Per paper

Table 11. Top funding agencies contributing to research in nephrology research

Sl.No.	Funding Agency	TP	%	TC	%	CPP
1	Indian Council of Medical Research (ICMR), New Delhi	82	1.0	1563	1.65	19.06
2	National Institutes of Health (NIH), USA	74	0.97	2610	2.76	35.27
3	United States Department of Health and Human Services, USA	74	0.97	2610	2.76	35.27
4	Department of Biotechnology (DBT), New Delhi	46	0.60	1349	1.43	29.33
5	Department of Science and Technology (DST), New Delhi	31	0.41	684	0.72	22.06
6	National Health Medical Research Council (NHMRC), Australia	31	0.41	2240	2.37	72.26
7	National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), USA	26	0.34	982	1.04	37.77
8	Glaxosmithkline (GSK Plc), United Kingdom	25	0.33	593	0.63	23.72
9	AstraZeneca, United Kingdom	22	0.29	1727	1.83	78.50
10	UK Research Innovation, United Kingdom	21	0.28	1889	2.00	89.95

TP=Total Publications, TC=Total Citations, CPP=Citations Per Paper

Table 12. Top ten publishers in the field of nephrology research

Sl. No.	Name of Publisher	Country	TP	%	TC	%	CPP
1	Elsevier, Amsterdam	Netherlands	1,681	22.08	28376	30.02	16.88
2	Springer Nature, Berlin	Germany	1,518	19.94	14971	15.84	9.86
3	Wiley, New York	USA	1,420	18.65	77829	82.33	54.81
4	Oxford University Press	United Kingdom	736	9.67	4753	5.03	6.46
5	Karger, Basel	Switzerland	355	4.66	4723	5.00	13.30
6	Mary Ann Liebert, New York	USA	260	3.41	3809	4.03	14.65
7	Taylor & Francis	United Kingdom	207	2.72	3563	3.77	17.21
8	Lippincott Williams & Wilkins, Philadelphia	USA	199	2.61	3557	3.76	17.87
9	American Society of Nephrology	USA	171	2.25	3759	3.98	21.98
10	Brazilian Society of Urology	Brazil	84	1.10	714	0.76	8.5

TP=Total Publications, TC=Total Citations, CPP=Citations Per Paper

A publication may be assigned one or more WoS Subject Categories. Pediatrics has contributed the highest WoS Subject category, i.e. 850 publications with 4897 citations (5.76 CPP and 35 H-Index) followed by Transplantation ranked second with 687 publications with 4108 citations, (5.98 CPP and 37 H-Index), Obstetrics Gynecology ranked third with 185 publications with 882 citations, Andrology with 145 and Oncology with 91 publications ranked fourth and fifth respectively followed by other WoS Subject Categories, as shown in the Table 8.

Most Preferred Journals in Nephrology Research: Table 9 identifies the core journals in the field of nephrology. Only the top 10 journals are taken into consideration for analysis. Based on citations per paper (CPP), the Journal of Urology from the Netherlands has received the highest (i.e., 18.99) citation per paper, followed by Renal Failure from the United Kingdom (18.03), European Urology from the Netherlands (17.96), and BJU International from the USA (17.70). About Impact Factor, European Urology from the Netherlands, published from the USA, has the highest impact factor (25.3), followed by Journal of Urology from the Netherlands with an impact factor (of 7.45), BJU International from the USA (5.969), and Nephrology Dialysis Transplantation from the United Kingdom (4.8).

Highly Productive Organizations/Institutions in the field of Nephrology research: Table 10 depicts the ranking list of India's top 10 highly productive Nephrology Research organizations based on their highest publications, citations, and citations per publication. According to the Web of Science database, All India Institute of Medical Sciences, New Delhi, produced the highest number of publications to the field of nephrology, i.e. 906 publications with received 16663 citations (17.63 CPP), followed by the Post Graduate

Institute of Medical Education Research, Chandigarh with 650 publications (9345 citations & 9.89 CPP), Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, Uttar Pradesh with 544 publications (8754 citations & 9.26) and King George S Medical University, Lucknow, Uttar Pradesh with 363 publications (1900 citations & 2.01 CPP).

Top funding agencies contributing to research in Nephrology Research: Table 11 analyses the top 10 funding agencies that are financially assisting research activities in the field of nephrology; it is evident from the table that the Indian Council of Medical Research, New Delhi, has the highest contribution of 82 publications,

constituting (1.08%) of the total publications followed by National Institutes of Health (NIH), USA, funded for 74 (0.97%) publications, United States Department of Health and Human Services, USA, sponsored for the 74 (0.97%) publications, Department of Biotechnology, New Delhi, funded for the 46 (0.60%) and Department of Science Technology, New Delhi funded for 31 (0.41%) publications. It can be inferred from the above analysis that Agencies from India, the United Kingdom, and the USA are the most supportive of research activities in Nephrology.

Most Productive Publishers: Table 12 depicts the top twenty publishers that contributed to publications. Elsevier, Netherlands, is the most prolific publisher with 1681 (22.08%) publications, and it has received the highest number of 28376 citations. Followed by Springer Nature, Germany, with 1518 (19.94%) publications and received 14971 citations; Wiley, New York, USA, with 1420 (18.65%) publications and received 77829 citations; Oxford University, Press, United Kingdom 736 (9.67%) publications and received 4753 citations and Karger, Basel, Switzerland 355 (4.66%) publications and received 4723 citations, followed by other publishers, as shown in Table 11.

CONCLUSION

The scientometric analysis of Indian nephrology research output from 1994 to 2023 highlights the substantial progress made in this critical field and the persistent challenges. Indian researchers have significantly contributed to global nephrology knowledge, steadily increasing publication output. The study reveals consistent growth in metrics like the Activity Index (AI) and Relative Growth Rate (RGR), demonstrating India's rising prominence in the global research landscape. Institutions such as AIIMS and PGIMER have played a pivotal role in driving this progress, supported by funding from both national and international agencies. Additionally, the preference for publishing in leading journals has enhanced the visibility and recognition of Indian nephrology research on the global stage. Despite these advancements, challenges remain. The overall citation impact of Indian publications still lags behind global leaders, highlighting the need to prioritize high-impact research. Furthermore, increasing international collaborations could elevate the quality and reach of Indian contributions. By addressing these challenges, policymakers and funding agencies can refine strategies to foster sustained growth, support impactful research, and enhance India's global standing in nephrology. This study offers a comprehensive foundation for future explorations, identifying emerging trends and areas for improvement within this vital medical specialty.

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