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Covid-19 and Cancer: A Scientometric Assessment of India's Publications During 2020-21

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The article examines and evaluates India's research output on the theme 'Covid-19 and Cancer' using bibliometric methods. A total of 520 India's publications were identified on the topic of 'Covid-19 and Cancer' in Scopus database, that were cited 2713 times with an average of 5.22 citations per paper. About 12.11% of these publications received external funding support and registered 8.25 citations per paper. The largest number of India's publictaions (88.46%) were published in Medicine journals and adults constitutes the largest population age group (15.38%) studied among India's total publications. Lung cancer research constitutes the largest publications share (9.42%) among different types of cancers and surgery reported the largest publication share among treatment methods studies in India's total publications on this topic. The maximum number of publications emerged from USA, Italy and U.K. (2641, 1357 and 1153 publications), and publications from China (24.56, Spain (14.52) and Italy (13.12) received the highest citation per paper. The organisations that produced the highest number of publications were Tata Memorial Hospital, Mumbai (75 papers), All India Institute of Medical Sciences, New Delhi (63 papers), Homi Bhabha National Institute, Mumbai (59 papers) and Postgraduate Institute of Medical Education & Research, Chandigarh (35 papers). The organisations with highest citation impact per paper and relative citation index were Tata Medical Center, Kolkata (13.0 and 2.49), BHU-Varanasi (12.70 and 2.43), VMMC and Safdarjang Hospital, New Delhi (5.0 and 0.96) and Tata Memorial Hospital, Mumbai (4.73

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and 0.91). The authors that produced the highest number of publications were B. Biswas (12 papers), S. Bhatnagar (11 papers) and A. Batra (9 papers). The authors who had the highest citation impact per paper and relative citation index were P. Chaturvedi (13.25 and 2.54), C.S. Pramesh (12.29 and 2.35) and S. Gupta (4.0 and 0.77). The journals that produced the highest number of publications were *Indian Journal of Medical and Paediatric Oncology* (with 28 papers), *Indian Journal of Surgical Oncology* (19 papers) and *Journal of Surgical Oncology* (18 papers) and the most impactful journals were*Clinical Oncology* (19.17), *JCO Global Oncology* (19.09) and *Indian Pediatrics* (17.80). The most studied subfields as reflected in keyword frequency were Covid-19, Pandemic (332), Neoplasms (175), Cancer Patients (112), Malignant Neoplasm (100), Cancer Surgery (79) and Cancer Chemotherapy (66).

Keywords: *Covid-19, Cancer, Scientometrics, India*

1 INTRODUCTION

The current Covid-19 crisis has a lesser impact on healthy and fit children and adolescents, while claiming its deadly toll among all other segments of the population: the sick, the unfit and the elderly, including patients with cancer. Patients with cancer are a distinctly vulnerable population; they are often immuno compromised and are at an increased risk of experiencing Covid-19 associated complications.

Proper cancer prevention, control, care and post-cancer survivorship rely on the critical importance of early diagnosis, timeless onset of treatment and surveillance for recurrence. These processes were affected by interruptions or delays, caused by the pandemic, in the delivery of preventive interventions, such as vaccinations, tobacco control and cancer screening. Cancer patients are also more vulnerable to the clinical impact of SARS-CoV-2 infection[1].

Malignant disease predisposes to severe Covid-19 for multiple reasons, primarily because (i) patients with cancer fall into general at-risk categories because of their average advanced age, predisposing factors such as obesity and smoking, and comorbidities such as T2D and hypertension; (ii) cancer intrinsically has negative effects on patients' general health status; and (iii) antineoplastic therapies such as surgery, chemotherapy and radiotherapy may debilitate the immune system and cause immunosene scence and inflammaging[2].

Despite the challenges experienced during the pandemic, the global oncology community has responded with an unprecedented level of investigation, collaboration, and technological innovation through the rapid development of Covid-19 registries that have allowed an increased understanding of the natural history, risk factors, and outcomes of patients with cancer who are diagnosed with Covid-19[3]. The results from registery

efforts indicate: (i) The 30-day all-cause mortality rate among patients with cancer and Covid-19 was high, with estimates ranging from 13% to 57%; (ii) The overall factors that were consistently associated with mortality across the registries included age, sex, and number of comorbidities, (iii) Cancer-specific factors as being associated with high mortality were thoracic cancer, hematologic cancer, low ECOG performance status, and active and progressive cancer, (iv) Revealed additional vulnerabilities in this large patient population that were associated with higher mortality, including race, ethnicity, and certain laboratory parameters (eg, hypoalbuminemia and lymphopenia) and (v) Identification of the benefits of convalescent plasma and remdesivir therapies for the treatment of Covid-19 has been suggested among patients with cancer, especially those with hematologic cancer.

11 LIERATURE REVIEW

Although a number of bibliometric studies were carried out on Coronoviris and Covid-19, but only two bibliometric studies exists on "Covid-19 and Cancer". Among such studies, Yumnam and Singh conducted a bibliometric analysis of 1457 scholarly records on 'Covid-19 and Cancer', indexed in the Web of Science (WoS) Core Collection database. The study assessed the trends of research and addresses the knowledge gap and evaluates the characteristics of the current body of literature on this theme. It also identifies the contributing authors, institutions and countries associated with this theme. Mieke, Grant, Louis, Verna DNK, Raúl, Chris M, Karen, Pramesh, Richard and Deborah [4]examined research (1445 records) related to 'Covid-19 and Cancer' to understand: (i) the type of research that has been conducted (e.g. patients, services and systems) and (ii) whether the pandemic has impacted the state of global cancer research using Web of Science between January 2019 and February 2021. The majority (57%) were reviews, opinion papers or concerned with modelling impact of delays to diagnosis and treatment. The main research domains focused on managing or estimating COVID-19 risk to cancer patients accounting for 384 papers (25% share). The authors observed a shift in research focus rather than a decline in absolute output. However, there is variation based on national income and collaborations are minimal. There has been a focus on pan-cancer studies rather than cancer site-specific studies.

Since no bibliometric study had been undertaken at national level on this topic, as a result we decided to undertake the present study with the main purpose of evaluating India's research output on 'Covid-19 and Cancer'.The major objectives of this study are to study the literature characterstics and research trends in India's output, with focus on publications distribution by document and source type, publication growth and citation impact, publication

distribution by broad subjects, significant keywords, population age group, type of cancer and by treatment methods, identification of India's collaborative output and important collaborating partners and leading Indian organisations, authors and journals contributing on this theme.

2 METHODOLOGY

The authors performed a bibliometric search on the theme 'Covid-19 and Cancer' using a well organised search strategy, which identified, retrieved and downloaded all relevant publications records from the Scopus database (https://www.scopus.com) on this theme. The search strategy using two set of key document and source words related to "Covid-19" and "Cancer" in field tags, "Keyword" or "Title" (Article Title) and limiting the search up to 1st November 2021 period and to country "India" in affiliation tag. The search yielded 520 records, which were further analysed using additional analytical provisions in the Scopus database. Further, VOSvieweri was used to map the data of prolific authors co-authorship, countries co-authorship, publications co-citations, all keywords, and bibliographic coupling of journals..

Title ("COVID19" or "2019 novel coronavirus" or "coronavirus 2019" or "coronavirus disease2019" or "2019-novelCoV" or "2019 ncov" or covid 2019 or covid19 or "corona virus 2019" or ncov-2019 or ncov2019 or "nCoV 2019" or 2019-ncov or covid-19 or "Severe acute respiratory syndrome coronavirus 2" or "SARS-CoV-2") or KEY ("Covid 19" or "2019 novel coronavirus" or "coronavirus 2019" or "coronavirus disease 2019" or "2019-novel CoV" or "2019 ncov" or Covid 2019 or covid19 or "Corona virus 2019" or ncov-2019 or ncov2019 or "nCoV 2019" or 2019-ncov or covid-19 or "Severe acute respiratory syndrome coronavirus 2" or "SARS-CoV-2") and Key (cancer* or oncology* or carcinoma* or neoplasm) and (Limit-To (Affillcountry, "India"))

3 ANALYSIS AND RESULTS

31 OVERALL OUTPUT

Scholars globally, have published 9143 publications on 'Covid-19 and Cancer' as covered in Scopus database on 1st November 2021. India has 520 publications on this topic, which received 2713 citations, averaging 5.22 citations per publication. The share of India's publications in global output was 5.89%. Of the 520 India's publications on this theme, 63 publications (12.11%) received external funding support from 50+ global and Indian

research agencies and they together registered 588 citations, averaging 8.25 citations per paper. The leading funding agencies providing support (along with their output) to research in this area are Indian Council of Medical Research (7 papers), Department of Science & Technology, India. Pfizer and Roche (6 papers each), Glaxo Smith Klibe, National Cancer Institute, National Institute of Health and Novartis (5 papers each), Astra Zeneca and Department of Biotechnology, India (4 papers each). etc. Of the 520 Indian publications, articles constituted the largest share (46.73%), followed by reviews (21.73% share), letters (20.38% share), notes (5.0% share), editorials (3.65% share), conference papers (1.15% share), short surveys (0.77% share) and book chapters (0.58% share).

32 TOP 10 COUNTRIES

About 70 countries unevenly participated in global research on 'Covid-19 and Cancer'. The top 10 countries individually contributed 295 to 2641 papers each and together contributed 8572 papers, constituting 93.75% share of global publications. Among top 10 countries, the only three countries published more than the group average (857.2) of top 10 countries were: USA (2641 papers), Italy (1357 papers) and U.K. (1153 papers). Three countries registered average citation per paper above the group average (12.56) of top 10 countries: China (24.56), Spain (14.52) and Italy (13.12) (Table 1).

Table 1. Profile of Top 10 Countries in Global Output in 'Covid-19 and Cancer'

S.No	Country	TP	TC	CPP
1	USA	2641	28833	10.92
2	Italy	1367	18203	13.32
3	U.K.	1153	12981	11.26
4	China	746	18322	24.56
5	India	520	2713	5.22
6	France	505	6211	12.30
7	Spain	466	6764	14.52
8	Germany	459	5262	11.46
9	Canada	420	4930	11.74
10	Australia	295	3427	11.62
	Total of top 10 countries	8572	107646	12.56
	Global total	9143		
	Share of top 10 countries in global total	93.75		

Figure 1 displays the mapping of the collaborations among top countries on 'Covid-19 and Cancer', which are depicted in three clusters, with India in the center of the map. When selecting criteria for at least five publications for

a country, 32 out of 88 countries meet the threshold. The strongest collaboration is between India and USA (link strength = 72), followed by India and UK (link strength = 47) and India and Australia (link strength = 23). The Cluster 1 (in Red color) on the map includes 17 countries like Australia, Belgium, Brazil, Canada, USA, U.K. so on with similar research interests; Cluster 2 (in Green color) includes 14 countries like India, China, Japan, etc., and the Cluster 3 (in blue color includes only one country Saudi Arabia. The linear thickness that connects the two countries shows the strength of their relationship. The thicker the line, the stronger the collaboration. It seems that geographical importance is not the most important aspect influencing mutual relationships.

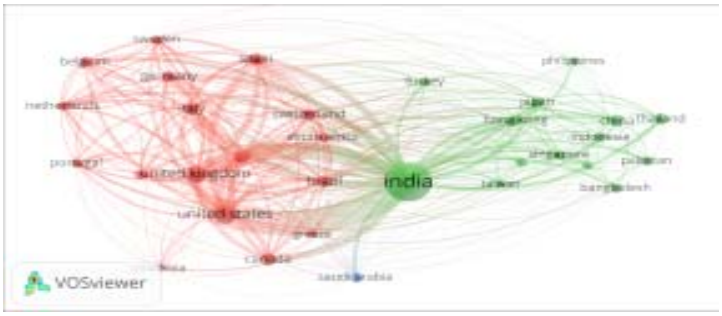

Fig.1: Countries Co-authorship Network

33 SUBJECT-WISE DISTRIBUTION OF PUBLICATIONS

520 of India's publications on 'Covid-19 and Cancer'may be classified under 4 broad subject categories (as per Scopus database classification), with largest publication share (88.46%) reported on Medicine, followed by Biochemistry, Genetics and Molecular Biology (22.12%), Pharmacology, Toxicology and Pharmaceutics (7.69%) and Immunology and Microbiology (4.62%). In terms of impact, publications on Biochemistry, Genetics and Molecular Biology registered the highest citation impact per paper (10.27) and Pharmacology, Toxicology and Pharmaceutics the least (4.08) (Table 2)

Table 2. Subject-Wise Distribution of India's Papers on 'Covid-19 and Cancer'

S.No.	Name of the Subject	TP	TC	CPP	%TP
1	Medicine	460	2346	5.10	88.46
2	Biochemistry, Genetics and Molecular Biology	115	1181	10.27	22.12
3	Pharmacology, Toxicology and Pharmaceutics	40	163	4.08	7.69
4	Immunology & Microbiology	24	245	10.21	4.62
5	**India's total**	**520**	**2713**	**5.22**	**100.00**

34 TYPES OF CANCER

Among types of cancer impacted during Covid-19 in India, the largest share (9.42%) was reported for Lung Cancer, followed by Head and Neck Cancer (8.27%), Breast Cancer (7.31%), Mouth Cancer (5.38%), Blood Cancer (5.19%), Female Genital Track Cancer (4.23%), Uterine Cervix Track Cancer (3.85%), Ovary Cancer (3.46%), Prostate Cancer (3.27%), Liver Cancer (3.08%), Colorectal Cancer (2.69%) et al. In terms of research impact, Pancreas Cancer registered the highest citation impact per paper (10.20), followed by Breast Cancer (6.32), Lung Cancer (6.16), Digestive System Cancer (5.38), Esophagus Cancer (5.14), Blood Cancer (5.0), etc (Table 3)

Table 3. Publication Distribution by Type of Cancer in Literature on 'Covid-19 and Cancer'

S.No	Type of Cancer	TP	TC	CPP	%TP	S.No	Type of Cancer	TP	TC	CPP	%TP
1	Lung Cancer	49	302	6.16	9.42	12	Renal Cell Cancer	13	50	3.85	2.50
2	Head & Neck Cancer	43	179	4.16	8.27	13	Rectum Cancer	10	27	2.70	1.92
3	Breast Cancer	38	240	6.32	7.31	14	Bladder Cancer	9	45	5.00	1.73
4	Mouth Cancer	28	101	3.61	5.38	15	Endometrium Cancer	9	43	4.78	1.73
5	Blood Cancer	27	95	3.52	5.19	16	Stomach Cancer	9	43	4.78	1.73
6	Female Genital Track Cancer	22	82	3.73	4.23	17	Digestive System Cancer	8	43	5.38	1.54
7	Uterine Cervix Cancer	20	64	3.20	3.85	18	Colon Cancer	7	27	3.86	1.35
8	Ovary Cancer	18	55	3.06	3.46	19	Esophagus Cancer	7	36	5.14	1.35
9	Prostate Cancer	17	56	3.29	3.27	20	Pancreas Cancer	5	51	10.20	0.96
10	Liver Cancer	16	92	5.75	3.08		**India's total**	520	2713	**5.22**	
11	Colorectal Cancer	14	64	4.57	2.69						

35 PUBLICATION BY TREATMENT METHODS

Among treatment methods of cancer impacted during Covid-19 in India, the largest share (20.18%) was reported for Surgery, followed by Chemotherapy (15.19% share), Radiotherapy (11.35% share), Epidemiology (6.92% share), Palliative Care (6.73% share), Diagnosis (6.549% share), Pathology (6.35% share), Screening (2.12% share), Quality of Life (2.12% share) and Prognosis

(1.73% share). In terms of research impact, Prognosis registered the highest (14.33) citation impact per paper, followed by Pathology (12.73), Surgery (4.58), Radiotherapy (4.0), etc (Table 4)

Table 4. Publication Distribution by Treatment Method in Literature on 'Covid-19 and Cancer'

S. No	Type of Treatment Method	TP	TC	CPP	%TP
1	Surgery	106	487	4.59	20.38
2	Chemotherapy	79	186	2.35	15.19
3	Radiotherapy	59	236	4.00	11.35
4	Epidemiology	36	90	2.50	6.92
5	Palliative Care	35	85	2.43	6.73
6	Diagnosis	34	80	2.35	6.54
7	Pathology	33	420	12.73	6.35
8	Screening	11	29	2.64	2.12
9	Quality of Life	11	20	1.82	2.12
10	Prognosis	9	129	14.33	1.73
	Global total	**520**	**2713**	**5.22**	

36 PUBLICATION DISTRIBUTION BY POPULATION AGE GROUP

On classifying literature on 'Covid-19 and Cancer' by population age, Adults constituted the largest group (15.38%), followed by Children (9.62% share), Adolescents (9.62% share), Aged (8.46% share) and Adolescents (4.81% share). In terms of impact, Aged registered the highest (6.50) citations per paper, followed by Adolescents (6.08), Children (4.64), Adults (3.91) and Middle Aged (2.19)

Table 5. Publication Distribution by Population Age Groups

S.No	Type of Population Age Group	TP	TC	CPP	%TP
1	Adults	80	313	3.91	15.38
2	Middle Aged	48	105	2.19	9.23
3	Adolescents	25	152	6.08	4.81
4	Children	50	232	4.64	9.62
5	Aged	44	286	6.50	8.46
	Global total	**520**	**2713**	**5.22**	

37 SIGNIFICANT KEYWORDS

Figure 5 displays the all significant -keywords appearing in Indian literature on Covid-19 and Cancer" using the VOSviewer software. A minimum

frequency of 50 was chosen. Of the 5,592 keywords, 44 meet the threshold and spread in 4 clusters with 4 different colors. The size of the circle indicates the number of occurrences and the bigger the size of the circle shows the more research domain. The thickness of the lines denotes the relationship between the keywords. Table 10 shows the most frequently occurred top 39 keywords. Among them, the largest frequency of occurrence (497) was reported by keyword Covid-19, followed by Pandemic (332), Neoplasms (175), Cancer Patients (112), Malignant Neiplasm (100), Cancer Surgery (79), Cancer Chemotherapy (66), etc.{Table 6)

Table 6: List of Top 39 Most Occurred Keywords

S.No	Name of the Kyword	Frequency	S.No	Name of the Keyword	Frequency	S.No	Name of the Keyword	Frequency
1	Covid-19	497	16	TElemedicine	39	31	Adult Respiratory Distress Syndrome	19
2	Pandemic	332	17	Head & Neck Cancer	38	32	Chronic Kidney Failure	19
3	Neoplasms	175	18	Breast Cancer	38	33	Anesthesia	18
4	Cancer Patient	112	19	Cardiovascular Disease	34	34	Diagnosis	16
5	Maligninant Neoplasm	100	20	Teleonsulation	34	35	Cancer Immunotherapy	17
6	Cancer Surgeries	79	21	Immunosuppressive TReatment	24	36	Clinical Trials	17
7	Cancer Chemotherapy	66	22	Surgical Oncology	23	37	Chemotherapy	16
8	Cormorbidity	59	23	Genital Track Cancer	22	38	Chemioradiotherapy	16
9	Mortality	58	24	Vaccination	22	39	Childhood Cancer	16
10	Camncer Radiotherapy	52	25	Cancer Palliative THerapy	21	49		
11	Diabetes Mellitus	52	26	Cancer Screening	22	50		
12	Lung Cancer	49	27	Cancer STaging	20			
13	Antineoplastic Agents	47	28	Immune Response	20			
14	Hypertension	44	29	Mouth Cancer	20			
15	Cancer Therapy	42	30	Uterine Cervix Cancer	20			

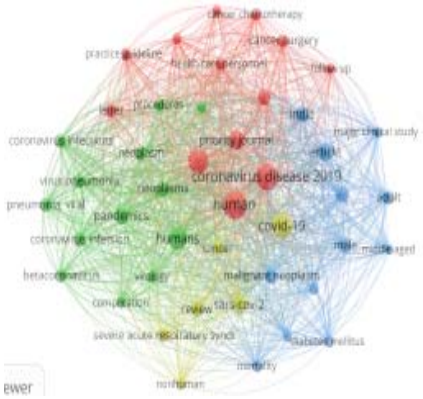

Fig.5: All Keywords (keyword with min 50 times occurred) Network

38 PROFILE OF TOP 20 ORGANIZATIONS

In all 150 organisations participated unevenly in global research on 'Covid-19 and Cancer': 116 organisations contributed 1-5 paper each, 21 organisations 6-10 papers each, 9 organisations 11-20 papers each and 4 organisations 21-75 papers each. The top 20 organisations individually contributed 8 to 75 papers and together contributed 409 papers and 1477 citations, constituting 78.65% and 54.44% share in India's publications and citations.On further analysis, it was observed that: (i) Four organisations contributed papers higher than their group average (20.45): Tata Memorial Hospital, Mumbai (75 papers), All India Institute of Medical Sciences, New Delhi (63 papers), Homi Bhabha National Institute, Mumbai (59 papers) and Postgraduate Institute of Medical Education and Research, Chandigarh (35 papers); and (ii) Five organisations registered citation per paper and relative citation index above their group average (3.61 and 0.69): Tata Medical Center, Kolkata (13.0 and 2.49), BHU-Varanasi (12.70 and 2.43), VMMC and Safdarjang Hospital, New Delhi (5.0 and 0.96), Tata Memorial Hospital, Mumbai (4.73 and 0.91) and Postgraduate Institute of Medical Education and Research, Chandigarh (4.0 and 0.77) (Table 7).

Table 7. Profile of Top 20 Most ProductiveOrganizationson "Covid-19 and Cancer"

S.No	Name of the organization	TP	TC	CPP	HI	ICP	%ICP	RCI
1	Tata Memorial Hospital (TMH), Mumbai	75	355	4.73	9	17	22.67	0.91
2	All India Institute of Medical Sciences (AIIMS), New Delhi	63	226	3.59	7	8	12.70	0.69
3	Hobi Bhabha National Institute (HBNI), Mumbai	59	182	3.08	7	13	22.03	0.59
4	Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh	35	140	4.00	7	3	8.57	0.77
5	All India Institute of Medical Sciences (AIIMS), Rishikesh	18	54	3.00	4	1	5.56	0.57
6	Manipal Academy of Higher Education (MAHE), Manipal	16	33	2.06	4	4	25.00	0.40
7	King George Medical University (KGMU), Lucknow	16	31	1.94	3	0	0.00	0.37
8	Katurba Medical Collge (KMC), Manipal	12	17	1.42	3	1	8.33	0.27
9	Rajiv Gandhi Cancer Institute & Research, New Delhi	12	19	1.58	3	2	16.67	0.30
10	Army Hospital Rearch& Referal, New Delhi	12	1	0.08	1	1	8.33	0.02
11	Christian Medical College (CMC), Vellore	11	30	2.73	3	0	0.00	0.52
12	Cancer Institute, Chennai	11	20	1.82	2	1	9.09	0.35
13	Tata Medical Center, Kolkata	10	130	13.00	2	1	10.00	2.49
14	Banaras Hindu University, Varanasi	10	127	12.70	5	3	30.00	2.43
15	VMMC & Safdarjang Hospital, New Delhi	9	45	5.00	3	3	33.33	0.96
16	Asian Institute of Medical Sciences (AIMS), Faridabad	8	0	0.00	0	0	0.00	0.00
17	Reginal Cancer Center (RCC), Trivandrum	8	21	2.63	3	0	0.00	0.50
18	SGPGIMS	8	19	2.38	2	2	25.00	0.45
19	Dr D.Y.P Vidyapeeth, Pune	8	4	0.50	2	6	75.00	0.10
20	All India Institute of Medical Sciences, (AIIMS), Bubaneswar	8	23	2.88	3	1	12.50	0.55
	Total of 20 organizations	409	1477	3.61	73	67	16.38	0.69
	India's total	520	2713	5.22				1.00
	Share of top 20 organizations in India's total	78.65	54.44					

391 PROFILE OF TOP 20 AUTHORS

243 authors participated unevenly in India's research on 'Covid-19 and Cancer': 226 authors contributed 1-5 papers each, 15 authors 6-10 papers each and 2 authors 11-12 papers each. The top 20 authors individually contributed 5 to 12 papers each and together 145 papers and 358 citations, constituting 27.88% and 13.20% share of India's papers and citations. On further analysis, it was observed that: (i) Seven authors contributed papers higher than their group average (7.25): B. Biswas (12 papers), S. Bhatnagar (11 papers), A. Batra (9 papers), J.P. Agarwal, P. Chaturvedi, P. Mehta, A Patel and A. Rajan (8 papers each); (ii) Five authors registered citation (14.4 and 1.49), per paper and relative citation index above their group average (2.47 and 0.47): P. Chaturvedi (13.25 and 2.54), C.S. Pramesh (12.29 and 2.35), S. Gupta (4.0 and 0.77), S. Bhatnagar (3.18 and 0.61) and G.Chinnaswamy (2.50 and 0.48).(Table 8)

Table 8. Profile of Top 20 Most Productive Authorson 'COVID-19 and Cancer'

S.No	Name of the author	Affiliation of the author	TP	TC	CPP	HI	ICP	%ICP	RCI
1	B. Biswas	TMC - Kolkata	12	19	1.58	1	0	0.00	0.30
2	S. Bhatnagar	AIIMS-New Delhi	11	35	3.18	3	0	0.00	0.61
3	A. Batra	AIIMS-New Delhi	9	0	0.00	0	0	0.00	0.00
4	J.P.Agarwal	TMH - Mumbai	8	6	0.75	2	3	37.50	0.14
5	P. Chaturvedi	TMH - Mumbai	8	106	13.25	4	2	25.00	2.54
6	P.Mehta	AIMS - Faridabad	8	0	0.00	0	0	0.00	0.00
7	A.Patel	Army Hospital Research & Referral, New Delhi	8	0	0.00	0	0	0.00	0.00
8	S.Rajan	KG.MU -Lucknow	8	10	1.25	2	0	0.00	0.24
9	N.Akhtar	KGMU - Lucknow	7	10	1.43	2	0	0.00	0.27
10	C.K.Das	PGIMER-Chandigarh	7	0	0.00	0	0	0.00	0.00
11	V.Kumar	KGMU - Lucknow	7	10	1.43	2	0	0.00	0.27
12	C.S.Pramesh	TMH - Mumbai	7	86	12.29	4	3	42.86	2.35
13	J.Bajpai	TMH - Mumbai	6	12	2.00	2	2	33.33	0.38
14	G.Chinnaswamy	TMH - Mumbai	6	15	2.50	3	0	0.00	0.48
15	S.Gupta	TMH - Mumbai	6	14	2.33	2	0	0.00	0.45
16	S.Gupta	KGMU - Lucknow	6	24	4.00	2	0	0.00	0.77
17	V.G.Gupta	AIIMS-New Delhi	6	0	0.00	0	0	0.00	0.00
18	S.Bakhasi	AIIMS-New Delhi	5	8	1.60	2	0	0.00	0.31
19	S.Bhethanabhotia	PGIMER-Chandigarh	5	0	0.00	0	0	0.00	0.00
20	D.Chakrabarti	K.GMU - Lucknow	5	3	0.60	1		0.00	0.11
		Total of 20 authors	145	358	2.47	1.6	10	6.90	0.47
		India's total	520	2713	5.22				
		Share of 20 authors in India's total	27.88	13.20					

Figure 2 shows the Indian author's co-authorship network using VOSViewer. Of the 2234 authors, 56 authors were on the threshold of the selection of authors with at least 5 articles. Only 56 top authors were selected to clearly visualize the author network. The various colors represent a total of 5 clusters connected together, with 166 connections indicating collaboration with a total strength of 442 for all clusters. Of these, cluster 1 is represented with red color and consists of 16 authors including J.P. Agarwal, S. Bhatnagar, A. Das, R. Garg, A. Gupta, N. Gupta, R. Gupta, and others. Cluster 2 is represented with green color and consists of 13 authors, including S. Bakhshi, A. Singh, V. Patil, and others. Cluster 3 is represented with blue color and consists of 11 authors, including A. Batra, B. Biswas, C.K. Das, S. Ganguly, and others. Cluster 4 is represented with yellow color and consists of 8 authors, including D. Chakrabarti. S. Gupta, V.Kumar, S. Sharma, and others. Lastly, Cluster 5 is represented with purple color and consists of 3 authors, including J. Bajpai, S. Banerjee, and M. Lambertini.

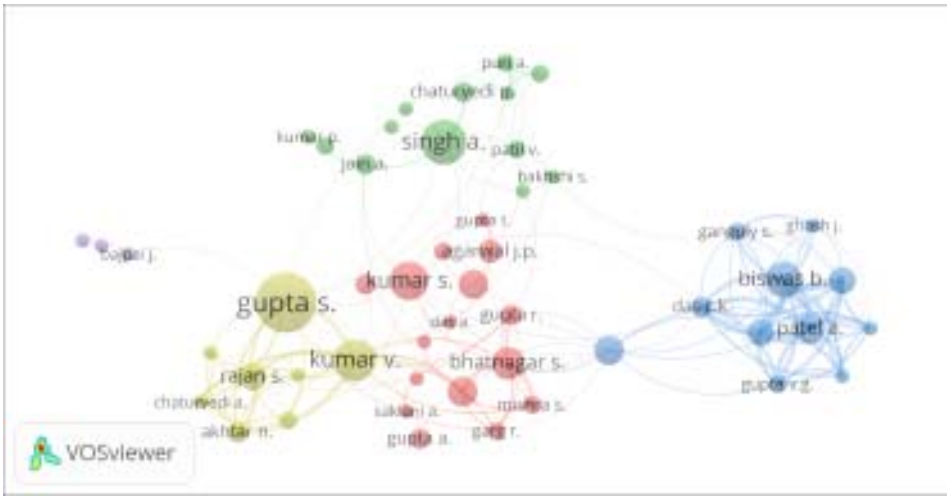

Fig.2: Authors Co-authorship Network

392 PROFILE OF TOP 20 JOURNALS

Of the total 520 Indian publications on 'Covid-19 and Cancer', 517 publications are published in 150 journals and 3 papers in book series.. Of the 150 journals participated unevenly in global research on "Covid-19 and Cancer": 138 journals contributed 1-5 papers each, 4journals 6-10 papers each and 8 journals 11-28 papers each.The top 20 journals that published the most papers are presented in Table 8, and these 15 journals contributed 196 papers, constituting 38.06% shareof total journal publications in this research field.

On further analysis it was found that (I) the top 5 most productive journals

include *Indian Journal of Medical and Paediatric Oncology*(28 papers),*Indian Journal of Surgical Oncology*(19 papers), *Journal of Surgical Oncology* (18 papers), *Oral Oncology*(17 papers) and *Indian Journal of Cancer*(13 papers); and (ii) the top five journals in terms of citation impact per paper are: *Clinical Oncology* (19.17), *JCO Global Oncology* (19.09), *Indian Pediatrics* (17.80), *Diabetes and Metabolic Syndrome Clinical Research & Review* (17.0) and *Asia Pacific Journal of Cancer Prevention* (15.20). (Table 9)

Table 9. Profile of 20 Top Journals on 'Covid-19 and Cancer '

S.No	Name of the journal	TP	TC	CPP
1	Indian Journal of Medical and Paediatric Oncology	28	7	0.25
2	Indian Journal of Surgical Oncology	19	42	2.21
3	Journal of Surgical Oncology	18	64	3.56
4	Oral Oncology	17	51	3.00
5	Indian Journal of Cancer	13	10	0.77
6	Pediatric Blood & Cancer	12	39	3.25
7	Ecancermedicalscience	11	5	0.45
8	JCO Global Oncology	11	210	19.09
9	Indian Journal of Palliative Care	9	15	1.67
10	Indian Journal of Anaesthesia	7	30	4.29
11	Clinical Oncology	6	115	19.17
12	Indian Journal of Gynecologic Oncology	6	11	1.83
13	Asia Pacific Journal of Cancer Prevention	5	76	15.20
14	Diabetes and Metabolic Syndrome Clinical Research & Review	5	85	17.00
15	Indian Journal of Pediatrics	5	5	1.00
16	Indian Pediatrics	5	89	17.80
17	Indian Journal of Research in Pharmaceutical Sciences	5	1	0.20
18	Lancet Oncology	5	73	14.60
19	World Neurosurgery	5	10	2.00
20	BMJ Case Reports	4	1	0.25
	Total of 20 journals	196	939	4.79
	India's total	515		
	Share of top 20 journals in India's total	38.06		

Figure 3 shows the current relationship to the bibliographic coupling. A bibliographic coupling occurs when two articles refer to the third most popular article in their bibliography. This suggests that the two studies are likely to focus on a related topic. This map shows 4 clusters of journals related to 'Covid-

19 and Cancer.' In the Cluster 1, the journals *Indian Journal of Surgical Oncology* and *Indian Journal of Cancer* were highlighted, in the cluster 2 the journals *Oral Oncology* and *Journal of Surgical Oncology*, in the cluster 3 the journals *Indian Pediatrics* and *Pediatric Blood and Cancer* and in the cluster 4 the journals *Indian Journal of Medical and Paediatric Oncology* and *Indian Journal of Urology*. A group of journals related to 'Covid-19 and Cancer' is also highlighted. Hence, this map shows the relationship between each journal and the impact of their studies on this research area.

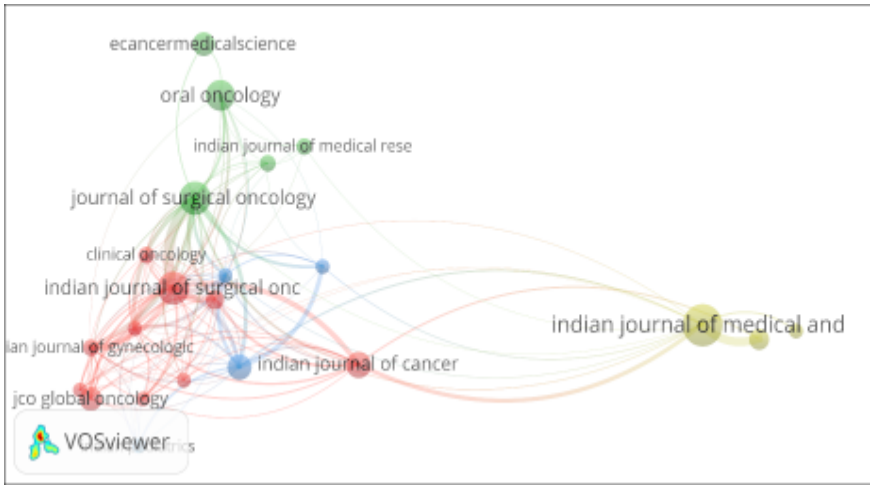

Figure 3: Bibliographic coupling of Indian journals related to 'Covid-19 and Cancer'

393 HIGH CITED PAPERS

The high-cited papers from Indian 'Covid-19 and Cancer' are listed in Table 10 along with the total citations received. Interestingly all the papers are published in 2020 and were published in different journals. The paper by A. Hussainet al is received a total of 301 citations, the next four papers are received citations between 100 – 162, and the remaining papers are received citations 40 – 100.

Table 10: Top 15 High-Cited Papers on "Covid-19 and Cancer" from India

Author(s)	Year	Title	Journal Name	TC
Hussain A et al	2020	COVID-19 and diabetes: Knowledge in progress	Diabetes Research and Clinical Practice	301
Desai A et al	2020	Covid-19 and cancer: Lessons from a pooled meta-analysis	JCO Global Oncology	162
Bhaskar S et al	2020	Cytokine Storm in COVID-19—Immunopathological Mechanisms, Clinical Considerations, and Therapeutic Approaches: The REPROGRAM Consortium Position Paper	Frontiers in Immunology	128
Coles C.E et al	2020	International Guidelines on Radiation Therapy for Breast Cancer During the COVID-19 Pandemic	Clinical Oncology	114
Singh A.K et al	2020	Prevalence of co-morbidities and their association with mortality in patients with COVID-19: A systematic review and meta-analysis	Diabetes, Obesity and Metabolism	113
Singh K.K et al	2020	Decoding sars-cov-2 hijacking of host mitochondria in covid-19 pathogenesis	American Journal of Physiology - Cell Physiology	94
Shankar A et al	2020	Cancer care delivery challenges amidst coronavirus disease -19 (covid-19) outbreak: Specific precautions for cancer patients and cancer care providers to prevent spread	Asian Pacific Journal of Cancer Prevention	76
Renu K et al	2020	Coronaviruses pathogenesis, comorbidities and multi-organ damage – A review	Life Sciences	71
Balasubramanian S et al	2020	Coronavirus Disease 2019 (COVID-19) in Children - What We Know So Far and What We Do Not	Indian Pediatrics	67
Pramesh C.S and Badwe R.A.	2020	Cancer management in India during COVID-19	New England Journal of Medicine	64
Fu J et al	2020	Expressions and significances of the angiotensin-converting enzyme 2 gene, the receptor of SARS-CoV-2 for COVID-19	Molecular Biology Reports	63
Mehanna H et al	2020	Recommendations for head and neck surgical oncology practice in a setting of acute severe resource constraint during the COVID-19 pandemic: an international consensus	The Lancet Oncology	54
Nandy K et al	2020	Coronavirus disease (COVID-19): A systematic review and meta-analysis to evaluate the impact of various comorbidities on serious events	Diabetes and Metabolic Syndrome: Clinical Research and Reviews	50
Dariya B et al	2020	Understanding novel COVID-19: Its impact on organ failure and risk assessment for diabetic and cancer patients	Cytokine and Growth Factor Reviews	42
Chan J.C.N et al	2020	The Lancet Commission on diabetes: using data to transform diabetes care and patient lives	The Lancet	40

With bibliographic coupling, the relationship between two documents is determined by the number of references between the two articles. But, in co-citation, the correlation is determined by the frequency with which they are cited together. This analysis is important to identify pairs of most cited articles. Bibliographical coupling is reviewed while citing together is a futuristic perspective. The map of the co-citation of articles is presented in Figure 4. The paper "COVID-19 and diabetes: Knowledge in progress" by Hussain, Akhtar et al. published by Diabetes Research and Clinical Practice in 2020, has counted highest number of citations (TC=301), followed by the paper by "Desai, Aakash et al. "COVID-19 and Cancer: Lessons from a Pooled Meta-Analysis." *JCO global oncology* vol. 6 (2020)" has received the 162 citations and the paper by "Coles, C E et al. "International Guidelines on Radiation Therapy for Breast Cancer During the COVID-19 Pandemic." *Clinical oncology (Royal College of Radiologists (Great Britain))* vol. 32,5 (2020)" has received 114 citations. It is noted that authors with more publications and citations (e.g. P. Chaturvedi and C.S.Pramesh) do not necessarily have a significant influence in this regard. The larger citations from these authors may be due to the larger number of articles they produced, but these articles are typically not read by other scholars in the field.

Fig.4: Highly cited papers Co-citation network

4 SUMMARY AND CONCLUSION

Global research on 'Covid-19 and Cancer' had an uneven partcipitation of 70 countries in 9143 global publications as indexed in Scopus database. of which the top 10 countries together contributed 8572 papers, which constitutes 93.75% share of global publications. USA (2641 papers), Italy (1357 papers) and U.K. (1153 papers) leads in global contribution and contributed above the group average (857.2) of top 10 countries publications.. China (24.56), Spain (14.52) and Italy (13.12) leads in citation impact per paper and registered their citation impact above the group average (12.56) of top 10 countries (Table 1).

Only 520 (5.89%) publications were out of 9143 global publications were

from India and they together received . 2713 citations, averaging 5.22 citations per publication. The 63 (12.11%) out of 520 India's publication received external funding support from various research agencies and together registered 588 citations, averaging 8.25 citations per paper.

The adults population age group constituted the largest group (15.38%) among India's total publications, followed by children (9.62% share), adolescents (9.62% share), aged (8.46% share) and adolescents (4.81% share).

India's publications (520) on 'Covid-19 and Cancer' are scattered across four broad subject categories (as per Scopus database classification), with largest publication share (88.46%) coming from Medicine, followed by Biochemistry, Genetics & Molecular Biology (22.12%), Pharmacology, Toxicology and Pharmaceutics (7.69%) and Immunology and Microbiology (4.62%).

The most significant keywords associated with 'Covid-19 and Cancer' as reflected in their frequency of appearance are Covid-19, Pandemic (332), Neoplasms (175), Cancer Patients (112), Malignant Neiplasm (100), Cancer Surgery (79), Cancer Chemotherapy (66), etc.

Lung Cancer research constitutes the largest publications share (9.42%) among India's total publications, followed by Head and Neck Cancer (8.27% share), Breast Cancer (7.31% share), Mouth Cancer (5.38% share), Blood Cancer (5.19% share), Female Genital Track Cancer (4.23% share), Uterine Cervix Track Cancer (3.85% share), Ovary Cancer (3.46% share), Prostate Cancer (3.27% share), Liver Cancer (3.08%), Colorectal Cancer (2.69% share) et al.

Surgery as a treatment method accounted for the largest publications share (20.18%) among India's total publication, followed by Chemotherapy (15.19% share), Radiotherapy (11.35% share), Epidemiology (6.92% share), Palliative Care (6.73% share), Diagnosis (6.549% share), Pathology (6.35% share), Screening (2.12% share), Quality of Life (2.12% share) and Prognosis (1.73% share).

In all 160 organisations and 243 authors participated unevenly in global research on "Covid-19 and Cancer", of which the top 20 organizations and authors together contributed 78.65% and 27.88% and 54.44% and 13.20% respectively share inIndia's total publications and citations.

B. Biswas (12 papers), S. Bhatnagar (11 papers), A. Batra (9 papers), J.P. Agarwal, P. Chaturvedi, P.Mehta, A Patel and A. Rajan (8 papers each); (ii) Five authors registered citation (14.4 and 1.49), per paper and relative citation index above their group average (2.47 and 0.47): P. Chaturvedi (13.25 and 2.54), C.S. Pramesh (12.29 and 2.35), S. Gupta (4.0 and 0.77), S. Bhatnagar (3.18 and 0.61) and G.Chinnaswamy (2.50 and 0.48).(Table 8)

The top most productive organisations were: Tata Memorial Hospital, Mumbai (75 papers), All India Institute of Medical Sciences, New Delhi (63 papers), Homi Bhabha National Institute, Mumbai (59 papers) and Postgraduate Institute of Medical Education & Research, Chandigarh (35 papers). The top most impactful organizations in terms of citations per paper and relative citation index were Tata Medical Center, Kolkata (13.0 and 2.49), BHU-Varanasi (12.70 and 2.43), VMMC & Safdarjang Hospital, New Delhi (5.0 and 0.96), Tata Memorial Hospital, Mumbai (4.73 and 0.91) and Postgraduate Institute of Medical Education & Research, Chandigarh (4.0 and 0.77)

The top most productive authors were B. Biswas (12 papers), S. Bhatnagar (11 papers), A. Batra (9 papers), J.P. Agarwal and , P. Chaturvedi (8 papers). The top most impactful authors were C.S. Pramesh (12.29 and 2.35), S. Gupta (4.0 and 0.77), S. Bhatnagar (3.18 and 0.61) and G.Chinnaswamy (2.50 and 0.48).

Indian Journal of Medical and Paediatric Oncology (with 28 papers) was the most productive journal contributing on this theme, followed by, *Indian Journal of Surgical Oncology* (19 papers), *Journal of Surgical Oncology* (18 papers), *Oral Oncology* (17 papers) and *Indian Journal of Cancer* (13 papers). *Clinical Oncology* (19.17) was the most impactful journal on this theme, followed by *JCO Global Oncology* (19.09), *Indian Pediatrics* (17.80), *Diabetes and Metabolic Syndrome Clinical Research & Review* (17.0) and *Asia Pacific Journal of Cancer Prevention* (15.20).

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