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Colorectal Cancer Research in SAARC Countries: A Scientometric analysis

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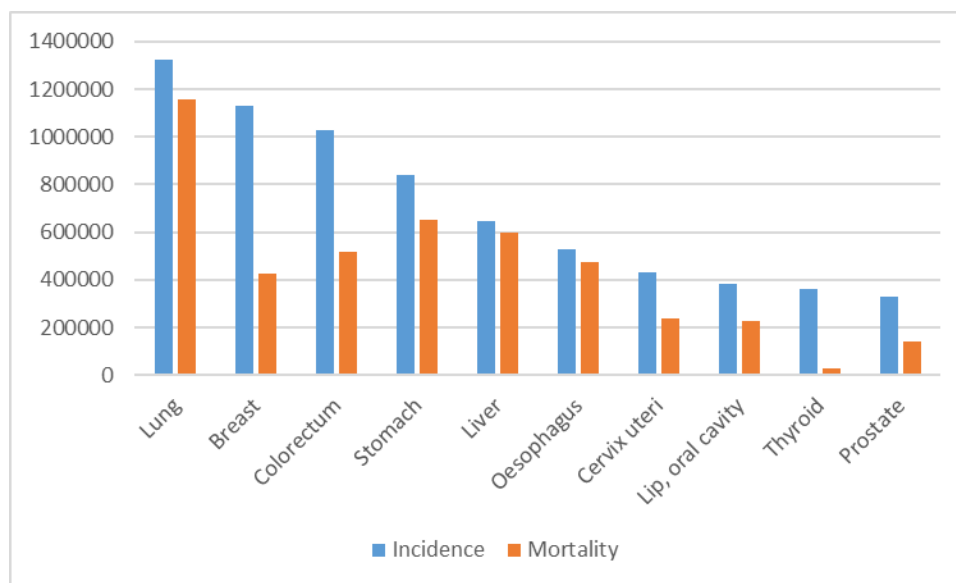
Abstract

The study examined 2053 papers related to the publications of SAARC Countries on Colorectal cancer indexed in the web of science databases during 2010- 2018. The world colorectal cancer output (116203 publications) was formed from several countries. The present study analyzed the research output, authorship pattern, collaborative pattern, and activity index of five SAARC Countries viz. India, Pakistan, Bangladesh, Sri Lanka, and Nepal. The study revealed that India is a leading country among the five SAARC Countries with major research contributions. India's continuous collaboration with other developed countries shows a higher activity index particularly in the context of individual research productivity. Developed countries like the USA, Australia, and the UK are the top collaborating countries with SAARC regions.

Keywords: Scientometrics, Colorectal Cancer, SAARC, Research trends, Collaborative Coefficient, Degree of Collaboration.

Introduction:

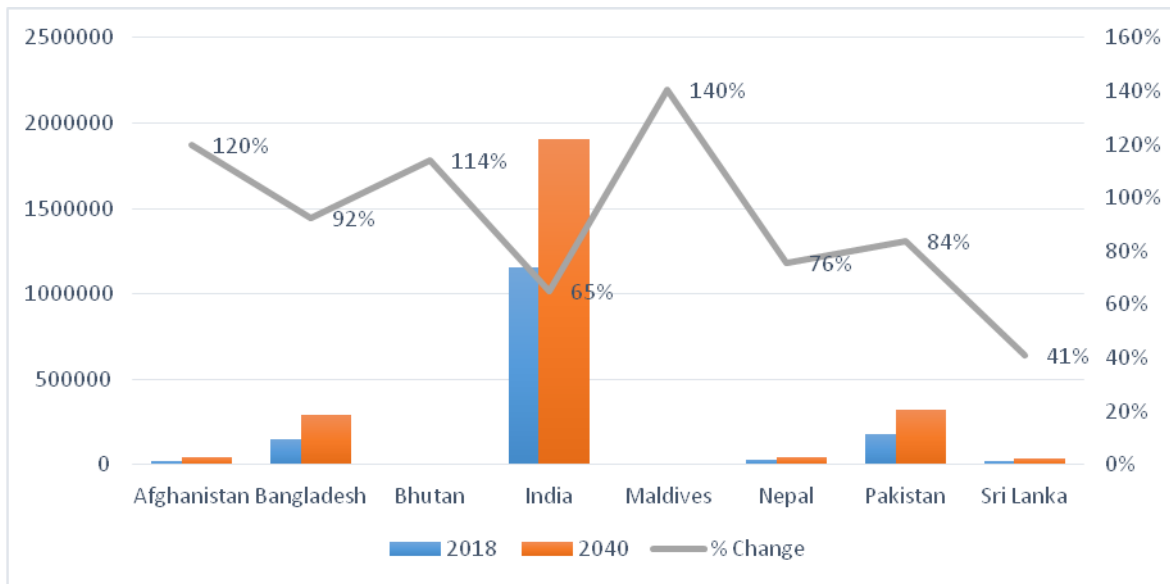
Colorectal cancer (CRC) is a common and deadly disease. The risk of developing CRC is influenced by both environment and genetic factors. CRC incidence and mortality rates vary around the world (Arnold et al., 2017). According to the World Health Organization GLOBOCAN database; Globally, CRC is the third most commonly diagnosed cancer in males and second in females, with 1.8 million new cases and led to 861000 deaths in 2018. Rates are substantially higher in males than females. The figure presented below shows the estimated number of incidents and mortality worldwide of which Colorectal Cancers are among the major cases found (Bray et al., 2018). The estimated number of cancer incidents and mortality in SAARC Countries also shows Colorectal cancer is one of the most common causes.



Source: Globocan, 2018. International Agency for Research in Cancer, WHO

Figure 1: Estimated number of Cancer incident and mortality of SAARC

Chandrasinghe et al., 2017 in their observation, colorectal cancer (CRC) related incidence have been significantly increasing in the south Asian region due to changing socio-economic landscape and population demographics. They also pointed out that the observed pattern may vary due to the lack of robust high-quality data from this region to evaluate the disease pattern and comparison. South Asian Association for Regional Cooperation (SAARC) is the geopolitical, economic and regional intergovernmental organization union of nations in South Asia. SAARC includes eight countries viz. Afghanistan, Bangladesh, Bhutan, India, Nepal, Maldives, Pakistan and Sri Lanka. SAARC comprises 3% of the world's area and 9.12% of the global economy. The population across all of the member countries is over 1.7 billion, accounting for 21% of the world's population. Therefore, it is important to study the CRC related research collaboration undertaken in this region to counter the increasing cases.



Source: Globocan, 2018. International Agency for Research in Cancer, WHO

Figure 2: Estimated number of incident cases 2018-2040

Review of Literature:

There were ample numbers of literature that considered various aspects globally few studies are related to the SAARC region on various disciplines. The studies related to various disciplines such as Chronic Liver Disease (CLD) research output by Naheem et al., (2017) in SAARC Countries during 1996- 2005; using the Scopus database. They focused on the pattern of literature growth, global publications share and ranking, authorship pattern, collaborative coefficient, productivity and impact of most productive institutions and authors, sources and highly cited papers; on authorship pattern and collaboration in biotechnology, research Singh, (2018) used Scopus database from 2007- 2016. Their studies showed that India is the most productive and highest contributor among the SAARC countries. Batcha, (2018) evaluated the research output in cardiovascular disease research for five SAARC countries and found that India is the principal contributor among the SAARC nations. A study on research productivity was also found in other disciplines like social science wherein they (Dhawan et al., 2015) examined composition and dynamics of social science research output in five South Asian countries during 1996- 2013, by using Scopus and Scimago database. It reveals that social sciences research in South Asia shows to be growing exponentially, doubled in publication every six years. Among five South Asian countries, India's share 84%; followed by Pakistan 6.4% and Bangladesh 3.2%. Research performance in Library & Information Science of SAARC countries during 1996-2015 were also evaluated by using the Scopus database and found India is the most productive country in LIS research (Shukla & Maurya, 2018); (Uddin & Singh, 2014a), examined computer science research in SAARC countries during the last 25 years, focusing on global share and rank, growth trends and impact, collaboration levels within and outside of SAARC countries, top-ranking institutions and individuals in the region, most preferred journals in the region, and text-based research. We also found that they (Uddin & Singh, 2014b) also measured the overall research output and collaboration in South Asian countries and their contribution globally. To our knowledge from previous literature search, no studies have examined the productivity in CRC research output particularly in the SAARC region. The previous studies (Chinnaraj, M., & Narzary, R., 2018), (Narzary, R., & Murugan,

C., 2018) failed to focus on the SAARC region. Hence the present study is set to throw light on CRC research productivity of the SAARC region using the Scientometrics approach.

Objectives:

The main objective of the study is to analyze colorectal cancer research output among five SAARC Countries like India, Pakistan, Bangladesh, Sri Lanka, and Nepal; based on publications output as indexed in the web of science database. The study is set to focus on the following aspects like; trends in growth of Colorectal Cancer research in SAARC Countries, document wise distribution of CRC research in SAARC, authorship pattern, collaboration coefficient analysis of SAARC Countries, Activity Index and its top international collaborating countries.

Materials and Methods:

The global publication data of five SAARC Countries in colorectal cancer has been retrieved from the web of science databases for the last 9 years (2010-2018). A keyword “colorectal cancer” was used in “title, abstract and keyword” field tag and 2010-2018. An additional filter was set according to the affiliation country to include the publication of eight SAARC countries. Data extracted were saved into text format files for further analysis. A total of 2053 records were retrieved as a research output of five SAARC Countries. For analyzing data, Bibexcel and MS-Excel were used.

The following are some of the measures adopted in this study:

Degree of Collaboration (DC)

The degree of collaboration of authorship was calculated using the formula given by (Subramanyam, 1983).

$$C = \frac{NM}{NM+NS}$$

C= Degree of Collaboration.

NM= No. of Multi-authored papers.

NS= No. of Single author papers.

Collaboration Coefficient (CC)

The measure has been suggested by (Ajiferuke et al., 1988) and based on fractional productivity defined by (Price & Beaver, 1966).

$$cc = 1 - \frac{\sum_{j=1}^k \left(\frac{1}{j}\right) f_j}{N}$$

Where,

F_j denotes the number of j authored research papers,

N denotes the total number of research papers published,

K is the greatest number of authors per paper.

According to Ajiferuke et al., CC tends to zero as single author paper dominated and to 1-1/j as j authored papers dominated. This implies that the higher the value of CC, the higher the probability of multi or mega authored papers.

Modified Collaboration Coefficient (MCC)

Modified Collaboration Coefficient (MCC) can be defined as (Savanur & Srikanth, 2010)

$$MCC = \frac{A}{A-1} \left\{ 1 - \frac{\sum_{j=1}^k \left(\frac{1}{j} \right) f_j}{N} \right\}$$

Where,

A is the total number of authors in a collection.

MCC is not defined for A=1, i.e., for all single-author publications which are not a factor since collaboration is meaningless unless the existence of two authors available. CC approaches MCC only when $A \rightarrow \infty$, but otherwise strictly less than MCC by the factor $1-1/A$.

Activity Index (AI)

Activity Index (AI) characterizes the relative research efforts of a country in a given subject. In the present study, the Activity Index has been calculated for different years to show the performance of the SAARC Countries during different years. Activity Index was first suggested by Frame and used among others by (Schubert & Braun, 1986), (De Solla Price, 1981), (Karki & Garg, 1997). It is defined as:

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

$$AI = \frac{n_{ij}/n_{io}}{n_{oj}/n_{oo}} \times 100$$

Where,

n_{ij} - Indian output of papers in a particular field

n_{io} - Total Indian output on all subjects

n_{oj} - World output of papers in a particular field

n_{oo} - Total world output on all subjects

Results and Discussion:

Table 1 shows the year-wise growth of Colorectal Cancer analysis of 5 SAARC Countries.

Table 1: Year-wise growth of Colorectal Cancer output

Year	India	Pakistan	Bangladesh	Sri Lanka	Nepal	Total SAARC
2010	91	5	2	4	0	102
2011	96	8	1	0	0	105
2012	120	11	1	2	1	135
2013	146	15	1	0	1	163
2014	174	16	6	1	2	199
2015	214	33	4	2	5	258
2016	310	29	3	7	5	354

2017	293	50	10	4	3	360
2018	307	46	13	7	4	377
Total	1751	213	41	27	21	2053
% out of 2053	85.289	10.375	1.997	1.315	1.022	100

The world has published 116,203 publications in colorectal cancer during 2010-2018, out of which, the total research output of 5 SAARC Countries amounted to 2053 publications. Among 5 SAARC Countries, India is the highest contributor with 1751 (85.289%) publications; followed by Pakistan with 213 (10.375%), Bangladesh with 41 (1.997%), Sri Lanka with 27 (1.315%) and Nepal 21 with (1.022%). The five SAARC Countries showed the linear growth rate in colorectal cancer research output during the study period. It shows that India has the highest research output in 2016 whereas Bangladesh in 2017, Sri Lanka in 2016 and 2018, and Nepal 2015 and 2016.

Table 2: Document type of Colorectal Cancer research

Document type	Records	%	Citations	Citation Per papers	h-index
Article	1588	77.350	27169	17.108	45
Review	318	15.489	5345	16.808	34
Letter	99	4.822	38	0.383	4
Editorial Material	25	1.217	45	1.800	3
Meeting Abstract	14	0.681	11	0.785	2
Article; Proceedings Paper	5	0.243	13	2.600	2
Article; Book Chapter	2	0.097	17	8.500	1
Article; Retracted Publication	1	0.048	1	1.00	1
Correction	1	0.048	0	1.00	0
Total	2053	100	32639	0.062	

Table 2 shows that the document type distribution of Five SAARC Countries and its contribution to Colorectal Cancer research. It shows nine document types such as Article, reviews, letters, Editorial Material, Meeting Abstract, Article; Proceedings Paper, Article; Book Chapter, Article; Retracted Publication, and Correction. Among them the highest publications were published in the form of Article with 1588 (77.350%), citations with 27169, citation per papers with 17.108 and h-index with 45; followed by Review 318 (15.489%), citations 5345, citation per papers 16.808 and h-index with 34. The lowest publication was found in Article; Retracted Publication and Correction with 1 (0.048%), a citation with 1 and 0, citation per papers with 1.00 and h-index is 1 and 0.

Table 3: Authorship pattern of Colorectal Cancer

No. of Authors	No. of Papers	%
Single Author	52	2.532
Two Authors	202	9.839
Three Author	292	14.223
Four Authors	312	15.197
Five Author	310	15.099

Six Authors	223	10.862
Seven Author	183	8.913
Eight Authors	110	5.358
Nine Author	84	4.091
Ten and above Authors	285	13.882
Total	2053	100

Table 3 indicates the authorship pattern on colorectal cancer research of five SAARC Countries. The highest number of the papers was published by four authors i.e.312; followed by five authors i.e.310, three authors with 292, ten and above authors with 285, six authors with 223, two authors with 202 respectively. The least number of papers was published by a single author with i.e.52. Table 4 shows that the Collaboration Coefficient Analysis of India. Among the five SAARC Countries, India has the highest publication records of 1751.

Table 4: Collaboration Coefficient analysis of India

Year	Single Author	Two authors	Three authors	Four Authors	Five and above authors	Total	CC	MCC	DC
2010	2	13	16	11	49	91	0.289	0.292	0.538
2011	3	19	9	16	49	96	0.305	0.308	0.510
2012	3	19	15	23	60	120	0.293	0.295	0.500
2013	3	15	19	31	78	146	0.275	0.276	0.534
2014	2	13	25	25	109	174	0.257	0.258	0.626
2015	5	18	25	25	141	214	0.265	0.266	0.658
2016	8	31	46	47	178	310	0.278	0.278	0.574
2017	10	29	43	29	182	293	0.281	0.281	0.621
2018	10	28	48	51	170	307	0.282	0.282	0.553
Total	46	185	246	258	1016	1751	0.278	0.278	0.580

CC= Collaboration Coefficient; MCC= Modified Collaborative Coefficient; DC= Degree of Collaboration.

India's author collaboration implies that the multi-authored contributed the highest number of papers i.e.1016; followed by four authors with 258, three authors with 246, and two authors with 185. And the least number of publications was contributed by a single author. The average CC and MCC are the same as 0.278 and DC is 0.580. The highest CC of 0.305 and MCC of 0.308 is identified in 2011 and the lowest of CC is 0.257 and MCC is 0.258 in 2014.

Table 5: Collaboration Coefficient analysis of Pakistan

Year	Single author	Two authors	Three authors	Four authors	Five and above authors	Total	CC	MCC	DC
2010	0	1	1	1	2	5	0.704	0.880	0.400
2011	0	1	2	2	3	8	0.717	0.819	0.375
2012	0	0	1	3	7	11	0.774	0.851	0.636
2013	0	1	4	5	5	15	0.728	0.779	0.333
2014	0	0	2	7	7	16	0.761	0.811	0.437

2015	0	0	11	3	19	33	0.751	0.774	0.575
2016	0	1	2	3	23	29	0.775	0.802	0.793
2017	1	8	5	8	28	50	0.722	0.736	0.560
2018	4	1	7	3	31	46	0.700	0.715	0.673
Total	5	13	35	35	125	213	0.732	0.735	0.586

CC= Collaboration Coefficient; MCC= Modified Collaborative Coefficient; DC= Degree of Collaboration.

Table 5 represents the author's collaboration analysis of Pakistan. A total of 213 records were published. The contribution was mostly in the form of multi-authored publications with 125; followed by three and four authored with 35, two authors with 13. The least publication was by a single author. The average number of CC is 0.732, MCC is 0.735 and DC is 0.586. The highest CC of 0.775 is found in 2016 and the lowest is 0.700 in 2018. The highest MCC is 0.880 in 2010 and the lowest of 0.715 in 2018. The highest DC 793 was in 2016.

Table 6: Collaboration Coefficient analysis of Bangladesh

Year	Single author	Two authors	Three Authors	Four authors	Five and above authors	Total	CC	MCC	DC
2010	0	0	1	0	1	2	0.735	1.470	0.500
2011	0	0	0	0	1	1	0.800	0.000	1.000
2012	0	0	0	0	1	1	0.800	0.000	1.000
2013	0	0	0	0	1	1	0.800	0.000	1.000
2014	1	0	0	1	4	6	0.658	0.789	0.666
2015	0	0	0	2	2	4	0.775	1.033	0.500
2016	0	1	0	0	2	3	0.700	1.050	0.666
2017	0	1	0	2	7	10	0.760	0.844	0.700
2018	0	0	1	3	9	13	0.778	0.842	0.692
Total	1	2	2	8	28	41	0.749	0.767	0.682

CC= Collaboration Coefficient; MCC= Modified Collaborative Coefficient; DC= Degree of Collaboration

Table 6 indicates the author's collaboration coefficient analysis of Bangladesh. The total output of 41 records was published during 2010-2018. In the case of a single-author publication, it was found only one record during our study period. The papers were contributed by multi-authors with 28 records; followed by four authors' i.e.8, two and three authors with 2 publications. The average number of CC is 0.749, MCC is 0.767 and DC is 0.682. The highest CC of 0.800 is found in 2011, 2012, 2013 and the lowest is 0.658 in 2014. The highest MCC is 1.470 in 2010 and the lowest of 0.842 in 2018. The highest DC of 1.000 is found in 2011, 2012 and 2013.

Table 7: Collaboration Coefficient analysis of Sri Lanka

Year	Single author	Two authors	Three authors	Four authors	Five and above authors	Total	CC	MCC	DC
2010	0	0	0	1	3	4	0.787	1.049	0.750
2011	0	0	0	0	0	0	0.000	0.000	0.000
2012	0	0	0	1	1	2	0.775	1.550	0.500
2013	0	0	0	0	0	0	0.000	0.000	0.000

2014	0	0	0	0	1	1	0.800	0.000	1.000
2015	0	0	0	1	1	2	0.775	1.550	0.500
2016	0	0	2	1	4	7	0.755	0.880	0.571
2017	0	0	1	1	2	4	0.755	1.006	0.500
2018	0	0	2	1	4	7	0.755	0.880	0.571
Total	0	0	5	6	16	27	0.764	0.793	0.592

CC= Collaboration Coefficient; MCC= Modified Collaborative Coefficient; DC= Degree of Collaboration

Table 7 explains the collaboration coefficient analysis of Sri Lanka. The total output of 27 records has been published during the study period. The single author and two authors have not contributed during the study. The multi-authored publication has the highest record with 16; followed by four authored 6, three authors with 5 publications. The average number of CC is 0.764, MCC is 0.793 and DC is 0.592. The highest CC of 0.800 is observed in 2014 and the lowest is 0.755 in 2016, 2017 and 2018. The highest MCC is 1.550 in 2015 and the lowest of 0.880 in 2016 and 2018. The highest DC of 1.000 is found in 2014.

Table 8: Collaboration Coefficient analysis of Nepal

Year	Single author	Two authors	Three authors	Four authors	Five and above authors	Total	CC	MCC	DC
2010	0	0	0	0	0	0	0.000	0.000	0.000
2011	0	0	0	0	0	0	0.000	0.000	0.000
2012	0	1	0	0	1	2	0.650	1.300	0.500
2013	0	0	1	0	0	1	0.670	0.000	0.000
2014	0	0	0	0	2	2	0.800	1.600	1.000
2015	0	0	1	1	3	5	0.764	0.955	0.600
2016	0	1	0	1	3	5	0.730	0.912	0.600
2017	0	0	2	0	1	3	0.713	1.069	0.333
2018	0	0	0	0	3	3	0.800	1.200	1.000
Total	0	2	4	2	13	21	0.741	0.430	0.619

CC= Collaboration Coefficient; MCC= Modified Collaborative Coefficient; DC= Degree of Collaboration.

Table 8 shows the collaboration coefficient analysis of Nepal. The total output recorded by Nepal is 21. Single authors have no publications. The multi-authors published the highest number of papers with 13; followed by three authors with 4, two and four authors with 2 publications. The average number of CC is 0.741, MCC is 0.430 and DC is 0.619. The highest CC of 0.800 is observed in 2014 and 2018 and the lowest is 0.650 in 2012. The highest MCC is 1.600 in 2014 and the lowest of 0.912 in 2016 and 2018. The highest DC of 1.000 is found in 2014 and 2018.

Table 9: Activity Index of five SAARC Countries

Year	World Output	India	Activity Index	Pakistan	Activity Index	Bangladesh	Activity Index	Sri Lanka	Activity Index	Nepal	Activity Index	Total SAARC
2010	9230	91	65.365	5	29.471	2	61.335	4	186.901	0	0.000	102

2011	9809	96	64.928	8	44.431	1	28.791	0	0.000	0	0.000	105
2012	11100	120	71.727	11	54.031	1	25.445	2	77.486	1	49.842	135
2013	11647	146	83.133	15	70.259	1	24.275	0	0.000	1	47.504	163
2014	12495	174	92.372	16	69.860	6	136.093	1	43.418	2	88.558	199
2015	14410	214	98.548	33	124.919	4	78.629	2	59.677	5	191.935	258
2016	15554	310	132.286	29	101.718	3	54.633	7	193.721	5	177.877	354
2017	16192	293	120.100	50	168.485	10	175.089	4	106.317	3	102.512	360
2018	15766	307	129.277	46	138.421	13	233.775	7	191.150	4	140.412	377
Total	116203	1751	1.506	213	0.183	41	0.035	27	0.023	21	0.018	2053

Table 9 shows the Activity Index of SAARC Countries in colorectal cancer research output. The world CRC research output shows an increasing pattern from 2010-2018. India has recorded an overall activity index of 1.506. India's highest Activity Index came in 2016 (132.286) and the lowest found in 2011 (64.928). Pakistan has recorded 0.183 overall activities in the present study. Pakistan's highest Activity Index came in 2017 (168.485) and the lowest was in 2011 (29.471). Bangladesh has recorded 0.035 overall activities. The highest percentage of activity index by Bangladesh recorded in the year 2018 (233.775) and the lowest activity output in 2012 (25.445). The overall activity index of Sri Lanka is 0.023. Nepal has recorded 0.018 overall activities during the study period.

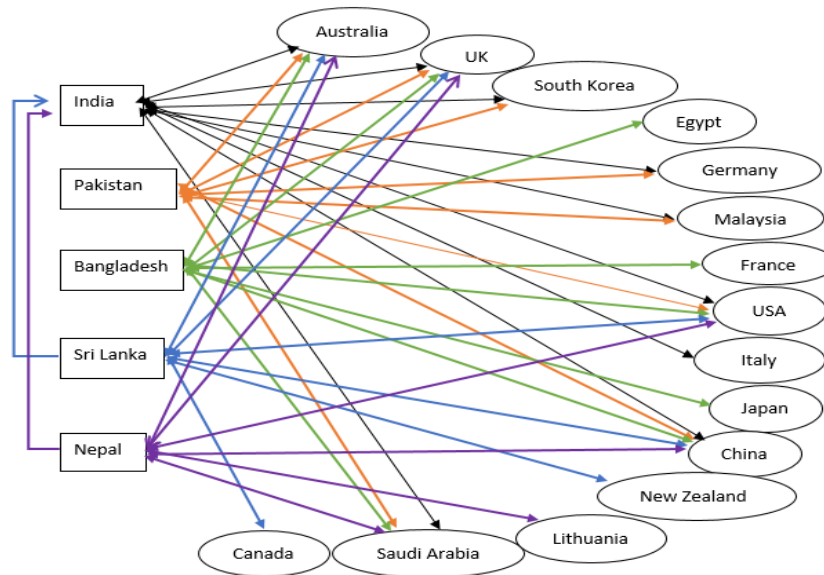


Figure 3: International Collaboration of SAARC Countries

Figure 3 shows the top international collaborating countries with SAARC. For example, if we see at the figure the black line with the arrow indicates India's major collaborating countries are Australia, UK, USA, South Korea, Malaysia, Italy, China, Saudi Arabia. The highest collaborating partner in the case of India in the US. Similarly, an orange line with an arrow shows Pakistan's collaborating country. The Peoples Republic of China is the highest

collaborating partner of Pakistan; Bangladesh's highest collaborating partner is Australia; Sri Lanka with Australia and Nepal's collaborating country is India.

Findings and Conclusion:

The findings from the study revealed that out of 116,203 publications in colorectal cancer, 2053 research output was published by 5 SAARC Countries. Among the SAARC, India is the highest contributor with 1751 (85.289%) publications of which publications were published in the form of Article i.e. 1588 (77.350%), with 27169 citations per paper with 17.108 and h-index of 45. The authorship pattern on colorectal cancer research of five SAARC Countries under shows that most of the papers were published by the collaboration of four authors i.e. 312, while the least number of papers was published by a single author with 52 records. Collaboration Coefficient among five SAARC countries shows that India has the highest publication records with a total of 1751 publications, out of which 1016 publications were contributed by multi- authors. The average CC and MCC are the same as 0.278 and DC is 0.580. The author's collaboration of Pakistan also shows that most of the publications are multi-authored i.e. of 125 records. The average number of CC is 0.732, MCC is 0.735 and DC is 0.586. The author's collaboration coefficient of Bangladesh shows the total output of 41 records from 2010-2018. Most of the papers (28) were Multi-authored with an average number of CC as 0.749, MCC as 0.767 and DC as 0.682. Sri Lanka too exhibited the same results with most of the publication by multi-authored collaboration with 16 records. The average number of CC is .764, MCC is 0.793 and DC is 0.592. Nepal also had most of its contributions to multi-authored collaboration with 13 records. The average number of CC is 0.741, MCC is 0.430 and DC is 0.619.

Activity Index of five SAARC Countries in colorectal cancer research output during shows that for India's highest activity was observed during 2016 (132.286) and the lowest in 2011 (64.928); Pakistan's highest activity Index came in 2017 (168.485) and lowest in 2011 (29.471). In the case of Bangladesh, the highest percentage of activity was recorded in 2018 (233.775) and the lowest activity in 2012 (25.445). The overall activity index of Sri Lanka is 0.023. Nepal has recorded 0.018 overall activities during the study period.

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