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Tracheo-esophageal Fistula (TEF) Research: A Scientometric Assessment of Global Publications during 2000-19

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Abstract

The present study examines 3818 global research publications on "Tracheo-esophageal Fistula" (TEF), based on indexed publications from Scopus database during 2000-19. It examines global and top 10 most productive countries publication output profile, publications across broad subjects and listing of important keywords indicating research trends, top 25 organizations and authors profile, prominent media of communications and identifying the characteristics of high-cited papers, using various bibliometric parameters. The global research on "Tracheo-esophageal Fistula" registered 4.43% and 48.24% annual and ten-year cumulative growth and averaged 12.83 citations per paper. The TEF field witnessed the uneven participation of 104 countries, where 77.21% publications share and 93.82% citations share of the global output and citations originated from top 10 countries. USA leads the ranking with global publication share of 29.28% share, followed U.K. (9.17%), India (7.78%), etc. during 2000-19. Four countries, namely Netherlands (2.15), Canada (1.62), USA (1.54) and, U.K. (1.24)., registered relative citation index higher than their group average (1.22). 559 organizations and 656 authors participated in global research on "Tracheo-esophageal Fistula" during 2000-19, of which the top 25 global organizations and authors contributed 21.08% and 8.17% to global publication share and 33.93% and 16.14% global citation share respectively during 2000-19. University College London, U.K (61 papers), Harvard Medical School, USA and Cincinnati Children's Hospital Medical Center, USA (48 papers each) were found to be the most productive organizations. Massachusetts General Hospital, USA (37.86 and 2.95), UCL Institute of Child Health, U.K. (33.52 and 2.61) and Mayo Clinic, USA (33.29 and 2.59) were found to be the most impactful organizations in terms of citation per paper and relative citation index. S.S. Rothenberg, (20 papers), D. Tibboel (18 papers) and P. Bagolan were the most productive authors. G.J. Mathisen (61.27 and 4.78), L. Spitz (61.20 and 4.77) and R.S. Kirby (60.5 and 4.72) were the most impactful authors. Journal of Pediatric Surgery, Pediatric Surgery International (144 papers) and Annals of Thoracic Surgery (67 papers) were the most productive journals. Birth Defects Research. Part A. Clinical and Medical Teratology (38.30) and Seminar in Pediatric Surgery (24.14) were the most impactful journals in terms of citation per paper.

Keywords: *Tracheo-esophageal Fistula; Pediatric Surgery; Global publications; Scientometrics; Bibliometrics*

Introduction

Tracheo-esophageal fistula (TEF) is defined as a congenital (present since birth) or acquired (developed due to some diseases) condition characterized by abnormal communication (fistula) between the esophagus and the trachea. The esophagus is the tube that connects the throat to the stomach. The trachea is the tube that connects the throat to the windpipe and lungs. Normally, when the esophagus and

trachea tubes are not connected, it is called TE fistula or TEF. It can happen in one or more places [1]. In TEF, the pouch, the upper part of the food pipe does not connect with the lower part and stomach. It ends usually in a pouch, which means the food cannot reach the stomach. Instead of a complete food pipe, the TEF babies have two pouches (upper and lower) separated by a gap. Common type includes a blind ended upper pouch (not connected normally to the stomach) and a lower pouch connected to the wind pipe. The trachea is a windpipe tube that connects the throat to the windpipe and lungs) carries air to the lungs. The esophagus carries food to the stomach. Sometimes during development these two tubes do not separate completely but remain connected by a short passage [2].

Although the events leading to separation of the primitive trachea and esophagus are not completely understood, the most commonly accepted hypothesis is that a defect in the lateral septation of the foregut into the trachea and esophagus causes TEF. The trachea and esophagus develop from a common primitive foregut, and at approximately 4 weeks of gestation, the developing respiratory and gastrointestinal tracts are separated by epithelial ridges. The foregut divides into a ventral respiratory tract and a dorsal esophageal tract; the fistula tract is thought to derive from an embryonic lung bud that fails to undergo branching. These defects of mesenchymal proliferation are thought to lead to TEF formation [3-4].

There are three main types of TEF. In 85 to 90 percent of trachea-esophageal fistulas, the top part of the esophagus ends in a blind sac, and the lower part inserts into the trachea. In the second type, the upper part of the esophagus is connected directly to the trachea, while the lower part ends in a pouch. In a rare type of fistula called an H type, both the esophagus and trachea are complete, but they are connected by a small passageway. This is the most difficult type of trachea-esophageal fistula to diagnose, because both eating and breathing are possible. TEFs often occur in babies with additional birth defects.

Tracheo-esophageal fistula can occur due to cancer of the food pipe infiltrating into the wind pipe (and rarely, vice versa) or due to non-cancer (benign) causes like prolonged ventilation, trauma and following some operations [5]. TE fistula is a birth defect, which occurs in 1 in 5,000 births, and occurs as a fetus is forming in its mother's uterus. TE fistula often happens with another birth defect called esophageal atresia. This means your baby's esophagus doesn't form well during pregnancy [1]. When a baby with a TE fistula swallows, liquid can pass through the connection between the esophagus and trachea. When this happens, liquid gets into your baby's lungs. This can cause pneumonia and other problems [1].

Infants with TEF classically present with respiratory distress, feeding difficulties, choking, and risk for aspiration. TEF is most commonly associated with other congenital anomalies, particularly cardiac defects. TEF is a common abnormality of the upper respiratory and digestive track with increased risk in case there is already a family history of this defect. The causes may range chromosomal abnormalities and environmental factors. The TEF may lead to other organ abnormalities of the heart (13 - 34%), backbone (6-21%0, limbs (5 - 9%), anus and rectum (10-16%) and kidney (5-14%) [2].

The diagnosis for Tracheo-esophageal fistula is confirmed by Bronchoscopy and Esophagoscopy. The surgical treatment of Tracheo-esophageal fistula consists of disconnection of the fistula (abnormal communication) and closure of resultant holes in food pipe as well as the wind pipe. We usually try to put some living tissue in between these repaired holes. In the neck this procedure can be easily performed by open method. However, in the chest it requires major Thoracotomy [5].

Literature Review

There is no quantitative study available so far on bibliometric assessment of Tracheoesophageal Fistula research output both at national and international level. However, only one related bibliometric study is available. Feng, Martynov, Suttkus, Lacher and Mayer [6] examined 2170 global publications (from 85 countries published in 388 journals and yielding 26,755 citations) on esophageal atresia (EA) research during 1945 to 2018, indexed in Web of Science database. It studied the quantity and quality as well as key topics in EA research with regards to global collaborations among countries and authors. Publications on EA from 1945 to 2018 were extracted from the Web of Science core collection database. Productivity (quantity) was assessed by the number of publications. Quality was estimated from the number of citations, citation rate per item and year, h-index, and impact index. Collaborative networks were evaluated using VOS viewer. All measures were analyzed for countries, authors, and journals.

Objectzves

The global research output on "Tracheo-esophageal Fistula" was examined in the present study using both quantitative and qualitative indicators, based on indexed publications in Scopus database during 2000-19. In particular, the focus of the study was on analyzing : (i)

publication type and source, (ii) growth in annual and cumulative publications, (Iii) the publications impact, (iv) top 10 countries publications - contribution, impact and share of international collaboration, iv) publications by broad subjects and identification of significant keywords (vi) top 25 organizations and 25 authors - contribution, impact and share of international collaboration, (vii) channels of research communications - most productive and impactful journals and (viii) characteristic features of highly- cited papers.

Methodology

The global research publications on "Tracheo-esophageal Fistula" during 2000-19 was identified, retrieved and downloaded in Scopus (http://www.scopus.com) database using an well-conceived advanced search strategy for the present study. The two keywords, namely "Tracheoesophageal Fistula" or "Tracheo-oesophageal Fistula" were searched in "KEY" AND "TITLE" tags and the search output confined to period '2000-19 (as shown below). This search strategy was refined subsequently by country to identify the top 10 most productive countries in "Tracheo-esophageal Fistula" research. The search strategy yielded 3818 global publications and these publications were further analyzed by broad subjects, collaborating countries, author-wise, organization-wise and journal-wise, etc., by using analytical provisions of Scopus database. Citations to publications were counted from date of their publication till 15 August 2020.

(KEY ("Tracheoesophageal Fistula" or "Tracheo-oesophageal Fistula") OR TITLE("Tracheoesophageal Fistula" or "Tracheo-oesophageal Fistula")) AND PUBYEAR > 1999 AND PUBYEAR < 2020.

Analysis and Results

The global research publications on "Tracheo-esophageal Fistula" (TEF) resulted in 3818 publications in 20 years (2000-19) as covered in Scopus database. The annual output on TEF research registered 4.43% average growth, up from 104 publications in the year 2000 to 220 publications in the year 2019. Its ten-year cumulative publications output registered 48.24% absolute growth, up from 1538 publications during 2000-09 to 2280 publications during 2010-19. The 3818 global TEF publications averaged to 12.83 citations per paper (CPP) during 2000-19, which decreased from 20.01 CPP and 7.99 CPP during 2000-09 to 2010-19. The 73.18% (2794) of the global publications on TEF appeared as articles, followed by reviews (11.94%), letters (5.84%), notes (2.85%), conference papers (2.70%), editorials (1.60%), book chapters (1.26%), short surveys (0.55%), erratum (0.05%) and undefined (0.03%). The 3.72% (142) publication out of 3818 received funding from more than 100 funding agencies. These 142 funded papers have received 1813 citations, averaging 12.77 citations per paper. The largest funding support was provided by National Institute of Health, USA (26 papers), followed by National Natural Science Foundation, China and National Institute of Health Research (16 papers each), etc. (Table 1).

Publication Period	World			
	TP	TC	CPP	FP
2000	104	1925	18.51	
2001	129	2890	22.40	
2002	135	2319	17.18	1
2003	140	4911	35.08	
2004	168	3319	19.76	
2005	155	2783	17.95	1
2006	151	3061	20.27	
2007	171	3312	19.37	3
2008	187	3003	16.06	3
2009	198	3253	16.43	2
2010	193	3306	17.13	3
2011	189	2972	15.72	5
2012	221	2319	10.49	5
2013	242	2519	10.41	8
2014	251	1997	7.96	11
2015	230	1917	8.33	14
2016	239	1411	5.90	11
2017	246	1125	4.57	18
2018	249	504	2.02	30
2019	220	158	0.72	27
200-09	1538	30776	20.01	10
2010-19	2280	18228	7.99	132
2000-19	3818	49004	12.83	142

Table 1: *World Publication Output and Citations Count in Tracheo-esophageal Fistula (TEF) Research during 2000-19. TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; FP=Funded Papers.*

Top 10 most productive countries

104 countries participated unevenly in global "Tracheo-esophageal Fistula" (TEF) research: 73 countries contribute 1 - 10 papers each, 10 countries 11 - 20 papers each, 16 countries 21 - 50 papers each, 3 countries 51-100 papers each, 11 countries 101 - 350 papers each and 1 country 1118 papers.

The 77.21% publications share and 93.82% citations share of the global output and citations on TEF come from top 10 countries. USA leads the ranking with global publication share of 29.28% share, followed U.K. (9.17%), India (7.78%) and 7 countries namely Germany, Japan, Italy, China, Canada, Turkey and Netherlands (from 3.30% to 5.19% share) during 2000 - 19. The global publication increased in USA, China, Canada, Italy, India and Turkey (from 0.13% to 6.03%), as against decrease in Germany, Netherlands, Japan and U.K. (from 0.35% to 3.16%) during 2000-09 to 2010-19. Four countries registered relative citation index higher than their group average (1.22): Netherlands (2.15), Canada (1.62), USA (1.54) and, U.K. (1.24). The share of international collaborative papers in national publication output of these top 10 countries varied from 4.66% (Japan) to 41.61% (Canada), with average value of 15.98% (Table 2).

S.No	Name of the Country	Number of Papers			Share of Papers			TCP	CPP	ICP	%ICP	RCI
		2000-09	2010-19	2000-19	2000-09	2010-19	2000-19	2000-19				
1	USA	395	723	1118	25.68	31.71	29.28	22120	19.79	163	14.58	1.54
2	U.K.	170	180	350	11.05	7.89	9.17	5588	15.97	66	18.86	1.24
3	India	115	182	297	7.48	7.98	7.78	1546	5.21	14	4.71	0.41
4	Germany	83	115	198	5.40	5.04	5.19	3025	15.28	46	23.23	1.19
5	Japan	90	103	193	5.85	4.52	5.06	2074	10.75	9	4.66	0.84
6	Italy	60	128	188	3.90	5.61	4.92	2805	14.92	37	19.68	1.16
7	China	32	133	165	2.08	5.83	4.32	1118	6.78	15	9.09	0.53
8	Canada	46	115	161	2.99	5.04	4.22	3354	20.83	67	41.61	1.62
9	Turkey	60	92	152	3.90	4.04	3.98	878	5.78	9	5.92	0.45
10	Netherlands	63	63	126	4.10	2.76	3.30	3470	27.54	45	35.71	2.15
	Total of 10 countries	1114	1834	2948	72.43	80.44	77.21	45978	15.60	471	15.98	1.22
	World	1538	2280	3818				49004	12.83			
	Share of top 10 countries in global output	72.43	80.44	77.21				93.82				

Table 2: *Global Publication Output and Share of Top 10 Most Productive Countries in "Tracheo-esophageal Fistula" (TEF) Research during 2000-19. TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; ICP=International Collaborative Papers; RI=Relative Citation Index.*

Collaborative linkages among top 10 countries

All the top 10 countries have one to one collaborative linkages, as observed from table 3. The top three countries with largest collaborative linkages (144, 69 and 65) with 7 - 9 other countries each were depicted by USA, Canada and U.K. The top three countries with least collaborative linkages (8, 8 and 12) with 2 countries each were China, Turkey and India. Among country-country collaborative linkages, USA-Canada had registered highest number of collaborative linkages (34), followed by USA-Netherlands (22), USA-Italy (18), USA-U.K. (18), USA-Germany (17), etc (Table 3).

S. No	Country Name	Collaborative Linkages with Other Countries	Total Collaborative Linkages (Number of countries)
1	USA	2(18), 3(10), 4(17), 5(8), 6(18), 7(7), 8(34), 9(6), 10(22)	144 (9)
2	U.K.	1(18), 3(2), 4(11), 5(2), 6(6), 8(15), 9(2), 10(9)	65(8)
3	India	1(10), 2(2)	12(2)
4	Germany	1(17), 2(11), 5(2), 6(7), 8(3), 10(12)	52(6)
5	Japan	1(8), 2(2), 4(2), 6(2), 8(2), 10(2)	18(6)
6	Italy	1(18), 2(6), 4(7), 5(2), 8(8), 10(12)	53(6)
7	China	1(7), 8(1)	8(2)
8	Canada	1(34), 2(15), 4(3), 5(2), 6(8), 7(1) , 10(6)	69(7)
9	Turkey	1(6), 2(2)	8(2)
10	Netherlands	1(22), 2(9), 4(12), 5(2), , 6(12), 8(6)	63(6)

Table 3: *Collaboration Linkages among Top 10 Countries during 2000-19.*

Subject-wise distribution of research output

Among four subjects contributing to global "Tracheo-esophageal Fistula" (TEF) research, medicine accounted for the largest publication share (97.67%), followed distantly by biochemistry, genetics and molecular biology (8.33%), pharmacology, toxicology and pharmaceutics (1.47%) and immunology and microbiology (0.50%) during 2000 - 19. Based on the activity index, it was observed the research activities have increased in biochemistry, genetics and molecular biology (from 79.63 to 113.74), pharmacology, toxicology and pharmaceutics (1.47%) and immunology and microbiology (from 78.39 to 114.58), as against decrease in medicine (from 100.79 to 99.47) during 2000-09 to 2010-19. Immunology and microbiology recorded the highest citation impact per paper of 24.89 and the pharmacology, toxicology and pharmaceutics the least (10.30) (Table 4).

S.No	Subject*	Number of Papers (TP)			Activity Index		TC	CPP	%TP
		2000-09	2010-19	2000-19	2000-09	2010-19	2000-19		
1	Medicine	1514	2215	3729	100.79	99.47	47277	12.68	97.67
2	Biochemistry, Genetics and Molecular Biology	102	216	318	79.63	113.74	7524	23.66	8.33
3	Pharmacology, Toxicology and Pharmaceutics	17	39	56	75.36	116.62	577	10.30	1.47
4	Immunology and Microbiology	6	13	19	78.39	114.58	473	24.89	0.50
	Global Output	1538	2280	3818			49004	12.83	

Table 4: *Subject-Wise Breakup of Global Publications "Tracheo-esophageal Fistula" (TEF) Research during 2000-19. TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper.*

Significant keywords

Important keywords (56) have been identified (assumed to be significant) from the research literature on global "Tracheo-esophageal Fistula", indicating research trends in this area. The 56 keywords are listed in table 5 in the decreasing order of the frequency of their occurrence in the literature during 2000-19.

S.No	Name of the Keyword	Frequency	S.No	Name of the Keyword	Frequency	S.No	Name of the Keyword	Frequency
1	Tracheo-esophageal Fistula	3705	21	Endotracheal Intubation	243	41	Anastomosis Surgical	165
2	Esophagus Atresia	1286	22	Esophageal Neoplasms	229	42	Esophagus Anastomosis	156
3	Esophageal Atresia	885	23	Anastomosis Leakage	225	43	Aspiration Pneumonia	147
4	Esophagus	519	24	Airway Obstruction	218	44	Congenital Heart Defects	146
5	Computer Assisted Tomography	445	25	Laryngectomy	213	45	Kidney Malformation	146
6	Trachea	436	26	Esophagus Cancer	205	46	Heart Ventricle Septum Defect	139
7	Surgical Techniques	423	27	Trachea Stenosis	203	47	Limb Malformation	138
8	Dysphagia	413	28	Pregnancy	198	48	Patent Ducts Arteriosus	122
9	Stent	391	29	Pathology	197	49	Birth Weight	121
10	Thorax Radiography	378	30	Prognosis	196	50	Deglutition Disorder	120
11	Gastro esophageal Reflux	357	31	Respiratory Distress	192	51	Intubation Intratracheal	120
12	Thoracotomy	352	32	Thoracoscopy	190	52	Stomach Fundoplication	118
13	Tracheostomy	335	33	Cancer Radiotherapy	188	53	Duodenum Atresia	113
14	Esophagoscopy	325	34	Fistula	187	54	Sepsis	112
15	Pneumonia	294	35	Esophagography	186	55	Esophagitis	109
16	Artificial Ventilation	290	36	Congenital Heart Malformation	182	56	Respiratory Failure	109
17	Esophagus stenosis	280	37	Vertebra Malformation	179			
18	Anus Atresia	276	38	Esophagus Resection	177			
19	Tracteomalacia	251	39	Esophagus Surgery	177			
20	Congenital Malformation	246	40	Dyspnea	174			

Table 5: *List of Significant Keywords Appearing in Global Publications "Tracheo-esophageal Fistula" (TEF) Research during 2000-19.*

Top 25 most productive global organizations

559 organizations unevenly participated in global "Tracheo-esophageal Fistula" (TEF) research during 2000 -19: 292 organizations published 1 - 5 papers each, 156 organizations 6 - 10 papers each, 87 organizations 11 - 20 papers each, 23 organizations 21 -50 papers each and 1 organization 61 papers.

The productivity of top 25 most productive organizations varied from 19 to 61 publications per organization; together they contributed 21.08% (805) global publications share and 33.93% (16629) global citations share during 2000-19. The scientometric profile of top 8 most productive and top 8 most impactful organization is presented in table 6.

S.No	Name of the Organization	TP	TC	CPP	HI	ICP	ICP (%)	RCI
1	University College London, U.K.	61	1137	18.64	16	16	26.23	1.45
2	Harvard Medical School, USA	48	1184	24.67	18	16	33.33	1.92
3	Cincinnati Children's Hospital Medical Center, USA	48	650	13.54	14	4	8.33	1.06
4	All India Institute of Medical Sciences, New Delhi, India	43	412	9.58	13	0	0	0.75
5	Hospital for Sick Children, University of Toronto, Canada	42	969	23.07	18	15	35.71	1.8
6	Children's Hospital, Boston, USA	41	978	23.85	15	12	29.27	1.86
7	Postgraduate Institute of Medical Education and Research, Chandigarh	38	208	5.47	9	1	2.63	0.43
8	Baylor College of Medicine, USA	37	482	13.03	13	11	29.73	1.02
9	Erasmus MC, Netherlands	34	901	26.5	18	16	47.06	2.07
10	UCL Institute of Child Health, U.K.	31	1039	33.52	14	8	25.81	2.61
11	Mayo Clinic, USA	31	1032	33.29	14	3	9.68	2.59
12	University of Toronto, Canada	29	781	26.93	12	11	37.93	2.1
13	Massachusetts General Hospital, USA	28	1060	37.86	15	4	14.29	2.95
14	University Medical Center, Utrecht, Netherlands	27	760	28.15	13	4	14.81	2.19

Table 6: *Top 10 Most Productive and Top 10 Most Impactful Organizations in "Tracheo-esophageal Fistula" Research during 2000-19.TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; ICP=International Collaborative Papers; RI=Relative Citation Index.*

- Nine organizations registered their publication output above the group average (32.2) of all organizations : University College London, U.K (61 papers), Harvard Medical School, USA and Cincinnati Children's Hospital Medical Center, USA (48 papers each), All India Institute of Medical Sciences, New Delhi, India (43 papers), Hospital for Sick Children, University of Toronto, Canada (42 papers), Children's Hospital, Boston, USA (41 papers), Postgraduate Institute of Medical Education and Research, Chandigarh (38 papers), Baylor College of Medicine, USA (37 papers) and Erasmus MC, Netherlands (34 papers);

- Fifteen organizations registered their citation per paper and relative citation index above the group average (20.66 and 1.61) of all organizations: Massachusetts General Hospital, USA (37.86 and 2.95), UCL Institute of Child Health, U.K. (33.52 and 2.61), Mayo Clinic, USA (33.29 and 2.59), University Medical Center, Utrecht, Netherlands(28.15 and 2.19), University of Toronto, Canada (26.93 and 2.10), Erasmus MC, Netherlands (26.5 and 2.07), Harvard Medical School, USA (24.67 and 1.92), Children's Hospital, Boston, USA (23.85 and 1.86), Erasmuc MC Sophia Children's Hospital, Netherlands (23.67 and 1.84), Amsterdam UMC-Vrije University, Amster-

dam (23.5 and 1.83), Hospital for Sick Children, University of Toronto, Canada (23.07 and 1.80), University of Texas MD Anderson Cancer Centre, USA (22.2 and 1.73), IRCCS Ospedale Pediatrico Bambino, Italy (22.1 and 1.72), Children's Hospital of Philadelphia, USA (21.69 and 1.69) and Children's Mercy Hospital and Clinic, USA (21.16 and 1.65).

Institutional collaboration among top 15 organizations

All the 15 organizations have one to one collaborative linkages with other organizations. The top 3 organizations registering highest institutional collaboration linkages were: Harvard Medical School, USA University College London, U.K. and Children's Hospital, Boston, USA (40, 35 and 30 linkages with 4 organizations) In contrast, the organizations registering the least collaboration linkages were: All India Institute of Medical Sciences, New Delhi, India, Postgraduate Institute of Medical Education and Research, Chandigarh, India and University of Texas MD Anderson Cancer Centre, USA (2, 2 and 3 linkages with 1-2 organizations). On individual to individual basis the largest number of collaborative linkages (26) are between Cincinnati Children's Hospital Medical Center, USA and Children's Hospital, Boston, USA, followed by Harvard Medical School, USA and Children's Hospital, Boston, USA (6 linkages), University College London, U.K and UCL Institute of Child Health, U.K.(23 linkages), Hospital for Sick Children, University of Toronto, Canada University of Toronto, Canada (19 linkages), Harvard Medical School, USA and Medical College of Wisconsin, USA (12 linkages), Harvard Medical School, USA and Massachusetts General Hospital, USA (12 linkages) (Table 7).

S.No	Name of the Organization	Collaborative Linkages among Top 15 Organizations	Total Collaborative Linkages
1	University College London, U.K.	5(2), 9(2), 11(23), 14(1)	35(4)
2	Harvard Medical School, USA	3(1), 6(26), 12(1), 15(12)	40(4)
3	Cincinnati Children's Hospital Medical Center, USA	2(1), 5(2), 6(1), 8(1), 10(2), 12(3), 14(1)	11(7)
4	All India Institute of Medical Sciences, New Delhi, India	7(2)	2(1)
5	Hospital for Sick Children, University of Toronto, Canada	3(2), 8(1), 9(1), 11(3), 12(1), 14(19)	27(6)
6	Children's Hospital, Boston, USA	2(26), 3(1), 10(2), 15(1)	30(4)
7	Postgraduate Institute of Medical Education and Research, Chandigarh	4(2)	2(1)
8	Baylor College of Medicine, USA	3(1), 5(1), 9(4), 12(1), 13(2)	11(5)
9	Erasmus MC, Netherlands	5(1), 8(4), 11(1)	6(3)
10	Mayo Clinic, USA	3(2), 6(2)	4(2)
11	UCL Institute of Child Health, U.K.	1(23), 5(3), 9(1)	27(3)
12	Medical College of Wisconsin, USA	2(12), 5(1), 8(1), 15(1)	15(4)
13	University of Texas MD Anderson Cancer Centre, USA	8(2), 14(1)	3(2)
14	University of Toronto, Canada	3(1), 5(19), 13(1)	21(3)
15	Massachusetts General Hospital, USA	2(12), 12(1)	13(2)

Table 7: *Collaborative linkages among top 15 organizations in "Tracheo-esophageal Fistula" (TEF) Research during 2000-19.*

Top 25 most productive authors

656 authors unevenly participated in global "Tracheo-esophageal Fistula" (TEF) research during 2000-19: 560 authors published 1-5 papers each, 79 authors 6-10 papers each and 17 authors 11-20 papers each. The research productivity of top 25 most productive authors

varied from 9 to 20 publications per author. Together they contributed 8.17% (312) global publications share and 16.14% (7907) global citations share during 2000-19. The detailed scientometric profile of top 10 most productive and 10 most impactful authors is presented in table 8.

S.No	Name of the Author	Affiliation of the Author	TP	TC	CPP	HI	ICP	ICP (%)	RCI
1	S.S. Rothenberg	Presbyterian-St Luke's Medical Center, USA	20	678	33.9	10	2	10	2.64
2	D. Tibboel	Erasmus MC, Netherlands	18	450	25	12	10	55.56	1.95
3	P. Bagolan	IRCCS Ospedale Pediatrico Bambine, , Italy	15	323	21.53	8	1	6.67	1.68
4	A. Pierro	UCL Institute of Child Health, London, U.K.	15	255	17	7	6	40	1.33
5	T.H. Baron	Mayo Clinic, USA	14	336	24	8	1	7.14	1.87
6	H. Reutter	Univ-Klinikum Bone und Medizinische Fukaultat, Germany	14	209	14.93	8	5	35.71	1.16
7	J.A. Tovar	Hospital Universitario La Paz, Spain	14	232	16.57	9	8	57.14	1.29
8	G.K. Gittes	Children's Mercy Hospital and Clinic, USA	13	190	14.62	9	1	7.69	1.14
9	B.D. Solomon	National Human Genome Research Institute, USA	13	508	39.08	12	3	23.08	3.05
10	R.J.Rintala	University of Helsinki, Finland	12	598	49.83	11	0	0	3.88
11	D.J. Mathisen	Massachusetts General Hospital, USA	11	674	61.27	6	0	0	4.78
12	M.P. Parkarinen	University of Helsinki, Finland	11	586	53.27	10	0	0	4.15
13	L. Spitz	UCL Institute of Child Health, London, U.K.	10	612	61.2	8	0	0	4.77
14	R.S.Kirby	Center for Disease Control and Prevention, USA	10	605	60.5	8	1	10	4.72
15	D.J. Ostlie	Children's Merces Hospital and Clinic, USA	10	345	34.5	8	1	10	2.69

Table 8: *Top 10 Most Productive and Top 10 Most Impactful Authors in Global "Tracheo-esophageal Fistula" (TEF) Research during 2000-19. TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; ICP=International Collaborative Papers; RI=Relative Citation Index.*

- Twelve authors registered their publications output above the group average of 12.48: S.S. Rothenberg, (20 papers), D. Tibboel (18 papers), P. Bagolan and A. Pierro (15 papers each), T.H. Baron, H. Reutter and J.A. Tovar (14 papers each), G.K. Gittes, U. Krishnan, K. Lakhoo, K.L. N. Rao and B.D. Solomon (13 papers each).

- Eight authors registered their citation per paper and relative citation index above the group average (25.34 and 1.98) of all authors: D.J. Mathisen (61.27 and 4.78), L. Spitz (61.20 and 4.77), R.S. Kirby (60.5 and 4.72), M.P. Parkarinen (53.27 and 4.15), R.J. Rintala (49.83 and 3.88), B.D. Solomon (39.08 and 3.05), D.J. Ostlie (34.5 and 2.690 and S.S. Rothenberg (33.9 and 2.64)

Medium of research communication

Of the total global output on "Tracheo-esophageal Fistula" (TEF) research during 2000 - 19, 98.59% (3764) appeared in journals, 1.20% (46) in books, 0.16% (6) in book series, 0.03% (1 each) as conference proceeding and undefined during 2000 - 19. Of the 510 journals which reporting 3764 articles, 396 published 1 - 5 papers each, 63 published 6 - 10 papers each, 45 published 11 - 50 papers each, 4 published 51 - 100 papers each and 2 published 144 - 259 papers each during 2000-19. The top 25 most productive journals contribution varies from 22 to 259 papers and they together accounted for 33.05% share of total global publications that appeared in journal medium during 2000-19, which decreased from 33.20% to 32.95% between 2000 - 09 and 2010-2019. The top 5 most productive journals were Journal of Pediatric Surgery (259 papers), Pediatric Surgery International (144 papers), Annals of Thoracic Surgery (67 papers), Diseases of the Esophagus and Pediatric Anesthesia (58 papers each). The top 5 most impactful journals in terms of citations per paper were: Birth Defects Research. Part A. Clinical and Medical Teratology (38.3), Seminar in Pediatric Surgery (24.14), Gastrointestinal Endoscopy (20.4), Journal of Thoracic and Cardiovascular Surgery (20.27) and Annals of Thoracic Surgery (19.07). Table 9 lists top 8 most productive and 8 most Impactful journals in global "Tracheo-esophageal Fistula" (TEF) Research during 2000 - 19.

S. No.	Name of the Journal	Number of Papers (TP)			TC	CPP
		2000-09	2010-19	2000-19	2000-19	
1	Journal of Pediatric Surgery	125	134	259	4539	17.53
2	Pediatric Surgery International	79	65	144	1656	11.5
3	Annals of Thoracic Surgery	23	44	67	1278	19.07
4	Diseases of the Esophagus	17	41	58	817	14.09
5	Pediatric Anesthesia	30	28	58	404	6.97
6	European Journal of Pediatric Surgery	20	35	55	635	11.55
7	Laryngoscope	20	30	50	611	12.22
8	Gastrointestinal Endoscopy	25	17	42	857	20.4
9	American Journal of Medical Genetics	8	30	38	712	18.74
10	Journal of Thoracic and Cardiovascular Surgery	15	22	37	750	20.27
11	Seminar in Pediatric Surgery	15	14	29	700	24.14
12	Birth Defects Research. Part A. Clinical and Medical Teratology	12	15	27	1034	38.3
13	Pediatric Pulmonology	10	12	22	380	17.27

Table 9: *Top 8 Most Productive and 8 Most Impactful Journals in Global "Tracheo-esophageal Fistula" (TEF) Research during 2000-19. *TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper.*

Highly -cited papers

Of the 3818 global publications in "Tracheo-esophageal Fistula" (TEF) Research during 2000 - 19, only 55 (1.44% share) publications registered 101 to 2156 citations per paper (assumed here highly- cited) and they together received a total of 11721 citations, averaging to 213.11 citations per paper. The distribution of 55 highly cited papers is highly skewed: 37 papers each registered citations in the range 101 - 199, 13 papers in citation range 202 - 300, 4 papers in citation range 307 - 420 and 1 papers 2156 citations.

Among 55 highly cited papers, USA contributed the highest number of papers (33), followed by U.K (6), Canada (5 papers), Italy and Netherlands (4 papers each), Japan and Germany (3 papers each), Australia, Belgium, Denmark, Israel and Spain (2 papers each), Argen-

tina, Brazil, Finland, France, Hong Kong, India, Poland South Korea, Saudi Arabia, South Africa and Sweden (1 paper each). Of the 55 high cited papers (34 articles, 16 reviews and 5 conference papers), 25 papers involve zero collaboration and 19 national and 11 international collaborative.

The 55 high cited papers involve 323 authors and 177 organizations. Among the global participating organizations in 55 high-cited papers, The Mayo Clinic, USA and Massachusetts General Hospital, USA contributed the largest number (3 each) of papers, followed by University College, London, U.K., Harvard Medical School, USA, Hospital for Sick Children, University of Toronto, Canada, UCL Institute of Child Health, London, U.K., University of Toronto, Canada, University Medical Center, Utrecht, Netherlands (2 papers each). Among the global participating authors in 55 high-cited papers, D.J. Mathisen contributed the largest number of papers (3), followed by S.S. Rothenberg and L. Spitz (2 papers each).

Among the 41 global participating journals in high-cited papers, the largest number of papers (4 each) is contributed by Chest and Journal of Pediatric Surgery, followed by Annals of Thoracic Surgery, American Journal of Gastroenterology, Annals of Surgery, Birth Defects. Part A, Orphanet Journal of Rare Diseases, and Otolaryngology-Head and Neck Surgery (2 papers each) and 32 other journals with 1 paper each.

Summary and Conclusion

The global research on "Tracheo-esophageal Fistula" (TEF) resulted in 3818 publications 2000-19. The annual and ten-year cumulative global output on "Tracheo-esophageal Fistula" (TEF) research registered 4.43% and 48.24% growth during the last 20 years. The global publications on "Tracheo-esophageal Fistula" (TEF) averaged to 12.83 citations per paper (CPP) during 2000-19, which decreased from 20.01 CPP and 7.99 CPP during 2000 - 09 to 2010 - 19. The.12.77% (142) share of 3818 global publications on "Tracheo-esophageal Fistula" have received funding from national and international funding agencies and 142 funded papers have registered 1813 citations, averaging 12.77 citations per paper.

104 countries participated in global research on "Tracheo-esophageal Fistula", of which 77.21% share of the global research output and 93.82% share of the global citations came from top 10 countries, with USA leading with top rank (with 29.28% share), followed U.K. and India (9.17% and 7.78%) and other 7 countries (from 3.30% to 5.19% share) during 2000 - 19. The share of publications in global output increased in USA, China, Canada, Italy, India and Turkey (from 0.13% to 6.03%), as against decrease in Germany, Netherlands, Japan and U.K. (from 0.35% to 3.16%) during 2000-09 to 2010 - 19. Four countries registered relative citation index higher than their group average (1.22): Netherlands (2.15), Canada (1.62), USA (1.54) and, U.K. (1.24). The share of international collaborative papers (ICP) in its total publication output of top 10 countries varied from 4.66% to 41.61%, with average value of 15.98% during 2000 – 19.

Medicine, is the most sought subject with the largest national publication share (97.67%) in global "Tracheo-esophageal Fistula" (TEF) research, followed by biochemistry, genetics and molecular biology (8.33% share), pharmacology, toxicology and pharmaceutics (1.47%) and immunology and microbiology (0.50%) during 2000 - 19. As reflected in activity index, the research activities in biochemistry, genetics and molecular biology, pharmacology, toxicology and pharmaceutics and immunology and microbiology, as against decrease in medicine during 2000 - 09 to 2010 - 19. The highest citation impact per paper (24.89) was registered by Immunology and microbiology and pharmacology, toxicology and pharmaceutics the least (10.30).

559 organizations and 656 authors participated in global research on "Tracheo-esophageal Fistula" research during 2000 - 19, of which the top global organizations and authors contributed 21.08% and 8.17% to national publication share and 33.93% and 16.14% global citation share respectively during 2000 - 19. The leading organizations in terms of publication productivity were: University College London, U.K (61 papers), Harvard Medical School, USA and Cincinnati Children's Hospital Medical Center, USA (48 papers each), All

India Institute of Medical Sciences, New Delhi, India (43 papers), Hospital for Sick Children, University of Toronto, Canada (42 papers), etc. The leading organizations in terms of citation impact per paper and relative citation index were: Massachusetts General Hospital, USA (37.86 and 2.95), UCL Institute of Child Health, U.K. (33.52 and 2.61), Mayo Clinic, USA (33.29 and 2.59), University Medical Center, Utrecht, Netherlands (28.15 and 2.19), University of Toronto, Canada (26.93 and 2.10), Erasmus MC, Netherlands(26.5 and 2.07), Harvard Medical School, USA (24.67 and 1.92), *et al.* The leading authors in terms of publication productivity were: S.S. Rothenberg (20 papers), D. Tibboel (18 papers), P. Bagolan and A. Pierro (15 papers each), T.H. Baron, H. Reutter and J.A. Tovar (14 papers each), G.K. Gittes, U. Krishnan, K. Lakhoo, K.L. N. Rao and B.D. Solomon (13 papers each). The leading authors in terms of citation impact per paper and relative citation index were: D.J. Mathisen (61.27 and 4.78), L. Spitz (61.20 and 4.77), R.S. Kirby (60.5 and 4.72), M.P. Parkarinen (53.27 and 4.15), R.J. Rintala (49.83 and 3.88), B.D. Solomon (39.08 and 3.05), D.J. Ostlie (34.5 and 2.690 and S.S. Rothenberg (33.9 and 2.64).

The journals medium accounted for 98.59% global share in global research on "on "Tracheo-esophageal Fistula" (TEF) research during 2000-19, of which the top 25 most productive journals (of 510 participating) accounted for 33.05% of total global output in journals during 2000-19. Journal of Pediatric Surgery contributed the largest number of papers (259), followed by Pediatric Surgery International (144 papers), Annals of Thoracic Surgery (67 papers), Diseases of the Esophagus and Pediatric Anesthesia (58 papers each). Birth Defects Research. Part A. Clinical and Medical Teratology registered the highest citation impact per paper (38.30), followed by Seminar in Pediatric Surgery (24.14), Gastrointestinal Endoscopy (20.4), Journal of Thoracic and Cardiovascular Surgery (20.27) and Annals of Thoracic Surgery (19.07).

Only 55 (1.44% share) of 3818 global publications on "Tracheo-esophageal Fistula" (TEF) research during 2000-19 received 101 to 2156 citations per paper. They together received a total of 11721 citations, averaging to 213.1 citations per paper. USA contributed the highest number of papers (33) among 55 highly cited papers, followed. U.K (6), Canada (5 papers), Italy and Netherlands (4 papers each), Japan and Germany (3 papers each), etc. The 55 high cited papers involve 323 authors and 177 organizations and published in 41 journals, of which 4 papers each are published in Chest and Journal of Pediatric Surgery, followed by 2 papers each in Annals of Thoracic Surgery, American Journal of Gastroenterology, Annals of Surgery, Birth Defects. Part A, Orphanet Journal of Rare Diseases, and Otolaryngology-Head and Neck Surgery and 1 paper each in 32 other journals.

Conclusion

With the development of endoscopic techniques, the treatment of tracheoesophageal fistula (TEF) has made marked progress. As surgical intervention is often not an advisable option due to advanced malignancy and poor performance status of the patients, bronchoscopy intervention provides a good choice to palliate symptoms and reconstruct the airway and esophagus [7]. Most TEF is due to malignancy with the patients having a short survival time. The treatment of TEF is a tough challenge. Although the efficacy has been achieved after application of interventional therapy, the treatment strategy should be improved continuously to make the patients live a better and longer time.

Bibliography

1. Tracheoesophageal Fistula and Esophageal Atresia.
2. "My baby can't swallow": PGI gets 250 cases a year. Times of India 20 June 2017, Chandigarh magazine section (2017): 1.
3. Crisera CA., *et al.* "Defective epithelial-mesenchymal interactions dictate the organogenesis of tracheoesophageal fistula". *Pediatric Surgery International* 16.4 (2000): 256-261.
4. Salik Irim and Paul Manju. Tracheoesophageal Fistula (2020).
5. Tracheo-esophageafistula.

6. Feng Xiaoyan., *et al.* "Publication trends and global collaborations on Esophageal Atresia research: A bibliometric study". *European Journal of Pediatric Surgery* 8.3 (2020).

7. Mingyao Ke., *et al.* "The reatment strategy for tracheoesophageal fistula". *The Journal of Thoracic Disease* D7.4 (2015): S389-S397.

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