

Impact of COVID-19 on Children and Adults: A Bibliometric Assessment of Global Publications

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ABSTRACT

The paper presents an analysis of quantitative and qualitative dimensions of global research output (3488 records) on "Impact of COVID-19 on Children and Adolescents", based on indexed publications in Scopus database. The global publications on this theme averaged 8.31 citations per paper. About 1.49% share of its total publications in this area received external funding support. The 145 countries participated in global research output on "Impact of COVID-19 on Children and Adults", of which the top 10 countries accounted for 85.21% and more than 100% share of global publications and citations. The USA, U.K. and Italy leads in global publications ranking and productivity as against China (3.16), U.K (1.28) and USA (1.27) leading in terms of relative of relative citation index. The 412 organizations and 661 authors participated in global research on this theme, with top 15 most productive organizations and authors contributing 21.07% and 4.30% global publications share and 38.05% and 12.98% global citations share. Harvard Medical School, USA, Huazhong University of Science and Technology, China and Tongji Medical College, China leads the world as the most productive organizations (with 480, 67 and 63 publications) and Huazhong University of Science and Technology, China (31.97 and 3.85), Tongji Medical College, China (19.92 and 2.40) and Children Hospital of Philadelphia, USA (19.30 and 2.32) leading as the most impactful organizations in the world in terms of citation per paper and relative citation index. D. Buonsenso, C. Calvo and X. Lu were the most productive authors (with 15, 12 and 12 papers) and X. Lu (103.83 and 12.49), A. Licari (40.11 and 4.83) and G.L. Marseglia (34.09 and 4.1) were the most impactful authors. JAMA Pediatrics, Pediatrics Infectious Disease Journal and Acta Paediatrica International Journal of Pediatrics were the most productive journals (with 71, 60 and 58 papers) and Pediatrics (36.59, JAMA Pediatrics (19.49) and Acta Paediatrica International Journal of Pediatrics (14.93) were the most impactful journals.

Key words: COVID-19, Impact, Children, Adolescents, Global, Publications, Scientometrics, Bibliometrics.

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INTRODUCTION

Coronavirus disease 19 (COVID-19), originated at Wuhan city of China in early December 2019 has rapidly widespread with confirmed cases in almost every country across the world and has become a new global public health crisis. The etiological agent was designated as Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The virus was originated in bats and human transmission primarily occurs through direct, indirect, or close contact with infected people through infected secretions such as respiratory secretions, saliva or through respiratory droplets that are expelled when an infected person coughs, sneezes, or speaks. The World Health Organization coined the term COVID-19 and declared this novel coronavirus disease as a pandemic on March 11, 2020. The virus infects the human respiratory epithelial cells by binding through Angiotensin-Converting Enzyme 2 (ACE2) receptors. The major clinical symptoms of the disease are fever, non-productive cough, fatigue, malaise and breathlessness. Severe illness such as pneumonia, acute respiratory distress syndrome

(ARDS), and death occurs in the elderly and patients with comorbid conditions.¹ Globally, as 15 May 2021, there have been 161,513,458 confirmed cases of COVID-19, including 3,352,109 deaths, reported to WHO from 213 countries and territories.²

There are more than 2.2 billion children in the world who constitute approximately 28% of the world's population. Those aged between 10 to 19 years make up 16 % of the world's population (UNICEF, 2019). Of all COVID-19 cases reported worldwide last year, children under 18 years accounted for about 8%, despite comprising 29% of the global population, according to the World Health Organization.³ Children of all ages can get COVID-19. Children, particularly those younger than 12 to 14 years of age, appear to be affected less commonly than adults, although children typically have a lower risk of exposure than adults and are tested less frequently than adults. In surveillance from various countries children typically account for up to 15 percent of laboratory-confirmed cases.⁴ To date, data on COVID-19 in children and

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adolescents remain scarce, despite the number of confirmed COVID-19 cases now exceeding 8 million globally. Nevertheless, a small proportion of children and adolescents develop severe disease and require ICU support, frequently needing prolonged ventilatory support. However, fatal outcome is rare overall.⁵

The unexpected disruption of the social fabric and norms has affected the behavioral and mental health of the public, including children. The mental health of children has been influenced by several ways, as this unprecedented situation changed a way they typically grow, learn, play, behave, interact, and manage emotions. Children with pre-existing psychiatric disorders such as attention-deficit/hyperactivity disorder (ADHD), anxiety, depression, mood disorders, and behavior disorders could be adversely impacted during this stressful situation.⁶

The COVID-19 pandemic is harming health, social and material well-being of children worldwide, with the poorest children, including homeless children and children in detention, hit hardest. School closures, social distancing and confinement increase the risk of poor nutrition among children, their exposure to domestic violence, increase their anxiety and stress, and reduce access to vital family and care services. Widespread digitalisation mitigates the education loss caused by school-closures, but the poorest children are least likely to live in good home-learning environments with internet connection. Furthermore, increased unsupervised on-line internet use has magnified issues around sexual exploitation and cyber-bullying.⁷

COVID-19 affects all components of the respiratory system, including the neuromuscular breathing apparatus, the conducting airways, the respiratory airways and alveoli, the pulmonary vascular endothelium, and pulmonary blood flow. Viral pneumonia is the most frequent serious clinical manifestation of COVID-19, prominently featuring fever, cough, dyspnea, hypoxemia, and bilateral infiltrates on chest radiography. Dry cough is more common than a productive cough. Dyspnea appears after a median time of 5 to 8 days. Severe hypoxemic respiratory failure consistent with the Berlin definition of the acute respiratory distress syndrome (ARDS) occurs in a significant proportion of patients with COVID-19 pneumonia. While the pulmonary system is most commonly affected, extrapulmonary clinical manifestations of COVID-19 exist and affect multiple other organs and organ systems including cardiovascular, renal, hepatic, gastrointestinal, ocular, dermatologic, and neurological systems, which could have significant health consequences.^{8,9}

Bibliometrics, together with novel visualization methods of scientific information, have been used here which is helpful in identifying emerging outbreaks of infectious disease. Bibliometrics is also recognized as an essential tool and is widely used in a variety of fields to measure and evaluate scientific research quantitatively and qualitatively.¹⁰

Literature Review

Although several bibliometric studies have been recently carried out on global and national output of Coronavirus research as well as on COVID-19. One recent study was undertaken by Monzani, Tagliaferri, Bellone, Genoni and Rabbone,¹¹ which analysed 2301 global publications on COVID-19 in pediatric age using data from Scopus database during January 1, 2020 and June 11, 2020. A bibliometric methodology was applied to evaluate the total number of papers and citations, journal and publication types, the top-productive institutions and countries and their scientific collaboration, the core keywords. Grover, Gupta and Mamdapur¹² carried out another bibliometric study on the "Impact of COVID-19 on Mental Health of Children and Adolescents, which studied 1787 global papers indexed in Scopus database during 2020-21.

Since no recent comprehensive study was available on this topic, we decided to undertake the present study on the "Impact of COVID-19 on Children and Adults" using bibliometric methods to understand

bibliometric characteristics of global literature and to study the research trends. It also evaluates the performance of global countries, organizations, authors and journals, besides identifying the scatter of literature across broad subjects and keywords for understanding the research trends. The study used indexed publications data till 1 May 2021 from Scopus databases

MATERIALS AND METHODS

For this study, the global publications on the "Impact of COVID-19 on Children and Adolescents" were identified, retrieved and downloaded from the Scopus database (<http://www.scopus.com>) on 1.5.2021 using a well conceived search strategy. Here a set of two types keywords related to "COVID-19" and "Children or Adolescents" were used in "Keyword tag" and in "Article Title tag" (joined by Boolean operator "OR") of the Scopus database, yielding 3488 global records. The search strategy was further refined first by country to get publication output data of top 10 countries and secondly to get statistics on global output by subject, collaborating country, organization, author and journal. Citations to publications were counted from date of their publication till 1.5.2021.

TITLE ("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") 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 TITLE (CHILD* OR INFANT OR ADOLESCENT)

ANALYSIS AND RESULTS

Publication Growth

The global publications on "Impact of COVID 19 on Children and Adults" consisted of 3488 records (2021=2157; 2021=1331) as indexed in Scopus database during 2020 -2021. The 3488 global publications on this theme received 28972 citations and averaged 8.31 citations per paper (CPP). Only 52 (1.49%) out of 1797 global publications in this area were funded by national and international funding agencies. These 52 funded papers received 13345 citations, averaging 256.63 citations per paper. The major agencies providing funding support to global research in this area were U.S.Department of Health and Human Service (127 papers), National Institute of Health, USA (117 papers), National Natural Science Foundation of China (54 papers), National Institute of Health Research (32 papers), European Commission (27 papers), National Institute of Mental Health (21 papers), Center for Disease Control and Prevention, USA (18 papers), U.K. Research and Innovation (18 papers), etc.

The 59.09% (2061) and 15.63% (545) share of global publications appeared as articles and letters, followed by reviews, notes and editorials (9.98%, 7.94% and 5.42%), short surveys, erratum and conference papers (0.83%, 0.75% and 0.34) and data paper (0.03%).

Top Ten Most Productive Countries

The 145 countries took part in global research on "Impact of COVID-19 on Children and Adolescents" and their distribution was uneven: 93 countries published 1-10 papers, 36 countries published 11-50 papers, 4 countries published 51-100 papers and 12 countries published 104-941 papers each. The top 10 most countries among 145 participating countries, contributed 117 to 941 papers and together contributed 85.21% share of global publications output and more than 100% share

to global citation output.. USA, U.K., Italy and China are the top ranking countries with global publication share of 26.98%, 11.41% and 10.92% respectively, followed by India (6.34%), Canada, Spain, Turkey, Australia and France (from 3.35% to 4.96%). China (3.16), U.K (1.28), USA (1.27), France (1.22), Italy (1.15) and Australia (1.08) registered relative citation index above 1.0 The share of international collaborative papers in global output of the top 10 countries varied from 13.60% to 61.29%, with average value as 33.48% during 2020-21 (Table 1).

Collaboration among Top 10 countries

All the top 10 countries have had one to many collaborative linkages and their total collaborative linkages varied from 54 to 295. Their individual country to country collaborative linkages varied from 1 to 63. The top countries with most collaborative linkages (295, 269 and 155) were -- USA, U.K. and Italy. The three countries with least collaborative linkages (54, 94 and 114) were -- China, India and France. The research collaboration at country-country level was the most between USA-Canada (63 linkages), followed by USA – U.K. (59 linkages), USA-Canada (41 linkages), U.K. - Italy (37 linkages), USA-China (37 linkages), usa-Italy (34 linkages), U.K.-Spain (31 linkages), U.K. – Spain (28 linkages), etc. (Table 2).

Subject-Wise Distribution of Global Research Output

Among 9 broad subjects (as identified in Scopus database) contributing to research on “Impact of COVID-19 on Children and Adolescents”, Medicine contributed the largest publication share (83.89%) to global output, followed by Psychology (10.24%), Social sciences (7.68%), and other five subjects contributing less than 5.0% (from 1.58% to 4.90%). Environment Science registered the largest citation impact per paper (10.81) and least by Pharmacology, Toxicology and Pharmaceutics (4.47) (Table 3).

Sub-Field Wise Distribution of Papers

Mental health and related disorders accounted for the largest publications share (51.55%) of global publications on “The Impact of COVID-19 on Children and Adolescents”, followed by respiratory related disorders (17.06%) and the rest are on extra-pulmonary manifestations of COVID-19

Table 1: Profile of Top 10 Countries on “Impact of COVID-19 on Children and Adolescents”.

S.No	Name of the Country	TP	TC	CPP	%TP	HI	ICP	%ICP	RCI
1	USA	941	9904	10.52	26.98	44	259	27.52	1.27
2	U.K	398	4236	10.64	11.41	33	188	47.24	1.28
3	Italy	381	3647	9.57	10.92	31	109	28.61	1.15
4	China	336	8823	26.26	9.63	40	85	25.30	3.16
5	India	221	634	2.87	6.34	12	52	23.53	0.35
6	Canada	173	1166	6.74	4.96	18	99	57.23	0.81
7	Spain	156	1133	7.26	4.47	15	57	36.54	0.87
8	Turkey	125	343	2.74	3.58	10	17	13.60	0.33
9	Australia	124	1110	8.95	3.56	12	76	61.29	1.08
10	France	117	1186	10.14	3.35	15	53	45.30	1.22
	Total	2972	32182	10.83	85.21	23	995	33.48	1.30
	World	3488	28972	8.31					

TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; ICP=International Collaborative Papers; HI=h-Index; RCI=Relative Citation Index

Table 2: Collaborative linkages among top 10 countries.

S.No	Name of the Country	Number of Collaborative linkages with other 9 countries	TCL (NOC)
1	USA	2(59), 3(34), 4(37), 5(20), 6(63), 7(18), 8(9), 9(31), 10(24)	295 (9)
2	U.K	1(59), 3(39), 4(24), 5(23), 6(27), 7(31), 8(11), 9(31), 10(24)	269 (9)
3	Italy	1(34), 2(39), 4(6), 5(8), 6(6), 7(25), 8(10), 9(8), 10(19)	155 (9)
4	China	1(37), 2(24), 3(6), 5(5), 6(4), 7(3), 8(1), 9(9), 10(5)	94 (9)
5	India	1(20), 2(23), 3(8), 4(5), 6(7), 7(6), 8(4), 9(11), 10(10)	94 (9)
6	Canada	1(63), 2(27), 3(6), 4(4), 5(7), 7(7), 8(3), 9(14), 10(7)	138 (9)
7	Spain	1(18), 2(31), 3(25), 4(3), 5(6), 6(7), 8(7), 9(5), 10(13)	115 (9)
8	Turkey	1(9), 2(11), 3(10), 4(1), 5(4), 6(3), 7(7), 9(3), 10(6)	54 (9)
9	Australia	1(31), 2(31), 3(8), 4(9), 5(11), 6(14), 7(5), 8(3), 10(6)	118 (9)
10	France	1(24), 2(24), 3(19), 4(5), 5(10), 6(7), 7(13), 8(6), 9(6)	114 (9)

TCL=Total Collaborative linkages; NOC=Number of countries

Table 3: Subject-Wise Breakup of Indian Publications in “Impact of COVID-19 on Children’s and Adults” during 2020-21.

S.No	Subject	TP	TC	CPP	%TP
1	Medicine	2926	27364	9.35	83.89
2	Psychology	357	2030	5.69	10.24
3	Social Sciences	268	1165	4.35	7.68
4	Immunology and Microbiology	171	1849	10.81	4.90
5	Nursing	165	932	5.65	4.73
6	Biochemistry, Genetics and Molecular Biology	155	1216	7.85	4.44
7	Neurosciences	94	485	5.16	2.69
8	Environment Science	89	973	10.93	2.55
9	Pharmacology, Toxicology and Pharmaceutics	55	246	4.47	1.58
	Global output	3488	28972	8.31	

TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper

disease. Amongst extra-pulmonary manifestations, Cardiovascular related disorders accounts for the highest share (11.47%), followed by Systematic Inflammatory Response Syndrome (10.84%), Multisystem Inflammatory Syndrome (7.40%), Mucocutaneous Lymph Node Syndrome (&.08%), Diabetes related endocrine disorders (4.90%), etc. (Table 4).

Top 15 Most Productive Organizations

In all 412 organizations participated in global research on “Impact of COVID-19 on Children and Adolescents”, of which 251 organizations published 1-10 papers each, 141 organizations published 11-30 papers

Table 4: Distribution of Publications on Impact of COVID 19 on Children's and Adolescents by Type of Disease.

S.No	Name of the Disease*	TP	TC	CPP	%TP
1	Mental Health and Related Psychiatric Disorders	1798	20511	11.41	51.55
2	Respiratory Related Disorders	595	14136	23.76	17.06
3	Extra Pulmonary Manifestations				
3.1	Cardiovascular Disease and Related Disorders	400	4782	11.96	11.47
3.2	Systematic Inflammatory Response Syndrome	378	4220	11.16	10.84
3.3	Multisystem Inflammatory Syndrome	258	2201	8.53	7.40
3.4	Mucocutaneous Lymph Node Syndrome	247	4248	17.20	7.08
3.5	Diabetes and Related Endocrine Disorders	171	1753	10.25	4.90
3.6	Gastro Related Diseases	89	2372	26.65	2.55
3.7	Skin Related Diseases	62	880	14.19	1.78
3.8	Kawakasi Disease	59	403	6.83	1.69
3.9	Eye Disease-Conjunctivitis	53	1523	28.74	1.52
3.10	Neurological Diseases	37	381	10.30	1.06
	Renal	17	64	3.76	0.49
	Global total	3488			

There is duplication and overlapping of publications across subjects

each, 15 organizations 31-52 papers each and 5 organizations 51-80 papers each. The productivity of top 15 most productive organizations varied from 33 to 80 publications per organization; together they contributed 21.07% (735) global publications share and 38.05% (11025) global citations share. Their detailed scientometric profile of top 15 most productive organizations is presented in Table 5.

- Five organizations registered their publications output above their group average (49.0): Harvard Medical School, USA (80 papers), Huazhong University of Science and Technology, China (67 papers), Tongji Medical College, China (63 papers), Children Hospital, Boston, USA (61 papers) and IRCCS Ospedale Pediatrico Bambino Gesù, Italy (53 papers);
- Six organizations registered their citations per paper and relative citation index above the group average (15.0 and 1.81) of all organizations: Huazhong University of Science and Technology, China (31.97 and 3.85), Tongji Medical College, China (19.92 and 2.40), Childrens Hospital of Philadelphia, USA (19.30 and 2.32), INSERM, France (17.54 and 2.11), University of Melbourne, Australia (16.70 and 2.01) and Children Hospital, Boston, USA (16.34 and 1.97).

Institutional Collaboration among Top 15 Most Productive Organizations

The total collaborative linkages of top 15 organizations varied from 6 to 79. The individual organization to organization collaborative linkages varied from 1 to 62. Amongst top 15 most productive organizations, the top 3 organizations with largest linkages (79, 71 and 69) were Children Hospital, Boston, USA, Huazhong University OF Science and Technology, China and Harvard Medical School, USA. The top 3 organizations with least linkages (3, 6 and 12) were: INSERM, France, Università degli Studi di

Milano, Italy and Sapienza University of Rome, Italy. In terms of organization to organization linkages, the largest number of collaborative linkages (62) are between Huazhong University of Science and Technology, China and Tongji Medical College, China, followed by Harvard Medical School, USA and Children Hospital, Boston, USA (46 linkages), Hospital for Sick Children University of Toronto, Canada and University of Toronto, Canada (22 linkages), Children Hospital, Boston, USA and Hospital for Sick Children University of Toronto, Canada (10 linkages), etc (Table 6).

Top 15 Most Productive Authors

661 authors participated in global research on “Impact of COVID19 on Children and Adolescents”, of which 583 authors published 1-5 paper each, 72 authors 6-10 papers each and 6 authors 11-5 papers each. The research productivity of top 15 most productive authors varied from 8 to 15 publications per author. Together they contributed 4.30% (150) global publications share and 12.98% (3761) global citations share. Their detailed scientometric profile of top 15 most productive authors is presented in Table 7. On further analysis, it was observed that : (i) Six of top 15 authors registered their publications output above the group average of 10.0: D.Buonsenso (Italy) (15 papers), C.Calvo (Spain), X. Lu (China) and A. Villani (Italy)(12 papers each), A. Campana (Italy) and G.L. Marseglia (Italy)(11 papers each); and (ii) Four of top 15 authors registered their citation per paper and relative citation index above the group average (25.07 and 3.02) of all authors: X.Lu (China)(103.83 and 12.49); A. Licari (Italy)(40.11 and 4.83), G.L. Marseglia (Italy)(34.09 and 4.1) and D. Buonsenso (Italy)(32.2 and 3.87).

Medium of Research Communication

All papers on “Impact of COVID-19 on Children and Adolescents” appeared in 371 journals: 258 journals published in 1-5 papers each, 61 journals published 6-10 papers each, 29 journals published 11-20 papers each, 17 journals published 21-50 papers and 6 journals published 51-71 papers each. The top 15 most productive journals accounted for 20.286% share of global publications in journals.

JAMA Pediatrics was the topmost productive journal (with 71 papers) in reporting Indian research in the field of “Impact of COVID-19 on Children and Adolescents”, followed by *Pediatrics Infectious Disease Journal* (60 papers), *Acta Paediatrica International Journal of Pediatrics* (58 papers), *Frontiers in Pediatrics* (55 papers), *Journal of Pediatrics* (52 papers), *Pediatrics*(51 papers), *Pediatric Pulmonology* (48 papers), etc, *Pediatrics* was the most most impact ful journal in terms of citation per paper (36.59)., followed by *JAMA Pediatrics* (19.49), *Acta Paediatrica International Journal of Pediatrics* (14.93), *Journal of Pediatrics* (12.46), *Pediatrics Infectious Disease Journal* (12.05), *Archives of Disease in Childhood* (7.30), *Frontiers in Pediatrics* (6.35), etc. (Table 8).

High Cited Papers

Of the total global output in “Impact of COVID-19 on Children and Adolescents” (3488 publications), only 52 (1.49% share) accumulated 101 to 1167 citations per paper (cumulative total 13345 citations) since their publication during 2020-21, averaging to 256.63 citations per paper. The distribution of these 52 highly cited papers is skewed: Twenty seven papers registered citations in the range 101-194 per paper, 11 papers were in citation range 203-287, 9 papers in citation range 303-498, 4 papers in citation range 519-880 and 1 paper received 1167 citations. Of the 52 highly cited papers, 23 were published as articles, 10 as letters, 9 as reviews, 6 as notes, and 2 each as short surveys and editorials. Of the 52 highly cited papers, 8 resulted from contribution by single organizations per paper (non-collaborative papers) and 44 from two or more organizations per paper (32 national collaborative and 12 international collaborative papers).

Table 5: Top 15 Most Productive Organizations in Global Research on “Impact of COVID-19 on Children’s and Adolescents”.

S.No	Name of the Organization	TP	TC	CPP	HI	ICP	%ICP	RCI
1	Harvard Medical School, USA	80	1142	14.28	10	28	35.00	1.72
2	Huazhong University of Science and Technology, China	67	2142	31.97	17	23	34.33	3.85
3	Tongji Medical College, China	63	1255	19.92	16	20	31.75	2.40
4	Children’s Hospital, Boston, USA	61	997	16.34	10	24	39.34	1.97
5	Bambino Gesù Children’s Hospital, Italy	53	718	13.55	10	21	39.62	1.63
6	INSERM, France	46	807	17.54	10	16	34.78	2.11
7	Hospital for Sick Children University of Toronto, Canada	46	497	10.80	11	32	69.57	1.30
8	University of Toronto, Canada	45	179	3.98	8	21	46.67	0.48
9	Sapienza University of Rome, Italy	45	263	5.84	9	13	28.89	0.70
10	University of Melbourne, Australia	43	718	16.70	7	30	69.77	2.01
11	University College London, U.K.	41	589	14.37	10	24	58.54	1.73
12	ThE Childrens Hospital of Philadelphia, USA	40	772	19.30	11	9	22.50	2.32
13	University of Milan, Italy	39	266	6.82	8	7	17.95	0.82
14	Baylor College of Medicine, USA	33	439	13.30	6	6	18.18	1.60
15	University of British Columbia, Canada	33	241	7.30	10	12	36.36	0.88
	Total of 15 organizations	735	11025	15.00	10.2	286	38.91	1.81
	Global total	3488	28972	8.31				
	Share of top 15 organizations in global total	21.07	38.05					

TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; ICP=International Collaborative Papers; HI=*h*-Index; RCI=Relative Citation Index

Table 6: Institutional Collaboration among Top 15 Productive Indian Organizations on “Impact of COVID-19 on Children’s and Adolescents”.

S.No	Name of the Organization	Number of Collaborative Linkages	TCL (NOO)
1	Harvard Medical School, USA	2(2), 3(1), 4(46), 6(1), 7(6), 8(3), 11(1), 12(5), 14(4)	69 (9)
2	Huazhong University of Science and Technology, China	1(2), 3(62), 4(2), 5(1), 11(4)	71(5)
3	Tongji Medical College, China	1(1), 2(62), 5(1), 11(4)	68(5)
4	Children’s Hospital, Boston, USA	1(46), 2(2), 6(2), 7(10), 8(4), 10(3), 12(8), 14(4)	79(9)
5	Bambino Gesù Children’s Hospital, Italy	1(1), 2(1), 3(1), 6(2), 9(10), 10(2), 11(2), 13(5)	24(8)
6	INSERM, France	1(1), 5(2),	3(2)
7	Hospital for Sick Children University of Toronto, Canada	1(6), 4(10), 8(22), 11(3), 12(5), 14(2), 15(9)	57(7)
8	University of Toronto, Canada	1(3), 4(4), 7(22), 11(1), 14(1), 15(10)	41(6)
9	Sapienza University of Rome, Italy	5(10), 11(1), 13(1)	12(3)
10	University of Melbourne, Australia	4(3), 5(2), 7(4), 11(5), 14(1)	15(5)
11	University College London, U.K.	1(1), 2(4), 3(4), 5(2), 7(3), 8(1), 9(1), 10(5), 14(1)	22(9)
12	The Childrens Hospital of Philadelphia, USA	1(5), 4(8), 7(5), 14(2)	20(4)
13	University of Milan, Italy	5(5), 9(1)	6(2)
14	Baylor College of Medicine, USA	1(4), 7(2), 8(1), 10(1), 11(1), 12(2), 14(4)	15(7)
15	University of British Columbia, Canada	7(9), 8(10)	19(2)

TCL=Total Collaborative Linkages; NOO=Number of organizations

Among the 52 highly cited papers, China participated in the largest number of papers (22 papers), followed by USA (18 papers), Italy and U.K. (5 papers each), Taiwan (3 papers), Australia, Austria, France, Hong Kong, Spain and Sweden (2 papers each), Belgium, Bulgaria, Canada, Germany, Israel, Singapore, Slovenia and Switzerland (1 papers each). The 52 high cited papers involve 306 organizations and 562 authors. These 52 highly papers appeared across 36 journals, of which 5 papers each were published in *New England Journal of Medicine* and *JAMA*

Pediatrics, 3 papers each in *JAMA-Journal of the American Medical Association* and *Lancet Child and Adolescent Health*, 2 papers each in *Acta Paediatrica*, *Circulation*, *The Lancet* and *Pediatrics*, 1 paper each in 28 other journals.

SUMMARY AND CONCLUSION

Using quantitative and qualitative indicators, the present paper provides a bibliometric assessment of global literature (3488 records) on “Impact

Table 7: Top 15 Most Productive Authors in “Impact of COVID 19 on Children’ and Adolescents”.

S.No	Name of the Author	Affiliation of the Author	TP	TC	CPP	HI	ICP	%ICP	RCI
1	D.Buonsenso	The Gemelli University Hospital, Italy	15	483	32.20	5	6	40.00	3.87
2	C.Calvo	La Paz University Hospital, Spain	12	218	18.17	4	2	16.67	2.19
3	X.Lu	Huazhong University of Science and Technology, China	12	1246	103.83	7	3	25.00	12.49
4	A.Villani	Bambino Gesù Children’s Hospital, Italy	12	173	14.42	5	1	8.33	1.73
5	A.Campana	Bambino Gesù Children’s Hospital, Italy	11	249	22.64	5	2	18.18	2.72
6	G.L.Marseglia	Policlinico San Matteo, Italy	11	375	34.09	5	0	0.00	4.10
7	L.Provenzi	University of Pavia, Italy	10	16	1.60	3	0	0.00	0.19
8	R.Borgatti	University of Pavia, Italy	9	15	1.67	3	0	0.00	0.20
9	E.H. Choi	Seoul National University, South Korea	9	113	12.56	4	1	11.11	1.51
10	A.Licari	University of Pavia, Italy	9	361	40.11	5	0	0.00	4.83
11	D.Andina	Niño Jesús University Children’s Hospital, Spain	8	138	17.25	3	0	0.00	2.08
12	Z.A.Bhutto	Hospital for Sick Children University of Toronto, Canada	8	127	15.88	3	7	87.50	1.91
13	M.Ceyhan	Ankara Numune Education and Research Hospital, Turkey	8	11	1.38	1	0	0.00	0.17
14	S.Esposito	University of Parma, Italy	8	109	13.63	3	0	0.00	1.64
15	K.G.Friedman	Harvard Medical School, USA	8	127	15.88	4	3	37.50	1.91
Total of top 15 authors			150	3761	25.07	4	25	16.67	3.02
Global total			3488	28972	8.31				
Share of top 15 authors in global total			4.30	12.98					

TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; ICP=International Collaborative Papers; HI=*h*-Index; RCI=Relative Citation Index

Table 8: Top 15 Most Productive Journals in “Impact of COVID-19 on Children and Adolescents”.

S.No	Name of the Journal	TP	TC	CPP
1	JAMA Pediatrics	71	1384	19.49
2	Pediatrics Infectious Disease Journal	60	723	12.05
3	Acta Paediatrica International Journal of Pediatrics	58	866	14.93
4	Frontiers in Pediatrics	55	349	6.35
5	Journal of Pediatrics	52	648	12.46
6	Pediatrics	51	1866	36.59
7	Pediatric Pulmonology	48	285	5.94
8	International Journal of Environmental Research and Public Health	45	85	1.89
9	Journal of Adolescent Health	45	273	6.07
10	Indian Pediatrics	44	225	5.11
11	Pediatric Blood and Cancer	42	240	5.71
12	Child Abuse and Neglect	34	94	2.76
13	Journal of Pediatrics and Child Health	34	83	2.44
14	Archives of Disease in Childhood	33	241	7.30
15	Indian Journal of Paediatrics	33	154	4.67
Total of 15 journals		705	7516	10.66
Global total		3476		
Share of top 15 journals in global total		20.28		

of COVID-19 on Children and Adolescents” based on indexed publications in Scopus database covering 2020-21 period.. The global publications on this theme averaged 8.31 citations per paper. Only 1.49% share (52 papers) of the global publications on this subject received funding support from various national and international research agencies and averaged 256.63 citations per paper.

Although 145 countries participated in global research on “Impact of COVID-19 on Children and Adolescents”, but the combined output of top 10 most productive countries alone accounts for 85.21% share and more than 100% share of global publications and citations output. On one hand, USA, U.K., Italy and China contributed the global publication share of 26.98%, 11.41% and 10.92% respectively, but on the other hand China (3.16), U.K (1.28), USA(1.27) and France (1.22) registered comparatively higher relative citation index among top 10 countries. The share of international collaborative papers in global output varied from 13.60% to 61.29%, with average value as 33.48% during 2020-21. Top 10 countries have strong collaborative linkages among themselves with USA-Canada having the strongest collaborative linkages (63 linkages), followed by USA – U.K. (59 linkages), USA-Canada (41 linkages), U.K. - Italy (37 linkages), USA-China (37 linkages), usa-Italy (34 linkages), U.K.-Spain (31 linkages), etc

Medicine contributed the largest share (83.89%) to global publications output on “Impact of COVID-19 on Children and Adolescents”, followed by Psychology (10.24%), Social sciences (7.68%), and other five subjects contributing less than 5.0% (from 1.58% to 4.90%). The major focus of global research on “Impact of COVID-19 on Children and Adolescents” has been on mental health related disorders (51.55%), followed by respiratory related disorders (17.06%) and the rest on extra-pulmonary manifestations of COVID-19 disease.

The 412 organizations and 661 authors participated in global research on this theme, with the top 15 most productive organizations and authors

contributing 21.07% and 4.30% global publications share and 38.05% and 12.98% global citations share. Harvard Medical School, USA (80 papers), Huazhong University of Science and Technology, China (67 papers), Tongji Medical College, China (63 papers), Children's Hospital, Boston, USA (61 papers) and IRCCS Ospedale Pediatrico Bambino Gesù, Italy (53 papers) were the most productive global organizations and Huazhong University of Science and Technology, China (31.97 and 3.85), Tongji Medical College, China (19.92 and 2.40), Children's Hospital of Philadelphia, USA (19.30 and 2.32), INSERM, France (17.54 and 2.11), University of Melbourne, Australia (16.70 and 2.01) and Children's Hospital, Boston, USA (16.34 and 1.97) were the most impactful organizations in terms of citations per paper and relative citation index. The top 15 organizations have strong collaborative linkages among themselves, with Huazhong University of Science and Technology, China and Tongji Medical College, China have the strongest collaborative linkages (62) followed by Harvard Medical School, USA and Children's Hospital, Boston, USA (46 linkages), etc.

D. Buonsenso (15 papers), C. Calvo, X. Lu and A. Villani (12 papers each), A. Campana and G.L. Marseglia (11 papers each) were the most productive authors and X. Lu (103.83 and 12.49), A. Licari (40.11 and 4.83), G.L. Marseglia (34.09 and 4.1) and D. Buonsenso (32.2 and 3.87) were the most impactful authors.

JAMA Pediatrics (71 papers), *Pediatrics Infectious Disease Journal* (60 papers), *Acta Paediatrica International Journal of Pediatrics* (58 papers), *Frontiers in Pediatrics* (55 papers), *Journal of Pediatrics* (52 papers), *Pediatrics* (51 papers) and *Pediatric Pulmonology* (48 papers) were the leading most productive journals in reporting global research in the field of "Impact of COVID-19 on Children and Adolescents". *Pediatrics* (36.59), *JAMA Pediatrics* (19.49), *Acta Paediatrica International Journal of Pediatrics* (14.93), *Journal of Pediatrics* (12.46), *Pediatrics Infectious Disease Journal* (12.05), *Archives of Disease in Childhood* (7.30) and *Frontiers in Pediatrics* (6.35) were the leading journal in terms of citation impact per paper.

The 52 (1.49%) out of 3488 global publications on "Impact of COVID-19 on Children and Adolescents" registered 101 to 1167 citations per paper and they together received 13345 citations, averaging to 256.63 citations per paper. These 52 publications are assumed as highly cited and involve the 16 countries, 306 organizations, 562 authors and published in 36 journals.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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