

E-Cigarettes: A Scientometric Assessment of Global Publications Output during 2001-18

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ABSTRACT

The paper makes assessment of global e-cigarette publications (3885 publications) trends over the past 18 years (2001-8) via a bibliometric analysis, using Scopus database. The paper further provides an insight into qualitative performance of e-cigarettes research in terms of qualitative indicators, such as relative citation index, citations per paper, highly cited papers, top 15 global organizations and authors in the field, most favored subjects in the field. E-cigarettes annual and nine-year cumulative global publication output registered 113.60% and 7570.0% growth during the last 18 years and its citation impact averaged to 18.71 citations per paper. 89.63% share of the global research output and more than 100% share of global citation output in the field emanates from top 10 (among 37 participating countries) during 2001-18. Seven (out of top 10) countries registered relative citation index above their global average of 1.29: Canada and Italy (2.32 each), Greece (1.75), Australia (1.54), U.K. and Switzerland (1.42 each) and France (1.30) during 2001-18. Medicine is the most preferred subject on e-cigarettes research with 81.75% global publications share, followed distantly by pharmacology, toxicology and pharmaceuticals (13.15%), social sciences (9.146%), environment science (7.26%), etc. during this period. Among 525 organizations and 729 authors participating in e-cigarettes research, the top 15 organizations and the authors collectively contributed 26.64% and 13.64% global publication share and 47.78% and 33.25% global citation share, respectively during 2001-18. USA and U.K. were the leading global organizations with global publications share of 52.15% and

12.54%. University of California, San Francisco, USA and University of North Carolina at Chapel Hills, USA were the leading organizations with 135 and 87 papers. Roswell Park Cancer Institute, USA (53.79 and 2.88) and Food and Drug Administration, MD, USA (42.33 and 2.26) were the two leading organizations in terms of citation impact per paper and relative citation index. R. Polosa (61 papers) and K.E. Farsalinos (45 papers) were the two most productive authors on the subject. M.L. Goniewicz (77.02 and 4.12) and S.A. Glantz (69.50 and 3.71) were the two leading authors in terms of citation impact per paper and relative citation index. Nicotine and Tobacco Research (184 papers) and Tobacco Control (168 papers) were the leading journals (among 305 participating journals) publishing on this theme. 141 papers (among 3885 total papers) registered 100 to 2902 citations per paper, cumulating to a total 31459 citations, averaging to 223.11 citations per paper.

Key words: E-Cigarettes, Global publications, Scientometrics, Bibliometrics.

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INTRODUCTION

Electronic cigarettes are known by many different names, including e-cigarettes, e-vaporizers, or electronic nicotine delivery systems and alternative nicotine delivery systems. Some common nicknames for e-cigarettes are: e-cigs, e-hookahs, hookah pens, vapes, vape pens and mods (customizable, more powerful vaporizers).

They are battery-operated devices that people use to inhale an aerosol, which typically contains nicotine (though not always), flavorings and other chemicals. Most e-cigarettes consist of four different components, including: (i) a cartridge or reservoir, which holds a liquid solution (e-liquid or e-juice) containing varying amounts of nicotine, flavorings and other chemicals; (ii) a heating element (atomizer); a power source (usually a battery) and a mouthpiece that the person uses to inhale. In many e-cigarettes, puffing activates the battery-powered heating device, which vaporizes the liquid in the cartridge. The person then inhales the resulting aerosol or vapor (called as vaping).¹

A first-generation e-cigarette is one that closely resembles a cigarette and is disposable. A second-generation e-cigarette is a larger, usually pen-shaped device that can be recharged. A third-generation e-cigarette refers to devices that do not resemble a combustible cigarette and often have very large and sometimes customizable batteries. Some parts may

be replaceable, which is why they are sometimes called “mods.” These devices are refillable. More recently, e-cigarettes that have a sleek, high-tech design and easily rechargeable batteries have entered the market. One device, JUUL, emerged in 2016 and quickly established itself as a leading e-cigarette product by early 2018.²

E-cigarettes can be categorized into three groups disposable, rechargeable and modular can be refilled by the user. There are over 466 brands and 7764 unique flavors with about 242 new flavors added per month.³

The modern e-cigarette is often credited to Hon Lik, a Chinese pharmacist who invented the product in 2003; Lik's design was patented internationally in 2007 (Electronic Atomization Cigarette: US 20070267031 A1). E-cigarettes became commercially available in Europe and the USA around 2006. E-cigarettes have been taken up by millions around the world since they first appeared. Reported use of e-cigarettes has increased dramatically in recent years. The value of global sales of e-cigarettes was estimated to be 3.5 billion US\$ in 2015, with the largest three markets being the USA, Russia and Germany (collectively representing 60% of global sales).⁴

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A global survey found that identified 68 countries that regulate e-cigarettes at the national level using a range of regulatory mechanisms including laws (new or amended), alerts, circulars, decisions, decrees, notifications, orders, ordinances, rulings and statements.⁵ To date, over 20 countries, mostly in South America, the Middle East and South-East Asia, including India, have banned the sale of e-cigarette products.⁶

Electronic cigarettes are at the center of a public health policy debate today. Research so far suggests that e-cigarettes are less harmful than cigarettes when people who regularly smoke switch to them as a complete replacement. But e-cigarettes can still damage a person's health. E-cigarettes can lead to nicotine addiction and increased risk for addiction to other drugs. E-cigarette use also exposes the lungs to a variety of chemicals, including those added to e-liquids and other chemicals produced during the heating/vaporizing process.¹

LITERATURE REVIEW

Electronic cigarette of late has become an emerging phenomenon and becoming increasingly popular with smokers worldwide. There is a lack of data concerning the evaluation of research productivity in the field of electronic cigarette originating from the world.

Bibliometric analyses have been conducted on a wide range of health topics, including on in the field of tobacco, yet only few studies specifically focused on e-cigarettes has been published to our knowledge. Amongst these studies, Briganti, Delnevo, Brown, Hastings and Steinberg⁷ bibliometrically assessed e-cigarette publications (4490) during the 15 years (2003-18), using Scopus database in terms of Hirsch index, document type and frequency and publications by institution, journal and country. Filippidis and Somai⁸ studied the changes in the focus of e-cigarette research output (2003 records) over time, by analyzing e-cigarette related publications in Pubmed from 2007 to 2016: assessed the number of publications by time period and journal and visualized the frequency of words used in the titles in word clouds. Zyoud, Al-Jabi and Sweileh⁹ evaluated the research productivity of global output in the field of electronic cigarette, with the main objectives to study: (a) total and trends of contributions in EC research during all previous years up to the date of data analysis; (b) authorship patterns and research productivity; (c) countries contribution; and (d) citations received by the publications. Three hundred and fifty-six documents were retrieved, which were published in 162 peer-reviewed journals and from 27 countries.

The current study provides a more recent assessment of the literature on e-cigarette publications, yielding a much-focused sample (3885 documents). This study identified journals, institutions, authors and countries disseminating the most electronic cigarette research and also examine the authorship pattern and the citations retrieved from the Scopus database.

The study aims to examine global e-cigarettes research performance in terms of qualitative and quantitative indicators based on publications covered in Scopus database during 2001-18. The study in particular looks at the annual and cumulative global output and their growth rates, citation impact of research output, global output and share of top 10 most productive countries: their output, citation impact and international collaborative publications, distribution of publication output by broad sub-fields, productivity and citation impact of top 15 most productive organizations and authors, media of research communications and characteristic features of its top 141 highly cited papers.

METHODOLOGY

Publication data on e-cigarettes global research was downloaded from the international and multidisciplinary Scopus database (<http://www.scopus.com>) covering period from 2001-18. Four keywords used for

search are "E-Cigarette* or Electronic Cigarette* or electronic nicotine* or electronic vaping* and they were suffixed to "keyword tag", "Title of Paper tag" and the search output was restricted to the period '2001-18' using "date range tag". The search strategy yielded 3885 records. The search strategy was further modified for each country to get publication output of top 10 most productive countries on e-cigarettes. The resulted global output was distributed by subject, collaborating countries, author-wise, organization-wise and journal-wise, etc. by using analytical provisions of Scopus database such as "subject area tag", "country tag", "source title tag", "journal title name" and "affiliation tag". Citations to publications were counted from date of their publication till 2 September 2019. The study analyzed the publications data across a series of raw and relative bibliometric indicators with a view to understand the dynamics of global e-cigarettes research. A complete counting method, wherein every contributing author or organization covered in multiple authorship papers was fully counted was used. All authors or organizations to multi-authored papers have received equal credit in data counting and analysis. The data for the study was derived on 2 September 2019.

((KEY (E-Cigarette* or Electronic Cigarette*) OR TITLE (E-Cigarette* or Electronic Cigarette*)) AND PUBYEAR > 2000 AND PUBYEAR < 2019) OR ((KEY(electronic nicotine* or electronic vaping*) OR TITLE(electronic nicotine* or electronic vaping*)) AND PUBYEAR > 2000 AND PUBYEAR < 2019)).

ANALYSIS AND RESULTS

The e-cigarettes global research output in field of cumulated to 3885 publications in 18 years during 2001-18. The research on e-cigarettes registered 113.60% growth per annum, up from 1 in 2001 to 836 publications in 2018 and averaged 18.71 citations per paper. Nine-year absolute growth by 7570% in the field indicates that e-cigarettes research followed a strong growing trend, up from 50 to 3835 publications during eight-year periods 2001-09 to 2010-18 (Table 1). Articles, among document types, constitutes 62.63% (2433) share of total output, followed by reviews (383, 9.86%), notes (344, 8.85%), letters (343, 8.83%), editorials (214, 5.51%), short surveys (81, 2.08%) and others contributes less than 1% share: conference papers (0.69%), erratum (0.46%), book chapters (0.33%), data papers (0.26%) and undefined (0.49%) during 2001-18.

Leading Countries Publications Profile

E-cigarettes witnessed the participation of 77 countries, of which 47 countries published 1-10 papers each, 7 countries 11-20 papers each, 9 countries 21-50 papers each, 6 countries 50-100 papers each, 6 countries 101-200 papers each, 2 countries 487 and 2026 papers each during 2001-18. Significant global research output (89.63%) and global citation share (more than 100%) in the field, however, comes from just top 10 most productive countries. The USA and U.K. leads and occupied the top two ranks with global publications share of 52.15% and 12.54%. Other 8 countries are distantly away with global contribution varying from 1.96% to 4.14% during 2001-18 (Table 2). Seven countries scored relative citation index above global average (1.29): Canada and Italy (2.32 each), Greece (1.75), Australia (1.54), U.K. and Switzerland (1.42 each) and France (1.30). Further, these top 10 countries publish 14.71% to 67.00% share of their country output as international collaborative papers, with average share of 25.67%.

Subject-Wise Distribution of Research Output

Medicine is the dominant subject in e-cigarettes research (with 81.75% publications share), followed distantly by Pharmacology, Toxicology and Pharmaceutics (13.15%), Social Sciences (9.146%), Environment Science (7.26%), etc. during the period (Table 3). These 6 sub-fields of E-Cigarettes research (as identified in Scopus database classification)

Table 1: Annual and Cumulative Global Publications and Citations in E-Cigarettes during 2001-18.

Publication Period	World		
	TP	TC	CPP
2001	1	0	0.00
2002	3	24	8.00
2003	2	7	3.50
2004	1	61	61.00
2005	3	36	12.00
2006	1	15	15.00
2007	10	333	33.30
2008	9	357	39.67
2009	20	581	29.05
2010	13	1374	105.69
2011	36	2601	72.25
2012	54	2344	43.41
2013	121	7545	62.36
2014	461	15185	32.94
2015	716	14997	20.95
2016	817	13919	17.04
2017	781	10008	12.81
2018	836	3305	3.95
2001-09	50	1414	28.28
2010-18	3835	71278	18.59
2001-18	3885	72692	18.71

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

Annual average growth rate=113.60; Cumulative growth rate=7570.0%

witnessed fluctuations in their activity index during 2001-09 to 2010-18 compared to world average index of 100. In most sub-fields their activity index changed above and below to world average in 2010-18 compared to their corresponding status in 2001-09. The 6 sub-fields showed increased activity in Pharmacology, Toxicology and Pharmaceutics, Social Sciences, Environment Science and Biochemistry, Genetics and Molecular Biology as against decrease activity in Medicine and Psychology. Social Sciences registered the highest citation impact per paper of 24.94 and the Psychology (14.59) the least (Table 3).

Significant Keywords

61 important keywords have been identified from the literature which through light on the research trends in e-cigarettes research. These keywords are listed in Table 4 in the decreasing order of the frequency of their occurrence in the literature during 2001-18.

Profile of 15 Most Productive Global Organizations

Five Hundred Twenty Five (525) organizations participated in e-cigarettes Research during 2001-18. Of these organizations, 241 published 1-5 papers each, 142 organizations 6-10 papers each, 75 organizations 11-20 papers each, 54 organizations 21-50 papers each, 12 organizations 51-100 papers each and 1 organization 135 papers 2001-18.

The productivity of top 20 most productive organizations varied from 44 to 135 publications per organization; together they contributed 26.64% (1035) global publications share and 47.78% (34732) global citations share during 2001-18. Their scientometric profile is presented in Table 5.

- Five organizations registered their publication productivity above the group average (69.0) of all organizations: University of California, San Francisco, USA (135 papers), University of North Carolina at Chapel Hills, USA (87 papers), John Hopkins School of Public Health, Bloomberg, USA (78 papers), Virginia Commonwealth University, USA (73 papers) and Roswell Park Cancer Institute, USA (72 papers) during 2001-18.

Table 2: Publication Profile of 10 Leading Countries in E-Cigarettes during 2001-18.

S.No	Name of the Country	Number of Papers			Share of Papers			TC	CPP	ICP	%ICP	RCI
		2001-09	2010-18	2001-18	2001-09	2010-18	2001-18					
1	USA	22	2004	2026	44.00	52.26	52.15	447792	221.02	298	14.71	11.81
2	U.K.	4	483	487	8.00	12.59	12.54	12952	26.60	173	35.52	1.42
3	Canada	1	160	161	2.00	4.17	4.14	2384	14.81	72	44.72	2.32
4	Italy	3	152	155	6.00	3.96	3.99	6730	43.42	83	53.55	2.32
5	Australia	0	149	149	0.00	3.89	3.84	4298	28.85	65	43.62	1.54
6	Germany	0	113	113	0.00	2.95	2.91	1383	12.24	39	34.51	0.65
7	France	1	111	112	2.00	2.89	2.88	2732	24.39	31	27.68	1.30
8	Switzerland	3	100	103	6.00	2.61	2.65	2727	26.48	37	35.92	1.42
9	Greece	0	100	100	0.00	2.61	2.57	3276	32.76	67	67.00	1.75
10	China	7	69	76	14.00	1.80	1.96	676	8.89	29	38.16	0.48
	Total	41	3441	3482	82.00	89.73	89.63	83972	24.12	894	25.67	1.29
	World Total	50	3835	3885				72692	18.71			
								115.52				

Table 3: Subject-Wise Breakup of Global Publications in E-Cigarettes during 2001-18.

S.No	Subject*	Number of Papers (TP)			Activity Index		TC	CPP	%TP
		2001-09	2010-18	2001-18	2001-09	2010-18			
1	Medicine	41	3135	3176	100.31	100.00	51045	16.07	81.75
2	Pharmacology, Toxicology and Pharmaceutics	4	507	511	60.82	100.51	7952	15.56	13.15
3	Social Sciences	1	354	355	21.89	101.02	8854	24.94	9.14
4	Environment Science	1	281	282	27.55	100.94	6060	21.49	7.26
5	Biochemistry, Genetics and Molecular Biology	1	264	265	29.32	100.92	5202	19.63	6.82
6	Psychology	6	187	193	241.55	98.15	2815	14.59	4.97
	World Output	50	3835	3885			72692	18.71	

There is overlapping of literature covered under various subjects
TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper

Table 4: Significant Keywords in Global E-Cigarettes Literature during 2001-18.

S.No	Keyword	Frequency	S.No	Keyword	Frequency
1	Electronic Cigarettes	3576	33	Flavoring Agents	160
2	Smoking	2213	34	Chemistry	154
3	Smoking Cessation	1590	35	Smoking Regulation	165
4	Nicotine	1423	36	Advertising	148
5	Tobacco	1236	37	Nicotiana Tabacum	146
6	Electronic Nicotine Delivery System	1133	38	Environmental Exposure	143
7	Tobacco Products	646	39	Nicotine Patch	134
8	Vaping	609	40	Drug Effects	127
9	Epidemiology	554	41	Tobacco Smoking Pollution	127
10	Psychology	545	42	Smoke	125
11	Tobacco Dependence	531	43	Varenicline	121
12	Prevalence	457	44	Vapor	120
13	Public Health	438	45	Nicotine Agents	118
14	Tobacco Use	425	46	Formaldehyde	112
15	Adverse Effects	405	47	Smoking Prevention	110
16	Harm Reduction	355	48	Amfebutamone	109
17	Health Hazards	349	49	Product Safety	104
18	Aerosol	330	50	Smokeless Tobacco	104
19	Legislation and Jurisprudence	304	51	Randomized Controlled Trials	103
20	Nicotine Replacement Therapy	290	52	Pregnancy	101
21	Tobacco Industry	263	53	Cotinine	100
22	Prevention and Control	262	54	Addition	95
23	Nicotine Gum	253	55	Cannabis	94
24	Passive Smoking	244	56	Carbon Monoxide	93
25	Health Care Policy	235	57	Cardiovascular Disease	93
26	Smoking Ban	212	58	Cannabis Use	60
27	Propylene Glycol	210	59	Cancer Risk	57
28	Smoking Habit	190	60	Cannabis Smoking	56
29	Government Regulation	168	61	E-Liquids	43
30	Perception	166			
31	Internet	163			
32	Glycerol	163			

Table 5: Scientometric Profile of 15 Most Productive Global Organizations in E-Cigarettes Research during 2001-18.

S.No	Name of the Organization	TP	TC	CPP	HI	ICP	%ICP	RCI
1	University of California, San Francisco, USA	135	5050	37.41	32	21	15.56	2.00
2	University of North Carolina at Chapel Hills, USA	87	2174	24.99	25	3	3.45	1.34
3	John Hopkins School of Public Health, Bloomberg, USA	78	2022	25.92	26	18	23.08	1.39
4	Virginia Commonwealth University, USA	73	2559	35.05	24	30	41.10	1.87
5	Roswell Park Cancer Institute, USA	72	3873	53.79	32	35	48.61	2.88
6	University of Southern California, LA, USA	69	1977	28.65	24	6	8.70	1.53
7	Center for Disease Control and Prevention, Atlanta, USA	68	2860	42.06	23	7	10.29	2.25
8	University of California, San Diego, USA	65	2052	31.57	23	4	6.15	1.69
9	Food and Drug Administration, MD, USA	64	2709	42.33	25	5	7.81	2.26
10	King's College London, U.K.	63	1259	19.98	18	25	39.68	1.07
11	Universita degli di Catania, Italy	59	2410	40.85	22	34	57.63	2.18
12	Yale University School of Medicine, USA	59	1114	18.88	18	3	5.08	1.01
13	Onassis Cardiac Surgery Center, Sygrou, Greece	55	2174	39.53	21	38	69.09	2.11
14	Georgetown University Center, USA	44	1060	24.09	20	5	11.36	1.29
15	University College London, U.K,	44	1439	32.70	17	19	43.18	1.75
	Total of 15 organizations	1035	34732	33.56	23.3	253	24.44	1.79
	Total of the world	3885	72693	18.71				
		26.64	47.78					

- Seven organizations registered their citation impact per paper and relative citation index above the group average (33.56 and 1.79) of all organizations: Roswell Park Cancer Institute, USA (53.79 and 2.88), Food and Drug Administration, MD, USA (42.33 and 2.26), Center for Disease Control and Prevention, Atlanta, USA (42.06 and 2.25), Universita degli di Catania, Italy (40.85 and 2.18), Onassis Cardiac Surgery Center, Sygrou, Greece (39.53 and 2.11), University of California, San Francisco, USA (37.41 and 2.0) and Virginia Commonwealth University, USA (35.05 and 1.87) during 2001-18

Profile of Top 15 Most Productive Authors

Seven Hundred Twenty Nine (729) authors participated in e-cigarettes research during 2001-18, of which 561 authors published 1-5 papers each, 245 authors 6-10 papers each, 93 authors 11-20 papers each, 29 authors 21-50 papers each and 1 authors 61 papers.

The research productivity of top 15 most productive authors varied from 26 to 61 publications per author. Together they contributed 13.64% (530) global publications share and 33.25% (24168) global citations share during 2001-18. Their detailed scientometric profile is presented in Table 6.

- Six authors registered their publications output above the group average of 35.33: R. Polosa (61 papers), K.E. Farsalinos and M.L. Goniewicz (45 papers each), T. Eissenberg (42 papers), B.A. King (38 papers) and P. Caponnetto (37 papers) during 2001-18.
- Seven authors registered their citation impact per paper and relative citation index above the group average (45.60 and 2.44) of all authors: M.L. Goniewicz (77.02 and 4.12), S.A. Glantz (69.50 and 3.71), J.E. Etter (68.24 and 3.65), B.A. King (49.95 and 2.67), V.

Voudris (49.91 and 2.67), K.E. Farsalinos (47.11 and 2.52) and P. Caponnetto (46.97 and 2.51) during 2001-18.

Medium of Research Communication

Of the 305 journals which reported 3834 articles, 194 published 1-5 papers each, 47 published 6-10 papers each, 34 published 11-20 papers each, 20 published 21-50 papers each, 6 published 51-100 papers each and 4 published 101-184 papers each during 2001-18.

The top 15 most productive journals accounted for 32.50% share of total e-cigarettes output that appeared in journal medium during 2001-18, which increased from 26.67% to 32.57% between 2001-09 and 2010-18. The top most productive journal (with 184 papers) was *Nicotine and Tobacco Research*, followed by *Tobacco Control* (168 papers), *International Journal of Environment and Public Health* (125 papers), *Addictive Behaviors* (106 papers), etc. during 2001-18 (Table 7).

Highly-cited Papers

Of the total global output in e-cigarettes research (3885 publications), only 141 (3.63% share) cumulated 100 to 2902 citations per paper (cumulative total 31459 citations) since their publication during 2001-18, averaging to 223.11 citations per paper. The distribution of 141 highly-cited papers is skewed. Ninety Three (93) papers cumulated citations in the range 100-197 per paper, 31 papers were in citation range 201-297, 10 papers in citation range 312-393, 5 papers in citation range 434-723 and 2 papers were in citation range 1744-2902.

- Of the 141 highly-cited papers, 51 resulted from contribution by single organizations per paper (non-collaborative papers) and 90 from two or more organizations per paper (51 national collaborative and 39 international collaborative papers).

Table 6: Scientometric Profile of Top 15 Most Productive Authors in E-Cigarettes Research during 2001-18.

S.No	Name of the Author	Affiliation of the Author	TP	TC	CPP	HI	ICP	%ICP	RCI
1	R. Polosa	Universita degli di Catania, Italy	61	2370	38.85	21	36	59.02	2.08
2	K.E. Farsalinos	Onassis Cardiac Surgery Center, Sygrou, Greece	45	2120	47.11	21	33	73.33	2.52
3	M.L. Goniewicz	Roswell Park Cancer Institute, USA	45	3466	77.02	27	28	62.22	4.12
4	T. Eissenberg	Virginia Commonwealth University, USA	42	1821	43.36	19	17	40.48	2.32
5	B.A. King	Center for Disease Control and Prevention, Atlanta, USA	38	1898	49.95	10	1	2.63	2.67
6	P. Caponnetto	Universita degli di Catania, Italy	37	1738	46.97	18	21	56.76	2.51
7	A.McNeill	King's College London, U.K.	35	1351	38.60	15	12	34.29	2.06
8	J.B. Unger	University of Southern California, LA, USA	32	1379	43.09	18	1	3.13	2.30
9	V. Voudris	Onassis Cardiac Surgery Center, Sygrou, Greece	32	1597	49.91	18	17	53.13	2.67
10	J.E. Etter	Universite de Geneva, Switzerland	29	1979	68.24	20	10	34.48	3.65
11	S. Krishnan Sarin	Yale University School of Medicine, USA	28	748	26.71	13	0	0.00	1.43
12	D.B. Abrams	John Hopkins School of Public Health, Bloomberg, USA	27	823	30.48	14	9	33.33	1.63
13	A.C. Villanti	John Hopkins School of Public Health, Bloomberg, USA	27	733	27.15	12	6	22.22	1.45
14	S.A. Glantz	University of California, San Francisco, USA	26	1807	69.50	15	3	11.54	3.71
15	C.L. Perry	University of Texas at Austin, USA	26	338	13.00	11	0	0.00	0.69
	Total OF 15 authors		530	24168	45.60	16.8	194	36.60	2.44
	Total of the world		3885	72693	18.71				
	Share of 15 authors in the world output		13.64	33.25					

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

Table 7: Top 15 Most Productive Journals in E-Cigarettes Research during 2001-18.

S.No	Name of the Journal	Number of Papers		
		2001-09	2010-18	2001-18
1	Nicotine and Tobacco Research	4	180	184
2	Tobacco Control	1	167	168
3	International Journal of Environment and Public Health	0	125	125
4	Addictive Behaviors	2	104	106
5	Addiction	0	84	84
6	BMJ Online	0	84	84
7	Drug and Alcohol Dependence	0	76	76
8	PLOS One	0	68	68
9	American Journal of Preventive Medicine	4	59	63
10	Preventive Medicine	1	58	59
11	Journal of Adolescent Health	0	50	50
12	Pediatrics	0	50	50
13	Regulatory Toxicology and Pharmacology	0	49	49
14	BMC Public Health	0	40	40
15	Lancet	0	40	40
	Total of 15 Journals	12	1234	1246
	Total of world	45	3789	3834
	Share of 15 journals in world journal output	26.67	32.57	32.50

- Among highly-cited papers, USA had participation in the largest number of papers (96 papers), followed by U.K. (25 papers), Italy (16 papers), Greece (10 papers), New Zealand and Poland (6 papers each), Switzerland (5 papers), Australia, Canada and Netherland (4 papers each), France and Germany (3 papers each), Austria, Belgium, Sweden and South Africa (3 papers each), Argentina, Denmark, Hong Kong, Japan, Lebanon, Mexico and South Korea (1 paper each);
- The 141 highly-cited papers belonged to 976 authors and 364 organizations.
- The leading organizations participating in highly-cited papers were: University of California, San Francisco, USA and Roswell Park Cancer Institute, USA (9 papers each), Center for Disease Control and Prevention, Atlanta, USA, Food and Drug Administration, MD, USA and Onassis Cardiac Surgery Center, Sygrou, Greece (8 papers each), Università degli di Catania, Italy (7 papers), Virginia Commonwealth University, USA and University College London, U.K. (6 papers each), University of North Carolina at Chapel Hills, USA and John Hopkins School of Public Health, Bloomberg, USA (5 papers each), University of Southern California, LA, USA and King's College London, U.K. (4 papers each), etc.;
- The leading authors participating in highly-cited papers were: M.L. Goniewicz (10 papers), K.E. Farsalinos (8 papers), R. Polosa and V. Voudris (7 papers each), T. Eissenberg, P. Caponnetto, A. McNeill and J.E. Etter (5 papers each), B.A. King and S.A. Glantz (4 papers each), etc.;
- These 141 highly-cited papers appeared across 54 journals, of which 22 papers were published in *Nicotine and Tobacco Research*, 10 papers in *Tobacco Control*, 9 papers in *American Journal of Preventive Medicine*, 8 papers each in *Addiction* and *International Journal of Environmental Research and Public Health*, 6 papers in *PLOS One*, 4 papers each in *Addictive Behaviors* and *Pediatrics*, 3 papers each in *Annals of Internal Medicine*, *JAMA Pediatrics* and *New England Journal of Medicine*, 2 papers each in *American Journal of Respiratory and Critical Care Medicine*, *Archives of Toxicology*, *BMC Public Health*, *Circulation*, *Chest*, *Journal of Adolescent Health*, *Morbidity and Mortality Report*, *Preventive Medicine* and *Toxicology In Vitro* and 1 paper each in 32 other journals.

SUMMARY AND CONCLUSION

This study expands upon previous efforts of research studies to analyze the literature surrounding electronic cigarettes, using a more specific search method. 3885 global publications in e-cigarettes were published, as indexed in Scopus database in 18 years during 2001-18. The e-cigarettes annual and nine-year cumulative global output registered 113.60% and 7570.0% growth during the last 18 years. The annual publications on e-cigarettes increased from 1 in 2001 to 836 in 2018 and cumulative publications from 50 during 2001-09 to 3835 during 2010-18. The global publications on e-cigarettes averaged 18.71 citations per paper (CPP) during 2001-18, which decreased from 28.28 CPP to 18.59 CPP from 2001-09 to 2010-18.

77 countries participated in e-cigarettes research, of which top 10 countries contributed 89.63% share of the global research output and more than 100% share of global citation output during 2001-18. The largest global publication share comes from USA and U.K. (with 52.15% and 12.54% share) and other 8 countries global publication share varied from 1.96% to 4.14% during 2001-18. Seven countries out of top 10, namely Canada and Italy (2.32 each), Greece (1.75), Australia (1.54), U.K. and Switzerland (1.42 each) and France (1.30) registered relative citation index above top 10 countries average (1.29). The share of their

country output as international collaborative papers of top 10 countries varied from 14.71% to 67.0%, with average share of 25.67%.

Medicine contributed the largest share to e-cigarettes research (with 81.75% share), followed by Pharmacology, Toxicology and Pharmaceutics (13.15%), Social Sciences (9.146%), Environment Science (7.26%), etc. during the period. Pharmacology, Toxicology and Pharmaceutics, Social Sciences, Environment Science and Biochemistry, Genetics and Molecular Biology showed increase in activity index, as against decrease activity in Medicine and Psychology from 2001-08 to 2009-18. Social Sciences registered the highest citation impact per paper of 24.94 and the Psychology (14.59) the least.

Among 525 organizations and 729 authors participating in e-cigarettes research, the top 15 organizations and the authors collectively contributed 26.64% and 13.64% global publication share and 47.78% and 33.25% global citation share respectively during 2001-18. The leading organizations in terms of publication productivity were: University of California, San Francisco, USA (135 papers), University of North Carolina at Chapel Hills, USA (87 papers), John Hopkins School of Public Health, Bloomberg, USA (78 papers), Virginia Commonwealth University, USA (73 papers) and Roswell Park Cancer Institute, USA (72 papers) during 2001-18. The leading organizations in terms of citation impact per paper and relative citation index were: Roswell Park Cancer Institute, USA (53.79 and 2.88), Food and Drug Administration, MD, USA (42.33 and 2.26), Center for Disease Control and Prevention, Atlanta, USA (42.06 and 2.25), Università degli di Catania, Italy (40.85 and 2.18), Onassis Cardiac Surgery Center, Sygrou, Greece (39.53 and 2.11), University of California, San Francisco, USA (37.41 and 2.0) and Virginia Commonwealth University, USA (35.05 and 1.87) during 2001-18

The leading authors in terms of publication productivity were: R. Polosa (61 papers), K.E. Farsalinos and M.L. Goniewicz (45 papers each), T. Eissenberg (42 papers), B.A. King (38 papers) and P. Caponnetto (37 papers) during 2001-18. The leading authors in terms of citation impact per paper and relative citation index were: M.L. Goniewicz (77.02 and 4.12), S.A. Glantz (69.50 and 3.71), J.E. Etter (68.24 and 3.65), B.A. King (49.95 and 2.67), V. Voudris (49.91 and 2.67), K.E. Farsalinos (47.11 and 2.52) and P. Caponnetto (46.97 and 2.51) during 2001-18

Of the 305 participating journals (contributing 3834 articles), the top 15 most productive journals accounted for 32.50% share of total e-cigarettes research output during 2001-18. *Nicotine and Tobacco Research* was top most productive journal (184 papers), followed by *Tobacco Control* (168 papers), *International Journal of Environment and Public Health* (125 papers), *Addictive Behaviors* (106 papers), etc. during 2001-18

Only 141 out of 3885 papers registered 100 to 2902 citations per paper (cumulative total 31459 citations) since their publication during 2001-18, leading to 223.11 citations per paper. Among 141 highly-cited papers, 51 are non-collaborative and 90 collaborative (51 national and 39 international). USA contributed the largest number of papers (96 papers) among high cited papers, followed by U.K. (25 papers), Italy (16 papers), Greece (10 papers), New Zealand and Poland (6 papers each), Switzerland (5 papers), etc. The 141 highly-cited papers witnessed the participation of 976 authors and 364 organizations. The 141 highly-cited papers appeared across 54 journals, of which 22 papers were published in *Nicotine and Tobacco Research*, 10 papers in *Tobacco Control*, 9 papers in *American Journal of Preventive Medicine*, 8 papers each in *Addiction* and *International Journal of Environmental Research and Public Health*, 6 papers in *PLOS One*, 4 papers each in *Addictive Behaviors* and *Pediatrics*, etc.

REFERENCES

1. Electronic cigarettes (E-cigarettes). 2019. Revised September <https://www.drugabuse.gov/publications/drugfacts/electronic-cigarettes-e-cigarettes>

2. E-cigarettes: Facts, stats and regulations. 2018. <https://truthinitiative.org/research-resources/emerging-tobacco-products/e-cigarettes-facts-stats-and-regulations>
3. Thampi V, Nair R, Rawat R, Makhaik A, Dey S. A Review Study on Vaping and Status of Vaping in India. *J cancer Clin Trial*. 2018;3(2):1-4. DOI: 10.4172/2577-0535.1000147
4. Yvette B. Are e-cigarettes a safe alternative to smoking?. 2018. https://www.medicalnewstoday.com/articles/216550.php#what_are_they
5. Kennedy RD, Awopegba A, DeLeon E, Cohen JE. Global approaches to regulating electronic cigarettes. *Tobacco Control*. 2017;26(4):440-5.
6. Martin, Lorraine and Reihill. Here Are All the Valid Health Reasons Why So Many Countries Are Banning Vapes. 2019. <https://www.sciencealert.com/more-and-more-countries-are-banning-e-cigarettes>
7. Briganti M, Delnevo CD, Brown L, Hastings SE, Steinberg MB. Bibliometric analysis of electronic cigarette publications: 2003-2018. *Int J Environ Res Public Health*. 2019;16(3):E320. doi: 10.3390/ijerph16030320
8. Filippou TF, Melek S. A bibliometric overview of e-cigarette publications from 2007 to 2016. *European Respiratory Journal*. 2017;50:PA4484. DOI: 10.1183/1393003.congress-2017PA4484. https://erj.ersjournals.com/content/50/suppl_61/PA4484
9. Zyoud SH, Al-Jabi SW, Sweileh WM. Worldwide research productivity in the field of electronic cigarette: A bibliometric analysis. *BMC Public Health*. 2014;667. doi:10.1186/1471-2458-14-667

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