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THE 100 MOST CITED ARTICLES ON DENTAL FLUOROSIS FROM 2010 TO 2021: A BIBLIOMETRIC ANALYSIS

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ABSTRACT:

Objectives: **Bibliometric analysis is one of the most widely used tools to quantify the research prolificacy in a specific area of knowledge. This paper aims to provide a list of the top 100 cited articles published between 2010 and 2021 on dental fluorosis to offer an up-to-date quantitative-qualitative analysis of publications.**

Methods: **The Scopus database was reviewed with the term "dental fluorosis" in the title, abstract, and keywords to retrieve lists of the 100 most-cited articles on 16 December 2021. The number of citations, authors, publication year, country, and institution of origin were evaluated. A graphical illustration of keywords, co-authors, and countries was created using VOSviewer.**

Results: **The number of citations of the 100 articles varied from 654 to 42. All the studies were published in English and 62% were published in journals in the first quartile. The articles were published in 62 different journals, with the most popular publication being the Journal of the American Dentistry and Science of The Total Environment (n=5). The papers originated from 40 countries, with India (n=26) accounting for the largest number. The most prolific authors were A. M. Glenny and H.V. Worthington (n=5), and the institution was Manchester University (n=8). The majority of articles were on Environmental Science (n=39), followed by Dentistry and Medicine (n=26).**

Conclusions: **The present citation analysis provides insights into the current publications in dental fluorosis and will help researchers interested in this topic by saving considerable effort and time in finding appropriate article referrals.**

Keywords: Bibliometrics, Dental fluorosis, Most-cited article, Citation count, Impact factor, Co-author, VOSviewer.

INTRODUCTION

Fluorosis is an endemic disease characterized by excessive fluoride accumulation in the hard and soft tissues of the body.[1, 2] Dental fluorosis can be defined as a developmental enamel defect that occurs due to the impact of high concentrations of fluoride intake during the formation of teeth, especially on ameloblasts during enamel formation.[3] It mostly affects those living in areas with excessive fluoride in the drinking water and usually occurs in pediatric patients.[4-6] It causes a brownish discoloration of the teeth, characterized by bilateral, diffuse, thin, and horizontal white lines and spotted and/or pitted enamel.

While 1 ppm of fluoride in drinking water has been proven to reduce caries by 50–60%, high fluoride intake increases the likelihood of dental fluorosis.[7] It has been recently stated that not only fluoride in drinking water[8] or diet but also fluoride in oral care products are potentially responsible for the prevalence of dental fluorosis. Fluoride can also be found in beverages[9, 10], toothpaste[11], and baby food[12]. High

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fluoride toothpaste was associated with an increased prevalence of dental fluorosis, particularly in children aged 0–3 years.[13]

The number of publications on dentistry in 2020 was 450,000.[14] While examining all these articles published within a year is a problem in itself, reviewing the entire literature is a challenge for researchers during the groundwork for scientific research and article writing. Sciencetometry is the measurement and analysis of scientific literature and includes two main subtypes: bibliometrics and altmetrics.[15] Since Garfield[16] published the first analysis of the most cited articles in the Journal of the American Medical Association in 1987, similar citation analysis studies have been conducted in several fields of medicine[17, 18] and dentistry[19-22], providing useful information on aspects such as the types and levels of evidence in the articles, the most frequently studied topics, the historical development of the field, and current research trends. Bibliometrics uses statistical methods in the analysis of the literature, thereby facilitating the examination of the historical development of scientific domains of publications as well as publication features such as authors, article types, and citations.[23] The purpose of the bibliometric analysis is not to overrate or underrate any article. The number of citations revealed by the rankings does not reflect the scientific quality of the article or its impact on current clinical practice. It is considered only as an objective indicator of the impact of a researcher's scientific publication on subsequent publications in that domain.

To date, no comprehensive study of the most cited articles on dental fluorosis has been published. The present paper primarily aims to identify and perform a bibliometric analysis of the 100 most cited articles among the publications on dental fluorosis between 2010 and 2021 in the literature. The expectation is to provide a reference for future studies and clinical practices.

MATERIALS AND METHODS

This is a bibliometric citation analysis study. The Scopus database was used to list the articles published in the field of dental fluorosis on 16 December 2021. Scopus is a database that is commonly used for bibliometric analyses and is highly respected in this type of research.[24] This is primarily because the Scopus database covers the entire Medline and includes more than 23,000 indexed journals from medical, dental, and other scientific disciplines. Thereby, it offers a wider coverage of journals compared with other databases such as Web of Science and Pubmed.[24] A second reason is that the data transferred to Microsoft Excel with a few simple steps for bibliometric analysis and data visualization can be easily performed using VOSviewer.[25] The present bibliometric analysis includes original scientific articles, case reports, and reviews published between 2010 and 2021 in medical, dental, environmental sciences, or multidisciplinary journals that contain the term “dental fluorosis” in the title, abstract, or keywords and are ranked in the top 100 list with the highest number of citations. Editorials, letters to the editor, comments, scientific blogs, or technical notes have been excluded. Following these stages, a saved list was generated on Scopus and the abstracts of the selected studies were reviewed by two researchers (B.K.E and F.E) to determine whether the articles were directly related to dental fluorosis. Duplicates were identified and only one of the articles was included in the list. In the event of any doubt about an article, the full text was accessed and articles unrelated to the identified research questions were excluded from the

analysis. The data of the articles remained after all these processes were transferred to Microsoft Excel 2016 for Windows (in CSV format) and recorded in RIS format. The bibliometric indicators used to analyze the articles on dental fluorosis include the number of articles published in the same year, the country of the article, journals, authors, institutions, funding organizations, and citation data. For studies with authors from multiple countries, the country of the corresponding author was recorded as the country of the article. The mean number of citations was calculated using the following formula: "total number of citations ÷ total number of articles'". The authors with at least 2 articles in the top 100 and the Journals in which two or more top cited articles were published were also identified. The country co-authorship, co-authorship, and keyword co-occurrence data from Scopus were easily processed and visualization maps were constructed using VOSviewer (version 1.6.16). In the graphs provided by VOSviewer, clusters of different colors are created from the uploaded data, and the thickness of the lines between these clusters indicates the relative strength of the relation between them, with a thicker line representing a stronger relation.

The study data were statistically analyzed using the Statistical Package for the Social Sciences version 20.0 (SPSS Inc., Chicago, IL, USA). The results of the bibliometric analyses were expressed as counts (n) and percentages (%). Shapiro–Wilk test was employed to detect departures from normality. The Spearman rank test was used to determine correlations between variables. The p-value of <0.05 was considered to be statistically significant.

RESULTS

The number of citations received by the 100 selected articles ranged from 654 to 42. Each of the top five articles in the ranking received more than 200 citations, and each of the top 75 articles received more than 50 citations. The mean number of citations per article was 82.9, and the h-index was 60. A complete list of all analyzed articles with the number of citations is presented in Table 1.

It is clearly not possible to comment individually on all the articles in the list, but considering the content of the top three most cited articles, the most cited article, which received 654 citations and was published in the Chemico-Biological Interactions journal in November 2010 by Olivier Barbier et al.[26], was a review of published research on the molecular aspects of fluoride cytotoxicity due to fluoride exposure.

Another article published by Tanya Walsh et al.[27] and which received 245 citations, was another review on different concentrations of fluoride toothpaste to prevent cavities in children and adolescents, which evaluated randomized controlled trials comparing different concentrations of placebo or fluoride toothpaste.

The third most cited article with 231 citations was a review published by Eric T. Everett[28] in the Journal of Dental Research in 2011, examining the effects of fluoride on the formation of teeth and bones and the genetic variations in fluoride sensitivity.

Table 1. List of 100 top cited articles on dental fluorosis between 2010–2021

No	Authors	Title	No. Citations
1	Barbier, O., Arreola-Mendoza, L., Del Razo, L.M.	Molecular mechanisms of fluoride toxicity (2010) Chemico-Biological Interactions, 188 (2), pp. 319-333	654
2	Walsh, T., Worthington, H.V., Glenny, A.M., et al	Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. (2010) Cochrane database of systematic reviews (Online)	245
3	Everett, E.T.	Critical reviews in oral biology and; medicine: Fluoride's effects on the formation of teeth and bones, and the influence of genetics (2011) Journal of Dental Research, 90 (5), pp. 552-560.	231
4	Yousefi, M., Ghoochani, M., Hossein Mahvi, A.	Health risk assessment to fluoride in drinking water of rural residents living in the Poldasht city, Northwest of Iran (2018) Ecotoxicology and Environmental Safety, 148, pp. 426-430	213
5	Ramakrishnan, M., Shukri, M.M.	Fluoride, fluoridated toothpaste efficacy and its safety in children – Review (2018) International Journal of Pharmaceutical Research, 10 (4), pp. 109-114.	201
6	Shen, J., Schäfer, A.	Removal of fluoride and uranium by nanofiltration and reverse osmosis: A review (2014) Chemosphere, 117 (1), pp. 679-691	174
7	Brindha, K., Rajesh, R., Murugan, R., Elango, L.	Fluoride contamination in groundwater in parts of Nalgonda District, Andhra Pradesh, India (2011) Environmental Monitoring and Assessment, 172 (1-4), pp. 481-492	158
8	Ali, S., Thakur, S.K., Sarkar, A., Shekhar, S.	Worldwide contamination of water by fluoride (2016) Environmental Chemistry Letters, 14 (3), pp. 291-315	155
9	Somasundaram, S., Ravi, K., Rajapandian, K., Gurunathan, D.	Fluoride content of bottled drinking water in Chennai, Tamilnadu (2015) Journal of Clinical and Diagnostic Research, 9 (10), pp. ZC32-ZC34	150
10	Julien, K.C., Buschang, P.H., Campbell, P.M.	Prevalence of white spot lesion formation during orthodontic treatment (2013) Angle Orthodontist, 83 (4), pp. 641-647	148
11	Gooch B.F.,	U.S. public health service recommendation for fluoride concentration in drinking water for the prevention of dental caries (2015) Public Health Reports, 130 (4), pp. 318-331	142

12	Wong M.C.M., Clarkson J., Glenny A.-M., et al.	Cochrane reviews on the benefits/risks of fluoride toothpastes (2011) Journal of Dental Research, 90 (5), pp. 573-579	140
13	Ganvir V., Das K.	Removal of fluoride from drinking water using aluminum hydroxide coated rice husk ash (2011) Journal of Hazardous Materials, 185 (2-3), pp. 1287-1294	139
14	O'Mullane D.M., Baez R.J., Jones S., et al.	Fluoride and oral health (2016) Community Dental Health, 33 (2), pp. 69-99.	132
15	Perumal E., Paul V., Govindarajan V., et al	A brief review on experimental fluorosis (2013) Toxicology Letters, 223 (2), pp. 236-251.	132
16	Iheozor-Ejiofor Z., O'Malley L.A., Glenny A.-M., et al.	Water fluoridation for the prevention of dental caries (2013) Cochrane Database of Systematic Reviews, 2013 (12), art. no. CD010856	126
17	Zhang L., Huang D., Yang J., et al.	Probabilistic risk assessment of Chinese residents' exposure to fluoride in improved drinking water in endemic fluorosis areas (2017) Environmental Pollution, 222, pp. 118-125.	125
18	Suzuki M., Bandoski C., Bartlett J.D.	Fluoride induces oxidative damage and SIRT1/autophagy through ROS-mediated JNK signaling (2015) Free Radical Biology and Medicine, 89, pp. 369-378.	123
19	Rango T., Kravchenko J., Atlaw B., et al.	Groundwater quality and its health impact: An assessment of dental fluorosis in rural inhabitants of the Main Ethiopian Rift (2012) Environment International, 43 (1), pp. 37-47.	114
20	Yadav K.K., Kumar S., Pham Q.B., et al.	Fluoride contamination, health problems and remediation methods in Asian groundwater: A comprehensive review (2019) Ecotoxicology and Environmental Safety, 182, art. no. 109362	108
21	Ding Y., YanhuiGao, Sun H., et al.	The relationships between low levels of urine fluoride on children's intelligence, dental fluorosis in endemic fluorosis areas in Hulunbuir, Inner Mongolia, China (2011) Journal of Hazardous Materials, 186 (2-3), pp. 1942-1946.	106
22	Mandinic Z., Curcic M., Antonijevic B., et al.	Fluoride in drinking water and dental fluorosis (2010) Science of the Total Environment, 408 (17), pp. 3507-3512.	106
23	Ghosh A., Mukherjee K., Ghosh S.K., et al.	Sources and toxicity of fluoride in the environment (2013) Research on Chemical Intermediates, 39 (7), pp. 2881-2915.	105
24	Todd S.R., Dahlgren F.S., Traeger M.S., et al.	No visible dental staining in children treated with doxycycline for suspected rocky mountain spotted fever (2015) Journal of Pediatrics, 166 (5), pp. 1246-1251.	103

25	Wright J.T., Hanson N., Ristic H., et al.	Systematic review: Fluoride toothpaste efficacy and safety in children younger than 6 years: A systematic review (2014) Journal of the American Dental Association, 145 (2), pp. 182-189	99
26	Wong M.C.M., Glenny A.-M., Tsang B.W.K., et al.	Topical fluoride as a cause of dental fluorosis in children (2010) Cochrane Database of Systematic Reviews, 2010 (6), art. no. CD007693	96
27	Iheozor-Ejiofor Z., Worthington H.V., Walsh T., et al.	Water fluoridation for the prevention of dental caries (2015) Cochrane Database of Systematic Reviews, 2015 (6), art. no. CD010856	93
28	Peckham S., Awofeso N.	Water fluoridation: A critical review of the physiological effects of ingested fluoride as a public health intervention (2014) The Scientific World Journal, 2014, art. no. 293019	92
29	Tenuta L.M.A., Cury J.A.	Fluoride: Its role in dentistry (2010) Brazilian Oral Research, 24 (Suppl. 1), pp. 9-17.	91
30	Guissouma W., Hakami O., Al-Rajab A.J., et al.	Risk assessment of fluoride exposure in drinking water of Tunisia (2017) Chemosphere, 177, pp. 102-108.	90
31	Chankanka O., Levy S.M., Warren J.J., et al.	A literature review of aesthetic perceptions of dental fluorosis and relationships with psychosocial aspects/oral health-related quality of life: Review (2010) Community Dentistry and Oral Epidemiology, 38 (2), pp. 97-109.	90
32	Clark M.B., Slayton R.L.	Fluoride use in caries prevention in the primary care setting (2014) Pediatrics, 134 (3), pp. 626-633.	88
33	Rozier R.G., Adair S., Graham F., et al.	Evidence-based clinical recommendations on the prescription of dietary fluoride supplements for caries prevention A report of the american dental association council on scientific affairs (2010) Journal of the American Dental Association, 141 (12), pp. 1480-1489.	88
34	Kut K.M.K., Sarswat A., Srivastava A., et al.	A review of fluoride in african groundwater and local remediation methods (2016) Groundwater for Sustainable Development, 2-3, pp. 190-212.	87
35	Roncalli A.G., da Silva N.N., Nascimento A.C., et al.	Relevant methodological issues from the SBBrasil 2010 project for national health surveys [Aspectos metodológicos do projeto SBBrasil 2010 de interesse para inquéritos nacionais de saúde] (2012) Cadernos de Saude Publica, 28 (Suppl), pp. S40-S57	87

36	Gazzano E., Bergandi L., Riganti C., et al.	Fluoride effects: The two faces of janus (2010) Current Medicinal Chemistry, 17 (22), pp. 2431-2441.	85
37	Carey C.M.	Focus on fluorides: Update on the use of fluoride for the prevention of dental caries (2014) Journal of Evidence-Based Dental Practice, 14 (Supp;.), pp. 95-102	81
38	Yousefi M., Ghalehaskar S., Asghari F.B., et al.	Distribution of fluoride contamination in drinking water resources and health risk assessment using geographic information system, northwest Iran (2019) Regulatory Toxicology and Pharmacology, 107, art. no. 104408	75
39	Kimambo V., Bhattacharya P., Mtalo F., et al.	Fluoride occurrence in groundwater systems at global scale and status of defluoridation – State of the art (2019) Groundwater for Sustainable Development, 9, art. no. 100223	75
40	Podgorski J.E., Labhasetwar P., Saha D., et al.	Prediction Modeling and Mapping of Groundwater Fluoride Contamination throughout India (2018) Environmental Science and Technology, 52 (17), pp. 9889-9898	75
41	Rasool A., Farooqi A., Xiao T., et al.	A review of global outlook on fluoride contamination in groundwater with prominence on the Pakistan current situation (2017) Environmental Geochemistry and Health, 40 (4), pp. 1265-1281	74
42	Choi A.L., Zhang Y., Sun G., et al.	Association of lifetime exposure to fluoride and cognitive functions in Chinese children: A pilot study (2015) Neurotoxicology and Teratology, 47, pp. 96-101	73
43	Dehbandi R., Moore F., Keshavarzi B.	Geochemical sources, hydrogeochemical behavior, and health risk assessment of fluoride in an endemic fluorosis area, central Iran (2018) Chemosphere, 193, pp. 763-776	72
44	Mangum J.E., Crombie F.A., Kilpatrick N., et al.	Surface integrity governs the proteome of hypomineralized enamel (2010) Journal of Dental Research, 89 (10), pp. 1160-1165	72
45	Beltrán-Aguilar E.D., Barker L., Dye B.A.	Prevalence and severity of dental fluorosis in the United States, 1999-2004. (2010) NCHS data brief, (53), pp. 1-8	70
46	Rashid A., Guan D.-X., Farooqi A., et al.	Fluoride prevalence in groundwater around a fluorite mining area in the flood plain of the River Swat, Pakistan (2018) Science of the Total Environment, 635, pp. 203-215	67

47	Yu X., Chen J., Li Y., Liu H., et al.	Threshold effects of moderately excessive fluoride exposure on children's health: A potential association between dental fluorosis and loss of excellent intelligence (2018) Environment International, 118, pp. 116-124	66
48	Chen J., Liu G., Kang Y., et al.	Coal utilization in China: Environmental impacts and human health (2014) Environmental Geochemistry and Health, 36 (4), pp. 735-753	66
49	Fantong W.Y., Satake H., Ayonghe S.N., et al.	Geochemical provenance and spatial distribution of fluoride in groundwater of Mayo Tsanaga River Basin, Far North Region, Cameroon: Implications for incidence of fluorosis and optimal consumption dose (2010) Environmental Geochemistry and Health, 32 (2), pp. 147-163	65
50	Nurelhuda N.M., Ahmed M.F., Trovik T.A., et al.	Evaluation of oral health-related quality of life among Sudanese schoolchildren using Child-OIDP inventory (2010) Health and Quality of Life Outcomes, 8, art. no. 152	64
51	Ghanim A., Silva M.J., Elfrink M.E.C., et al.	Molar incisor hypomineralisation (MIH) training manual for clinical field surveys and practice (2017) European Archives of Paediatric Dentistry, 18 (4), pp. 225-242	63
52	Ullah R., Zafar M.S., Shahani N.	Potential fluoride toxicity from oral medicaments: A review (2017) Iranian Journal of Basic Medical Sciences, 20 (8), art. no. 1, pp. 841-848	63
53	Mondal P., George S.	A review on adsorbents used for defluoridation of drinking water (2015) Reviews in Environmental Science and Biotechnology, 14 (2), pp. 195-210	63
54	Villa A., Anabalon M., Zohouri V., et al.	Relationships between fluoride intake, urinary fluoride excretion and fluoride retention in children and adults: An analysis of available data (2010) Caries Research, 44 (1), pp. 60-68.	63
55		Fluoride toothpaste use for young children American dental association council on scientific affairs (2014) Journal of the American Dental Association, 145 (2), pp. 190-191.	62
56	Cury J.A., Tenuta L.M.A.,"7006668715	Evidence-based recommendation on toothpaste use (2014) Brazilian Oral Research, 28 (Special issue), pp. 1-7	62
57	Hussain J., Hussain I., Sharma K.C.	Fluoride and health hazards: Community perception in a fluorotic area of central Rajasthan (India): An arid environment (2010) Environmental Monitoring and Assessment, 162 (1-4), pp. 1-14	62

58	Santos A.P.P., Oliveira B.H., Nadanovsky P.	Effects of low and standard fluoride toothpastes on caries and fluorosis: Systematic review and meta-analysis (2013) Caries Research, 47 (5), pp. 382-390	61
59	Young S.M., Pitawala A., Ishiga H.	Factors controlling fluoride contents of groundwater in north-central and northwestern Sri Lanka (2011) Environmental Earth Sciences, 63 (6), pp. 1333-1342	61
60	Jha S.K., Singh R.K., Damodaran T., et al.	Fluoride in groundwater: Toxicological exposure and remedies (2013) Journal of Toxicology and Environmental Health - Part B: Critical Reviews, 16 (1), pp. 52-66	60
61	Singh K., Lataye D.H., Wasewar K.L., et al.	Removal of fluoride from aqueous solution: Status and techniques (2013) Desalination and Water Treatment, 51 (16-18), pp. 3233-3247	59
62	Chu Ch., Mei M.L., Lo E.C.M.	Use of fluorides in dental caries management (2010) General Dentistry, 58 (1), pp. 37-43	59
63	Zeng X., Hu J., Zhang M., et al.	Visual Detection of Fluoride Anions Using Mixed Lanthanide Metal-Organic Frameworks with a Smartphone (2020) Analytical Chemistry, 92 (2), pp. 2097-2102	58
64	Castro R.D.A.L., Portela M.C., Leão A.T., et al.	Oral health-related quality of life of 11- and 12-year-old public school children in Rio de Janeiro (2011) Community Dentistry and Oral Epidemiology, 39 (4), pp. 336-344	58
65	Arveti N., Sarma M.R.S., Aitkenhead-Peterson J.A., et al.	Fluoride incidence in groundwater: A case study from Talupula, Andhra Pradesh, India (2011) Environmental Monitoring and Assessment, 172 (1-4), pp. 427-443	58
66	Craig L., Lutz A., Berry K.A., et al.	Recommendations for fluoride limits in drinking water based on estimated daily fluoride intake in the Upper East Region, Ghana (2015) Science of the Total Environment, 532, pp. 127-137	57
67	Menéndez-Proupin E., Cervantes-Rodríguez S., Osorio-Pulgar R., et al.	Computer simulation of elastic constants of hydroxyapatite and fluorapatite (2011) Journal of the Mechanical Behavior of Biomedical Materials, 4 (7), pp. 1011-1020	57
68	Srivastava S., Flora S.J.S.	Fluoride in Drinking Water and Skeletal Fluorosis: a Review of the Global Impact (2020) Current environmental health reports, 7 (2), pp. 140-146	56
69	Chou R., Cantor A., Zakher B., Mitchell J.P., et al	Preventing dental caries in children < 5 years: Systematic review updating USPSTF recommendation (2013) Pediatrics, 132 (2), pp. 332-350	56

70	Zhang Q., Xu P., Qian H., et al.	Hydrogeochemistry and fluoride contamination in Jiaokou Irrigation District, Central China: Assessment based on multivariate statistical approach and human health risk (2020) Science of the Total Environment, 741, art. no. 140460	55
71	Levy S.M., Broffitt B., Marshall T.A., et al.	Associations between fluorosis of permanent incisors and fluoride intake from infant formula, other dietary sources and dentifrice during early childhood (2010) Journal of the American Dental Association, 141 (10), pp. 1190-1201	54
72	Suzuki M., Bartlett J.D.	Sirtuin1 and autophagy protect cells from fluoride-induced cell stress (2014) Biochimica et Biophysica Acta - Molecular Basis of Disease, 1842 (2), pp. 245-255	53
73	Khairnar M.R., Dodamani A.S., Jadhav H.C., et al	Mitigation of fluorosis - A review (2015) Journal of Clinical and Diagnostic Research, 9 (6), pp. ZE05-ZE09	52
74	Moncada G., Sepúlveda D., Elphick K., et al.	Effects of light activation, agent concentration, and tooth thickness on dental sensitivity after bleaching (2013) Operative Dentistry, 38 (5), pp. 467-476	52
75	Grandjean P.	Developmental fluoride neurotoxicity: An updated review (2019) Environmental Health: A Global Access Science Source, 18 (1), art. no. 110	51
76	Mathur V.P., Dhillon J.K.	Dental Caries: A Disease Which Needs Attention (2018) Indian Journal of Pediatrics, 85 (3), pp. 202-206	51
77	Choubisa S.L., Choubisa D.	Status of industrial fluoride pollution and its diverse adverse health effects in man and domestic animals in India (2016) Environmental Science and Pollution Research, 23 (8), pp. 7244-7254	51
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80	Li W., Jiang B., Cao X., et al.	Protective effect of lycopene on fluoride-induced ameloblasts apoptosis and dental fluorosis through oxidative stress-mediated Caspase pathways (2017) Chemico-Biological Interactions, 261, pp. 27-34	50

81	Muñoz M.A., Arana-Gordillo L.A., et al.	Alternative esthetic management of fluorosis and hypoplasia stains: Blending effect obtained with resin infiltration techniques (2013) Journal of Esthetic and Restorative Dentistry, 25 (1), pp. 32-39	50
82	Hussain I., Arif M., Hussain J.	Fluoride contamination in drinking water in rural habitations of Central Rajasthan, India (2012) Environmental Monitoring and Assessment, 184 (8), pp. 5151-5158	50
83	Grant W.B.	A review of the role of solar ultraviolet-B irradiance and vitamin D in reducing risk of dental caries (2011) Dermato-Endocrinology, 3 (3), pp. 193-198	50
84	Aravinthasamy P., Karunanidhi D., Subramani T., et al.	Geochemical evaluation of fluoride contamination in groundwater from Shanmuganadhi River basin, South India: implication on human health (2020) Environmental Geochemistry and Health, 42 (7), pp. 1937-1963	48
85	Song G.H., Gao J.P., Wang C.F., et al	Sodium fluoride induces apoptosis in the kidney of rats through caspase-mediated pathways and DNA damage (2014) Journal of Physiology and Biochemistry, 70 (3), pp. 857-868	48
86	Chen H., Yan M., Yang X., et al.	Spatial distribution and temporal variation of high fluoride contents in groundwater and prevalence of fluorosis in humans in Yuanmou County, Southwest China (2012) Journal of Hazardous Materials, 235-236, pp. 201-209	48
87	Yadav K.K., Kumar V., Gupta N., et al.	Human health risk assessment: Study of a population exposed to fluoride through groundwater of Agra city, India (2019) Regulatory Toxicology and Pharmacology, 106, pp. 68-80	47
88	Pramanik S., Saha D.	The genetic influence in fluorosis (2017) Environmental Toxicology and Pharmacology, 56, pp. 157-162	47
89	Davies R., Scully C., Preston A.J.	Dentifrices - An update (2010) Medicina Oral, Patologia Oral y Cirugia Bucal, 15 (6), pp. e976-e982	47
90	Onoriobe U., Rozier R.G., Cantrell J., et al.	Effects of enamel fluorosis and dental caries on quality of life (2014) Journal of Dental Research, 93 (10), pp. 972-979	46
91	Choubisa S.L.	Osteo-dental fluorosis in domestic horses and donkeys in Rajasthan, India (2010) Fluoride, 43 (1), pp. 5-12	46

92	Li D., Gao X., Wang Y., et al.	Diverse mechanisms drive fluoride enrichment in groundwater in two neighboring sites in northern China (2018) Environmental Pollution, 237, pp. 430-441	45
93	Liu Y.-J., Guan Z.-Z., Gao Q., et al.	Increased level of apoptosis in rat brains and SH-SY5Y cells exposed to excessive fluoride-A mechanism connected with activating JNK phosphorylation (2011) Toxicology Letters, 204 (2-3), pp. 183-189	45
94	Keshavarzi B., Moore F., Esmaeili A., et al.	The source of fluoride toxicity in Muteh area, Isfahan, Iran (2010) Environmental Earth Sciences, 61 (4), pp. 777-786	45
95	Reema, S.D., Lahiri, P.K., Roy, S.S.	Review of casein phosphopeptides-amorphous calcium phosphate.(2014) The Chinese Journal of Dental Research : The Official Journal of the Scientific Section of the Chinese Stomatological Association (CSA), 17(1), 7-14.	44
96	Singh N., Verma K.G., Verma P., et al.	A comparative study of fluoride ingestion levels, serum thyroid hormone & TSH level derangements, dental fluorosis status among school children from endemic and non-endemic fluorosis areas (2014) SpringerPlus, 3 (1), art. no. 7, pp. 1-5	44
97	Saha S., Tomaro-Duchesneau C., Tabrizian M., et al	Probiotics as oral health biotherapeutics (2012) Expert Opinion on Biological Therapy, 12 (9), pp. 1207-1220	44
98	Harsha L., Brundha M.P.	Prevalence of dental developmental anomalies among men and women and its psychological effect in a given population (2017) Journal of Pharmaceutical Sciences and Research, 9 (6), pp. 869-873	43
99	Pradeep Kumar R., Vijayalakshmi B.,	Assessment of fluoride concentration in ground water in Madurai district, Tamil Nadu, India (2017) Research Journal of Pharmacy and Technology, 10 (1), pp. 309-310	43
100	Berg, J., Gerweck, C., Hujoel, P. P.et al.	Evidence-based clinical recommendations regarding fluoride intake from reconstituted infant formula and enamel fluorosis: A report of the american dental association council on scientific affairs. (2011) Journal of the American Dental Association, 142(1), 79-87.	42

Article type and keywords:

Taking into consideration article types, all of the articles in the top 100 list based on the number of citations were published in English, with 72 original scientific articles and 28 review articles. The analysis of keywords, in turn, identified a total of 274

keywords, with 227 keywords appearing only once (Figure 1). The most used keyword was “fluoride” with 79 occurrences, followed by “fluorosis” (50), “dental fluorosis” (38), “drinking water” (37), and “dental caries” (32). There was a clear superiority of citations to reviews over citations to articles in number.[28-32, 27]

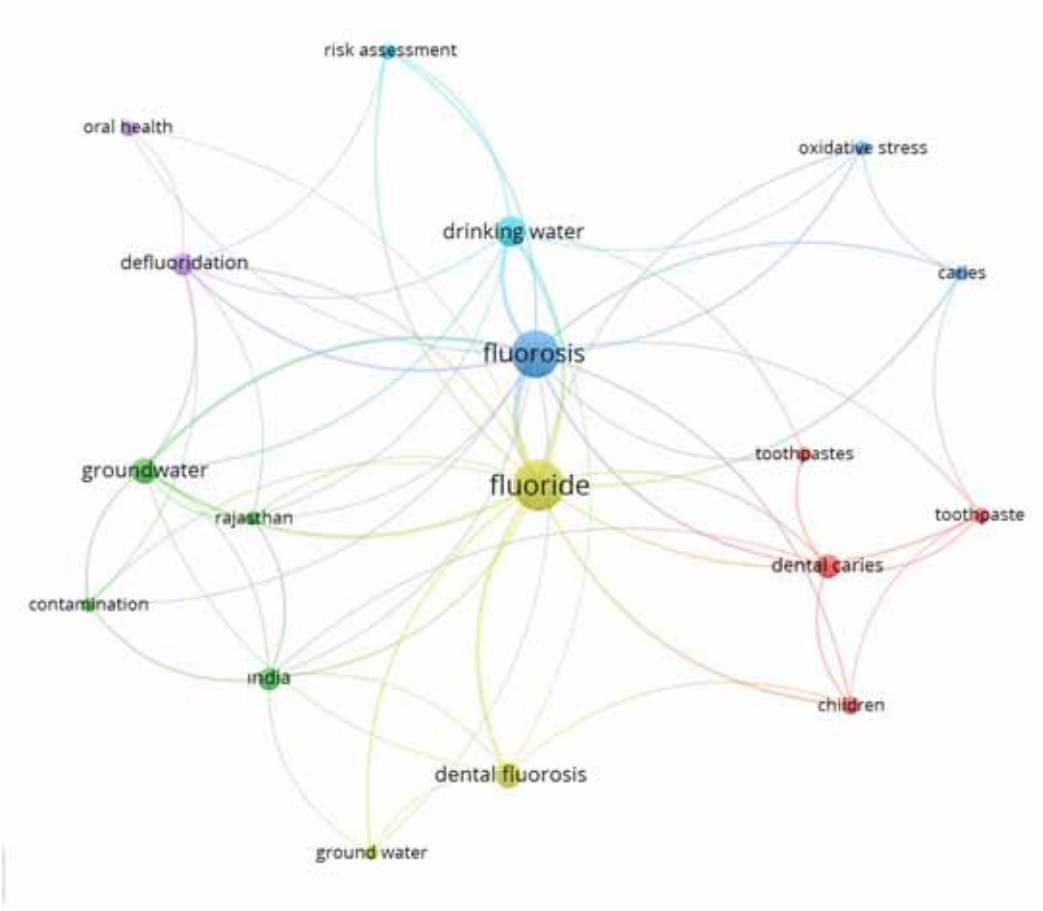


Figure 1. Keyword co-occurrence network of the 100 top-cited articles between 2010–2021. Image produced by VOSviewer.

Authors, countries, and institutions:

The total number of authors contributing at least once to the 100 most cited articles was 474. There were six single-author articles.[33, 34, 28, 35-37] Fifty-four articles had two to five authors, while 39 articles had six to 12 authors. Quantitatively, the authors with the highest number of articles were Anne Marie Glenny and Helen Victoria Worthington with 5 articles, followed by Tanya C. Walsh with 4 articles, and Edward Chi Man Lo with 3 articles (Table 2). The co-authorship network analysis is presented in Figure 2.

Table 2. Authors with at least 2 articles in the top 100

Name	First Author	Coauthor	Last author	Total
Glenny, A.M.	0	4	1	5
Worthington, H.V.	0	3	2	5
Walsh, T.	1	3	0	4
Lo, E.C.M.	0	2	1	3
Alam, R.	0	2	0	2
Ali, S.	2	0	0	0
Bartlett, J.D.	0	0	2	2
Beltrán-Aguilar, E.D.	1	1	0	2
Bhattacharya, P.	0	2	0	2
Choubisa, S.L.	2	0	0	2
Cury, J.A.	1	0	1	2
Farooqi, A.	0	2	0	2
Grandjean, P.	1	0	1	2
Gupta, N.	0	2	0	2
Iheozor-Ejiofor, Z.	2	0	0	2
Kumar, S.	0	2	0	2
Kumar, V.	0	2	0	2
Macey, R.	0	2	0	2
Marinho, V.C.C.	0	1	1	2
Rezania, S.	0	2	0	2
Singh, N.	0	1	1	2
Shekhar, S.	0	1	1	2
Singh, N.	0	1	1	2
Suzuki, M.	2	0	0	2
Tenuta, L.M.A.	1	0	1	2
Tsang, B.W.K.	0	2	0	2
Tugwell, P.	0	2	0	2
Welch, V.	0	2	0	2
Wong, M.C.M.	2	0	0	2
Yadav, K.K.	2	0	0	2
Yousefi, M.	2	0	0	2

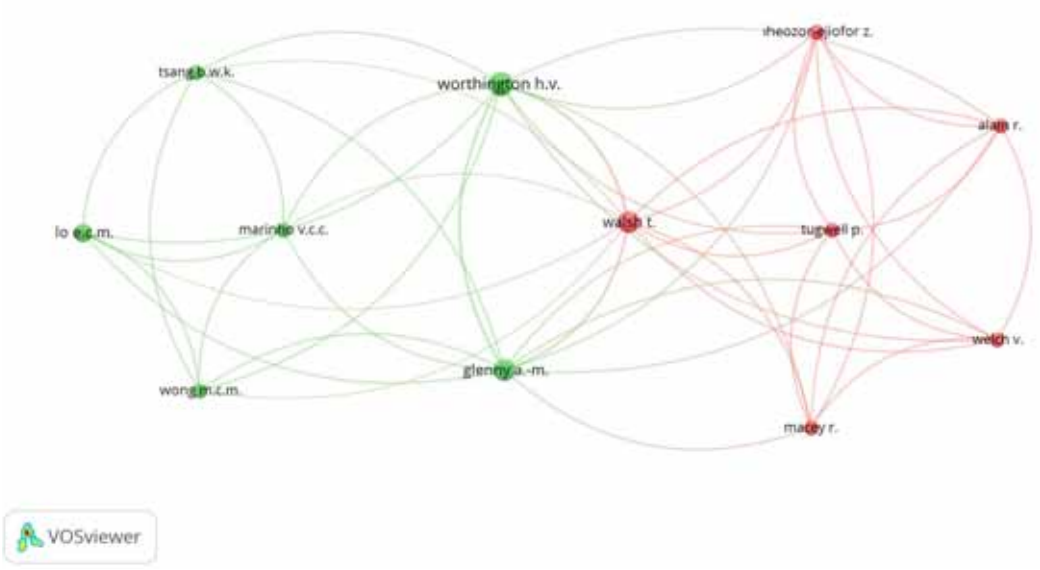


Figure 2. Co-author contribution with two or more articles with their network in the top-cited papers between 2010-2021. Image produced by VOSviewer.

The 100 most influential articles on dental fluorosis originated from 40 different countries. There were 26 studies conducted in India, 24 in the United States, 16 in China, 11 in the United Kingdom, 8 in Brazil, 5 in Iran, 4 in Australia, Canada, and Chile, and 3 in Ethiopia, Pakistan, Sri Lanka, and Sweden. Figure 3 presents the collaboration network of countries. The United States and India had the highest number of articles with international collaboration. There were 58 institutions affiliated with the first authors. Considering all the authors of an article, 73 articles were produced by individual institutions, 23 by international collaborations, and four by multi-institutional collaborations within the same country.

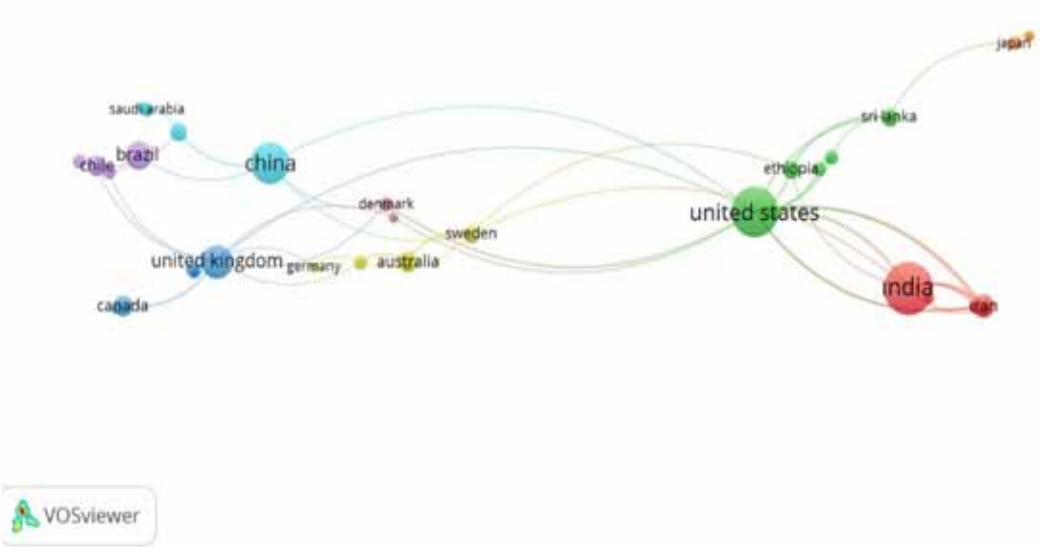


Figure 3. Bibliographic coupling between countries in the top 100 most-cited papers between 2010-2021 about dental fluorosis. Image produced by VOSviewer.

The most productive institutions were the University of Manchester (n = 8); followed by Centers for Disease Control and Prevention; the University of Iowa; the University of North Carolina at Chapel Hill; the University of Delhi; and Saveetha Dental College & Hospital (n = 4 for all). These were followed by the Chinese Ministry of Education; the University of Hong Kong; Universidad de Chile; the Chinese Academy of Sciences; and the American Dental Association (n = 3 for all) (Table 3).

Table 3. Institutions and departments with at least 4 articles including in the top 100.

Institution/Department	Country	Number of articles
The University of Manchester	England	8
University of Delhi	India	5
Ministry of Education China	China	4
Centers for Disease Control and Prevention	USA	4
The University of North Carolina	USA	4
Saveetha Dental College And Hospitals	India	4

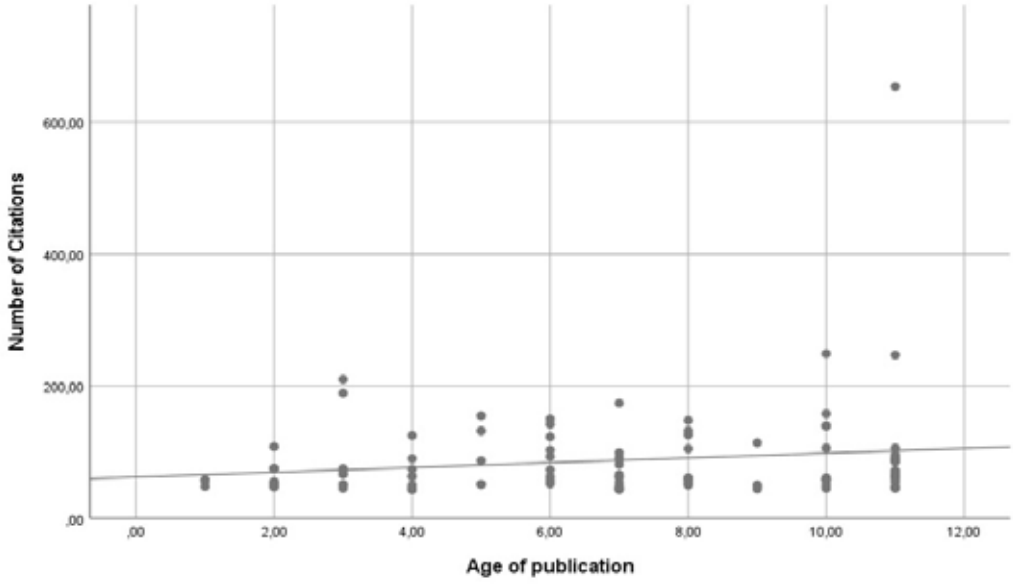
Journals, impact factors, and publication years:

The 100 most cited articles were published in 62 different journals. The journals publishing the most cited articles were the Journal of the American Dental Association[38-42] and Science of the Total Environment[43-47] with 5 articles, followed by the Journal of Dental Research[28, 48-50], the Cochrane Database of Systematic Reviews[51, 52, 27, 53], Environmental Monitoring and Assessment[54-57], and Environmental Geochemistry and Health[54-57] with 4 articles; Chemosphere[58, 59, 32], Groundwater for Sustainable Development[60-62], and the Journal of Hazardous Materials[63-65] with 3 articles (Table 4). These nine journals published 36% of the most cited articles on dental fluorosis. Environmental Sciences journals published 39 articles[66, 63, 67, 68, 43, 44, 64, 65, 69-77, 45, 78-83, 46, 84-96, 47], followed by Medical and Dental Journals with 26 articles[38, 39, 33, 97-102, 28, 37, 103, 40, 104, 105, 29, 49, 106, 41, 11, 107-110, 50, 42]. The IFs of the journals ranged from 0 to 10.39 (mean: 3.66 ± 2.49). There were only two journals (the Journal of Hazardous Materials – 10.39 and NCHS data brief – 10.29) that contributed four articles to the top 100 most cited articles list with a five-year impact factor greater than 10.[111, 63-65]

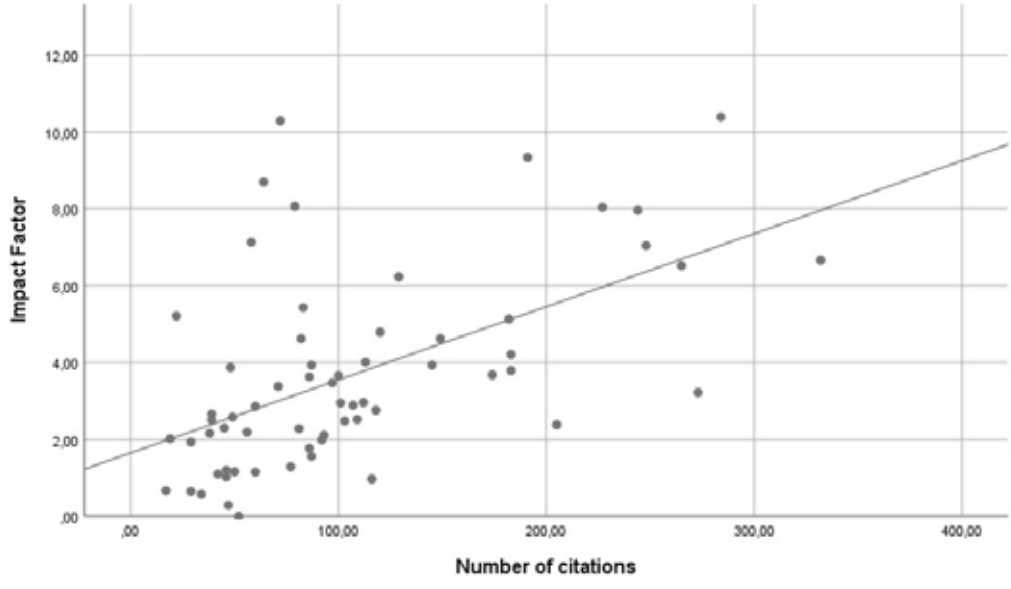
Of the journals, 36 were in the first quartile, 15 in the second quartile, 8 in the third quartile, and one in the fourth quartile. There was a statistically significant correlation between the impact factor of a journal and the number of citations of articles published in that journal ($r = 0.573$ $p < .001$) (Graphic 1). The most cited articles were published in 2010 (n = 19), followed by 2014 (n = 14), 2011 (n = 13), and 2013 (n = 11). In addition, no correlation was detected between the date of publication and the number of citations received ($r = 0.109$ $p = 0.281$) (Graphic 2).

Table 4. Journals in which two or more top cited articles were published

Journal	No. of articles	Cite Score (2020)	Impact factor (2020)	Quartile	Category
Science of the Total Environment	5	10.5	7.96	Q1	Environmental Science
Journal of the American Dental Association	5	4.2	0.97	Q2	Dentistry
Journal Of Dental Research	4	9.9	5.13	Q1	Dentistry
Environmental Monitoring and Assessment	4	3.6	2.52	Q2	Environmental Science, Medicine
Cochrane Database of Systematic Reviews	4	7.1	3.22	Q1	Medicine
Environmental Geochemistry and Health	4	5.6	3.38	Q1	Earth and Planetary Sciences, Environmental Science, Medicine
Chemosphere	3	10.1	7.04	Q1	Chemistry, Environmental Science, Medicine
Groundwater For Sustainable Development	3	5.2	5.21	Q1	Environmental Science, Social Science
Journal Of Hazardous Materials	3	13.4	10.39	Q1	Environmental Science
Brazilian Oral Research	2	3.4	2.3	Q1	Dentistry
Caries Research	2	5.2	3.66	Q1	Dentistry
Community Dentistry and Oral Epidemiology	2	4.4	2.95	Q1	Dentistry
Journal Of Clinical and Diagnostic Research	2	1.2	0.29	Q3	Clinical Biochemistry, Medicine
Pediatrics	2	9	3.79	Q1	Medicine



Graphic 1. Association of citation count with age of publication.



Graphic 2. Association of citation count with journals' impact factor.

DISCUSSION

The aim of this bibliometric study was to examine the characteristics of the top 100 most cited academic studies on dental fluorosis between 2010 and 2021, with the number of citations ranging from 41 to 654. Between the years examined in the study, the top 100 articles were found to receive a regular and an increasing number of citations until 2021 (more than the articles published within the first years). This reflects the continued attention of researchers to dental fluorosis articles and the potential academic significance of these articles in the future.

Citation analyses similar to this study were performed in other fields of dentistry in the literature.[21, 112, 22] The review of such studies revealed that the number of citations received by the top 100 most cited articles (after removing self-citations) ranged from 56 to 419 regarding early childhood caries, 246 to 2,115 in the field of endodontics, and 115 to 881 in the field of orthodontics. Compared with previous citation analyses, the present study found the number of citations to be close to that received by the 100 most cited articles on early childhood caries, and this finding is considered to be important as it reflects the significance of and academic attention to research on dental fluorosis.

The lack of a clear method to measure the scientific value of an article makes this issue controversial. It is believed that the number of citations received by the articles can be considered an acceptable index.[113] However, it should not be forgotten that the number of citations will vary depending on the sub-discipline groups and the scientific groups of their fields. In general, an article with 100 or more citations is considered a “classic” according to the research field and may even be an inspiring article; thus, new researchers in a particular field can read them before doing further research.[114] In the present study, only twenty four percent of the top 100 articles can be considered “classic” articles based on the number of citations, and the citation frequency of the articles varies between 101 and 654. These findings can be attributed to the fact that dental fluorosis is a more specific issue compared with other research topics and it is a dental problem occurring in certain regions.

Publication Year:

The year of publication has a significant impact on the number of citations. It is almost impossible to predict the real impact of long periods from the publication date of an article on academic society. The longer the time since publication, the greater chance there is of being cited, regardless of the scientific impact.[115] As one of the most remarkable findings of this study, although the number of the top 100 articles published after 2015 was much lower than those published prior to 2015 and that the number of citations per article published before 2015 was higher than those published after this date, there was no correlation between age of publication and citation number. Also it was found that 68% of the top cited 100 articles were published between 2010 and 2015. This may be because the articles after 2015 did not gain academic importance in the field of dental fluorosis, as they did not improve their academic quality and suitability for clinical practice and research. Moreover, despite the recently increased number of printed and online journals and the upward trend in the number of articles on other topics of bibliographic research in proportion to such increase, the annual mean numbers of articles on dental fluorosis published between 2010 and 2021 were found to be close. This may be because dental fluorosis is a

health problem that occurs in specific regions, preventing it from becoming a topic of interest worldwide, and therefore, it is a topic accepted by only a limited number of journals that aim to publish more on this subject.

Distribution of Countries and Institutions:

There were 1,974 articles published on dental fluorosis between 2010 and 2021 and the country distribution of these articles showed that India, China, and the United States of America were the top three countries. This suggests that fluorosis is common in these geographical regions. Considering the top 100 most cited articles, in turn, there was no change in the top three countries (66% of all articles), but China positioned second and the USA positioned third switched places. The articles on the topics of dentistry produce results that are inconsistent with this. There is a significant Anglo-Saxon predominance in the articles on orthodontics, early childhood caries, and endodontics. No article has been published on these topics from countries such as China and India, which was among the top 100 most cited articles.

The University of Manchester, the Centers for Disease Control and Prevention, and the University of Iowa were the top three contributors to the top 100 list (16% of all articles). When the top 100 most cited articles on dental fluorosis were examined, the institutions in the UK and USA were found to be the leader beyond comparison in terms of quality, by being the source of articles with a total number of citations much higher than those originating from the institutions in all other countries. This is due to the following reasons: It is natural for native English-speaking authors to cite more from their own regions. For example, American authors are more likely to cite local articles than foreign ones originating from outside their home country, and these cited articles are more likely to be published in American journals than those of foreign authors, who are not native speakers. Mainstream countries such as the USA and UK dominate the articles in the field of health sciences, and receive citations in parallel with the results of studies in other branches of dentistry (endodontics, early childhood caries, orthodontics, and cariology), resulting in the inevitable dominance of these countries.[116-118]

In addition, the analysis of dental fluorosis studies revealed articles from Iran in Asia[73, 92, 119, 120], Ethiopia in Africa[60, 121, 122], Australia in Oceania[123, 61, 48], and Chile[110] and Brazil[97, 105, 11, 107] in South America among the top 100 most cited articles, which suggests that dental fluorosis has an impact on a global scale. Therefore, sharing the achievements of countries and institutions in different regions with the public regarding this disease is of great importance in terms of informing dentists.

Distribution of Journals:

Considering the journals publishing the top 100 most cited articles, three journals published 15% of all articles**.** These journals were the Journal of The American Dental Association (n = 5), which received 12,533 citations in 2020 and has a current IF of 3.634, and Science of The Total Environment (n = 5), which received 254,874 citations in 2020 and has an IF of 7.963 in 2020 and Journal of Dental Research (n= 5), which received 35,358 citations in 2020 and has an IF of 6.116 in 2020. The impact factor of the 35 (54.7%) journals publishing the top 100 most cited articles was IFs above 3.0 and this can be considered as an indicator of the dynamism and

significance of dental fluorosis research. There were 10 articles on dental fluorosis published in five prominent journals with high IFs, such as the Journal of Hazardous Materials; Environment International; Cochrane Database of Systematic Reviews; Environmental Chemistry Letters; and Environmental Science & Technology, which have been among the leading journals in environmental sciences and chemistry for many years.

In addition, it was found that there were very few journals (Journal of Dental Research (IF2020 = 6.116) and Nature Medicine (IF2020 = 4.056)) with IFs close to that of the above-mentioned journal groups among the medical and dental journals publishing articles on dental fluorosis. It was also found that there were few journals such as Fluoride[34], which are multidisciplinary journals, that can connect non-medical and medical disciplines.

It is stated that the IF of a journal can be a determinant for the number of citations.[124] This study supports the theory that the number of articles and citations is positively correlated with the IF. In addition, almost all of the most cited articles on dental fluorosis were published in journals in the USA and UK. Considering the wide range of influence and high IFs of these prominent journals, it is possible to reach a large audience and therefore high numbers of citations. Since it is inevitable that most authors with studies of high scientific quality will prefer their articles to be published in these journals, it is most likely that these journals will maintain their high IFs.

Distribution of Authors:

Several authors (Glenny, A.M. (n = 5), Worthington, H.V. (n = 5), and Walsh, T. (n = 4)) contributed to top-cited articles both as co-authors and first authors in the field of dental fluorosis. The articles published by these three authors were cited 702 times in total. For example, Glenny, A.M. contributed to five studies[51, 52, 27, 50, 53] published between 2010 and 2015 and was one of the top-performing authors. These studies mainly support topical fluoride applications and water fluoridation. Moreover, our analysis revealed that Barbier's review titled “Mechanisms of molecular fluoride toxicity” was the most cited article (n = 654).[26] The study provided an understanding of the mechanisms by which fluoride affects cells at the molecular level in humans. The articles in the top 100 list were written by different authors and author groups, suggesting that the studies on dental fluorosis are not dominated by a specific author group. This, in turn, highlights a counter-argument to the idea that a relatively small number of authors can make a significant contribution to the impact of a journal or field of research, which has been argued in a number of previous bibliometric studies. However, it should be considered that the quality of the articles is as important as the number of articles in order for a certain author or author group to make significant contributions to the field of dental fluorosis, as in bibliographic studies on other dental issues such as endodontics, implantology, and oral cancers.[125, 126, 22]

Citation Bias:

The number of citations received by an article can also be a criterion for making it a “citation classic” as a useful indicator of the overall impact of such an article on the scientific field.[115] However, citation analyses can be affected by several factors such as publication date, research topic, and document type.[127] The erroneous and

exaggerated citation analyses to be accessed as a result of the analyses do not fully reflect the impact of an article. Taking into account the reasons for this, initially, many journals that have attained a specific place in the scientific field do not have open access or they want article processing charges that may seem high for researchers from the middle and low-income countries in order to make the articles open to reading. In general, these types of journals adopt a pay-per-read plan by embargoing the authors within a certain time limit. Therefore, it becomes difficult for researchers to access such articles. In support of this, some papers reported that open access articles had a better chance of being cited. Despite these disadvantages, dental fluorosis articles published in open access journals received only one-third of all citations.

Secondly, past research has shown that an article was more likely to be forgotten as time progressed. Therefore, the ranking of the most cited articles changes over time. Contrary to this argument, the present study found that the total number of citations received by the most cited articles published before 2015 was three times higher per article than those published after 2015, despite there being a longer time since publication. In fact, the total number of citations received by the articles published in 2010 corresponded to those received by the articles published between 2016 and 2020.

One of the most important advantages of the present study is the use of Scopus, the preferred research platform, that allows a wider source search (of articles also published in non-English languages) compared to WOS.

While our findings provide some valuable information, the limitations of this study need to be acknowledged. First, the search strategy is only based on the relevant search term in the title, abstract, or keywords. Therefore, there may be missed articles, although this is a slim possibility. Secondly, when the articles are reviewed according to the number of citations, the articles that are of great importance in their field but have not yet reached a high level of citations may not show high scientific value compared to those that were published a long time ago and therefore received high citation numbers.

CONCLUSIONS

Dental fluorosis research has grown impressively over the past two decades, as evidenced by improvements in research quality and increases in the number of research articles, with an annual average of three times higher than it was before 2000. This bibliometric study is the first to identify and discuss the 100 most cited articles published in the field of dental fluorosis. Despite the study limitations, researchers can immediately understand the significant progress made in dental fluorosis over the past decade by reviewing these top papers and can better identify the scientific questions for future research that should be targeted to fill the gap revealed by the current results. The fact that dental fluorosis articles are accepted and published in multidisciplinary journals instead of journals in different disciplines related to dental, medical, and environmental sciences may allow many different researcher groups to conduct joint studies in the future.

STATEMENT OF ETHICS:

Ethical approval was not required because this study was not conducted directly with humans, but analyzing data from previous studies.

ACKNOWLEDGMENTS:

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CONFLICT OF INTEREST:

The authors declare that they have no conflict of interest. The data that support the findings of this study are available on request from the corresponding author.

AUTHOR CONTRIBUTIONS

Basak Kiziltan Eliacik contributed to the acquisition, analysis, interpretation of the data and wrote the draft; Firat Erdogan contributed to the statistical analysis of gathered data, created VOSviewer maps and contributed to acquisition of data. Both Basak Kiziltan Eliacik and Firat Erdogan contributed to the final version of the manuscript.

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