

FEATURE ARTICLE

RANDOMIZED CONTROLLED TRIALS IN DENTAL JOURNALS ON CHILDREN AND ADOLESCENTS: A BIBLIOMETRIC ANALYSIS



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ABSTRACT

Background

Randomized controlled trials (RCTs) in dentistry provide essential evidence for dentists to practice evidence-based dentistry. This study aimed to analyze the scientific impacts of the RCTs conducted among children and adolescents published in dental journals and summarize the main contents of these studies.

Methods

An electronic literature search was conducted in the database Web of Science (WoS) Core Collection by two independent reviewers in June 2020, without an initial time limit. Articles reporting on RCTs conducted among children and adolescents in dental fields were identified. The most cited articles (the top 100 articles based on total citation counts and citation density) were selected. The bibliometric data were exported from the database WoS for further analysis. The citation counts were cross-checked in Google Scholar. In addition, the main content of the included RCTs was extracted and summarized.

Results

A total of 132 papers published in 28 journals reporting on RCTs in dentistry on children and adolescents were included in this study. The mean total citation count (within WoS) of the included RCTs was 60.0, ranging from 17 to 300, and the mean citation density value was 4.6, ranging from 1.3 to 15.0. The majority of the articles were in the thematic field of cariology ($n = 79$, 59.8%). Other thematic fields, orthodontology (20.5%), endodontology (5.3%), behavior science and quality of life (5.3%), oral and maxillofacial surgery (3.8%), oral hygiene (3.8%) and periodontology (1.5%) were involved as well. Around one-fifth of the articles ($n = 23$) were produced by the United States, and the included articles were most cited by the publications ($n = 1937$) from the United States as well.

Conclusions

A wide range of dental topics were covered in the included RCTs conducted among children and adolescents. These top-cited RCTs mainly focus on the thematic field of cariology. The United States is an influential country with a large number of publication outputs and citations.

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KEYWORDS

Randomized controlled trial, Dentistry, Children, Adolescent, Bibliometric analysis

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BACKGROUND

Evidence-based dentistry (EBD) is defined as “an approach to oral health care that requires the judicious integration of systematic assessments of clinically relevant scientific evidence, relating the patient’s oral and medical condition and history, with the dentist’s clinical expertise and the patient’s treatment needs and preferences”.¹ EBD includes three pillars, namely, relevant scientific evidence, dentists’ clinical expertise and patients’ needs and preferences.¹ As “dentists’ clinical expertise” and “patients’ needs and preferences” are subjective and can vary in different scenarios, “relevant scientific evidence” derived from high-quality, evidence-based researches is of critical importance. Indeed, randomized controlled trials (RCTs) as well as systematic reviews and meta-analysis, which are primarily based on RCTs contribute to high-level evidence in terms of the hierarchy of evidence.²⁻³

However, high-quality RCTs that can provide valuable clinical evidence are not sufficient in dentistry, especially for young patients.⁴ A previous bibliometric study found that the study design of the top 100 most-cited articles in pediatric dentistry journals was cross-sectional studies (39%), followed by literature reviews (18%) and laboratory studies (12%). In comparison, RCTs were found only in 4 articles.⁵ It is worth analyzing the articles reporting on RCTs in dentistry in children and adolescents and summarizing the available evidence provided by researchers to discover up-and-coming research topics.

As the global output of academic publications increases rapidly, an enormous amount of information may overwhelm readers. It is crucial to evaluate the scientific impacts of the publications through bibliometric analysis that consists mainly of bibliographic overviews, such as citation counts, lists of author productions, national or subject bibliographies and publishing patterns (eg, geographical aspects and indicators of performance).⁶ Bibliometric data can be used to provide a structured analysis for voluminous information, infer changing trends over time, identify the dominant area of a research field as well as its growth and development, detect the most prolific scholars and institutions, and present an overview of extant research.⁷ In addition, content analysis can be integrated into bibliometric analysis to provide quantitative measures through the harvesting of keywords, which shows the potential to identify emerging and promising research fields.⁶

Bibliometric analyses are extensively used in various disciplines, eg, social science, economics and medicine. However, bibliometric analyses in dental disciplines are not as common. Previous bibliometric studies in dental disciplines focused on one specified journal^{8,9} or several named journals,^{7,10-12} and some studies are limited in one specified theme, such as early childhood caries¹³ and dental im-

plants.¹⁴ So far, no comprehensive bibliometric analysis is available regarding the articles reporting on RCTs in dentistry in children and adolescents. Citation counts are considered as a marker of a paper’s impact in the literature. A highly cited paper reporting on RCTs may have a strong influence on researchers, students, and practitioners, thus generating changes in clinical practice. Moreover, recent highly cited publications reflect emerging research topics and trends. Therefore, this study aimed to analyze the scientific impacts of the RCTs conducted among children and adolescents published in dental journals and summarize the main contents of these studies.

METHODS

An electronic literature search was conducted in the database Web of Science (WoS) Core Collection by two independent reviewers in June 2020, without an initial time limit. The search algorithm was TS=(child OR *child* OR infant* OR toddler* OR preschool* OR pre-school* OR “pre school*” OR adolescent* OR teen* OR youth* OR newborn* OR offspring OR parent* OR caregiver*) AND TS=(random* trial OR random* control* OR random* clinical trial OR RCT). The search results were refined by selecting the category “Dentistry Oral Surgery Medicine” in the WoS. Subsequently, the results were filtered to exclude document types other than articles, that is, proceedings papers, letters, meeting abstracts, reviews, early accesses, corrections and reprints. The identified articles were ranked in descending order according to the total citation counts (citation data from the WoS). The titles and abstracts of the potential articles were screened by the same two reviewers. Articles were excluded if they were (1) not reporting on RCTs, (2) not conducted in children or adolescents, and (3) laboratory studies. After removing the ineligible articles, the top-cited 100 articles reporting on RCTs in dentistry on children and adolescents were selected according to the ranking of total citation counts. Besides, the potential articles were ranked again by citation density, which is defined as the average number of citations per year. The top 100 articles based on the citation density were cross-checked with the top 100 articles based on the total citation counts. Those not included in the top 100 articles based on total citation counts were added into the final collection of the top-cited RCTs in this study. In addition, the selected articles were cross-checked in Google Scholar to obtain the citation counts data for comparison.

DATA ANALYSIS

The bibliometric parameters of the selected articles, including article title, citation count, citation density, year of publication, authorship, country of authors, institution of publication and keywords, were obtained from citation data from the Clarivate Analytics, WoS Core Collection. The Bibliometrix Biblioshiny R-package software (<https://>

bibliometrix.org/Biblioshiny.html) was used to analyze and graphically map the relevant bibliometric data. The statistical analysis was conducted using the software SPSS (version 25, IBM SPSS statistics) with the statistical significance level set at 5%. Shapiro-Wilk test was used to assess the normality of the data, and the Spearman rank test was adopted to explore the correlation between the year of publication and citations. A simple linear regression model was employed to investigate the association between the total citation counts in WoS and those in Google Scholar.

In terms of content analysis, the commonly referred thematic fields of dentistry, such as cariology, orthodontology and endodontology, were adopted in the present study to classify the included RCTs.⁵ In addition, according to the primary outcome of the RCT, the tested intervention of each included study was summarized.

RESULTS

A total of 132 articles published in 28 dental journals reporting on RCTs conducted among children and adolescents were selected as the collection in this study (Appendix). The articles (#1-#100) were the top-100 cited RCTs based on total citation counts in the WoS, plus 32 articles (#101-#132) supplemented from the top-100 high citation density articles. The mean value of the collection's total citation counts (within WoS) was 60.0, ranging from 17 to 300, and the mean citation density value was 4.6, ranging from 1.3 to 15.0. The mean value of total citation counts of the top-100 articles (#1-#100) was 71.0, and their citation density values had a large variation, ranging from 1.3 to 15.0. Compared to the top-100 articles, the mean value of total citation counts of the articles from #101 to #132 was lower (27.0), and the range of the citation density value was smaller (3.4-9.0). The most cited article (#1) in the collection had the highest total citation counts (300) and also the highest citation density (15.0) reported an RCT on the effect of consuming a probiotic bacterium in milk on dental caries and caries risk in children.¹⁵ In contrast, a recently published article (#118) reporting on an RCT of silver diamine fluoride (SDF) treatment in children had only 27 total citation counts but the citation density value was as high as 9.0.¹⁶

As normal distribution of the data was not supported (Shapiro-Wilk test, $P < .05$), Spearman correlation was adopted to explore the association between the citation count and the age of publication (the time since publication) and a significant positive strong correlation was found (correlation coefficient = 0.648, $P < .001$). At the same time, there was a significant negative weak correlation between the citation density and the age of publication (correlation coefficient = -0.340, $P < .001$). In general, the collection's total citation counts were higher in Google Scholar than those in the WoS. Results of the simple linear regression

model indicate a significant strong positive association between the citation counts in the WoS and those in Google Scholar (Pearson correlation coefficient = 0.965, regression coefficient = 2.31, $R^2 = 0.932$, $P < .001$).

The majority of the articles in the collection are in the thematic field of cariology ($n = 79$), followed by orthodontology ($n = 27$), endodontology ($n = 7$), behavior science and quality of life ($n = 7$), oral and maxillofacial surgery ($n = 5$) and oral hygiene ($n = 5$). Table 1 displays the studied interventions of each RCT included in the collection. In the field of cariology, "fluoride" which was adopted to prevent and/or arrest dental caries, was the most frequently studied intervention, followed by dental restorations of different materials or techniques, probiotic bacterium as food supplements, and chewing gums with different ingredients. Additionally, sealant, toothpaste, motivational interviewing and oral health education methods were also commonly studied interventions in the collection's articles. Regarding orthodontology, most of the articles reported on the effect of using different appliances, for example, Bionator, Herbst and Twin-block appliances, in the orthodontic treatment. The effectiveness of pulpotomy techniques in treating primary teeth was the most frequently studied research question in the field of endodontology. The keywords cloud of the articles in the collection is presented in Figure 1. "Dental caries" was the most frequently referred keyword in the collection. In addition, "fluoride," "prevention" and "mutans streptococci" were also often used.

As shown in Figure 2A, the top-cited RCTs were often published in the journal *Caries Research* ($n = 25$), followed by the *American Journal of Orthodontics and Dentofacial Orthopedics* ($n = 21$) and *Journal of Dental Research* ($n = 17$). Among the top 20 journals, besides those that published dental research irrespective of thematic fields such as *Journal of Dental Research* and *Clinical Oral Investigations*, four were thematic journals specializing in orthodontology, and another three and two journals were in community dentistry and pediatric dentistry, respectively. The cumulative number of the top-cited articles in some journals increased sharply along the timeline (Figure 2B), such as *Caries Research*, *Journal of Dental Research* and *Clinical Oral Investigations*. The cumulative number of articles in the *American Journal of Orthodontics and Dentofacial Orthopedics* became steady around the year 2011. In terms of journal impact, *Caries Research* and *American Journal of Orthodontics and Dentofacial Orthopedics* had the highest impact (h-index = 19), followed by *Journal of Dental Research* (h-index = 12) and *Community Dentistry and Oral Epidemiology* (h-index = 10).

Regarding authors' affiliations, the University of Copenhagen made the greatest contribution to publishing the top-cited RCT articles ($n = 13$). The University of North Carolina and the University of Washington ranked second ($n = 9$),

Table 1. Summary of thematic fields and interventions of the RCTs in the collection.		
Thematic field	Intervention	Number of the RCTs
Cariology (n = 79)	Fluoride	21
	Restoration	11
	Probiotic bacterium	8
	Gum	7
	Sealant	6
	Toothpaste	6
	Motivational interviewing	5
	Oral health education	4
	Casein phosphopeptide amorphous calcium phosphate (CPP-ACP)	2
	Conventional, hall technique, nonrestorative	2
	Basic/intensive prevention strategy	1
	Home visit	1
	Multi-stage dental health promotion program	1
	Nutrition advice	1
	Prolonged breast feeding	1
	Resin infiltration	1
	Supervised tooth brushing	1
Orthodontology (n = 27)	Appliances	23
	Force	3
	Tooth extraction	1
Endodontology (n = 7)	Pulpotomy	6
	Apexification	1
behavior science and quality of life (n = 7)	medicine	3
	Audiovisual distraction	1
	General anesthesia	1
	Enhance of sense of coherence	1
	Caries management methods	1
Oral and Maxillofacial Surgery (n = 5)	Surgery methods	5
Oral Hygiene (n = 5)	App	1
	Different types of toothbrush	1
	Oral health education	3
Periodontology (n = 2)	Mouthrise	1
	Appliances	1
Total		132

Figure 1. The keywords cloud of the articles.

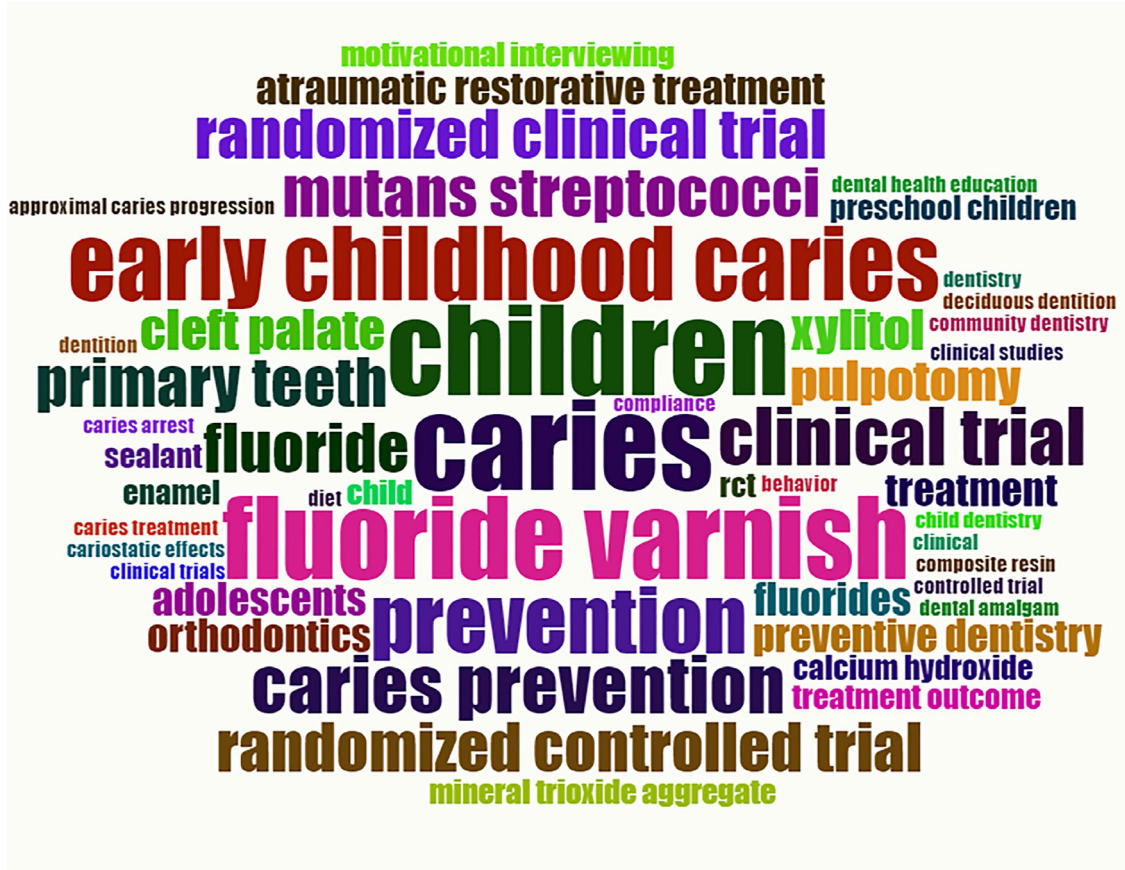


Figure 2. Journals to publish the top-cited RCTs. (A) shows the journals that published articles of top-cited RCTs; (B) shows the top-cited RCTs articles' trend of occurrence in the journals along the time.

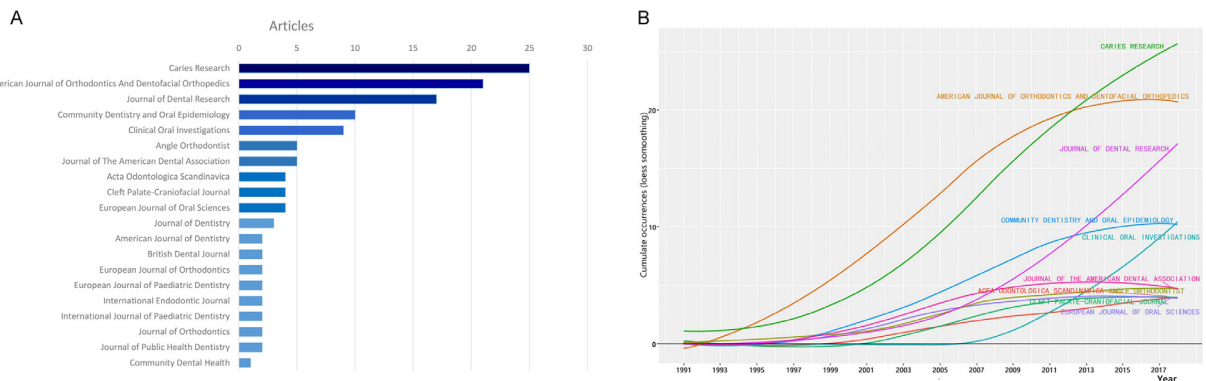
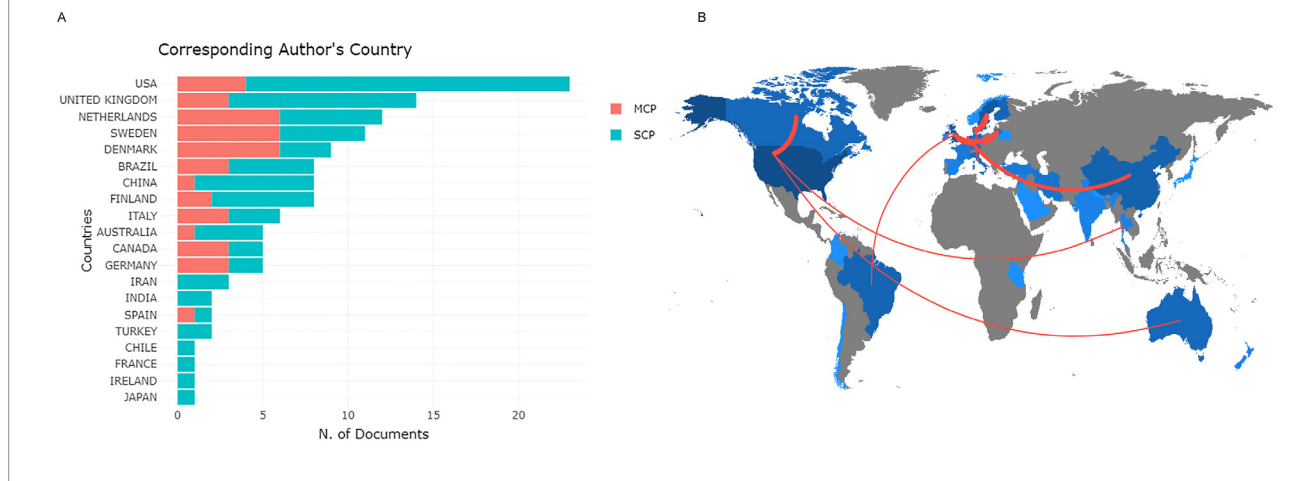


Figure 3. Map of country production and international collaboration. (A) shows the production of articles based on authors' country; (B) is a collaboration world map. The red line indicates the collaboration between the counties. The thickness of the red line shows the amount of collaboration outputs. A thicker red line means more collaboration between the two countries.



followed by Radboud University Nijmegen Medical Center ($n=8$), Karolinska Institutet ($n=7$), Umea University ($n=6$) and the University of Manchester ($n=6$). With respect to the country of the corresponding author's affiliation, the United States ranked first with 23 articles in the collection, followed by the United Kingdom ($n=14$) and the Netherlands ($n=12$) (Figure 3A). Netherlands, Sweden and Denmark had a high level of multiple countries publication (MCP), which was defined as the number of articles having at least one co-author from a different country. The map of country collaboration is shown in Figure 3B. Besides, the articles in the collection were most cited by authors in the United States ($n=1937$), United Kingdom ($n=979$), Netherlands ($n=721$), Finland ($n=677$), Sweden ($n=555$), Denmark ($n=515$), Brazil ($n=402$), Australia ($n=373$), Canada ($n=338$) and China ($n=326$).

DISCUSSION

The bibliometric analysis conducted in the present study identified 132 articles published in 28 dental journals reporting on RCTs in children and adolescents. The majority of the articles in the collection are in the thematic field of cariology. A large number of these top-cited articles were written by authors in the United States.

In general, a publication cited more than 400 times is considered a classic. However, in some fields with fewer researchers, an article with 100 citations may be regarded as a classic work.¹⁷ In the collection of the top-cited RCTs on children and adolescents published in dental journals, 15 articles have been cited more than 100 times. However, the other in-

cluded articles, even with less than 100 citation counts, are still considered important due to the relatively low citation counts in pediatric dentistry compared with other dental-related publications.^{6,8} Besides the top 100 articles based on the total citation counts, another 32 articles with high citation density were added to the collection in the present study. Our findings show that the total citation counts were positively related to the age of the publication. In contrast, the citation density had a negative correlation with the age of the publication. Most recently published articles may not have ample time to be cited. To rectify the possible time bias, articles with high citation density were also included in the present study, thus the number of articles selected is more than 100. In fact, several articles published in the last 5 years have high citation density, even though the total citation counts are relatively low. The articles that were cited frequently in a relatively short time period are considered important publications, as they show great potential of scientific impacts. Moreover, recent highly cited publications can reflect emerging research topics and research trends.

In the present study, citation counts in the database WoS were selected as the benchmark, while citation counts in Google Scholar were reported as a comparison. In line with findings reported in a previous study,¹⁸ the citation counts in Google Scholar were significantly higher than those in the WoS. There were a positive correlation of citation counts between the two databases. Citation counts in the WoS are usually retrieved from articles of selected peer-reviewed journals, whereas Google Scholar may include citations from more extensive sources, eg, theses, dissertations, technical reports, conference papers, books, preprints and non-

academic sources.¹⁸ Since the present study intended to target scientific publications specifically, the database WoS, which provides accurate and detailed bibliometric data of academic publications, is considered a better source to identify highly cited RCTs of children and adolescents in dental research.¹⁹

In addition to the bibliometric data analysis, we also conducted content analysis to provide information on research foci and emerging topics. It is not surprising that dental caries, affecting 621 million children worldwide,²⁰ was the most frequently studied topic in the top-cited RCTs in children and adolescents. This finding is consistent with a previous study in which bibliometric analysis of publications in pediatric dental journals irrespective of study designs was carried out.⁶ In terms of various interventions to prevent and/or treat dental caries, fluoride was the most frequently investigated topic in the top-cited RCTs. It is worth noting that silver fluoride such as SDF and nano silver fluoride was frequently investigated in the RCTs carried out in the last decade, which can be considered as an emerging research focus. Regarding the second most cited thematic field, orthodontology, most of the RCTs compared the clinical outcomes of using different appliances such as Herbst or Twin-block appliances. Despite this, RCTs on clear aligner treatment were not found in the collection. With patients' increasing desire for esthetic and comfortable alternatives to conventional fixed appliances, clear aligners have become a popular orthodontic treatment option. However, as there is a lack of evidence provided by high-quality RCTs, EBD regarding orthodontic treatment using aligners cannot be supported.²¹ In fact, our content analysis findings disclose gaps between the current evidence and the needs of dental practitioners and patients, and thus, well-designed high-quality RCTs should be conducted to fill the knowledge gaps.

In this study, the identified top-cited RCTs on children and adolescents were published in various types of dental journals, not limited to pediatric dentistry journals such as the *European Journal of Paediatric Dentistry* and the *International Journal of Pediatric Dentistry*. Several top-cited RCTs were published in the thematic journals according to the research focus. Besides, some authors prefer to publish findings of high-quality RCTs in journals with a high impact factor irrespective of thematic field (e.g., *Journal of Dental Research*). Thus, it is suggested that dental practitioners and researchers who are interested in dental treatments of children and adolescents should not limit their literature search only to named pediatric or thematic journals. Otherwise, important information may be missed because well-conducted RCTs providing valuable clinical evidence can be published in various journals.

In terms of the country of the corresponding author's affiliation, the United States has the largest number of the top-

cited RCTs included in this study. In addition, these top-cited RCTs were most cited by authors located in the United States as well. The United States is considered a leading country in dental research regarding various fields, eg, pediatric dentistry,⁶ dental traumatology,⁹ endodontology,¹⁰ oral and maxillofacial surgery¹² and implantology.¹⁴ However, contribution from the researchers in European, Asian and South American countries should not be neglected. On the contrary, authors in the Middle East and African countries had very few publications included in the top-cited RCTs collection, and this finding is consistent with a previous bibliometric analysis of publications in a leading dental journal (*Journal of Dental Research*).⁸ This may be due to constraints in research resources, as well as language barriers. As for international collaborations, the MCP index, which measures the international collaboration intensity of a country, was high in European countries, namely Netherland, Sweden and Denmark. They had broad collaboration networks, not only with countries within Europe such as Italy and Norway but also with countries in Asia (China), South America (Brazil) and Africa (Tanzania). It was reported that international co-authorship generally resulted in publications with higher citation counts than purely domestic papers,²² and higher citation counts were observed with an increasing geographical distance between the collaborating countries.²³ International collaborations are encouraged in the science community. The present study helps readers to gain insight into the international collaboration map so that researchers can search for collaborators in the future.

It should be pointed out that the current study has limitations. First, we did not perform a quality assessment of the included articles, such as the risk of bias of RCTs and reporting inadequacy of articles. Rather than reflecting on the quality of an article, citation counts enable a quantitative evaluation of the article's scientific impacts in a selected field. An article with high citation counts does not guarantee high quality of the trial. It is paramount to adequately assess the risk of bias of the included RCTs in a systematic review,²⁴ while it is not the main point of the current study. To facilitate a complete and transparent reporting of an RCT, the Consolidated Standards of Reporting Trials (CONSORT) statement was first proposed in 1996, and modified subsequently, with the latest version released in 2010.²⁵ The CONSORT checklist is commonly required by journals nowadays when a manuscript reporting on an RCT is submitted. However, articles published a long time ago rarely followed the CONSORT statement strictly. As a large number of articles included in this study were published more than ten years ago, probably a substantial proportion of them did not follow the CONSORT statement. Second, there is a possibility that articles that did not explicitly claim as RCTs or index as RCTs by the authors were missed in the present study. Third, we did not attempt to exclude self-citation counts from the total ci-

tation counts when conducting the analysis. The misconduct of self-citing to increase citation counts of the article is never encouraged, but sometimes authors may need to cite their previously published papers in a research series. Lastly, we adopted the database WoS Core Collection, which mainly includes English written articles, to identify potential references in the present study. There is a possibility that some impactful articles published or cited in publications in other languages may be missed. Despite this, the WoS Core Collection provides comprehensive information on citation network of 1.5 billion cited references and the journals included in the collection are indexed cover-to-cover, and other resource indexes are not as deep and complete as the WoS Core Collection.²⁶ Based on the complete and reliable bibliometric data provided by the WoS Core Collection, we conducted the current bibliometric analysis.

CONCLUSION

Within the limitations, the current study presents a comprehensive overview of the top-cited RCTs in children and adolescents published in dental journals using a bibliometric approach. To conclude, a wide range of dental topics were covered in the included RCTs conducted among children and adolescents. These top-cited RCTs mainly focus on the thematic field of cariology. The United States is an influential country with a large number of publication outputs and citations.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.jebdp.2021.101621](https://doi.org/10.1016/j.jebdp.2021.101621).

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Chloe Meng Jiang: Conceptualization, Methodology, Software, Writing – original draft, Visualization. **Gillian Hiu Man Lee:** Data curation, Writing – original draft, Writing – review & editing. **Edward Chin Man Lo:** Conceptualization, Supervision, Writing – review & editing. **Chun Hung Chu:** Supervision, Writing – review & editing. **May Chun Mei Wong:** Conceptualization, Methodology, Validation, Supervision, Writing – original draft, Writing – review & editing.

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