Oral Health Quality Of Life Among Teenagers: A Bibliometric Analysis

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ABSTRACT

Background: Oral health is an indispensable component of overall health, and oral health status significantly influences people's physical, mental, and social well-being. Oral health-related quality of life (OHRQoL), an important and widely used dental patient-reported outcome (dPRO), is attracting more and more researchers' attention and interest. This study aimed to analyze and map the existing scientific literature regarding OHRQoL through a bibliometric approach, including a summary of the characteristics of OHRQoL-related publications, the identification of prolific entities, high-frequency keywords analysis, and research trend analysis via periodic high-impact keywords.

Methods: A literature search was conducted in the Web of Science Core Collection to col- lect OHRQoL-related original research and review articles. After examination and deduplication, the following bibliometric information was extracted from each article: title, abstract, keywords, authors, affiliations, geographic origin (countries/regions), year of publication, journal name, and references. Various scien- tometric mapping tools including Microsoft Office spreadsheet, VOSviewer, Bib- lioshiny R-package software, and Scimago Graphica were used to analyze basic bibliometric parameters, leading producers, high-impact keywords, and research trends.

Results: A total of 3324 OHRQoL-related articles (3119 original research articles and 205 review papers) were collected, which received 65,704 citations. A total of 9950 authors from 2429 organizations contributed to this body of research. Prolific authors from Europe, USA, Brazil, New Zealand, China, and Canada were identified, and they also centered collaboration clusters in the co-author network. *Community Dentistry and Oral Epidemiology* was the most prolific journal. Twenty-one keywords with more than 200 occur- rences, and 23 keywords with more than 150 occurrences, were identified for publications of 1994-2021 and 2012-2021, respectively. Keyword analysis revealed hot topics such as instrument development and validation, studies targeting children and adolescents, as well as clinical studies in operative dentistry, implantology, orthodontics, and community dentistry. Oral Health Impact Profile is the most commonly used instrument in OHRQoL-related research.

Conclusions: OHRQoL is an impactful topic in dental health care as it is not only useful in dental research and patient-centered clinical outcome measures but also provides valuable guidance in dental public health administration and policy making. OHRQoL-related research

presents a dynamic landscape and is expected to continue presenting high productivity and broad application in the future.

Key words: Quality of life (QoL), Oral Health, Bibliometric Analysis, systemic analysis, adolescents.

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INTRODUCTION

According to the World Health Organization (WHO), quality of life (QoL) refers to "the individual's view of his or her situation in life in the context of culture and the system of values in which he or she lives, and in connection to its objectives, standards, and concerns." Based on data from the concept's physical, functional, and psychosocial components, it can be assessed in both healthy and ill people. The measuring of those with health issues has an impact on our understanding of how diseases and their treatments affect people's ability to go about their daily lives. 2 In almost every aspect of health care, including oral health, QoL is now acknowledged as a legitimate metric in patient assessment. 3 An essential aspect of overall health is oral health. 4 Clinical examinations that concentrate on the outward manifestations of present oral disorders and the results of therapies are the traditional way to assess oral health. 5 The use of "patient-reported outcomes" has been suggested to cover the measurement of health from the perspective of the patient rather than the doctor in order to get beyond the drawbacks of such a traditional method. Dental patient- reported outcomes (dPROs) are thought to be crucial for dental research in order to accurately reflect the effects of oral healthcare on patients and to firmly support dentist-patient communication. Oral health-related quality of life (OHRQoL), one of the most frequently reported dPROs12,13, is a multidimensional construct that includes a subjective assessment of the person's oral health, functional well-being, emotional well-being, expectations, and level of satisfaction with care, in addition to their sense of self. 3,5 Combining data from the four main dimensions (i.e. Oral Function, Orofacial Appearance, Orofacial Pain, Psychosocial Impact), 14,15,16,17 OHRQoL can be used to gauge how patients feel about whether changes in their oral health status and general quality of life actually affect them. 16,17

OHRQoL is gaining importance in dentistry as a result of the paradigm change toward a patient-centered, biopsychosocial approach to oral health care.

While many studies have concentrated on the dimensions and components linked with the theoretical model for OHRQoL, it has demonstrated significant relevance in both theoretical and practical dentistry research18,19,20,21,22 In the meanwhile, OHRQoL instruments have been incorporated into numerous clinical investigations as part of their outcome measures. 4,13,23,24,25 For research and clinical use, a number of OHRQoL instruments have so far been created and validated, including the Dental Impact Profile, Oral Health Impact Pro- file, Oral Impact on Daily Performance, and Oral Impact on Daily Life (DIP). 28 The most extensive and widely used tool among them is OHIP, particularly its abbreviated variant, OHIP-14. 29,30,31,32,33 In order to improve the sensitivity and validity of the assessment, OHIP has been tailored for a number of target populations over the course of its development and use, including the general population (non-patient),34 children of various ages,35 adolescents,36 indigenous populations,37 geriatric populations,26 and post-partum women,38.

Finding the general landscape of high-impact research and the evolving trend of a study field or issue has been made easier with the help of bibliometric mapping.30 The identification of prolific authors, journals, nations or regions that excel in publishing and research activity can also be aided by this. 39,40,41,42,43 To the best of our knowledge, the OHRQoL-related literature has only had one bibliometric analysis30, which only looked at the 100 publications with the highest citation counts and provided no data on the total body of research in this

area. A more thorough examination of the traits and developments in OHRQoL-related research is necessary in light of the significance of OHRQoL for dental research and oral health care. Therefore, the goals of this study were to: a) use bibliometric analysis methods to map the body of research on OHRQoL; and b) review the characteristics and development of OHRQoL-related research, including the identification of influential publications and prolific entities, as well as the analysis of high-impact keywords and research trends.

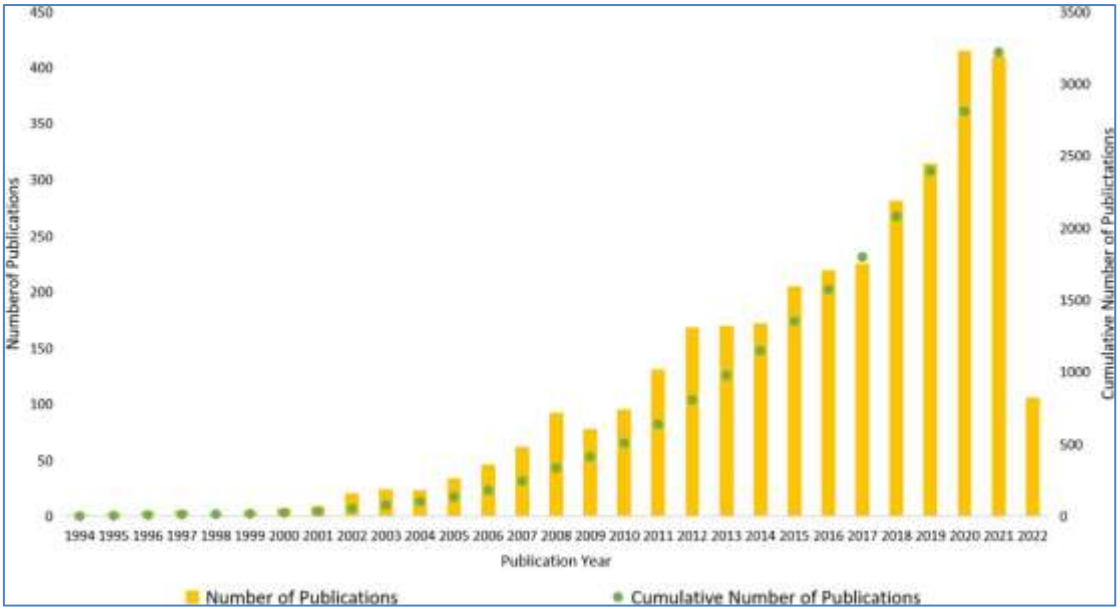
MATERIAL AND METHODS

Literature search: The Web of Science Core Collection (WoSCC), a sizable database that includes crucial bibliometric data for each record and has been extensively used in bibliometric studies, was used to conduct an electronic literature search in April 2022. 40,41 The aim of the search was to locate journal articles and reviews that had been published in scientific journals and were listed in the Science Citation Index Expanded (SCIE). No constraints on publication date were placed on the retrieval of English-language publications. Table 1 contains a list of the search approach.

The titles and abstracts of the retrieved references were double-checked by two authors (X. Y. and Y. C.). We considered papers discussing OHRQoL-related theoretical / methodological investigations as well as those reporting OHRQoL using specific scales, as was predetermined.

Data extraction: As tab-delimited text files, the complete records and referenced references of the included publications were exported. Titles, abstracts, keywords, authors, affiliations, nations or regions, year of publication, journal name, and references were all collected from the bibliometric data. For the keyword analysis, we both retrieved the author's keywords and KeyWord Plus. KeyWord Plus is an article feature that WoS's automatic computer algorithm creates by extracting words or phrases that frequently appear in the titles of the article's references but weren't in the article title (https://support.clarivate.com/ScientificandAcademicResearch/s/article/KeyWords-Plus-generation-creation-and-changes? language=en US). 43 It acts as a helpful addition to the author keywords that the article's authors supply and aids in describing the research aspects of the piece. 45 Data were verified twice for accuracy, and any discrepancies were fixed by going back and re-reading the original publication. Thesaurus files were used to unify word derivatives. Moreover, information was gathered using the WoSCC's "analyze outcomes" functionality.

Data analysis: For bibliometric analysis, a number of scientometric mapping tools were used, including the Microsoft Office spreadsheet (Microsoft Office 2020 Excel, v16.52; Microsoft Corp.), VOSviewer (v1.6.18; Center for Science and Technology Studies, Leiden University), the Biblioshiny R-package software (K-Synth Srl, Academic Spin-Off of the University of Naples Federico II; https://bibliometrix.org/Biblioshiny. The most popular tool for visualizing the outcomes of scientometric analysis and facilitating visual interpretations is VOSviewer. 46,47 Many VOSviewer functions, such as collaboration analysis (focusing on authors, institutions, and nations/regions), themes analysis (focusing on keywords or terms), and citation-based analysis, can be utilized in bibliometric mapping (e.g. bibliographic coupling and co-citations).



Basic bibliometric data were compiled, including the annual and cumulative numbers of publications and citations. Using the prior bibliometric analysis of the top 100 most-cited papers in OHRQoL, highly-cited articles were selected, and their characteristics (such as citation counts, study designs, research focuses, and OHRQoL instruments utilized) were assessed. 30 Clinical trial, cross-sectional study, cohort study, case-control study, validation study, narrative review, and systemic review were the several types of study designs that were categorized. The subjects of the included publications were divided into the following categories: theoretical modelling, instrument creation, cross-cultural validation, influence of oral health issues on OHRQoL, and impact of oral treatment on OHRQoL.

A spreadsheet was used to compile data on institutes, countries/regions, and productive authors. Prolific authors' H-index scores were gathered from WoS. For productive authors, the m-parameter was determined as the H-index divided by the number of years since their first paper was published. 48 The network visualization of VOSviewer was used to study co-authorship networks at the author and institution levels. Scimago Graphica's circular network was used to display international collaborations. According to Bradford's law, the most productive journals, known as core journals, made up one-third of all publications. 42,49 Using the Biblioshiny R-package, the annual amount of publishing for each core journal was tracked in order to examine the source dynamics.

The author keyword and Key- Word Plus created by WoS were included in the keyword analysis, which was conducted over two time periods: the entire OHRQoL research period (1994-2021) and the most recent ten years (2012-2021). While the last ten years are used to identify a study area or topic's current trend, the total research period is used to identify the overall high-impact research environment. Using VOSviewer's co-occurrence analysis feature, the high-frequency terms for both periods were extracted. The term map or network visualization displayed the logistic relationships between keywords or their influence on the research topic.

The keywords that commonly appeared could be regarded as having significant influence on OHRQoL research activity. The dataset of articles published between 2012 and 2021 was utilized to identify keyword patterns. We identified the top 15 repeating phrases for each of the five 2-year segments that made up the decade 2012-2021. Keywords from this list that appeared over numerous 2-year periods (2) were considered to have a strong influence and were included in the analysis. 43 Based on the strategy of looking at annual impact terms employed in prior studies, the average normalized citation scores of high-impact terms were derived to show their impact. 41,42 The average number of citations for all included

publications during that time period was divided by the number of citations in each manuscript to determine its relative citation score. If the score is greater than 1, it means that the publication did better than the average performance of all articles in terms of citations. The average of the normalized citation scores across all publications containing a given term was then used to determine the normalized score for each term. 41 On the basis of the term map visualizations in VOSviewer, the computation was carried out automatically. To determine the trend of citation or research interest, average normalized citation scores of periodic high-impact keywords were tracked across five 2-year intervals.

RESULTS

Overall results

3324 publications (including 3119 original research articles and 205 review papers) were included in the bibliometric analysis after the literature search, evaluation, and deduplication process. Figure 1 displays the annual and total number of publications. The publications found indicate that OHRQoL-related research started in 1994 and gained increased attention in 2005. In general, research on OHRQoL demonstrated a steadily rising trend with slight changes between 2008 and 2010. In 2020 and 2021, this topic showed the highest productivity.

Publications about OHRQoL were cited 65,704 times overall. This body of literature had an H-index of 96, with an average of 19.77 citations for each item. There were more than 100 citations for 87 publications. Table 2 provides a summary of the information from the 20 most-cited articles. These papers, which were all published in 2011 or before, garnered a total of 178–1295 citations, averaging 8.90–49.81 citations annually. The journal Community Dentistry and Oral Epidemiology published nine of the twenty (45.0%) submissions. Cross-sectional studies made up more than half of these high-impact articles (n = 11, 55.0%), followed by clinical trials (n = 5, 25.0%). The OHRQoL instrument OHIP received the most attention in these widely-cited articles.

Leading Producers

The data gathered from WoS shows that there were 9950 different authors who contributed to the research on OHRQoL, with an average of 2.99 authors per publication. The information, citation counts, H-index, and m-parameter for the top 10 writers are shown in Table 3. The most prolific author was Professor Mike T. John (81 papers), the most referenced author was Professor Saul Martins Paiva (1711 citations), and Professor David Locker received the highest average number of citations per publication (26.96 citations). High article citation counts, an H-index, and an m-parameter demonstrated their lack of expertise in the OHRQoL research field.

The research on OHRQoL involved 2429 organizations from 106 different countries. Tables 4 and 5 provide details on the top 10 productive organizations and nations. The oldest university in Brazil and one of the most esteemed institutions of higher learning and research in Latin America, Universidade de Sao Paulo (USP), made a significant contribution to OHRQoL studies with 135 publications (4.0% of the total OHRQoL-related literature). Toronto University had the most citations per piece (81.31 ci- tations). This outcome was in line with the most productive nations. Brazil was the most prolific nation, but the UK and Canada had the most citations (11,114) and the highest average number of citations per article (46.13), respectively.

Collaboration networks

The author collaboration networks were widely formed, as seen in Fig. 2a. Collaboration clusters in the cooperation network were concentrated on prolific authors including Mike T.

John, William Murray Thomson, Colman McGrath, Saul Martins Paiva, Georgios Tsakos, Thiago Machado Ardenghi, and Anne Nordrehaug Astrom. The University of Hong Kong, the University of Adelaide, the University of Sheffield, UCL, Universidade de Sao Paulo, Universidade Federal de Minas Gerais, the University of Minnesota Twin Cities, and Leipzig University were the focal points of extensive collaborations between European, Oceanian, North American, South American, and Asian institutions (Fig. 2b). Deep links and partnerships were formed between the UK, USA, Germany, Brazil, Australia, Sweden, Netherlands, Canada, and China, with the UK and USA displaying the highest levels of cooperation (Fig. 3).

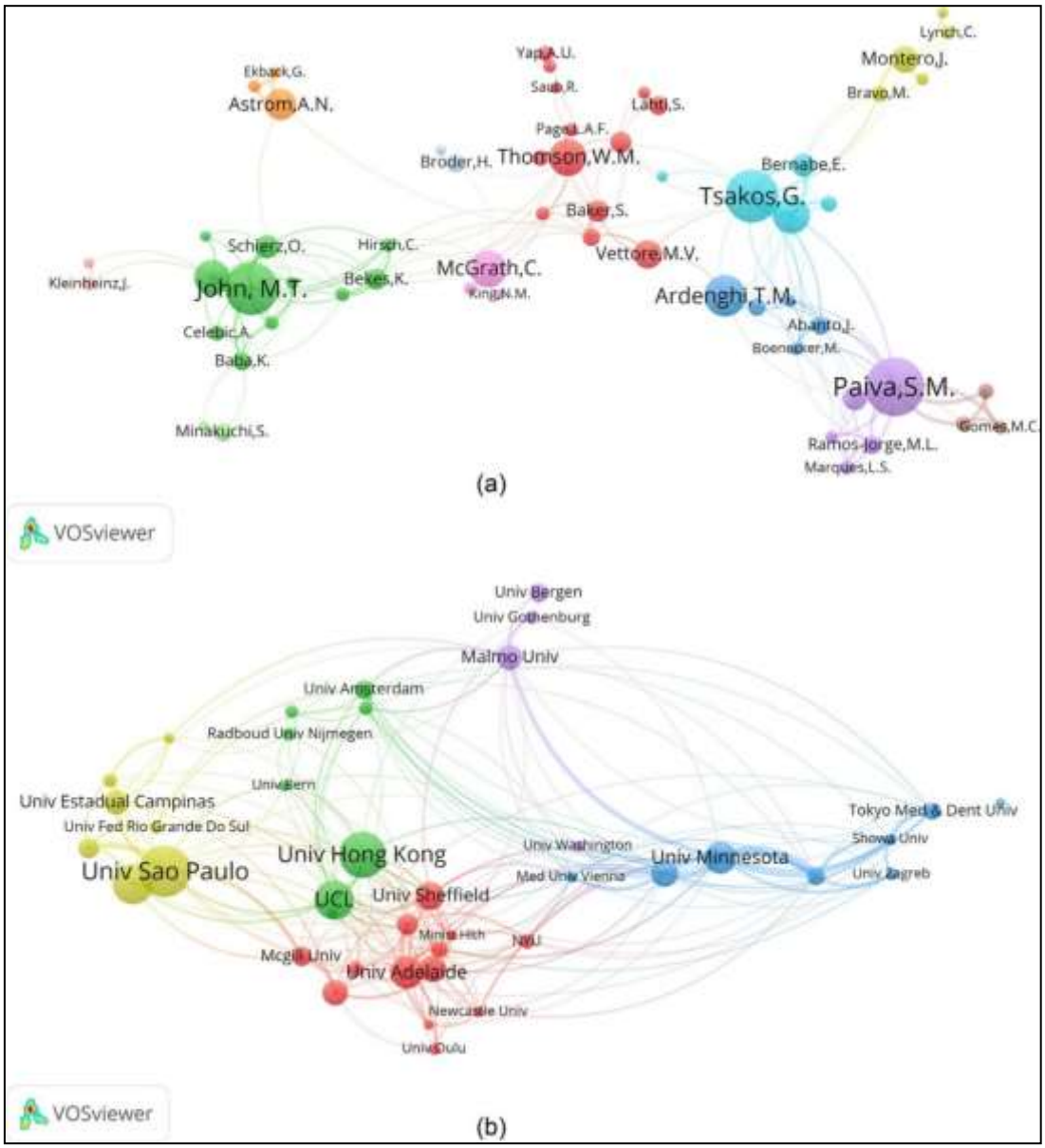


Fig. 2. Collaboration network (a) among authors with more than 10 publications, and (b) among institutions with more than 25 publications. Bubble size indicates the amount of publication. Bubbles of the same color form a collaboration cluster. Distance between bubbles revealed the correlation between two items.

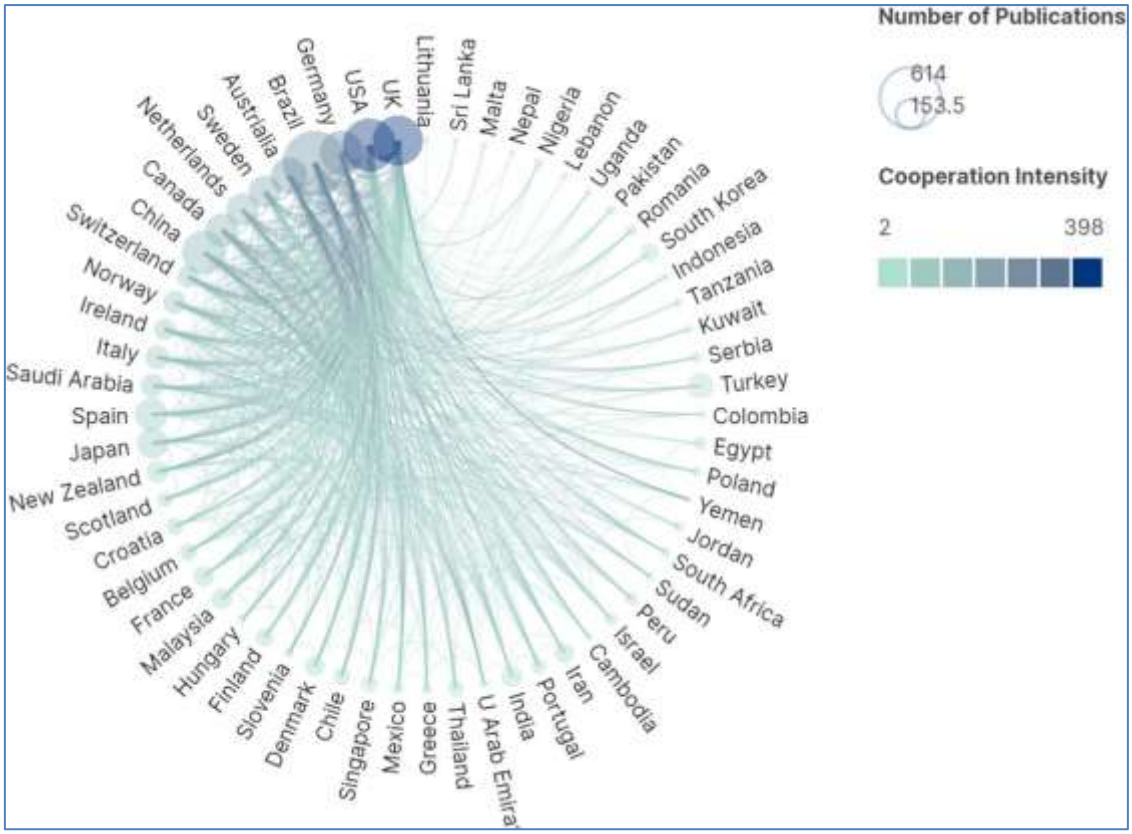


Fig. 3. Visualization of International collaborations. The bubble size indicates the amount of publication. The deeper color indicates the stronger cooperation intensity.

Contributing journals

Five publications, each with more than 100 pertinent papers published, served as the primary venues for OHRQoL-related research: BMC Oral Health (132 publications), Health and Quality of Life Outcomes (110 publications), Community Dentistry and Oral Epidemiology (178 publications), Journal of Oral Rehabilitation (148 publications), and Clinical Oral Investigations (108 publications). Additionally, six journals were determined to be the Bradford's law's core journals: the International Journal of Paediatric Dentistry (73 publications), Quality of Life Research (79 publications), Gerodontology (86 publications), Journal of Dentistry (90 publications), Gerodontology (86 publications), International Journal of Environmental Research and Public Health (73 publications), and Clinical Oral Implants Research (73 publications) (73 publications).

Core journals exhibit various levels of participation and effect at various times. Community Dentistry and Oral Epidemiology, the most productive journal, had the greatest impact in the 2000s, while BMC Oral Health, Clinical Oral Investigations, Journal of Oral Rehabilitation, and International Journal of Environmental Research and Public Health increased their influence from the 2010s to the present.

Keyword analysis

As can be seen in Table 6, there were found to be 21 keywords with more than 200 occurrences and 23 keywords with more than 150 occurrences for research papers produced during the course of the last decade (2012–2021). Almost two-thirds of high-frequency keywords in both periods had average normalized citation counts higher than 1, showing a strong interest in the linked topics among researchers. Hot research topics were connected with high frequency keywords. Keywords like "validation,""validity,""reliability,""questionnaire," and "version" showed that developing

and validating instruments remained a hot topic for study. Research on children and adolescents received more attention and citations for the target population than research on adults and the general public. Clinically relevant keywords like "dental caries,""dental implants,""malocclusions,""prevalence," and "dental care" revealed that operational dentistry, implantology, orthodontics, and community dentistry were of significant study interest. The most widely used instrument in OHRQoL-related research was OHIP, which was mentioned in 10.1% of papers from the last decade and 9.9% of publications over the course of the entire time. Two high-frequency keywords, "pain" and "patient satisfaction," were new to the 2012–2021 list compared to the 1994–2021 list and had above-average citation scores.

According to research focuses and clinical categories, which were depicted as different colours of phrases, the co-occurrence network of high-frequency keywords (30 occurrences) from 1994 to 2021 clearly showed clustering characteristics: Cluster 1 (red) represents periodontal, oral, maxillofacial, and mucosal diseases. Cluster 2 (yellow) represents geriatric dentistry and dental care. Cluster 3 (green) represents prosthodontics and implantology. Cluster 4 (blue) represents orthodontics. Cluster 5 (purple) represents pediatric dentistry. Words in red and yellow had an overlapping appearance, showing close ties between clusters 1 and 2.

Recent research hotspots and trends can be seen in the co-occurrence of keywords and the popularity of citations during the last 10 years (Fig. 6). Based on the growth of OHRQoL research over more than 20 years, some summative papers were published and received a high average normalized citation score, such as "consensus" (average normalized citation score: 2.16, same below), "meta-analysis," and "systematic review" (1.72). High-impact terms including "fear (1.74),""dental anxiety (1.56)," and "self-esteem (1.50)" were linked to patients' subjective reactions to dental diseases or treatments. High citation impact terms suggested that the most concerned oral disorders or conditions were periodontal diseases, traumatic dental injuries, burning mouth syndrome, early childhood caries, and tooth loss, whereas the most concerning treatments were dentures and orthognathic surgery.

Research trend analysis based on periodic high-impact keywords

In the periodic top 15 recurring terms lists of 2012–2021, with "oral health related quality of life" removed, 19 high-impact keywords were found, of which 10 terms appeared in each assessment period (Table 7). The bulk of high-impact phrases showed fluctuating trends in the number of citations they received. In the past ten years, terms like "anxiety,""meta-analysis,""systematic review,""profile,""self-esteem," and "patient-reported outcome" have all indicated an increase in the average normalized cita- tion scores. It should be noted that although "meta-analysis,""systematic review," and "patient-reported outcome" were not added to the list until 2018, they nonetheless had a large citation impact. The 2010s saw the pinnacle of the citation impact for the terms "dental caries,""early childhood caries,""prevalence,""periodontal illness," and "tooth loss," but the last ten years have seen a decline in that influence.

Table1. The search strategy used in this study for Web of Science Core Collection (search date:22/04/2022).

NO.	Search Terms	Number of hits
1	TS=(“oralhealthrelatedqualityoflife”OR“OHRQoL”OR“OHRQL”)	2581
2	TS=(“Geriatric Oral Health Assessment Index ”OR“ Oral Impacts on Daily Inventory”OR“DentalImpactProfile”OR“OralHealthRelatedQualityofLife-UK”OR “ Dental Impacts on Daily Living” OR “Rand Dental Health Index” OR “JawDisability Checklist” OR “Mandibular	2331

	Function Impairment Questionnaire" OR"SubjectiveOralHealthStatusIndicators"OR"ManchesterOrofacial PainDisabilityScale" OR "Psychological Impact of Dental Aesthetics Questionnaire" OR "JawFunctional Limitation Scale" OR "Chewing Function Questionnaire-AlternativeVersion" OR "Modified Symptom Severity Index" OR"Orofacial Esthetic Scale"OR "Brief Pain InventoryFacial" OR "New Chewing Function Questionnaire" OR"Craniofacial Pain and Disability Inventory" OR"children oral health profile"OR"earlychildhoodoralhealthimpactscale"OR"GOHAI"OR" OHIP"OR"OIDP"OR"OH-QoL"OR"OHQoL-UK"OR"DIDL"OR"RandDHI"OR"MFIQ"OR"SOHSI"OR"MOPDS"OR"PIDAQ"OR"JFLS"OR"Alt-CFQ"OR"Mod-SSI"OR"BPI-F"OR"New-CFQ"OR"CF-PDI"OR"COHIP"OR"ECOHIS"OR"QLO–H&N37") Performance" OR " Oral Health Impact Profile" OR " Oral Health Quality of Life	
3	#1OR#2	3652
4	LA=English	49,812,103
5	"MeetingAbstracts"OR"EditorialMaterials"or"ProceedingsPapers"OR"Letters"OR "Corrections" OR "News Items" OR "Retracted Publications" [Filter-Documenttype]	228
7	(#3AND#4)NOT#5	3426

Table 2. Information on the 20 most cited OHRQoL-related publications.

No.	Title	Authors	Journal	Publication Year	Total Citation	Average Citation per Year	Study design	Research Focus	Instrument used
1	Derivation and validation of a short-form oral health impact profile	Slade, GD	Community Dentistry and Oral Epidemiology	1997	1295	49.81	Cross-sectional	Instrument development	OHIP
2	Oral Health-related Quality of Life: What, Why, How, and Future Implications	Sischo, L; Broder, HL.	Journal of Dental Research	2011	509	42.42	Narrative review	Theoretical modeling	Multiple scales
3	Validity	Jokovic,	Journal of	2002	497	23.67	Cross-	Instrument	CPQ11–

	and reliability of a questionnaire for measuring child oral-health-related quality of life	A; Locker, D; Stephens, M; Kenny, D; Tompson, B; Guyatt, G	Dental Research				sectional	development	14
4	Tooth loss and oral health-related quality of life: a systematic review and meta-analysis	Gerritsen, AE; Allen, PF; Witter, DJ; Bronkhorst, EM; Creugers, NH	Health and Quality of Life Outcomes	2010	423	32.54	Systematic review	Impact of oral health condition on OHRQoL	Multiple scales
5	What do measures of 'oral health-related quality of life' measure?	Locker, D; Allen, F	Community Dentistry and Oral Epidemiology	2007	329	20.56	Narrative review	Theoretical modeling	Multiple scales
6	Parental perceptions of children's oral health: The Early Childhood Oral Health Impact Scale (ECOHIS)	Pahel, BT; Rozier, RG; Slade, GD	Health and Quality of Life Outcomes	2007	313	19.56	Cross-sectional	Instrument development	ECOHIS
7	How do age and tooth loss affect oral health impacts and quality of life? A	Steele, JG; Sanders, AE; Slade, GD; Allen, PF; Lahti,	Community Dentistry and Oral Epidemiology	2004	309	16.26	Cross-sectional	Impact of oral health condition on OHRQoL	OHIP

	study comparing two national samples	S; Nuttall, N; Spencer, AJ							

(*continued on next page*)

Table 2 (*continued*)

No.	Title	Authors	Journal	Publication Year	Total Citation	Average Citation per Year	Study design	Research Focus	Instrument used
8	Oral and general health-related quality of life with conventional and implant dentures	Heydecke, G; Locker, D; Awad, MA; Lund, JP; Feine, JS	Community Dentistry and Oral Epidemiology	2003	246	12.3	Clinical trial	Impact of oral treatment on OHRQoL	OHIP
9	Measuring the effect of intra-oral implant rehabilitation on health-related quality of life in a randomized controlled clinical trial	Awad, MA; Locker, D; Korner-Bitensky, N; Feine, JS	Journal of Dental Research	2000	244	10.61	Clinical trial	Impact of oral treatment on OHRQoL	OHIP
10	Oral health status and treatment satisfaction with mandibular implant overdentures and conventional dentures:	Awad, MA; Lund, JP; Shapiro, SH; Locker, D; Klemetti, E; Chehade, A; Savard, A; Feine,	International Journal of Prosthodontics	2003	241	12.05	Clinical trial	Impact of oral treatment on OHRQoL	OHIP

	A randomized clinical trial in a senior population	JS							
11	Psychometric properties of the Brazilian version of the Oral Health Impact Profile-short form	Oliveira, BH; Nadanovsky, P	Community Dentistry and Oral Epidemiology	2005	237	13.17	Cross-sectional	Cross-cultural Validation	OHIP
12	Impact of traumatic injuries to the permanent teeth on the oral health-related quality of life in 12–14-year-old children	Cortes, MI; Marcenes, W; Sheiham, A	Community Dentistry and Oral Epidemiology	2002	236	11.24	Case-control	Impact of oral health condition on OHRQoL	OIDP
13	The German version of the oral health impact profile - translation and psychometric properties	John, MT; Patrick, DL; Slade, GD	European Journal of Oral Sciences	2002	227	10.81	Cross-sectional	Instrument development	COHIP-G19

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Table 2 (*continued*)

No.	Title	Authors	Journal	Publication Year	Total Citation	Average Citation per Year	Study design	Research Focus	Instrument used
1	Assessing	Locker,	Community	2004	220	11.58	Clinica	Impact of	OHIP

4	the responsiveness of measures of oral health-related quality of life	D; Jokovic, A; Clarke, M	Dentistry and Oral Epidemiology				l trial	oral treatment on OHRQoL	
15	Comparison of the GOHAI and OHIP-14 as measures of the oral health-related quality of life of the elderly	Locker, D; Matear, D; Stephens, M; Lawrence, H; Payne, B	Community Dentistry and Oral Epidemiology	2001	211	9.59	Cross-sectional	Instrument validation	GOHAI and OHIP
16	Impact of oral diseases and disorders on oral health-related quality of life of preschool children	Abanto, J; Carvalho, TS.; Mendes, F M.; Wanderley, MT.; Bonecker, M; Raggio, DP.	Community Dentistry and Oral Epidemiology	2011	202	16.83	Cross-sectional	Impact of oral health condition on OHRQoL	ECOHIS
17	Open versus closed treatment of fractures of the mandibular condylar process - a prospective randomized multi-center study	Eckelt, U; Schneider, M; Erasmus, F; Gerlach, K L; Kuhlisch, E; Loukota, R; Rasse, M; Schubert, J; Terheyden, H	Journal of Cranio-Maxillofacial Surgery	2006	197	11.59	Clinical trial	Impact of oral treatment on OHRQoL	MFIQ
18	Questionnaire for measuring	Jokovic, A; Locker,	Pediatric Dentistry	2004	191	10.05	Cross-sectional	Instrument development	CPQ8–10

	oral health-related quality of life in eight- to ten-year-old children	D; Tompson, B; Guyatt, G							
19	Impact of oral health on the life quality of periodontal patients	Needleman, I; McGrath, C; Floyd, P; Biddle, A	Journal of Clinical Periodontology	2004	185	9.74	Cross-sectional	Impact of oral health condition on OHRQoL	OHQoL-UK
20	A longitudinal study of quality of life outcomes in older adults requesting implant prostheses and complete removable dentures	Allen, PF; McMillan, AS	Clinical Oral Implants Research	2003	178	8.9	Cross-sectional	Impact of oral treatment on OHRQoL	OHIP

Table 3. Information on the top 10 productive authors.

Author (Abbv.)	Institution	Country/ region	Number of articles	Number of citations	Citations per article	H-index	M-parameter
John, MT	University of Minnesota	USA	81	1659	20.48	39	2.79
Paiva, SM	Federal University of Minas Gerais (UFMG)	Brazil	68	1711	25.16	36	1.71
Tsakos, G	University College London	UK	65	1506	23.17	28	2.33
Thomson, WM	University of Otago	New Zealand	55	888	16.15	53	1.18
McGrath, C	The University of Hong Kong	China	53	1302	24.57	35	1.75
Locker, D	University of Toronto	Canada	52	1402	26.96	52	1.21
Sheiham, A	University College London	UK	47	1072	22.81	66	1.53
Ardenghi,	Universidade	Brazil	44	755	17.16	27	1.35

TM	Federal de Santa Maria						
Reissmann, DR.	University Medical Center Freiburg	Germany	42	845	20.12	25	0.64
Astrom, AN	University of Bergen	Norway	40	548	13.70	32	1.14

Table 4. Information on the top 10 productive institutions.

Institution	Number of articles (%)	Number of citations	Citations per article
Universidade de Sao Paulo	135 (4.0)	2333	17.28
Universidade Federal de Minas Gerais	122 (3.7)	3037	24.89
University College London	121 (3.6)	4596	37.98
The University of Hong Kong	120 (3.6)	4727	39.39
Universidade Estadual de Campinas	85 (2.5)	1224	14.4
University of Adelaide	84 (2.5)	3117	37.11
University of Minnesota Twin Cities	84 (2.5)	2173	25.87
University of Sheffield	77 (2.3)	1929	25.05
University of Toronto	74 (2.2)	6017	81.31
Leipzig University	71 (2.1)	1764	24.85

Table 5. Information on the top 10 productive countries.

Country	Number of articles (%)	Number of citations	Citations per article
Brazil	616 (18.5)	10,357	16.81
USA	429 (12.9)	10,692	24.92
UK	353 (10.6)	11,114	31.48
Germany	291 (8.8)	6461	22.20
China	256 (7.7)	6184	24.16
Canada	171 (5.1)	7889	46.13
Australia	167 (5.0)	4585	27.46
Spain	159 (4.8)	2707	17.03
Netherlands	158 (4.8)	3035	19.21
Sweden	157 (4.7)	3084	19.64

Table 6. List of high-frequency keywords during the overall research history (1994–2021) and during the last 10 years (2012–2021).

Keywords	Occurrence	Average Normalized Citations
1994-2021	>200 occurrences; 21 in total	
oral health related quality of life	2456	0.9871

impact	853	0.9536
validation	514	1.078
children	430	1.0827
validity	411	1.047
dental caries	356	1.1181
prevalence	354	1.1967
reliability	354	0.9843
OHIP	328	1.1133
adult	321	0.9596
questionnaire	320	1.1308
the elderly	294	0.8962
satisfaction	281	0.9547
disease	272	1.1312
adolescent	265	1.0389
version	254	1.0724
dental implants	222	1.0462
malocclusion	221	1.0507
association	207	1.0935
dental care	207	0.9248
population	207	1.1531
2012-2021	>150 occurrences; 23 in total	
oral health related quality of life	1909	0.9843
impact	680	0.9298
validation	366	1.066
children	346	1.0375
dental caries	311	1.1352
prevalence	283	1.2537

(*continued on next page*)

Table 6 (*continued*) Keywords	**Occurrence**	**Average Normalized Citations**
validity	273	1.0348
OHIP	261	1.1238
reliability	251	0.9298
adult	250	0.9194
questionnaire	238	1.0754
adolescent	220	1.055
satisfaction	220	0.9253
disease	203	1.2126
the elderly	194	0.9508
dental implants	186	1.0125
malocclusion	185	1.0656
association	183	1.0636
version	180	1.1146
pain	168	1.1707
dental care	162	0.9847
patient satisfaction	151	1.0777
population	151	1.2694

Table 7. Periodic average normalized citation scores of high-impact terms from 2012 to 2021.

Term	Average normalized citation score				
	2012-13	2014-15	2016-17	2018-19	2020-21
clinical trial	0.98	1.43	0.99	1.42	1.39
anxiety	N/A	0.93	0.95	1.24	1.64
dental caries	1.40	1.13	1.35	1.10	0.90
early childhood caries	N/A	1.55	1.45	1.59	0.65
epidemiology	1.30	1.38	2.10	0.91	0.83
meta-analysis	N/A	N/A	N/A	1.53	1.45
orthodontics	1.35	1.31	1.07	0.83	1.10
pain	1.22	0.90	0.78	0.92	1.67
patient-reported outcome	N/A	N/A	N/A	2.02	2.05
periodontal disease	1.06	1.68	1.64	0.95	1.27
population	1.33	1.12	1.53	1.01	1.37
preschool children	N/A	1.34	1.17	1.27	1.06
prevalence	1.15	1.30	1.44	1.20	0.97
profile	1.20	0.86	1.01	1.00	1.93
self-esteem	N/A	N/A	1.43	0.83	1.67
short-form	N/A	1.30	1.31	0.64	N/A
systematic review	N/A	N/A	N/A	1.47	1.75
therapy	N/A	0.74	1.58	0.89	1.59
tooth loss	0.76	1.50	1.71	1.20	1.22

N/A: not available.

DISCUSSION

According to the WHO, "health" refers to a person's overall physical, mental, and social well-being and does not just refer to the absence of disease.50 Dental therapy should aim to address the social and psychological needs of patients by restoring oral function and aesthetics in addition to treating oral diseases and disorders that already exist. 9 OHRQoL-related research has attracted more and more researchers' interest due to the growing emphasis on patient-centered healthcare and has demonstrated dynamic research characteristics. 13,51,52 In this analysis, almost 3,000 OHRQoL-related articles with over 9,000 authors from throughout the world were identified. Around 100 papers per year were created after 2011 as the number of publications connected to OHRQoL increased steadily. This environment often aligns with the increase in research output and citations seen in the profession as a whole. 39,44

The top 20 articles with the most citations were released between 1997 and 2011. These seminal articles, which received at least 178 total citations and an average of 8.9 per year, laid the groundwork for OHRQoL research in terms of instrument development and validation, research into the effects of oral health conditions or dental treatments on patients' OHRQoL, and theoretical modelling. Cross-sectional study designs are most frequently used in the creation and validation of OHRQoL instruments. 38,53,54,55,56 Clinical trials were frequently connected to the evaluation of oral treatment results, including implant restorations, dental care, and surgical and nonoperative management of mandibular condylar fractures,57,58,59,60,61. The comprehensiveness of treatment outcome assessment was improved in clinical trials by the use of patient- reported outcome measures using OHRQoL

instruments as valuable additions to the survival analysis and clinical parameters typically provided by dental researchers. 9 Three of the review articles on the most-cited list were released after 2007, when OHRQoL research began to gain momentum. 3,62,63 The high citation rate of reviews not only demonstrated the sound research foundation developed in the 1990s and 2000s, but it also showed that earlier, superior research and review publications had facilitated earlier, superior research outputs.

In this study, the number of articles, citation data, and H-index were used to illustrate the author's influence. According to Chen et al.41, two patterns of author impact include producing a number of articles with a high level of impact or being prolific and earning a moderate amount of citations. In addition to being listed among the top 20 most-cited works, Mike T. John, David Locker, Aubrey Sheiham, and Colman McGrath may exhibit both author impact patterns, while the remaining prolific authors may adhere to the second form of author impact. Since they typically place the co-author clusters in the core of the collaboration network, productive authors also use connections and collaborations to their advantage. The H- index is a succinct bibliometric indicator that evaluates both the quantity and the quality of a researcher's research output. It is defined as the number of publications that obtained more than or equal to h times of citations. The 48,64 M-parameter allows comparisons between researchers of various seniorities while taking into account the length of a researcher's academic career. 65 A 40 H-index was displayed on average among prolific authors. Prof. Mike T. John and Prof. Georgios Tsakos had an m-parameter higher than 2, which is evidence of their outstanding scientific impact. Most prolific authors had an m-parameter higher than 1, which describes a successful scientist. These findings demonstrated the significant influence and skill of successful authors in the area of OHRQoL research.

Many authors and institutions were discovered throughout Europe, Oceania, North America, South America, and Asia, indicating that researchers from all over the world have been interested in the OHRQoL. Contrary to the bibliometric results in other dental research fields, where the USA often produces the most publications, Brazil was the most productive nation. 40,41,42,43 Nonetheless, as seen by their significant citation counts, European and North American nations demonstrated stronger influence. All of the productive nations in Table 5 were rated top 30 in the World Bank's rankings of gross domestic product (GDP),66 which may be evidence that nations with larger economies tend to prioritize patient-centered research and oral health promotion.

52,67 The geographical characteristics of OHRQoL-related research can be identified by the identified distribution of successful authors, institutions, and nations. This information can also be utilized to predict how dental public health will develop in the future. Moreover, productivity is linked to the volume of grant funding, the allure of academic institutions that meet certain requirements, as well as communication and teamwork amongst researchers. 40,41 It is important to note that no well-known author or institution from Africa was found in this study, which was in line with the earlier evaluation of highly cited articles in the fields of dental public health and OHRQoL. 30,68 In other scientific areas, a comparable circumstance was also discovered. 40,69,70 In addition to the continent's unfavourable economic growth, research development in Africa may face obstacles such as low levels of research work acceptance by high-impact journals, inadequate training of the continent's future researchers due to the underdevelopment of tertiary education and the "brain-drain" effect, a lack of regional or international collaboration, and a lack of financial support. 69

The most OHRQoL-related articles were published in Community Dentistry and Oral Epidemiology (IF2020=3.383), which also produced nearly half of the top 20 most-cited publications. In the 2000s, when researchers were devoted to instrument creation and validation, Community Dentistry and Oral Epidemiology—one of the most reputa- ble publications in the field of dental public health—exhibited the greatest influence. After then,

journals like BMC Oral Health and Clinical Oral Investigations considerably increased the number of publications they were producing on OHRQoL. This may be explained by the rising prevalence of sophisticated OHRQoL measurement tools in the epidemiological and clinical research that makes up the common content of these two journals.

An efficient method for identifying the terrain and research hotspots in the area of OHRQoL is the analysis of term frequency and citation impact.

41,71 The identified high-frequency keywords in this study can basically be divided into four areas: targeted population, clinical categories, instrument development and validation, and patient-centered subjective outcome measures. It should be mentioned that in order to compare the high-frequency keywords from the past ten years (2012–2021) with those from the entire search history, newly added terms like "pain" and "patient satisfaction" that fell into the last group were discovered. Their popularity is a result of the increased focus on patients' subjective perceptions of dental diseases or treatments. 9,20,52,72

Regarding OHRQoL-related keywords, the network visualization and the term map offered different insights. A summary of the OHRQoL research covering a range of topics of interest, age groups, oral conditions, and therapies is provided by the clustering of high-frequency terms. Combining keywords for geri- atric dentistry and dental care (cluster 2) with those for periodontal, oral maxillofacial, and mucosal illnesses (cluster 1) may be the result of the higher prevalence of these conditions in the elderly. The quarterly keyword impact analysis sheds further light on the trend of the citation intensity, which is the main focus of the term map of recurrent keywords over the past ten years. Consensus, meta-analysis, and systematic reviews have high citation intensities, which denote the formation of comprehensive and summative articles based on the prior research. 13,73 Review articles are a great resource for future research effort, especially systematic reviews with a high level of evidence. 70,74 Dental public health management has been burdened by very prevalent chronic disorders such dental caries and tooth loss. Yet, improving public health policies and illness prevention may be related to the lowering trend of the citation effect of terms related to cariology, periodontics, and tooth loss. 75,76 Since it takes more time to identify the new oral public health concern and track down the shifting research hotspots, other bibliometric analyses were unable to identify this trend. 68, 70,71 The decreased citation impact of the terms "epidemiology" and "prevalence" can be linked to researchers' shifting attention from the epidemiological study to the impact of dental treatment therapies on OHRQoL.

The OHRQoL instrument OHIP is the one that is most frequently used in highly cited articles.

31 Also, it was noted as a high-frequency term for the time periods 1994–2021 and 2012–2021. According to our findings, OHIP's widespread adoption may be due to a number of factors, including: It was the first OHRQoL instrument to be created; it has many short-form versions to increase convenience and effectiveness; and it has been translated into numerous languages to enable use internationally. Slade and Spender created the first iteration of OHIP in 1994. 77 The OHIP-49, the 49-question original version of the questionnaire, was later deemed to be time-consuming, challenging to administer, and prone to causing respondent weariness. 78 The short-form OHIP-14 was created and validated as a result for its potency in differentiating subgroups of various features and detecting connections with clinical and sociodemographic factors. 52,53 Following this, OHIP-14 was translated into a number of languages, validated in a range of social contexts and cultural settings, and was frequently used in epidemiological studies and clinical trials. 9,32,36,78,79,80 The OHIP- 7Sp or OHIP-5 ultra-short form was further developed to increase the ease and simplicity of reporting dPROs. 25,26,31,32,81 Numerous OHRQoL instruments, including the Rand Dental Health Index (Rand DHI), Oral Health Related Quality of Life-UK (OHQoL-UK), Subjective Oral Health Status Indicators (SOHSI), Dental Impacts on Daily Living (DIDL), and Oral Impact

in Daily Performance, have been developed for the general adult population82,83,84 (OIDP). Furthermore, because of their unique characteristics and considerations, several OHRQoL instruments are created for specific age groups. 33 Our key-word analysis revealed that recent OHRQoL papers have placed a special emphasis on children and adolescents. Compared to the overall adult population, they exhibit substantially diverse physical, mental, and social features and needs. 40 More significantly, children and teenagers of various ages (e.g., 2- 5 years or preschool age, 6-7 years, 8-10 years, and 11-14 years) may be more susceptible to various dental conditions and diseases and experience the accompanying socio-dental effects in various ways. Tools including the Child Perceptions Questionnaire (CPQ), Child Oral Health Impact Pro- file (COHIP), Child Oral Impacts on Daily Performances (C-OIDP), and Early Childhood Oral Health Impact Scale (ECOHIS) are designed to study the effects on kids and teenagers. The Geriatric Oral Health Assessment Index90 and Dental Impact Profile26 were developed specifically for the senior population and focused on the group's very prevalent diseases, problems, and difficulties.

OHRQoL instruments provide significant guidance for dental public health administration and policy making in addition to being excellent tools that are widely utilized in dental research and patient-centered clinical outcome assessments.

17,87,91 There is still a long way to go, despite the fact that oral disease patterns have been changing quickly and the prevalence of various diseases has decreased as a result of better oral health policies and people's increased awareness of oral health. 3,75,76,81 According to the Global Oral Health Report 2003, socio-environmental and lifestyle factors have a strong correlation with mouth diseases. 75 There are significant differences in oral health among and within nations, regions, and population groupings, whether in developed or developing nations. 12,18,19,53,67,92,93 As a result, surveys carried out in various nations/regions, cities, and socioeconomic contexts revealed considerably varying OHRQoL features. 52,67,87 Hence, cross-cultural evaluation and research aimed at various populations are important since groups processing sociodemographic characteristics differ from one another and can together paint a complete picture of how oral problems or treatments affect people's quality of life. 15,33 OHRQoL is also a key component of value-based oral health care (VBOHC), which aims to enhance overall oral health and treatment results while also being cost-effective. 17,25,87 Moreover, public health strategies can be developed to enhance the level of oral health in the community, such as specialized programs for the underprivileged or tailored campaigns for oral education and promotion aimed at young children, teenagers, pregnant women, and the elderly.

Generally speaking, our findings about the production and citation landscape of OHRQoL research, such as prominent producers, research hotspots, and widely-used assessing tools, are in line with the prior bibliometric analysis of the top 100 most referenced publications on this topic30. All papers were evaluated and assessed in the present bibliometric analysis, unlike the top-100 analysis, which only looked at papers with lots of citations. Various search techniques and database selections (WoSAD for Clementino et al.30 and WoSCC for our research) led to variations in the number of prolific entities and citation data. The top 20 most-cited articles in our study provided a better definition of the traditional OHRQoL literature. Due to the disparate levels of research production in various therapeutic domains, topics, and time periods, the criteria for classifying a classic publication vary substantially. The range for the cutoff was generally 100–400 citation counts. 40,41,68,94 It is common knowledge that highly referenced articles need a significant amount of time (at least 10 to 15 years) to build up their citation effect. 30,68,95 Hence, the list of highly cited publications cannot include significant papers published recently that may better reflect the current research trend. To fill in this gap, high-frequency keyword and periodic high-impact keyword evaluations were conducted from 2012 to 2021.

The current study has some limitations, including the use of a single database and the inclusion of self-citation. The data source may result in many duplicate publications if additional databases (like Scopus and Google Scholar) are included, and the screening procedure may be difficult and prone to mistakes. The usage of prior methodology, ongoing interest in the subject, and a high link between the earlier and later publications may all be attributed to self-citation. 68,96 Also, it was stated that self-citation has no impact on the original impact factor (IF) or corrected IF of dental publications listed in the Journal Citation Reports (JCR). 96 We discovered during the investigation that many authors continued to research OHRQoL and published many studies on the subject; as a result, eliminating self-citation is deemed needless and unreasonable. The H-index should also be used with caution because it fluctuates depending on the research field and length of the academic career. 64,65,97 H-index can be influenced by administrative, educational, and therapeutic achievements in addition to research output and quality. 65 Given that the current study primarily focused on highly cited articles and productive writers, the limitations of the h-index should have little effect.

Because it may be applied to a variety of populations and clinical categories, the current study highlighted OHRQoL as a research area that is actively developing. Future studies on OHRQoL are likely to have a steady increase in the quantity of publications and citations. The use of OHRQoL for assessments of various topics or locations will continue to be supported by thriving research on instrument development, optimization, and cross-cultural validation. Also, more clinical trials will include OHRQoL assessments to gather important patient-centered data that is important for both dentist-patient communication and the assessment of benefits and risks.

CONCLUSIONS

OHRQoL is a significant topic in dental healthcare because it offers essential recommendations for dental public health administration and policy making in addition to being beneficial in dental research and patient-centered clinical outcome assessments. The current study examined the bibliometric traits of papers that dealt with OHRQoL, including the general state of the field, top authors, networks of collaboration, contributing journals, keyword analysis, and research trend analysis. Research on OHRQoL has a vibrant landscape, with many publications, many citations, and international collaborations. Future research on this subject is anticipated to continue to be highly productive and expand in scope.

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