ORIGINAL ARTICLE

Orthodontic treatment need from a bibliometric analysis of the last four decades: a bibliometric analysis

Yohana Yusra[1*]
Joko Kusnoto[1]
Indrayadi Gunardi[2]
Goalbertus[3]
Budi Kusnoto[4]

[1]Department of Orthodontics, Faculty of Dentistry, Universitas Trisakti, Indonesia
[2]Department of Oral Medicine, Faculty of Dentistry, Universitas Trisakti, Indonesia
[3]Department of Public Health and Preventive Dentistry, Faculty of Dentistry, Universitas Trisakti, Indonesia
[4]Department of Orthodontics, Faculty of Dentistry, University of Illinois at Chicago, United States of America

* Correspondence:
yohana@trisakti.ac.id

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ABSTRACT

Introduction: Malocclusion is a common oral disorder that strongly correlates with orthodontic treatment needs (OTN), however the complete picture of OTN remains unclear. This bibliometric study was conducted to develop a complete picture of the OTN from 1974-2022. The purpose of this study was to conduct a bibliometric analysis of scientific research pertaining to orthodontic treatment needs **Methods**: Type of study was bibliometric analysis. The term "orthodontic treatment need" was used to search for relevant articles in the Scopus database. VOSviewer, OpenRefine, and Tableau Public were used to illustrate the contributions of authors, journals, institutions, countries and the co-occurrence analysis and references analysis of the keywords. **Result:** There were 890 publications produced as a result of this study. Richmond emerged as the author with the most extensive publication record, having authored a remarkable 21 pieces that garnered a cumulative total of 524 citations. The analysis reveals that the United Kingdom, Brazil, and the United States emerged as the primary contributors to literature pertaining to the assessment of orthodontic treatment necessity. The analysis of keywords revealed the occurrence of seven distinct clusters, which are: Index of Orthodontic Treatment (IOTN), orthodontic treatment, quality of life, orthodontic, malocclusion, and oral health-related quality of life. The largest cluster identified in the study was "malocclusion," encompassing factors such as prevalence, the Dental Aesthetic Index (DAI), treatment necessity, and the need for orthodontic intervention. **Conclusion:** In general, the number of articles addressing the need for orthodontic treatment has increased, particularly in the third and fourth decades. In the fourth decade, there were more articles about the IOTN that contained keywords directly related to the index, as well as self-esteem, quality of life, and its socio-demographic and socio-economic status correlation.

KEYWORDS

orthodontic treatment need; malocclusion; bibliometric; quality of life.

INTRODUCTION

Malocclusion, denoting the misalignment of teeth or improper positioning of the jaws, has significantly increased attention in recent years, owing to advancements in dental education and heightened awareness.[1] With the worldwide prevalence about 56%,[2] this heightened awareness has precipitated a surge in the demand for orthodontic interventions. While a subset of these deviations bears adverse consequences for dentofacial development, manifesting as compromised orofacial function or dental trauma, the majority of cases can be attributed to the spectrum of normal biological variation.[3]

Despite the fact that malocclusion is neither a disease nor a life-threatening condition, the demand for orthodontic care continues to rise. Various articles on

the need for orthodontic treatment have been published, including articles on the prevalence of orthodontic treatment, the relationship between the need for orthodontic treatment and quality of life, and various indices used to measure it.[4,5]

The concept of orthodontic treatment needs includes psychosocial and facial considerations in addition to tooth arrangement. Consequently, it will be difficult to determine who requires treatment and who does not use only model studies or radiographic images. It is reasonable to attribute the severity of malocclusion to the need for orthodontic treatment when estimating the population's need for orthodontic treatment.[6] The use of instruments or measuring devices to calculate the need for orthodontic treatment in specific populations or communities was one of the most common topics of orthodontic studies. [7-11]

This tool is crucial in determining treatment priorities in such a limited dental health system and developing a plan for specialist training. In recent years, there appears to be a consensus regarding the individual characteristics and occlusal features that should be objectively evaluated to determine the need for orthodontic treatment.[12,13] Several studies on orthodontic treatment need indexes are also used to determine government funding priorities for low-income communities.[14] Orthodontic treatment needs are also associated with an individual's quality of life and socioeconomic status.[15,16]

Currently, the demand for orthodontic treatment is on the rise due to a growing awareness of the importance of aesthetics in appearance and the potential health implications of malocclusion that can adversely affect overall well-being. To date, there has been no bibliometric research conducted on OTN that has been published. This bibliometric analysis is expected to identify research gaps, providing a foundation for further investigation in the field of orthodontics. The purpose of this study was to conduct a bibliometric analysis of scientific research pertaining to orthodontic treatment needs.

METHODS

This bibliometric study assessed the evolution of studies on orthodontic treatment needed during the last four decades from the Scopus database. Scopus database was chosen because this database contained peer review articles that had been published by Elsevier, Springer, Wiley, Nature and others.[16] All data acquired was tabulated in Microsoft Excel 2019 (Microsoft Office, USA).

This study was to conduct a bibliometric analysis of scientific research pertaining to orthodontic treatment needs using the Scopus database. VOSviewer, OpenRefine and Table were used to map and cluster the result based on research questions (RQ) as follows. RQ (1): What were the publication trends in dentistry related to orthodontic treatment needs? RQ (2): Which authors, journals, institutions and countries were the most influential? RQ (3): How has the trend in orthodontic treatment needs research evolved?.

Several applications, including VOSviewer 1.6.18 (Universiteit Leiden, Netherland), OpenRefine 3.6.2 (Creative Commons Attribution 4.0 International License, Australia), and Tableau Public 2021.4 (LLC, a Salesforce Company, USA) were utilized for bibliometric analysis. After the data had been processed with VOSviewer and several intended visualizations had been acquired, the information was analyzed further using the OpenRefine application. Tableau Public was utilized to enable more interactive and congenial data visualization. This study used 3 methodological phases (Figure 1), namely (i) criteria search and source identification, (ii) data extraction and (iii) data analysis and interpretation.

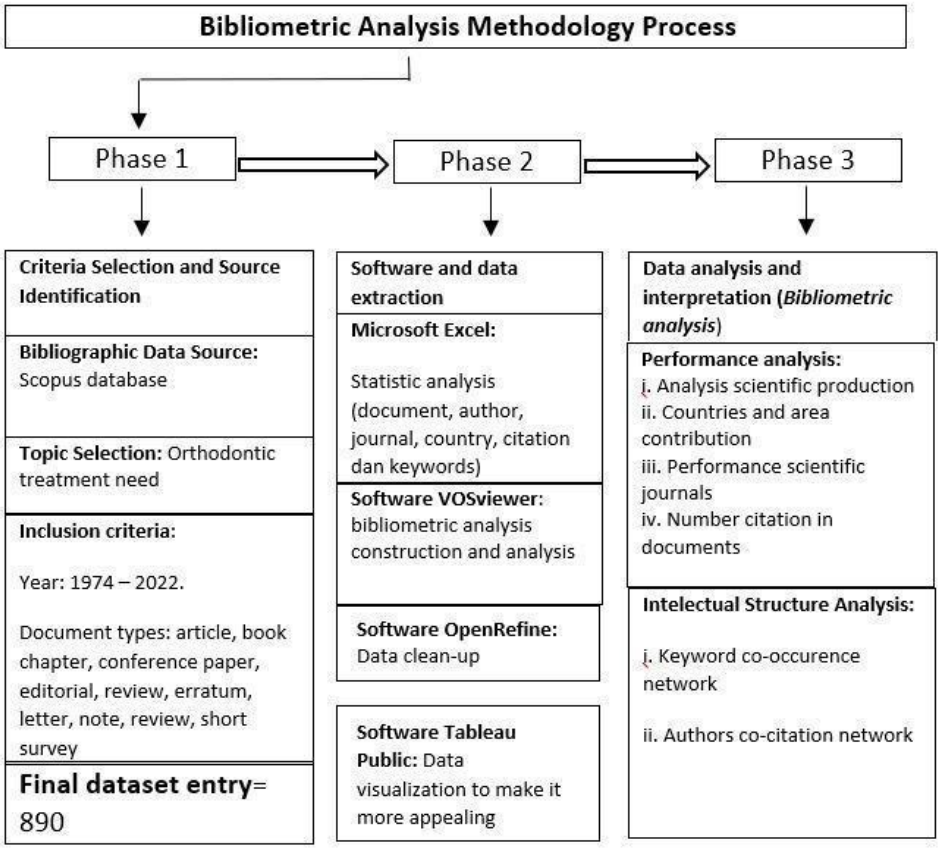


Figure 1. Flow diagram for bibliometric analysis

Criteria selection and source identification. On January 20, 2022, two researchers initiated this study by extracting data from the Scopus database using the key words "Orthodontic Treatment Need." This study was to explore the evolution of orthodontic treatment that needed research over the past four decades (1974 to 2022). In addition to collecting 890 articles, we gathered data in the form of not only articles, but also other relevant documents (proceeding, literature review, clinical study, etc).

Software and data extraction. During the second phase, two researchers reviewed data collected to ensure that the paper obtained was in accordance with the inclusion. The downloaded metadata included Authors, Affiliations, Title, Publication Years, Cited Publication, Abstract, and Author Keywords. Using the VOSviewer, the subsequent step was to obtain construction and graphics that defined intellectual structures.

Data analysis and interpretation. Three researchers analyzed and interpreted data using a combination of two bibliometric analysis methods: I Performance Analysis and (II) Science Mapping. Analysis of the production of scientific papers employed a number of bibliometric indicators, including publication of articles, contribution by the country and cited documents. The scientific structure was analyzed using a science mapping strategy, such as authors, documents, and fields.

RESULTS

Articles trend for the last four decades. The search strategy employed yielded 890 documents pertaining to the Orthodontic Treatment Need that were published during the previous four decades (1974-2022). Figure 2 depicts its upward trend in the number of articles published annually. During the first decade, from 1974

to 1984, there were only a limited number of articles published, specifically four. In the following decade, the number of articles began to rise, with as many as 45 emerging. Increasing the number of articles that were quite significant occurred in the third and fourth decades, as many as 838 articles. In 2016, a total of sixty articles were published, the highest number ever published.

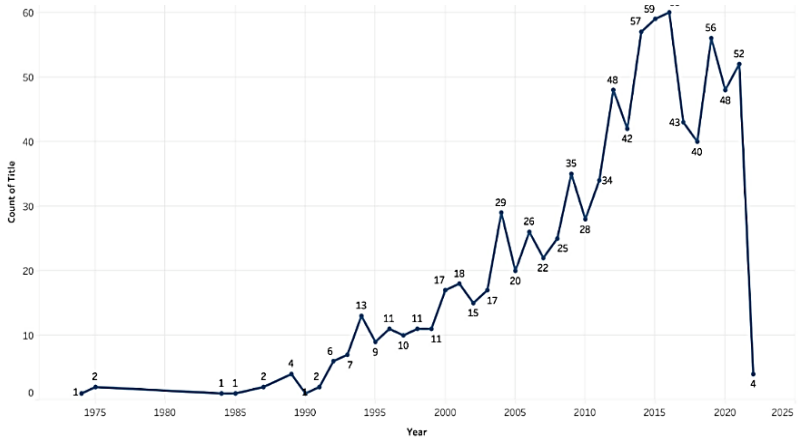


Figure 2. Trend Orthodontic Treatment Need articles published between 1974-2022

Network visualization based on author keyword. The data set's keywords were extracted to generate a co-accuracy network based on bibliographic data. To create a custom thesaurus, keywords were counted thoroughly, and to avoid duplication, assessment and revision were performed manually on all terms. In the data analysis, selected Author Keywords with the minimum number of keyword occurrences set to 5, 55 documents that meet the criteria were found. The network consisted of multiple nodes describing keywords and links describing their relationships. The distance between nodes was utilized to visually describe the network. The distance between two nodes might indicate whether their relationship was strong or weak. Similar keywords were grouped into multiple clusters.

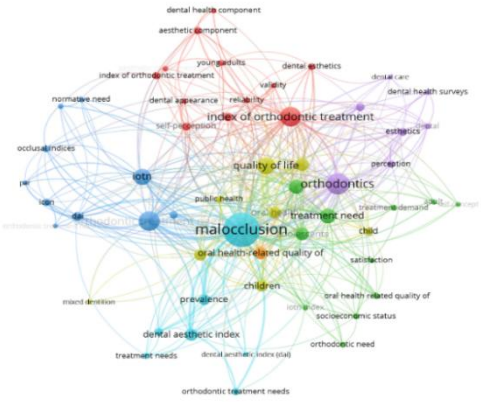
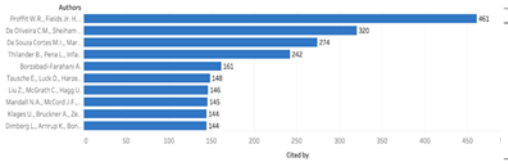


Figure 3. Network visualization based on author keyword

In VOSviewer, seven cluster keywords with 55 articles related to Orthodontic Treatment Need were Index of Orthodontic Treatment, IOTN, Orthodontic Treatment, Quality of Life, Orthodontic, Malocclusion, and Oral Health-related Quality of Life. The obtained data contained 398 links with a total link strength of 1126. (Figure 3). These keywords highlight the connection between topics studied in research on Orthodontic Treatment Need.



Document (Publication)	Citations	links
Profit W.R. (1998)	461	4
De souza Cortes M.I. (2002)	274	1
Thilander B. (2001)	242	10
de Oliveira C.M. (2004)	211	10
Tausche E. (2004)	148	6
Liu Z. (2009)	146	14
Mandall N.A. (2000)	145	5
Klages U. (2004)	144	12
Dimberg L. (2015b)	144	7
Klages U. (2006)	143	10

Figure 4. Author citation graph

Document citation. Figure 4 depicts an analysis of the pre-transit documents that were most prevalent. The analysis was conducted by examining the minimum citation count of 38 per document, and 107 documents. The prolific cited ten authors were Proffit W.R up to 461 citations, De Oliveira C M. (320 citations), De Souza Cortes (274 citations), Thilander B. (242 citations), Borzabadi (161 citations) and Tausche E. (148 citations). Some other author was cited between 144 and 148.

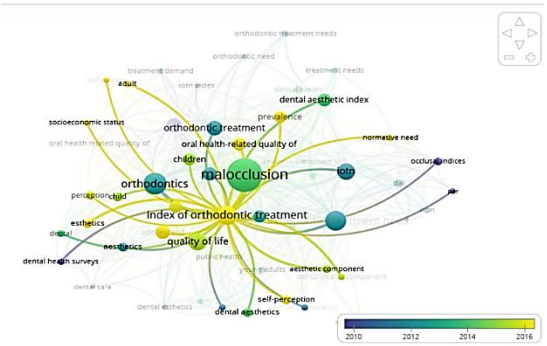


Figure 5. Research trend topic on orthodontic treatment needs.

Figure 5 showed research trends centered initially on the Orthodontic Treatment Need shifted to the malocclusion and the Index of Orthodontic Treatment. In the period 2010 to 2014, research continued to focus on malocclusion and various indexes used to determine the need for orthodontic treatment, such as IOTN, ICON, DAI, and PAR [1,18,19]. After 2014, the research trend shifted more towards the Index of Orthodontic Treatment, and this finding was consistent with a number of studies on perception, aesthetic, dental health component, Aesthetic Component, Adult, Adolescent, Self-Concept, and Oral Health Quality of Life.

Country	Documents	Citations	Total link strength
United Kingdom	133	3615	1359
Brazil	84	1537	593
United States	73	1357	827
India	59	396	317
Sweden	34	855	310
Nigeria	32	497	289
Iran	32	265	231
Italy	31	654	215
Saudi Arabia	27	288	236
China	26	452	308

Figure 6. Country citation network

Country citation. Analysis of the relationship between the state or region with the number of writings can be seen in Figure 6. Five countries with the most documents that were previously criticized namely Britain, 133 documents with 3615 cited, Brazil 84 documents with 1537 cited, the United States as many as 73 documents with 1357 cited, Sweden 34 documents with 855 cited and Dutch as many as 22 documents with Citations of 798.

When discussing the Orthodontic Treatment Need, it cannot not be separated from the names Peter H. Brook and William C. Shaw from the UK who created the IOTN. IOTN is an index that is simple and easy to use and can measure the needs

of orthodontic care objectively so that most of the research on orthodontic care needs uses a lot of IOTN as a measurement tool.[20]

In addition to Peter H. Brook and William C. Shaw there is also Cesar de Oliveira, a Senior Research Fellow, University College London whose article is also widely denied. Cesar de Oliveira together with Aubrey Sheiham published many articles on malocclusion and Orthodontic Treatment.[21-23]

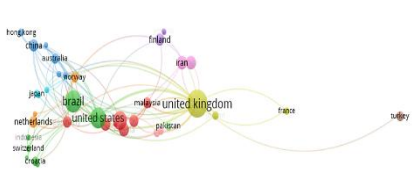


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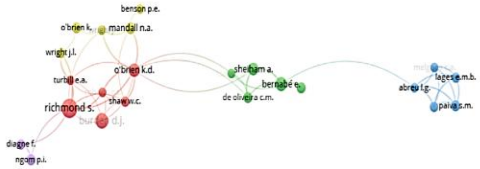
Figure 7. Country distribution based on citations

Country distribution. Figure 7 shows the distribution of countries that published articles about Orthodontic Treatment Need. There were three dominant countries that published articles about the Orthodontic Treatment Need, namely the United Kingdom, Brazil and the United States. The country that contributed the most articles was the United Kingdom, which had 133 articles, followed by Brazil with 84 articles and the United States with 73 articles. The collaboration between the United Kingdom was more with the countries of Jordan, France, Malaysia, Pakistan, United States and Brazil. When viewed from the closeness of the circle, Brazil was collaborating quite strongly with the United States, Switzerland and Indonesia. The United States collaborated with Brazil, Croatia and Pakistan.



Author	Documents	Citations	Total link strength
Richmond S.	21	524	25
Onyeaso C.O.	17	267	0
Burden D.J.	13	349	5
Borzabadi-farahani A.	12	329	6
Bernabé E.	11	338	14
o'brien K.D.	10	569	23
Bellot-arcis C.	10	169	20
Willems G.	10	166	19
Montiel-company J.M.	10	165	13
Sheiham A.	9	843	15

Figure 8. Author clustering.

Author collaboration. Figure 8 shows 5 collaborative clusters of authors related to the needs of orthodontic care. Eighty-two authors were obtained in the cluster but only 23 authors had strong collaboration. The first cluster was a collaboration between Richmond S, Burden D.J, Roberts C.T, Shaw W.C, Turbil E. A. The second cluster was with Bernabe E, De Oliveira C.M, Flores-MIR C., Sheiham A., Tsakos G. The third cluster of Abreu I.G, Abreu M.H.N.G., LAGES E.M.B., Melgaço C.A., Paiva S.M. The fourth cluster consisted of Benson P.E., Mandall N.A., O'Brien K., Wright J., Wright J.L and the fifth cluster were Diagne F., and Ngom P.I. The writer who published the most articles was Richmond S with as many as 21 articles with a total of 524 citations followed by O'Brien K who published as many as 10 articles with 569 citations.

DISCUSSION

Since 1974, there has been a significant increase in the trend of publications with the topic of orthodontic treatment need. Major increases were noted in the third and fourth decades (Figure 2). Thus, it is essential to conduct epidemiological studies in order to collect data on both the prevalence of malocclusion and the orthodontic care needs of the population, as the number of articles published annually increases concurrently with the need for orthodontic care. This estimation was crucial for the planning of an orthodontic service in terms of its manufacturing resources and costs, as well as for the monitoring of implemented dental health programs.[16]

Based on author keywords, there were four clusters obtained from the analysis (Figure 3). Malocclusion was the largest cluster, comprised of Prevalence, Dental Aesthetic Index (DAI), Treatment Need, and Orthodontic Treatment Need. The keywords perception, aesthetic, dental health survey, and dental care frequently appeared in the Orthodontics cluster. The third cluster was an index for orthodontic treatment, with the keywords of reliability, validity, dental appearance, dental health component, and aesthetic component. The fourth cluster, Orthodontic Treatment Need contained the keywords IOTN, Perceived Needs, PAR, ICON, and DAI. The keywords that appeared in the Quality of Life cluster were public health, oral health, children, mixed dentition, adolescent, and epidemiology. Cluster Orthodontic Treatment consisted of treatment needs, satisfaction, adult, socioeconomic status, and IOTN. The final cluster was Oral Health Related Quality of Life.

Based on document citation (Figure 4), WR Proffit was a prominent author with documents comprising 461 citations. William R. Proffit, DDS, MS, PhD is a professor, former head of the Department of Orthodontics, and professor emeritus at the School of Dentistry at the University of North Carolina at Chapel Hill. Proffit has a significant impact on the field of orthodontics in both the US as well as globally. Profit is also the author of the textbook "Contemporary Orthodontics," which has been published in 12 languages and serves as the main textbook for both Pre- and Post-Doctoral students in the field of orthodontics. He has also published more than 200 research articles and 20 book chapters.[24,25]

In Figure 5, the description of the research trend in the fourth decade continued to focus on the use of the IOTN. [26-29] as well as numerous articles addressing the relationship between malocclusion or orthodontic care needs and self-esteem and quality of life. Malocclusion may have a negative impact on the patient's psychological condition and quality of life, including self-esteem and self-image, in addition to its physical effects.[21,30-34]

In addition, the relationship between the IOTN and socioeconomic status was a trend in research. It was reported that economically disadvantaged populations lacked access to oral health services. Orthodontic care was not always covered by health insurance, so financially deprived individuals could not perhaps receive it.[36,37] The socioeconomic status was also investigated as one of the predictors of orthodontic treatment duration.[38]

Articles on the use of IOTN in children in the period of mixed teeth were also widely published. Also widely published were articles on the use of the IOTN in children with mixed teeth. Detecting the onset of malocclusion in children at an early age could prevent its progression. Index for Preventive and Interceptive Orthodontic Need (iPion) was a useful index. [39-42] Based on country citation and distribution (Figure 6 and 7), the United Kingdom was the highest cited publication compared to other countries. Research on orthodontics often originated from the United Kingdom, while the inventor of IOTN was also from the same country.

This bibliometric analysis also exhibited a noteworthy constraint. Our examination was exclusively confined to publicly available data sourced from the Scopus database, presumed to have already undergone rigorous peer review. To enhance the comprehensiveness of future inquiries, it is advisable to incorporate data from alternative databases.

Regardless of the vast amount of literature found on this topic, there were still an excellent number of research topics that could be explored in relation to IOTN especially in the Southeast Asian region.

CONCLUSION

In general, the number of articles addressing the need for orthodontic treatment has increased, particularly in the third and fourth decades. In the fourth decade, there were more articles about the IOTN that contained keywords directly related

to the index, as well as self-esteem, quality of life, and its socio-demographic and socio-economic status correlation. Regardless of the vast amount of literature found on this topic, there were still an excellent number of research topics that could be explored in relation to OTN especially in the Southeast Asian region.

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