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25 years of Clinical Implant Dentistry and Related Research (CIDRR): A modern bibliometric and Altmetrics network analysis

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Abstract

Introduction: Since its establishment in 1999, the journal of *Clinical Implant Dentistry and Related Research* (CIDRR) has consistently disseminated notable clinical and translational research within the domain of oral implantology. As the journal approaches its milestone 25th anniversary, this study endeavors to systematically delineate the publication trends, level of evidence, and bibliometric indices characterizing the initial quarter-century of CIDRR's scholarly activity. Notably, the investigation adopts a contemporary methodology by incorporating Altmetric analysis, thereby enriching the evaluation with an assessment of the broader societal and online impact of the published research.

Methods: A comprehensive search was performed in SCOPUS and PubMed to access the bibliographic data of all articles published in the journal from 1999 to 2024. Additionally, Altmetric database was used to obtain social media attention scores (AAS). Journal's overall performance via impact factor and quartile range was assessed. Most cited papers were identified and the most prolific authors, institutions and countries and the collaboration networks among those were assessed. The level of evidence of all articles was determined based on Oxford level of evidence scale. All articles were categorized based on their major topic in the field of implant dentistry.

Results: Throughout its first 25 years of activity, CIDRR published 1912 articles with an annual growth rate of 2.67% and consistently being ranked at Q1 quartile in

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"Dentistry (miscellaneous)" and "Oral Surgery" journal categories. When clinical studies are considered, level I and II evidence constituted 22.82% and 11.82% of all articles, respectively. Sweden, the USA, and Italy as well as Göteborgs Universitet, Sahlgrenska Akademin. and Malmö Högskola were the most prolific countries and institutions respectively. "Implant system/design/characteristics," "Bone Augmentation," and "Implant Prosthesis" were the top most investigated topics.

Conclusions: The examination of the journal's initial 25 years highlighted that CIDRR has surpassed similar dental research journals in publishing a greater number of high-level evidence articles. It also showcased diverse country- and author-collaboration networks. However, the journal's social media presence is still evolving. This article, presenting a comprehensive overview of the journal's scientometric and bibliographic activities, serves as a valuable reference for researchers, clinicians, and stakeholders, offering insights into both traditional and contemporary perspectives.

KEYWORDS

Altmetrics, bibliometrics, dental implants, dental journals, implant dentistry, level of evidence, scientometric

Summary Box

What is known

- Oral implantology has advanced with technological strides, emphasizing the importance of universal platforms such as Clinical Implant Dentistry and Related Research (CIDRR) journal for sharing crucial scientific evidence. In its 25th anniversary year (2024), our study delves into CIDRR's publication history, examining bibliometric indices, authorship networks, and evidence levels.

What this study adds

- This study provides valuable insights into CIDRR, highlighting its impactful articles, key authors, and major research themes. The assessment of the level of evidence underscored the journal's commitment to high-quality research, with a notable 22.82% of articles classified as level I evidence. Additionally, the Altmetric analysis provides a glimpse into CIDRR's online visibility, revealing top-ranked articles based on Altmetric Attention Scores and their engagement on social media platforms.

1 | INTRODUCTION

Oral implantology stands as a dynamic frontier within dentistry, propelled forward by continual advancements in clinical practice, digital technologies, and innovation. The burgeoning body of scientific evidence underscores the need for a unified platform and community to disseminate research findings effectively to clinicians and researchers. A pivotal shift from opinion-based to evidence-based practice in implantology is evident, driven by the dissemination of high-quality research publications to clinicians, stakeholders, and researchers.[1,2] Hence, the role of media in providing research articles to stakeholders is paramount in this field, with scientific journals serving as crucial conduits for knowledge dissemination.[2] Among the prominent journals in dentistry, oral surgery, and more specifically oral implantology, stands *Clinical Implant Dentistry and Related Research* (CIDRR). Established in 1999 by Wiley, CIDRR is recognized as a premier resource for clinicians, researchers, educators, and students engaged in the study or application of osseointegrated implants in oral and maxillofacial contexts. The journal is dedicated to advancing scientific and technical developments pertinent to dental implants and related subjects. CIDRR welcomes original research and reviews encompassing all facets of osseointegrated implants, bone biology, bone grafts, and bone substitutes. Its comprehensive scope addresses both clinical and basic science aspects, catering to the diverse interests and needs of the oral implantology community.

In commemoration of the 25th anniversary of the CIDRR journal in 2024, this study endeavors to furnish a comprehensive analysis of the publication history within this journal, specifically focusing on

bibliometric indices, authorship networks, and level of evidence mapping. Beyond conventional bibliometric parameters and chronological publication trends, a contemporary Altmetric analysis was also conducted to discern the impact of articles disseminated in this journal across various social media platforms. This multifaceted approach aims to provide a nuanced understanding of the journal's scholarly influence and its reach within both academic and broader online communities.

2 | MATERIALS AND METHODS

2.1 | Study design and protocol

This study was conceptualized within a cross-sectional, bibliometric, and Altmetric analysis with full adherence to the latest guidelines and protocols for this methodology.[3–6] To ensure the quality of study and reported material and outcomes, Standards for reporting qualitative research (SRQR) guidelines and checklist were considered[7] (Appendix S1). The study was deemed exempt from institutional review board approval and ethical review due to the exclusive use of publicly available data and information, in accordance with the ethical guidelines and regulations.

2.2 | Data sources and search strategy

Initially, the online archive of the CIDRR was utilized to identify all articles published in this journal through February 2024 (www.wiley.com/journal/17088208; last accessed February 1, 2024). Next, the bibliographic, Altmetric and citation data were gathered for all research articles published within the whole timeframe of the journal from its inception to date (1999–2024). PubMed (Medline) (last accessed February 9, 2024) was used to access bibliographic information (article titles, abstracts, author and institutional information, publication date etc.). In addition, the Scopus portal was used (last accessed February 9, 2024) to obtain the citation information. Lastly, Altmetric portal (www.altmetrics.com; last accessed February 9, 2024) was used to include the Altmetric data for the articles published in CIDRR. The search strategy for each database is provided in Appendix B. Data extraction was performed by two authors (H.S and P.N) independently.

2.3 | Overall journal trend analysis (1999–2024) and bibliometric data collection

General trends and main characteristics of the journal was analyzed via obtaining the total number of publications in each year, cumulative number of documents, number of issues per year, journals impact factor (JIF), cite score, H-index, quartile range and the total number of cited, and uncited articles in each year. The impact factor of CIDRR as well as other citation data were obtained from the latest update (2022) of the journal citation reports (JCR) (Web of Science, Clarivate Analytics) released online at the end of June 2023. From the same data portal, the journal ranking based on JIF was obtained within the categories of "Dentistry: Miscellaneous" and "Dentistry: Oral surgery" journal categories.

The variables were defined as follows:

- **Journal impact factor (JIF)**: The JIF of the journal in a particular year was calculated using the following formula:

$$\mathbf{JIF}_{\mathbf{Year}} = \frac{C_{Year-1} + C_{Year-2}}{CD_{Year-1} + CD_{Year-2}},$$

where: Year = The particular year. JIF_{year} = The impact factor of a journal in a specific JCR year, such as 2022. C_{year-2} = Total citations in JCR year to items published in "year−2" (e.g. 2022−2 = 2020). C_{year-1} = Total citations in JCR year to items published in "year−1" (e.g., 2022−1 = 2021). CD_{year-2} = Number of citable documents in "year−2" published in the journal. CD_{year-1} = Number of citable documents in "year−1" published in the journal.

- **Journal H-index**: A journal's H-index is determined by the number of articles in that journal that have received at least H citations each.
- **Annual growth rate** $= \left(\left[\frac{\text{Number of documents in the last year}}{\text{Number of documents in the first year}} \right]^{\left[\frac{1}{\text{Last year} - \text{First year}} \right]} - 1 \right) \times 100$

2.4 | Top cited papers

The top 100 most cited papers along with their bibliometric data were collected. Scopus (www.scopus.com; last accessed February 15, 2024) citation index was used as the reference for assessing the top cited documents. The total citation count (TCC), authorship details and date of publication were gathered to display the most impactful articles of the past 25 years of publication in CIDRR.

2.5 | Authorship and author collaboration networks

An authorship network analysis was performed on all researchers who had published at least one paper in CIDRR between 1999 and 2024. The total number of publications as well as the authors' TCC, H-index, M-index and G-index were collected. These variables were defined as follows:

- **H-index**: an H-index of "X" corresponds to the number of publications with at least "X" citations within the included papers.
- **G-index**: G-index was introduced in 2006 as the largest number of an author's top articles that have received together at least G number of citations.[8]

- **M-index**: The M-index is defined as $\frac{H}{n}$, where H is the H-index and n is the number of years since the first published paper of the scientist.

In addition, co-authorship network analysis was performed to map the author collaborations within the published articles in the journal. This was performed initially on all authors who participated in the journal documents with at least 5 published articles and secondarily, limited to the authors with at least 10 published papers in the journal. In addition to this, the fractionalized authorship score was also calculated based on the following formula:

- **Fractionalized Frequency (AUj)**$= \sum_{h \in AUj} \frac{1}{Number\ of\ co-authors\ (h)}$,

here: ***AUj*** denotes a set of articles co-authored by an author *j*. *h* represents the documents included in ***AUj***.

The formula calculates the fractional frequency by summing up the reciprocal of the number of co-authors for each document in the author's set. This way, it gives a measure of an author's contribution, accounting for the collaborative nature of the publications. As the number of co-authors increases, the fraction for each co-author decreases, resulting in a lower fractionalized authorship for each individual. This reflects the idea that when there are more co-authors, each author's contribution is proportionally smaller.

2.6 | Global and institutions collaboration networks

The global collaboration mapping of the countries of authors participated in CIDRR journal publications was performed by visualization of the network corresponding to the number of documents published by collaboration between at least two countries. This was performed at general level (including all countries of all authors of all papers) and at the level of top 10 collaborations (top 10 countries with more than 10 collaborations). In addition, an identical analysis was performed on the institutions of the participating authors in the CIDRR publications within the 25-year timeframe.

2.7 | Topic and keywords trends

All author keywords were imported and analyzed. This was performed mainly to generate the keywords co-occurrence network visualization, most repeated keywords, and keyword clusters (the highly co-occurred group of keywords) within the CIDRR journal articles. The threshold of keyword inclusion was set at minimum of 10 times of occurrence among all papers. Moreover, the minimum number of co-occurrences to visualize the link between the keywords was set at 3.

When it comes to the topic analysis, all included articles were assessed by two independent examiners (P.N, H.S), who were blinded to the authorship information of the articles, and categorized based on their main topic in the field of oral implantology. Following initial assessment, 15 topics were defined, and all articles were labeled based on this classification: "Anatomy," "Complex and/or fully edentulous rehabilitations," "Complications," "Bone augmentation," "Immediate/early placement," "Immediate/early loading," "Implant system/design/characteristics," "Implant Prosthesis," "Peri-implant diseases and conditions," "Peri-implant soft tissue," "Sinus augmentation," "short implants," "Surgical guides," "Zygomatic Implants," and "Miscellaneous." The "Miscellaneous" category included any topic with less than 20 articles published on (orthodontic implants, implant education, biologics, and so forth). The complete definition of each of the generated categories is provided in Appendix C.

2.8 | Level of evidence analysis

All included research documents were screened by one examiner (P.N) who was blinded to the author/institution/country information of the articles and was calibrated by evaluating 20 papers and reaching an excellent (>85%)[9] intra-rater agreement level. By screening at title/abstract level or full-text level (where needed), the level of evidence (LOE) of research published in CIDRR in the first 25 years of journal history was mapped. For this purpose, the Oxford 2011 level of evidence rating scale[10] was used. Fundamentally, this consists of five levels (I-V) of evidence based on the study design of the studies. We also added a level 6 of evidence (VI) as a modification to this scale, referring to animal, in-vitro, ex-vivo, and pre-clinical studies. A full description of this scale is provided in Appendix D. As a sub-analysis, we combined LOE and topic analysis to explore the major topics that yield the highest number of level I evidence/quality research in the field on implantology published in CIDRR.

2.9 | Altmetric analysis

In the Altmetric database (Altmetric, London, United Kingdom) (www.altmetric.com; last accessed on February 16, 2024), the advanced search tab was used to sort the research papers based on "journal or collection" option corresponding to CIDRR. All detected articles and their respective Altmetric data were exported as an electronic spreadsheet. This included Altmetric Attention Score (AAS) which is defined as follows:

- **AAS**: is a score calculated based on an algorithm using the weighted number of all the attention a research output receives from online and social media platforms such as LinkedIn, Facebook, X (formerly called Twitter), YouTube, Pinterest, and so forth.[11] The AAS is visualized as an Altmetric donut (Figure 9A) that contains multiple colors, which represents an online source (medium blue for LinkedIn, light blue for X (formerly called Twitter), red for news, yellow for blogs, etc.).

2.10 | Funding analysis

The data pertaining to funding status of the included papers along with the name of the funding party were extracted. This was used to determine the most impactful funding support contributing to the published articles in CIDRR. The funding status of the papers were reported either as binary outcome (Yes/No) or with a more complete format (with the name of the funding party). To summarize the funding support, we set a threshold of at least 10 articles funded by the agencies to be included in the article.

2.11 | Statistical analysis

The statistical analysis was performed by an author (H.S) with experience in Bibliometric and scientometric analyses. Descriptive statistics were expressed as number and percentage (%). Bibliometric data analysis was performed via the "Bibliometrix 3.1.4" package for Rstudio (RStudio Team, Boston, MA, USA). The Bibliometrix package allows for quantitative calculations of the respective items included in the analyzed articles. The visualization of the bibliographic metrics was performed in VOSviewer (version 1.6.17, Leiden University Center for Science and Technology Studies, Leiden, The Netherlands).

3 | RESULTS

3.1 | Overall journal characteristics

The journal's first quarter century history indicated 1912 published documents (1999:2024) (Figure 1). This showed a mean annual growth rate of 2.67% in the number of published articles. The average age of documents was 9.37 years. In total, 46 853 references were cited within the published articles during the mentioned timespan. Table 1 summarizes the general characteristics of the history of the journal within the first 25 years of active publication.

3.2 | Journal's overall performance and impact factor

The journal's initial impact factor (2 years IF) in 2000 was 0.933, which increased to 3.068 in 2005. Although it briefly dipped below 3, it steadily rose to 3.635 in 2015 and maintained a level above 3 until 2022, reaching 3.532. In terms of quartile ranking within the

TABLE 1 General characteristics.

Description	Results
Timespan	1999:2024
Documents (*N*)	1912
Annual growth rate %	2.67
Document average age	9.37
Average citations per document	31.73
References	46 853
Authors	5088
Authors of single-authored docs	33
Single-authored docs	46
Co-authors per Doc	4.85
International co-authorships %	32.43
Total citation count	60 667
H-Index	101
G-Index	144
M-Index	3.885
Issues/year	1999: 2 2000–2011: 4 2012–Present: 6

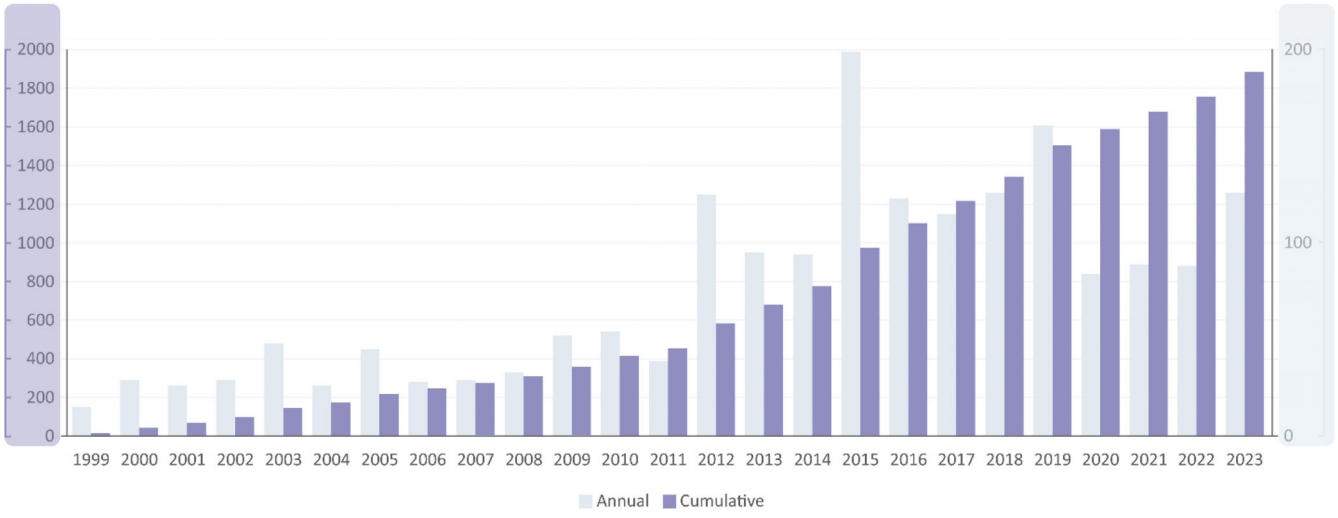


FIGURE 1 Overall publication trends and journal performance. The total number of annual and cumulative published documents 1999–2023.

"Dentistry (miscellaneous)" category, the journal started in Q2 in 2000 and 2001, transitioning to Q1 from 2002 onwards, where it has consistently remained. Additionally, in the "Oral Surgery" category, despite being in Q3 in 2000 and 2001 and Q2 in 2002, the journal has consistently achieved Q1 status thereafter. The summary of findings with regards to journal's quartile, impact factor and ranking is presented in Figure 2A–C.

Moreover, the journal citation analysis revealed that the articles published in this journal have received a total of 60 667 citations. This also indicated an H-, G-, and M-index of 101, 144, and 3.885, respectively. On average, each document has received 31.73 citations.

3.3 | Most impactful articles

Based on the total citation counts for each article, the top 100 most cited papers were identified. Table 2 depicts the top 10 papers, and the full list of these documents is provided in Appendix E. Briefly, "'*All-on-four' immediate-function concept with Brånemark system® implants for completely edentulous mandibles: A retrospective clinical study*" by Maló P et al. 2003,[12] "*10-Year Survival and Success Rates of 511 Titanium Implants with a Sandblasted and Acid-Etched Surface: A Retrospective Study in 303 Partially Edentulous Patients*" by Buser D et al. 2012[13] and "*All-on-4 immediate-function concept with Brånemark System® implants for completely edentulous maxillae: A 1-year retrospective clinical study*" by Maló P. et al. 2005[14] were the top 3 most impactful papers by receiving 532, 453, and 386 number of citations.

3.4 | Author collaborations and clusters

In total 5088 researchers participated in the articles published in CIDRR, which resulted in an average of 4.85 co-authors per document. 32.43% of the articles published were conducted with international collaborations (authors affiliated with institutions from more than one country). On the other hand, 46 single-authored documents were also noted in the 25-year timespan (Table 1).

When it comes to the author collaboration networks, 191 authors were detected with at least 5 publications which formed 120 clusters (Figure 3A). Moreover, when the minimum number of published

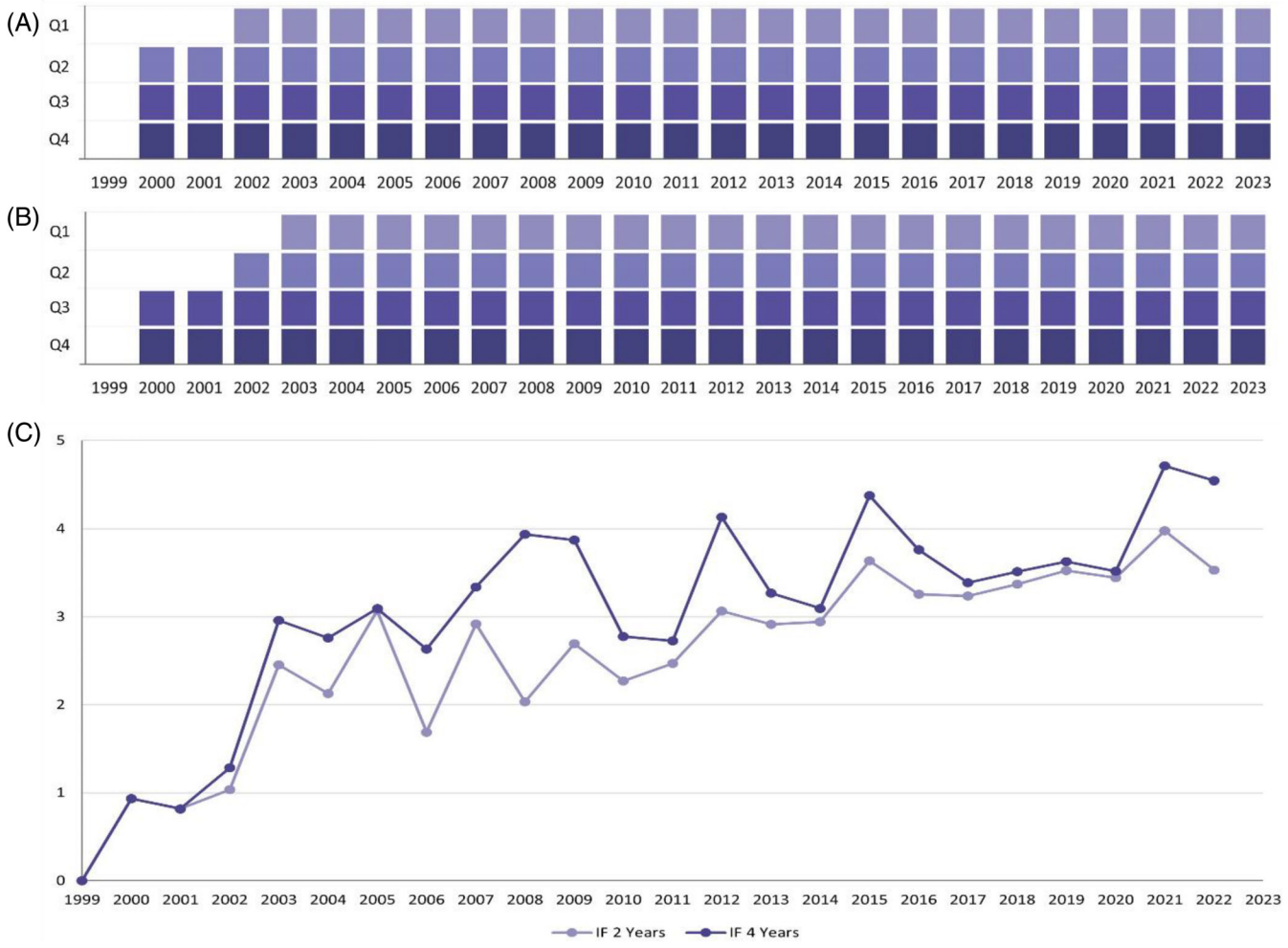


FIGURE 2 (A) Journal's quartile rank in "Dentistry" category and (B) "Oral Surgery" category. (C) Journal's 2- and 4-year impact factor throughout the defined time period.

TABLE 2 Top 10 most impactful (most-cited) papers published in CIDRR 1999:2024 (for top 100 list see Appendix E).

Title	Authors	Year	TCC
"All-on-four" immediate-function concept with Brånemark system® implants for completely edentulous mandibles: A retrospective clinical study[12]	Maló P et al.	2003	532
10-Year Survival and Success Rates of 511 Titanium Implants with a Sandblasted and Acid-Etched Surface: A Retrospective Study in 303 Partially Edentulous Patients[13]	Buser D et al.	2012	453
All-on-4 immediate-function concept with Brånemark System® implants for completely edentulous maxillae: A 1-year retrospective clinical study[14]	Maló P. et al.	2005	386
Brånemark Novum: a new treatment concept for rehabilitation of the edentulous mandible. Preliminary results from a prospective clinical follow-up study.[27]	Brånemark P.I et al.	1999	350
Ramus or Chin Grafts for Maxillary Sinus Inlay and Local Onlay Augmentation: Comparison of Donor Site Morbidity and Complications[28]	Clavero J. et al.	2003	328
A computed tomographic scan-derived customized surgical template and fixed prosthesis for flapless surgery and immediate loading of implants in fully edentulous maxillae: A prospective multicenter study[29]	Van Steenberghe D et al.	2005	325
Bone reformation with sinus membrane elevation: A new surgical technique for maxillary sinus floor augmentation[30]	Lundgren S et al.	2004	322
Foreign Body Reaction to Biomaterials: On Mechanisms for Buildup and Breakdown of Osseointegration[31]	Trindade R. et al.	2016	300
Measurements comparing the initial stability of five designs of dental implants: A human cadaver study[32]	O'Sullivan D et al.	2000	299
Bone tissue responses to surface-modified zirconia implants: A histomorphometric and removal torque study in the rabbit[33]	Sennerby L et al.	2005	289

Abbreviation: TCC, Total Citation Count.

documents was set at 10, the clusters decreased to 65 with 73 authors (Figure 3B). Among these authors, Sennerby L, De Bruyn H, Jemt T, Wennerberg A, and Piattelli A contributed to the highest number of documents with 79, 57, 54, 43, and 38 papers. However, when considering the fractionalized authorship score, the ranking order was changed to: Jemt T (24.20), Sennerby L (21.06), De Bruyn H (13.70), Wennerberg A (9.82), and Albrektsson T (8.72). Figure 4 depicts the most contributed authors to the CIDRR publications based on the number of documents and fractionalized authorship score.

3.5 | Country and institution collaboration and clusters

In total authors from 69 countries participated in the research published in CIDRR. Based on the number of published documents, the most prolific countries and institutions were identified. With regards to institutions, Göteborgs Universitet ($n = 249$), Sahlgrenska Akademin ($n = 173$), Malmö Högskola ($n = 80$), University of Bern ($n = 78$), and Branemark Clinic ($n = 74$) ranked the top 5. When it comes to the country analysis, the top five most prolific were: Sweden ($n = 382$), United States ($n = 332$), Italy ($n = 256$), China ($n = 157$), and Germany ($n = 154$). Moreover, the results of international collaborations revealed that USA:SWITZERLAND, $n = 25$, ITALY:USA, $n = 18$, USA:SPAIN, $n = 18$, CHINA:USA, $n = 17$, and SWEDEN:BELGIUM, $n = 16$ performed the highest number of collaborations based on the number of mutual publications. The complete results of these three analyses are presented in Table 3. Also, Figure 5A depicts the proportional bubble plot of most prolific countries categorized by their continent of origin. Figure 5B illustrates the countries, continents, and the number of most prolific institutions within each country.

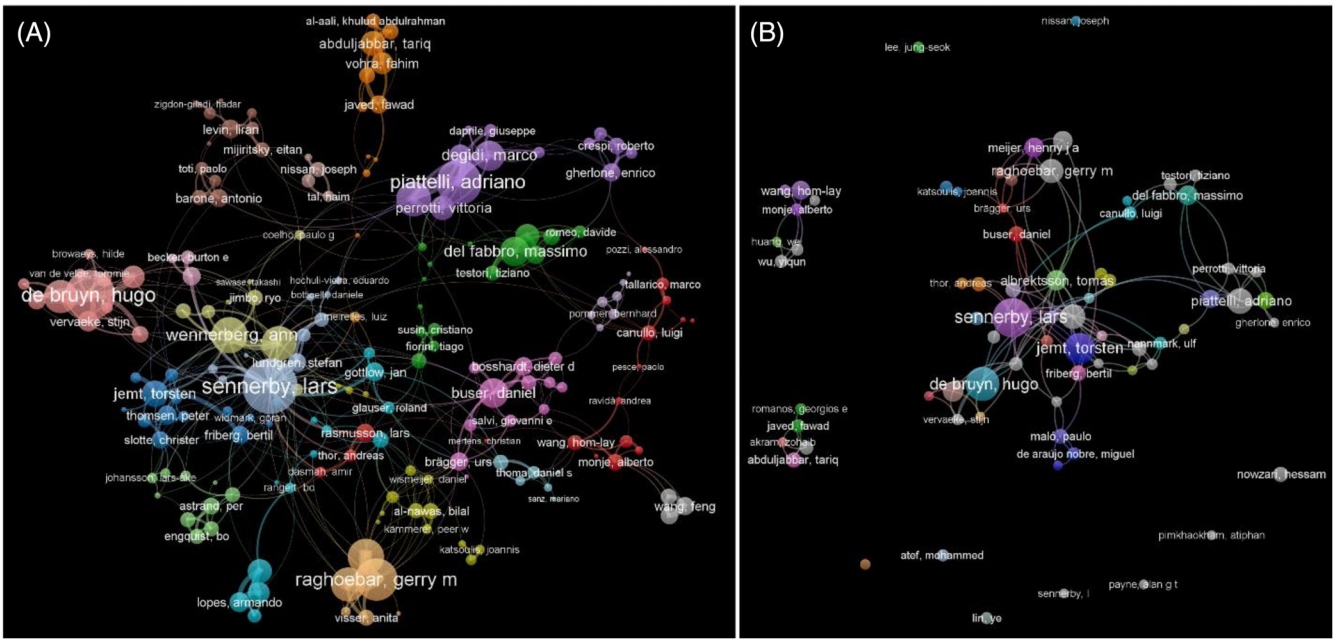


FIGURE 3 Co-authorship network visualization. (A) When authors with at least 5 publications were included. (B) When a minimum of 10 articles was set as the threshold.

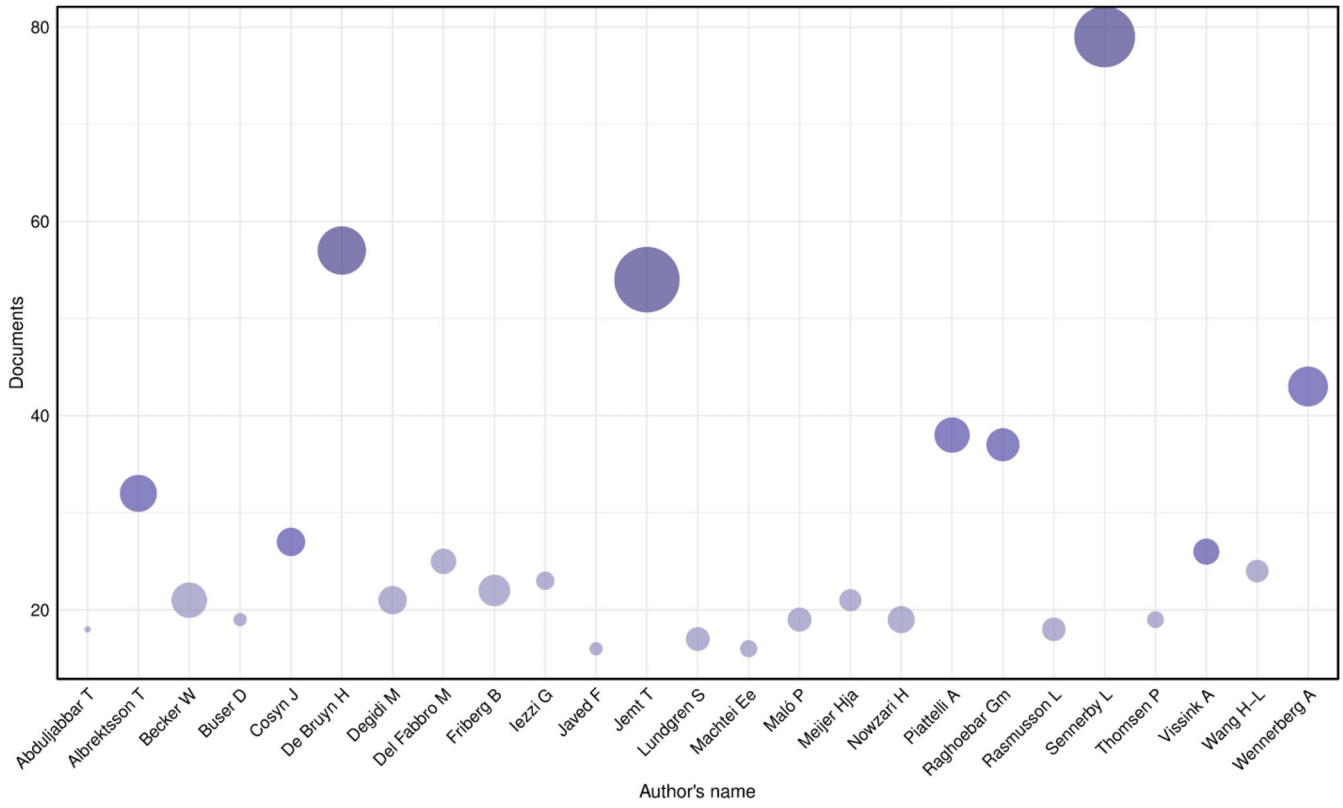


FIGURE 4 Author performance plot for the top 25 prolific authors between 1999 and 2024 published in CIDRR. The number of documents published by each author is depicted in Y-axis, in addition, the size of each node (circle) corresponds to the fractional score of each author. Note that based on number of documents *Sennerby L* is the most prolific author and when fractional score considered, this was replaced by *Jemt T*.

TABLE 3 Ranking of institutions, countries, and country-collaboration based on the number of published documents in CIDRR.

Institution (documents *N*)	Country (documents *N*)	Collaborations (documents *N*)
Göteborgs Universitet (249)	Sweden (382)	USA:SWITZERLAND (25)
Sahlgrenska Akademin (173)	United States (332)	ITALY:USA (18)
Malmö Högskola (80)	Italy (256)	USA:SPAIN (18)
University of Bern (78)	China (157)	CHINA:USA (17)
Branemark Clinic (74)	Germany (154)	SWEDEN:BELGIUM (16)
Universiteit Gent (61)	Switzerland (149)	BELGIUM:NETHERLANDS (15)
Università degli Studi di Milano (55)	Brazil (143)	USA:BRAZIL (14)
Universidade de São Paulo (50)	Belgium (109)	ITALY:SWITZERLAND (13)
University of Michigan (46)	Spain (108)	ITALY:SPAIN (10)
University of G. d'Annunzio Chieti and Pescara (44)	Netherlands (77)	SAUDI ARABIA:PAKISTAN (10)
Malmo University Faculty of Odontology (44)	Japan (75)	USA:GERMANY (10)
Universität Zürich (40)	Israel (62)	BRAZIL:SPAIN (9)
Universitair Medisch Centrum Groningen (39)	South Korea (59)	BRAZIL:SWITZERLAND (9)
Universidade Estadual Paulista Júlio de Mesquita Filho (37)	Turkey (57)	GERMANY:SWITZERLAND (9)
Rijksuniversiteit Groningen (37)	Egypt (52)	ITALY:BRAZIL (9)

3.6 | Level of evidence

With regard to LOE of articles published in CIDRR two analyses were performed. Initially, when the modified scale (considering animal, in vitro and pre-clinical studies as level VI evidence) was used, levels I-VI yielded 17.46%, 9.04%, 23.13%, 20.08%, 6.78%, 23.50% of all documents. Moreover, when the conventional 5-level scale was used, the proportion of level I category increased to 22.82%. Similarly, other groups experienced an increase in their proportion of total documents (11.82%, 30.24%, 26.25%, and 8.87% for levels II-V respectively). Figure 6 depicts the LOE pyramids for both scales used, and Appendix F summarizes the aforementioned results.

3.7 | Major topics and keywords analysis

The included author keywords formed 6 clusters (dental implants, peri-implantitis, immediate loading, bone augmentation, osseointegration and bone density) with 106 items and 1395 links corresponding to the co-occurrence of these keywords in the manuscripts (Figure 7).

The results of topic analysis revealed that articles concerning "Implant system/design/characteristics" ($n = 282$, 14.83%), "Bone Augmentation" ($n = 281$, 14.77%), and "Prosthodontics" ($n = 195$, 10.25%) were the top three mostly published topics in the 25-year time period. On the other hand, the topics of "Anatomy" ($n = 38$), "Peri-implant Soft tissue" ($n = 35$), and "Zygomatic implants" ($n = 25$) displayed the smallest proportion of the documents published with approximately 2% each. The "miscellaneous" topic category including all minor topics other than the ones mentioned above yielded 159 documents in total (8.36%). The results of sub-analysis on proportion of the major topics within the highest level of evidence category (LOE = 1) published in this journal indicated that the category of "Bone Augmentation" constituted 22.59% of the level I evidence ($n = 75$) followed by "Implant Prosthesis" ($n = 36$, 10.84%), and "Implant system/design/characteristics" ($n = 34$, 10.24%). In contrast, the topics of "Anatomy" and "Zygomatic Implants" constituted less than 1% of level I evidence with only 1 document each. The complete summary of this sub-analysis is provided in Figure 8 and Appendix G.

3.8 | Altmetrics analysis

Articles published in CIDRR have received a total mention of 921 based on the Altmetrics data. The top 3 ranked articles based on their AAS were: *"A Dental Prosthesis from the Early Modern Age in Tuscany (Italy)"* (AAS = 143), *"Dental implant failure rates in patients with self-reported allergy to penicillin"* (AAS = 102), and *"Antihypertensive Medications and the Survival Rate of Osseointegrated Dental Implants: A Cohort Study"* (AAS = 75). The full ranking of top 30 papers is available in Table 4. The majority of the articles displayed an AAS ranging between 1 and 30 where only 5 documents received more than 40 AAS (only two articles achieved AAS > 100) (Figure 9B). Analyzing the worldwide region where the online mentions were performed, USA (92 mentions), Spain (82 mentions), Sweden (46 mentions), UK (39 mentions), and Germany (15 mentions). Figure 9C,D depicts the country and continent-specific AAS.

Moreover, when the Altmetric history of the journal was considered, the highest attention score (604 mentions) was obtained through social media platforms. This was followed by policy and patents (162 mentions), news and blogs (95 mentions), other sources (55 mentions), and academic sources (5 mentions) (Figure 9E).

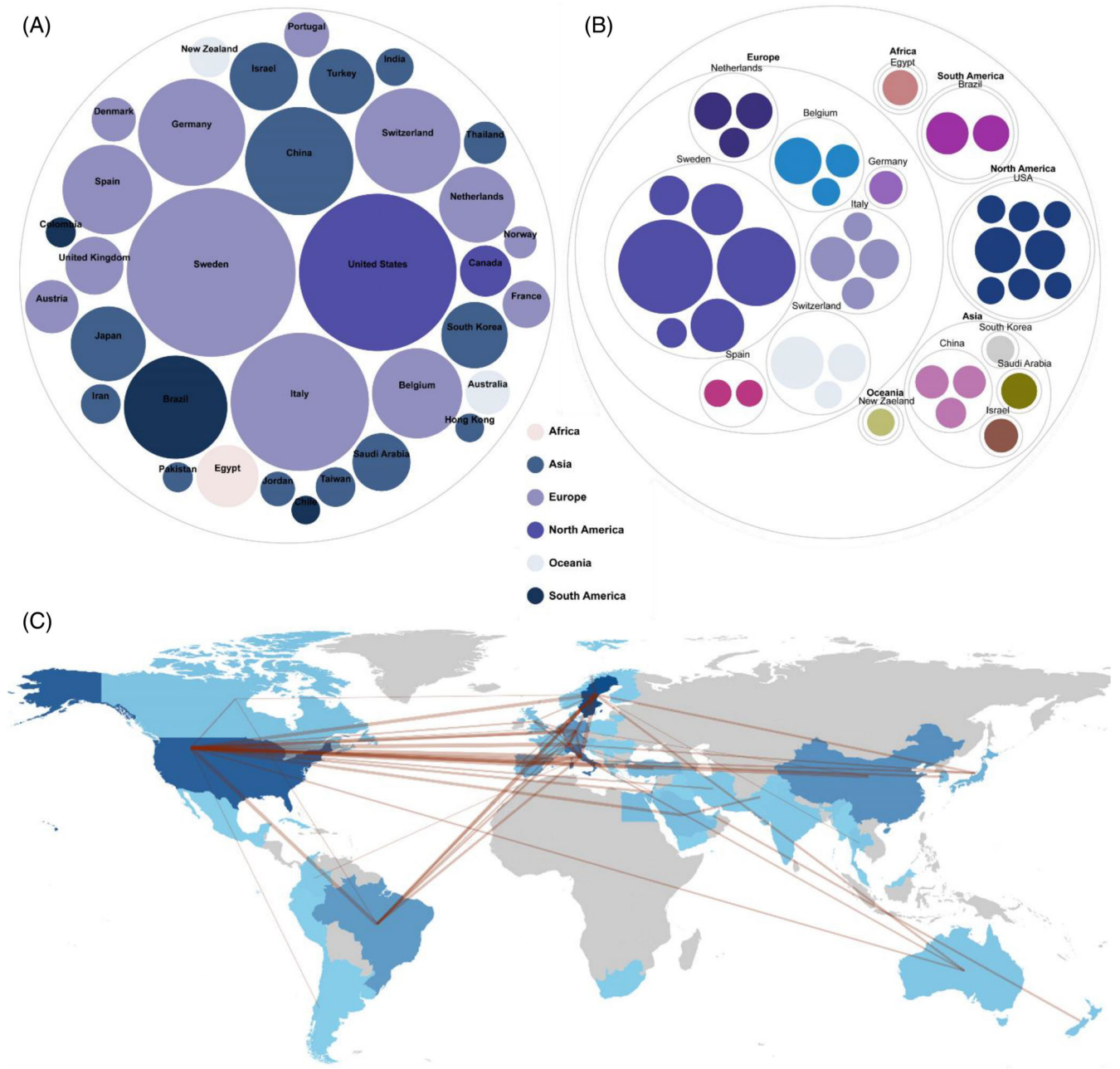


FIGURE 5 Country, continent, and institution bubble plots. (A) Top 30 most prolific countries marked by their continent of origin. Note that the size of the bubble corresponds to the number of published documents. (B) Institutes participated in CIDRR publications from each country and continent. Note that each bubble corresponds to one of the institutions from each country and the size of the bubble denotes the number of documents. (C) Country collaboration map. The countries that participated in the published articles in CIDRR are marked in different shades of blue, with darker shades indicating a higher number of published documents for each country. The red indicate collanoration between two countries, with the thickness corresponding to the number of joint publications between the connected countries.

3.9 | Funding

The analysis of funding support within the articles featured in CIDRR indicated the involvement of 12 funding agencies, each contributing support to a minimum of 10 articles. Notably, the National Natural Science Foundation of China emerged as the predominant supporter, backing 60 documented articles. This was followed by Deanship of Scientific Research, King Saud University and Japan Society for the Promotion of Science with 25 and 21 articles. The complete list of funding support is available in Figure 10.

4 | DISCUSSION

With the exponential growth in prevalence of dental implants, dental journals focusing on clinical research on oral implantology play a

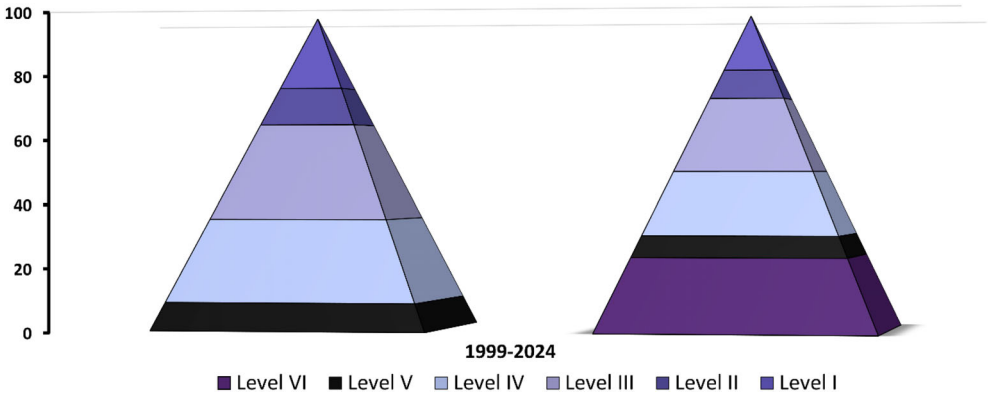


FIGURE 6 Level of evidence pyramids. (A) (left) The conventional scale without inclusion of pre-clinical, animal, or in-vitro studies. (B) (right) Modified scale with the inclusion of the mentioned study designs into level VI of evidence. Note the increase in proportion of level I evidence when the level VI articles are excluded.

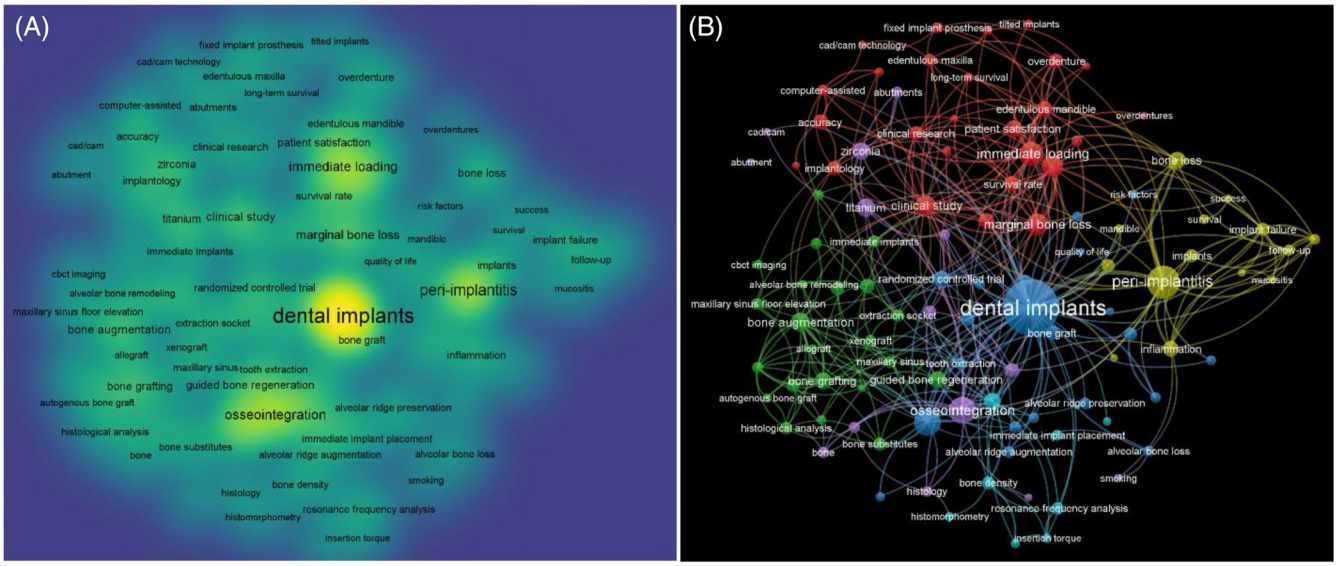


FIGURE 7 Keyword networks and co-occurrence visualization. (A) this network shows the six formed clusters of keywords (blue, purple, red, yellow, green, and Turquoise). The thickness of the lines corresponds to the number of co-occurrence between two keywords. The size of the node (circles) corresponds to the number of occurrences of a keyword within the included articles. (B) the density plot of the keyword networks the intensity of the yellow color corresponds to the higher number of occurrence of each keyword (e.g., "dental implants" showed the highest occurrence).

pivotal role in the education and development of science in this field.[4,15–17] CIDRR is one of the highest impact journals in the field of clinical implant dentistry.[18,19] This study focused on providing an overview of the first 25 years of activity of this journal, implementing various analytical approaches and with the use of different indices. Herein, we aimed to furnish a valuable reference for researchers, clinicians, and policy makers by assessing the scope and focus of the journal, as well as its scholarly performance, this study contributes to a comprehensive understanding of CIDRR's evolution and impact within the dynamic field of oral implantology. The insights gleaned herein are intended to inform and guide stakeholders, facilitating informed decision-making and fostering a nuanced appreciation for the journal's multifaceted contributions over its quarter-century of activity.

Overall, the main results of this study indicated a significant growth in the annual number of published papers in 2012 compared to the first 13 years (1999–2011), this was mainly due to the increase in number of issues per year from 4 to 6. The year 2015 had the highest number of published documents ($n = 199$). A slight decrease occurred in this parameter after the COVID outbreak in 2019 where the number of annually published articles were decreased to its half number (from 161 in 2019 to 84 in 2020), however, it experienced a gradual resurgence to its initial levels, ultimately reaching 126 documents by 2022. In essence, this corresponded to a total annual growth rate of 2.67%.

The authorship cluster analysis revealed more than 10 clusters of authors contributing to the publications in this journal. This indicates that the journal has accepted papers from a wide range of different research groups with a diversity in involved researchers. Moreover, the fractional frequency analysis for authorship yielded interesting results. While based on the number of documents *Sennerby L*, *De Bruyn H*, *Jemt T*, *Wennerberg A and Piattelli A* were the top five most prolific researchers, when fractional count considered the ranking was changed to: *Jemt T*, *Sennerby L*, *De Bruyn H*, *Wennerberg A*, *and Albrektsson T*. This effectively illustrates how the heightened number

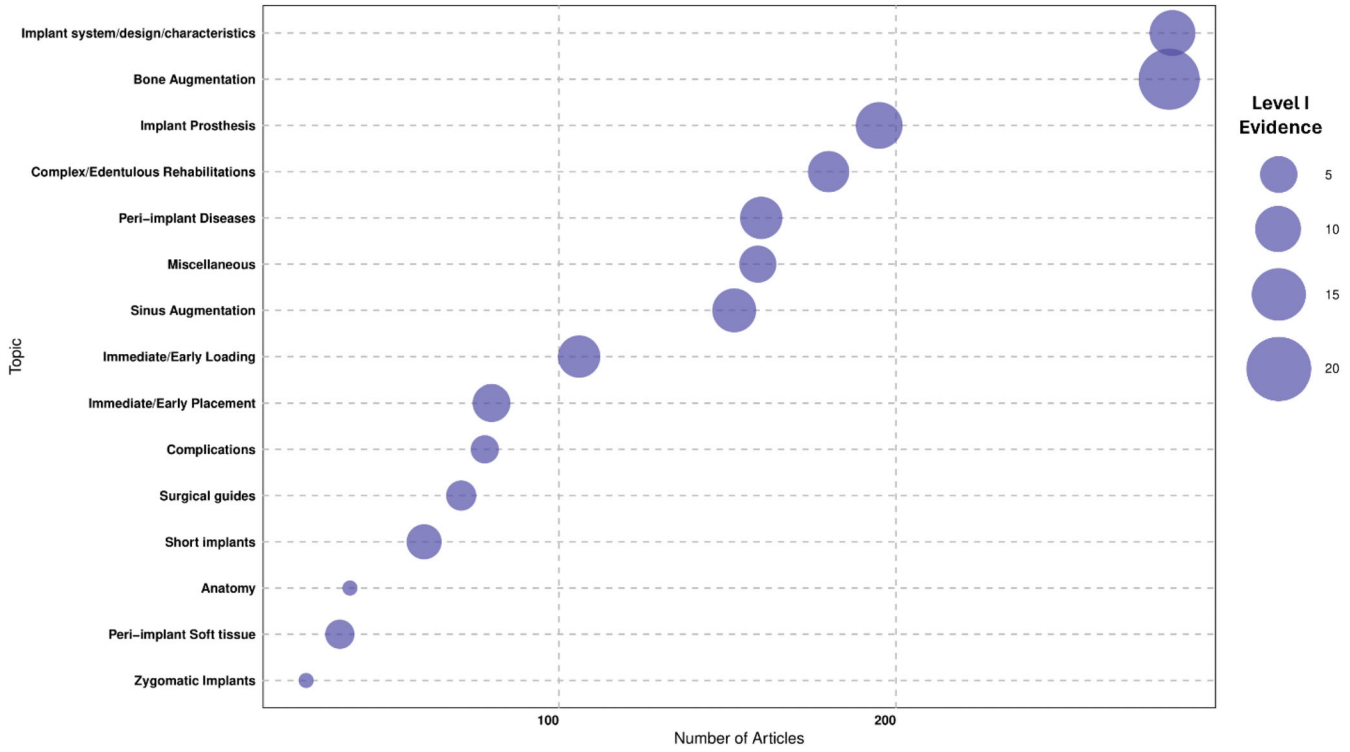


FIGURE 8 Topic analysis. The X-axis represents the number of documents published on the specific topic. Also, the size of bubbles corresponds to the percentage of that specific topic among level I evidence documents.

of authors in an article contributes to diminishing the fractional index. To summarize, researchers engaged in publications with fewer authors would attain a higher fractional score.[20]

One of the key aspects of this study was LOE mapping. Two different scales were implemented with or without inclusion of level VI articles (animal, in-vitro, pre-clinical, etc.). When considering clinical studies only, 22.82% of the articles published in CIDRR fit into level I evidence quality. Meng et al.,[21] analyzed five major periodontology journals and reported only 10.4% of articles fitting into level I evidence category. Moreover, Wu et al.,[18] analyzed 763 papers published in six oral implantology journals from 2008 to 2018 and reported only 2.4% level I articles. In addition to these, a similar approach to our study by Jamjoom et al.,[22] performed as a scientometric analysis of Saudi Dental Journal which resulted in only 5.56% of level I evidence in articles published in that journal. When it comes to other disciplines, Chen et al. assessed articles published in the top five orthodontic journals, which revealed a 1.3% and 25.1% of level I and II evidence, respectively.[23] Overall, these results indicate that CIDRR has shown a higher tendency in publishing higher quality articles and probably stricter criteria in terms of articles' assessment for eligibility to be published.

Two different approaches were performed in exploring the major topics of interest within the scope of the journal. A manual approach to topic categorization along with automated keyword analysis was conducted. Interestingly, major topics detected by both had overlapping topics of "bone augmentation," "Implant system/design/characteristics," and "immediate loading." Therefore, it can be postulated that the major topics covered by CIDRR correspond to the abovementioned categories. The approach followed in this article allowed for a comparison between the keywords provided by the authors of articles (as they define their main category) versus the objective assessment by the two blinded examiners and manually categorizing the articles into major topics.

A noteworthy finding was that 32.43% of CIDRR articles involved authors from different countries, reflecting substantial international collaboration. Moreover, researchers from 69 countries and 6 continents were involved. These statistics underscore the diversity and global participation inherent in CIDRR's scholarly contributions. This widespread involvement not only emphasizes the journal's commitment to fostering international collaboration but also signifies its capacity to attract a diverse range of researchers from various corners of the globe. A bibliometric analysis on *Periodontology 2000* by Ahmad et al.,[24] showed that USA, Switzerland and Australia were the top 3 most prolific countries. The same group analyzed 100 years of *Journal of Dental Research* and revealed USA, Netherlands and Japan appearing at top three.[25] Despite the USA being among the top three in our study, Sweden and Italy occupied the remaining two positions. This could be due to two major differences between our study and the others, the topic focusing on implant dentistry and the fact that the other studies only analyzed top 100 most cited papers in contrast to which we analyzed 1912 articles published in CIDRR.

With the outbreak of social media usage in the 21st century, even in the research world, there has been a tendency toward introducing alternative metrics to assess research articles' impact.[26] One of the

TABLE 4 Top 30 articles based on their Altmetric Attention Score (AAS).

AAS	Title
143	A Dental Prosthesis from the Early Modern Age in Tuscany (Italy)
102	Dental Implant Failure Rates in Patients with Self-Reported Allergy to Penicillin
75	Antihypertensive Medications and the Survival Rate of Osseointegrated Dental Implants: A Cohort Study
54	Proton Pump Inhibitors and the Risk of Osseointegrated Dental Implant Failure: A Cohort Study
47	The NobelGuide® All-on-4® Treatment Concept for Rehabilitation of Edentulous Jaws: A Retrospective Report on the 7-Years Clinical and 5-Years Radiographic Outcomes
25	The Use of Sci-Hub in Systematic Reviews of the Scholarly Literature
19	Titanium as a Modifier of the Peri-Implant Microbiome Structure
17	Health, Maintenance, and Recovery of Soft Tissues around Implants
15	Clinical Implant Dentistry and Related Research
12	Clinical Bonding Failure of RNC Restorations to ZrO2
11	Immediate Provisional for Single-Tooth Implant Replacement with Brånemark System: Preliminary Report
11	Does Intraoperative Perforation of Schneiderian Membrane During Sinus Lift Surgery Causes an Increased the Risk of Implants Failure?: A Systematic Review and Meta Regression Analysis
11	Prospective Controlled Clinical Study Investigating Long-Term Clinical Parameters, Patient Satisfaction, and Microbial Contamination of Zirconia Implants
11	Osseointegration of Zirconia in the Presence of Multinucleated Giant Cells
11	The Effect of Platelet Proteins Released in Response to Titanium Implant Surfaces on Macrophage Pro-Inflammatory Cytokine Gene Expression
9	Minimally Invasive Treatment for Papillae Deficiencies in the Esthetic Zone: A Pilot Study
9	"Peri-Implantitis": A Complication of a Foreign Body or a Man-Made "Disease." Facts and Fiction
9	Short Implants (5 to 8 mm) Versus Longer Implants (>8 mm) with Sinus Lifting in Atrophic Posterior Maxilla: A Meta-Analysis of RCTs

TABLE 4 (Continued)

AAS	Title
9	Long-term Evaluation of Peri-implant Bone Level after Reconstruction of Severely Atrophic Edentulous Maxilla via Vertical and Horizontal Guided Bone Regeneration in Combination with Sinus Augmentation: A Case Series with 1 to 15 Years of Loading
8	Long Term Clinical Performance of 10 871 Dental Implants with up to 22 years of Follow-up: A Cohort Study in 4247 Patients
8	Bone Loss Around Oral and Orthopedic Implants: An Immunologically Based Condition
8	Clinical, Tomographic, and Histological Assessment of Periosteal Guided Bone Regeneration with Cortical Perforations in Advanced Human Critical Size Defects
8	Immediate Implant Placement into Extraction Sockets with Labial Plate Dehiscence Defects: A Clinical Case Series
8	Microstructural Volumetric Analysis of Vertical Alveolar Ridge Augmentation Using Autogenous Tooth Roots
8	Influence of the Connector and Implant Design on the Implant–Tooth-Connected Prostheses
8	Bacterial Microleakage at the Abutment-Implant Interface, In Vitro Study
8	Osseointegration and Foreign Body Reaction: Titanium Implants Activate the Immune System and Suppress Bone Resorption During the First 4 weeks after Implantation
8	Clinical Applications of Cell-Based Approaches in Alveolar Bone Augmentation: A Systematic Review
7	Implant Displacement into Maxillary Sinus
7	Effect of Antibiotic Prophylaxis in Dental Implant Surgery: A Multicenter Placebo-Controlled Double-Blinded Randomized Clinical Trial

most commonly used new metrics is the AAS, which uses a proprietary algorithm that calculates the volume of attention received by a research output across numerous online sources (e.g., X [formerly named Twitter], Facebook, etc.). The AAS is commonly presented as the Altmetric donut (Figure 9A) that uses different colors to represent different sources of attention. Our study resulted in interesting findings regarding the modern and classic indices. Only four studies in the top 30 AAS score were among the top 100 most-cited papers. Additionally, the article with the highest AAS (143) (*A Dental Prosthesis from the Early Modern Age in Tuscany* (*Italy*)), had a topic more appealing to the social media posts and news feed rather than the clinical oral implant research studies. These simply indicate how different the conventional and modern indices can be in assessing the research articles' impact and disagree with the hypothesis of modern indices being able to replace the more conventional bibliographic metrics. In fact, herein, we emphasize that these two indicators are complementary to each other, and both reflect different aspects of impact of a research study. Lastly, when compared to other related journals' AAS (Periodontology 2000: 2328, Journal of Periodontal Research: 2763 and Clinical Oral Implant Research: 3057) CIDRR yielded lower score (921) which indicates that the journal is still in the process of gaining traction and recognition on social media platforms.

5 | CONCLUSION

In this Altmetric and bibliometric analysis of articles published in the *Clinical Implant Dentistry and Related Research journal*, we identified and characterized the Journal's most influential articles in the last 25 years. The articles, which were identified by conventional

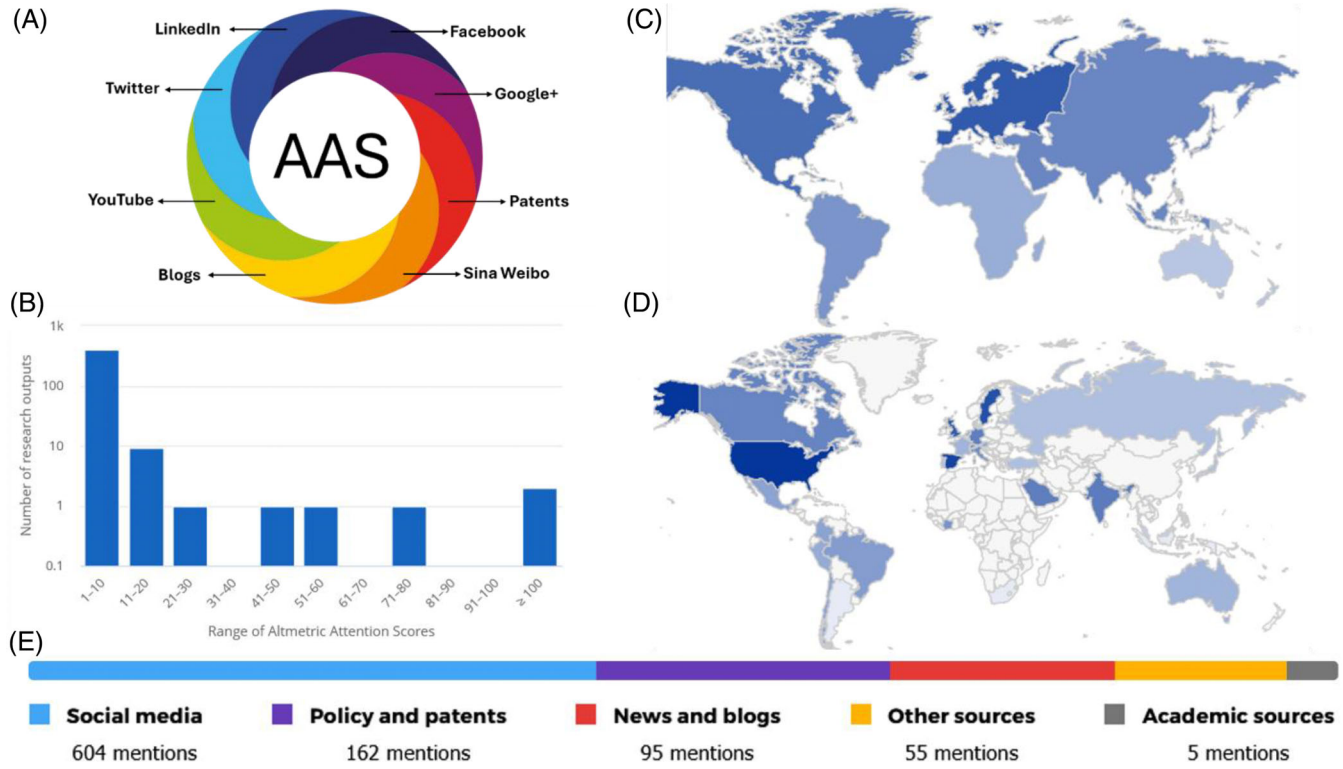


FIGURE 9 Altmetric analysis. (A) Altmetric donut, illustrating the social media mentions contributing to the Altmetric Attention Score. (B) the number of publications in CIDRR within each range of Altmetric Attention Score. (C and D) continent- and country-contributions in the resultant Altmetric Attention Score. (E) fractionalized number of mentions obtained by the articles published in CIDRR, from different resources (major categories) contributing in the Altmetric database.

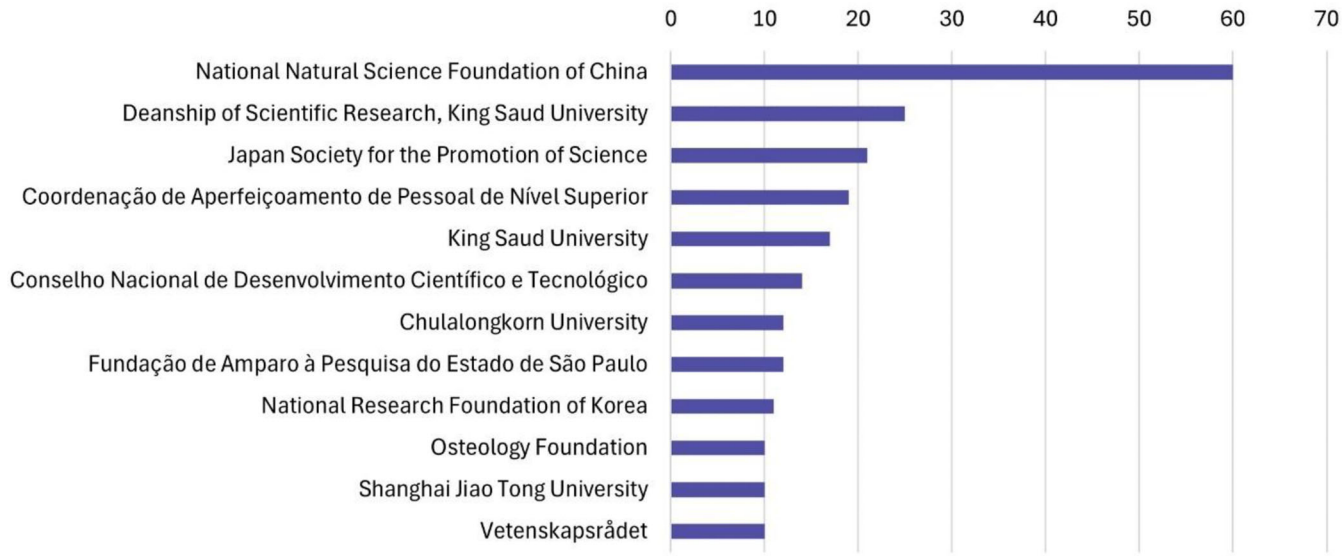


FIGURE 10 Funding analysis. Institutions contributed the most to the funding support of projects published in CIDRR. (with a minimum of 10 articles published).

bibliometric analysis employing citation rates, as well a novel metric of research influence based on engagement with public and social media platforms, covered a range of topics in clinical oral implantology. The analysis provided insight into the level of evidence of articles that have been relevant to the Journal's readership, but also identified articles of contemporary relevance. The study suggests that the Journal's level of evidence is mainly above the other disciplines in dentistry while engagement with social media platforms is not yet mature, with

opportunities to build. Finally, the study may serve as a framework for researchers who are looking to publish in this journal as well as those who would evaluate the impact of other academic journals.

AUTHOR CONTRIBUTIONS

H.S: Conceptualization; statistical analysis; manuscript writing; critical review; final draft approval. **P.N**: Data collection and synthesis; data presentation; level of evidence mapping; manuscript writing. **S.B**: Conceptualization; critical review; final approval. **L.T**: Conceptualization; critical review; final approval. **A.M**: Conceptualization, critical review; final approval. **J.N**: Conceptualization; critical review; final approval. **HL-W**: Conceptualization; critical review; final approval. **MHS**: Conceptualization; critical review; final approval.

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None.

CONFLICT OF INTEREST STATEMENT

Dr Hom-Lay Wang is the co-editor-in-chief of the CIDRR journal. Drs. Shayan Barootchi and Lorenzo Tavelli, and Alberto Monje are associate editors of the journal and Drs José Nart and Muhammad H.A Saleh are among the editorial board members.

DATA AVAILABILITY STATEMENT

The data pertaining to this study would be provided upon reasonable request from the first or corresponding author.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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