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Factors Influencing the Impact of Randomized Clinical Trials on Dental Implants: A Bibliometric Analysis

Running title: Factors Influencing Citation Counts for Dental Implants

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ABSTRACT

Objective: To analyze bibliometrics, characteristics and the risk of bias of randomized controlled trials (RCTs) on dental implants published in six high-impact factor journals and to identify factors contributing to citation number.

Material and methods: A systematic electronic search was conducted in four databases (PubMed, Scopus, Web of Science, and Cochrane Central Register of Controlled Trials) to identify RCTs on dental implants published in six dental journals between 2016 and 2017. Twenty-five bibliometric variables and paper characteristics were extracted to evaluate their contribution to the citation count. Risk of bias analysis was performed using the RoB2 tool. Negative binomial regression was used to examine the effects of predictor variables on the Citation count. Significance level was set to 5%.

Results: A total of 150 RCTs included received a cumulative citation count of 3,452 until July 2022. In the negative binomial regression analysis, open-access RCTs exhibited 60% more citations, and RCTs that presented statistical significance received 46% more citations. Conversely, first author affiliations from Africa, Asia and Oceania continents showed 49% fewer citations than publications from Europe. Regarding the risk of bias, 73.3% of the RCTs had some concerns, while 26% were deemed to have a high risk of bias. Only one RCT (0.07%) showed a low risk of bias.

Conclusion: Within the limitation of the study, Factors such as open access, statistically significant results, and country influence the number of citations received by the RCTs on dental implants.

Keywords:

Randomized Controlled Trials, Dental Implants, Peri-implantitis, Bibliometrics.

1. INTRODUCTION

Researchers and clinicians commonly utilize the journal impact factor and article citation count as indicators of research merit, reflecting the influence, quality, or significance of research outcomes. The Impact Factor (IF) , previously known as the Science Citation Index (SCI), was initially published through the Institute for Scientific Information (ISI) approximately 50 years ago. Since then, citation counts have been incorporated to assess the impact and quality of individual research, institutions, and scientific journals (Garfield, 1972; King, 2004). High-impact journals adhere to strict inclusion criteria, employ abstract filtering strategies, and maintain a rigorous review process to ensure publication of high-quality articles (Egghe et al., 2013).

Nevertheless, researchers often strive to publish their work in high-impact journals to enhance their visibility and influence the citation count (Bhandari et al., 2007). Several factors can influence citation rate, including the subject field, the country of journal publication, language, and the article type (original article, short report, review, etc.) (Onodera & Yoshikane, 2015). Furthermore, there are instances of citation manipulation practices aimed at increasing an author's h-index, which can affect the reliability of the citation numbers as a proxy measure for overall quality (Bartneck & Kokkelmans, 2011). Numerous studies have explored the factors associated with citation rates in the dental and biomedical fields (Vanclay, 2013; Onodera & Yoshikane, 2015; Susarla et al., 2015; Cheng et al., 2017; Beydokhti et al., 2020; Păduraru et al., 2022). Although citation rates are a suitable statistical measure to assess the impact or utilization of the articles, it is essential to consider cautions and recognize its limitations (Onodera & Yoshikane, 2015).

Mendeley is a robust reference management tool that enables users to create and organize their bibliographies. It has been increasingly utilized to address the limitations of citation numbers (Gunn, 2013). Mendeley reads provide an early measure of an article's impact since they are unaffected by publication delays (Maflahi & Thelwall, 2016). This metric can be indicative of readership as Mendeley users add articles to their personal libraries when they find them useful or interesting. Consequently, Mendeley reads have the potential to serve as a reliable indicator of an article's potential long-term impact (Thelwall, 2017). Moreover, “views count” is an important metric that indicates the total impact of an article, as it represents the number of abstract or full-text clicks the article has received. This metric is calculated through usage data in SciVal (Boopathi & Gomathi, 2020). Scopus Views Count reflects the interest of the whole research community like graduate students, researchers in corporate sector and clinicians who typically do not publish or receive citations, making them less visible within citation-based metrics. Therefore, analyzing these three indicators and their correlation with other factors is of utmost importance for a comprehensive evaluation of an article's impact.

The dental implant field faces several challenges in conducting Randomized Clinical Trials (RCTs). One major challenge is the high cost associated with the overall implant treatment, which can make it difficult to perform large-scale trials with sufficient statistical power (Friedman et al., 2015). However, conducting well-designed RCTs is crucial as they help minimize possible biases, ensure transparency, and generate robust scientific evidence that can directly influence healthcare decision making for stakeholders, such as readers, policymakers, and guideline developers (Uetani et al., 2009; Glasziou et al., 2014). Furthermore, publishing RCTs in high-impact journals can offer advantages in terms of visibility and citation numbers, potentially increasing researchers and overall impact (Bhandari et al., 2007).

The Cochrane Risk of Bias tool (RoB 2 tool) is a standardized quality assessment tool used to evaluate the risk of bias in RCTs. It consists of five domains and includes signaling questions that aid researchers identify potential biases (Sterne et al., 2019). However, despite the importance of minimizing biases in RCTs, a previous study found a high incidence of selective outcome reporting (SOR) in dental implant clinical trials. SOR can mislead readers and compromise the internal validity of results (Sendyk et al., 2019). Given the significance of RCTs in the dental implant field and their potential impact on healthcare decision-making, it is imperative to assess the quality and bibliometric characteristics of these studies. Therefore, our study aims to examine the bibliometric characteristics and risk of bias in dental implant RCTs published in six high-impact journals during 2016-2017. Additionally, we seek to identify factors contributing to citation number, Mendeley reads, and Scopus views of these articles.

2. MATERIALS AND METHODS

2.1 Study design and search strategy

To identify relevant journals for our study, we conducted a comprehensive electronic search in the PubMed database using the [MeSH] term “dental implants” and applied search restrictions to retrieve randomized controlled trials published between January 2016 and December 2017. Table 1 presents the top six dental journals with the highest number of RCTs publications and the highest journal impact factor (Journal Citation Reports 2021). After identifying the target journals, a systematic literature search was conducted in May 2022 across four electronic databases: Medline via PubMed, Scopus, Web of Science, and Cochrane Central Register of Controlled Trials. The search aimed to retrieve all RCTs, and corresponding protocols published in the selected journals during the period of 2016-2017. The chosen timeframe was applied to ensure equal opportunity for all included articles to receive citations. This approach is consistent with prior research that has indicated a citation window of three to five years as the recommended timeframe for capturing the long-term cumulative citation and publication impact (Wang, 2013; Abramo et al., 2019; Clermont et al., 2021). The Medline/PubMed search strategy was adapted accordingly for each electronic database. The complete search strategy is provided in Table S1.

Table 1: Journal Impact Factor (IF-2021)

Journal name	Abbreviation	eISSN	IF	Quartile
Journal of Clinical Periodontology	JCP	1600-051X	7.478	Q1
Clinical Oral Implants Research	COIR	1600-0501	5.021	Q1
Journal of Periodontology	JP	1943-3670	4.494	Q1
Clinical Implant Dentistry and Related Research	Clin Implant Dent Relat Res	1708-8208	4.259	Q1
International Journal of oral implantology*	Int. J. Oral Implant.	2631-6420	3.654	Q2
International Journal of Oral and Maxillofacial Implants	JOMI	1942-4434	2.912	Q2

*In 2016 and 2017, articles from the International Journal of Oral Implantology (ISSN: 26316420) were published under the journal title “European Journal of Oral Implantology” (ISSN:1756-2414). To include these articles in our analysis, we searched using the journal's previous title. The retrieved studies were exported to Microsoft Excel and the duplicates were eliminated.

2.2 Eligibility criteria and trial selections

To ensure a rigorous study selection process, we applied strict inclusion and exclusion criteria. The inclusion criteria were: (a) clinical trials in which participants were randomly assigned to the intervention arm; (b) the primary outcome focused on interventional dental implant or peri-implantitis treatment. Trials that primarily evaluated bone grafting procedures without reporting dental implant installation and evaluation were excluded. Two reviewers (M.A.H and G.C.L.S.A) independently performed the two-phase screening: by Title/Abstract and Full-Text. Discrepancies at any stage were resolved through joint discussion with a third expert reviewer. The inter-rater reliability test (Cohen’s Kappa) was calculated to measure the agreement between the two reviewers by applying a pilot test for 10% of the retrieved studies (n=15) to ensure accuracy and reproducibility (McHugh, 2012).

2.3 Data extraction

The data extraction was conducted independently by the same two reviewers (M.A.H and G.C.L.S.A), with any discrepancies resolved through joint discussion with a third expert reviewer. The following bibliographic parameters and publication characteristics were extracted from each study: (1) number of references, (2) number of pages of the publication, (3) funding source, (4) accessibility of the paper, (5) research group self-referencing (number of cited references authored by study authors i.e., author citing their previous work), (6) the recency of references, which is the number of references published during the previous five years, (7) Difference between the online publishing date and issue date (in months), (8) Primary outcome variable, (8) Study design, (9) Sample size calculation, including if the sample size calculation was based on the primary outcome, (10) protocol registration, (11) statistical significance of the results, (12) follow-up period, (13) first author's gender, (14) corresponding author's gender (as defined by the author on social media platforms, or using website(http://www.gender-guesser.com) , (15) country of the primary author, (16) countries of the authors, (17) number of figures, (18) Altmetric score (a metric that measures online attention, visibility and engagement with scientific publication gets through various digital platforms), (19) Citation count, (20) Citation density (average citation per year), (21) Field-Weighted Citation Impact (a metric that accounts for differences in citation rates across scientific fields), (22) Early citations (number of citations in the first year following publication), and (23) Mendeley reads count, and (24) Scopus views count (25) WOS usage count.

2.4 Risk of Bias assessment

We conducted risk of bias assessment of the included studies using the Cochrane RoB 2 tool (Sterne et al., 2019). Two reviewers (M.A.H and G.C.L.S.A) independently evaluated each article, and any disagreements were resolved by a third reviewer (N.V.S). The RoB 2 tool comprises five specific domains that evaluate bias arising from the randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of the reported results. Each domain includes signaling questions, which are answered with "yes", "probably yes", "no", or "probably no". Based on these answers, the overall risk of bias is classified as low (indicating a low risk of bias in all the domains), some concerns (indicating some concerns in at least one domain but without a high risk of bias in any domain) or high (indicating a high risk of bias in at least one domain or some concerns in multiple domains). Each reviewer provided a comment to support their answer. Separate versions of the RoB2 tool were used for cluster and crossover RCTs (March 18/2021 version).

Regarding the fifth domain of the RoB 2 tool, which evaluates the selection of the reported results, we followed a specific route to identify protocol registration numbers of the included trials. First, we thoroughly searched the publications to identify any registration numbers provided. If the registry number was not mentioned in the publication, additional efforts were exerted to find it in secondary publications related to the trial. Subsequently, we searched the ClinicalTrials.gov registry. In instance where the registration number could not be located, we contacted the corresponding authors via email on two separate occasions, spaced approximately 2-3 weeks, to inquire twice about the status of protocol registration. In cases where the email addresses were invalid or no response, we contacted the first author. If no response was obtained from the authors even after the second attempt, the trial's registration status was considered unclear.

2.5 Statistical Analysis

We employed Cohen's kappa test to assess inter-rater agreement for the eligibility criteria. Descriptive statistics were used to summarize the characteristics of included studies. Frequency distributions were calculated for qualitative variables, while means and standard deviations were computed for quantitative variables. The Kolmogorov–Smirnov test was used to evaluate the normal distribution of the variables. Univariable and multivariable negative binomial regression analyses were conducted to determine the association between different explanatory variables and citation numbers.

Variables for the multiple regression models were tested using a forward selection approach following established precedent for less stringent p-value cutoffs at the screening stage (Mickey & Greenland, 1989; Bursac et al., 2008). The explanatory variables were the h-indexes of the first author and corresponding author, impact factor quartile, publication in open access, statistical significance found for the primary outcome, Altmetric score, continent where the research was conducted, protocol registry, funding, time of follow-up, sample size, number of references, figures, number of countries of the authors, gender, and number of authors. The outcomes were number of Citations, Mendeley Reads count and Scopus views count.

Furthermore, the risk of bias analyses, including the overall risk of bias and domain-specific judgments, were transformed into ordinal variables (0 for high risk of bias, 1 for some concerns, and 2 for low risk of bias) to investigate their association to citation counts. Statistical significance was determined when p-values were lower than 0.05. All the statistical analyses were performed using Stata 15.0 (StataCorp LCC, College Station, USA).

3. RESULTS

The initial electronic search identified 763 RCTs. After removing duplicates, 325 RCTs were screened for titles and abstracts. Among them, 168 studies were excluded as they evaluated soft and hard tissue regeneration procedures, as well as sinus lifting. The remaining 157 papers underwent a thorough reading, and seven were further excluded as the primary outcome did not involve dental implants. Consequently, 150 RCTs were selected for data extraction and statistical analysis (Figure 1). The study demonstrated a high level of inter-examiner agreement, with a kappa (k) value of 0.81 and 92.4% agreement between the examiners.

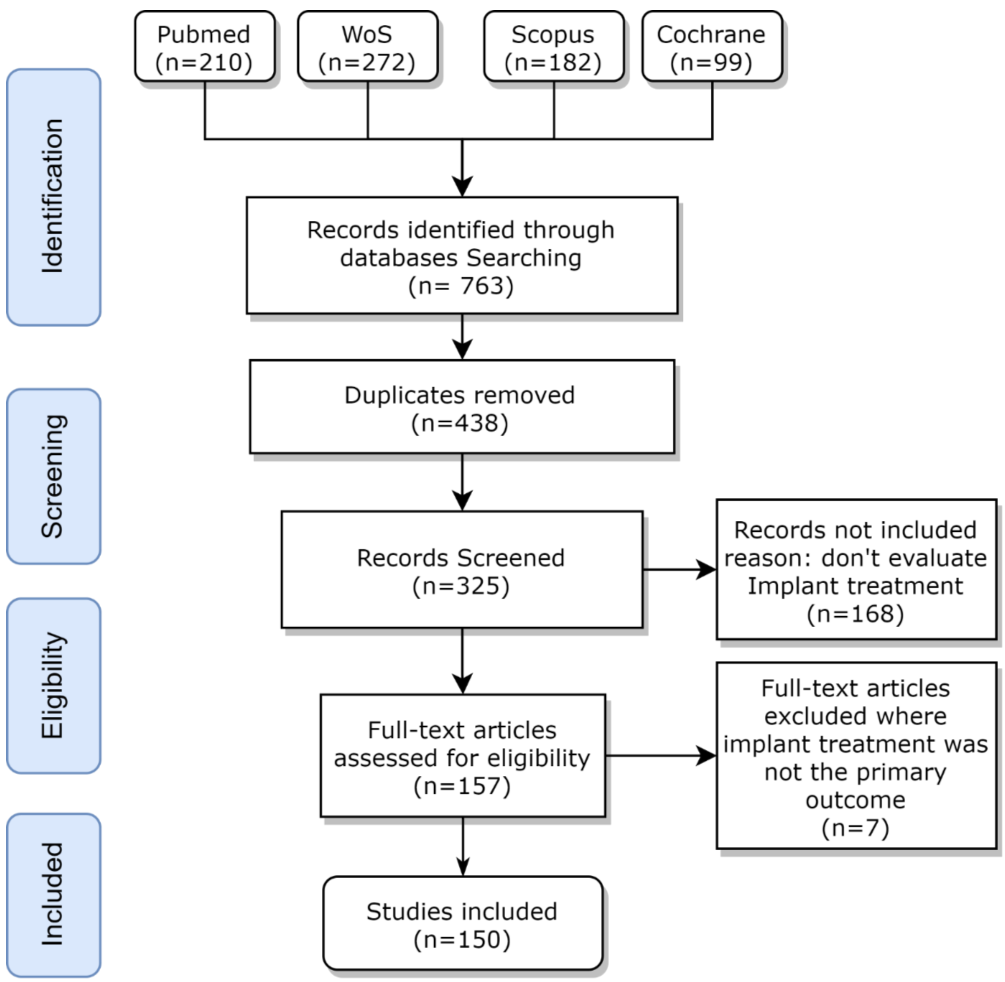

Figure 1: Study Flowchart

3.1 bibliometric parameters and Characteristics of studies

The bibliographic parameters and publication characteristics are listed in table 2. The RCTs were selected and categorized according to the top six journals with the highest impact in implantology field. Among these journals, Clinical Oral Implants Research (COIR) had the highest percentage of included studies (30%), while Journal of Periodontology (JP) had the lowest representation (3%). Moreover, COIR had a higher number of citations (33.8%), while JP had the lower (2.6%). Table 3 provides detailed information on the number of studies included in each journal, the total citations numbers, and average citation per RCT. RCTs Metrics and characteristics of each Journal are summarized on Table S2

Table 2: Metrics and Characteristics of include RCTs

Factors	**Mean**	**SD**	**Minimum**	**Maximum**
Publication characteristics				
Number of authors	5.56	1.60	1	12
Number of countries	1.76	1.08	1	8
Number of pages	9.59	2.88	5	18
Number of references	36.29	16.10	6	97
Number of figures	4.147	2.73	0	20
Reference Recency (Months)	13.21	6.95	0	39
Number self-referencing†	5.01	4.35	0	18
Research group self-referencing %‡	16.8%	17.0%	0%	81%
Difference between the online publishing date and issue date (months)	6.19	6.15	0	21
Sample size (patients)	46.7	34.83	7	210
Sample size (Implants)	80.06	59.91	20	372
Number of the primary outcomes	2.75	2.16	1	13
Follow-up period (months)	24.43	30.9	0	180
Bibliometric parameters				
Number of citations	23.01	18.83	1	104
Early citations §	3.81	4.01	0	22
Citation density¶	3.39	2.84	0	14.14
Mendeley reads	96.41	39.17	3	228
Scopus Views count (since 2012)	23.99	12.98	2	75
Altmetric Score	0.96	3.91	0	38
Field-weighted citation Impact (FWCI)	1.95	1.47	0.15	7.53
WOS usage count (since 2013)	8.62	6.17	0	40
Journal Impact factor 2021	4.51	1.22	2.91	7.48

Author Indices	29.46	22.95	2	81
First author h-index	19.68	19.43	1	81
Corresponding author h-index	29.46	22.95	2	81

†number of references authored by the study authors, ‡Percent of references authored by the study authors to the total number of references, §number of citations in the first year following publication, ¶Average citation per year.

Table 3: Comparative Analysis of the included RCTs and Citation Metrics Across Six Dental Journals

Journal name	Number of RCTs	Median	Mean (SD)	[Min.-max.]	Total Citation Count
Journal of Clinical Periodontology (JCP)	15	33	45.2 (25.4)	[8 – 90]	678
Clinical Oral Implants Research (COIR)	45	21	26.0 (21.2)	[3 – 104]	1169
Journal of Periodontology (JP)	5	23	18.6 (10.9)	[5 – 28]	93
Clinical Implant Dentistry and Related Research (Clin Implant Dent Relat Res)	34	16.5	21.4 (13.2)	[3 – 58]	727
International Journal of oral implantology (Int. J. Oral Implant)	30	12.5	15.1 (10.6)	[2 – 42]	452
International Journal of Oral and Maxillofacial Implants (JOMI)	21	13	15.9 (13.6)	[1 – 60]	333

The first author's country of origin was classified into three continent categories: Europe, Americas, and Others (including Africa, Asia, and Oceania), encompassing a total of 25 countries. The distribution of the RCT numbers and the number of citations per country are reported in Figure 2. Moreover, an overview of Characteristics and Impact Indicators of Randomized Controlled Trials (RCTs) in dental implant, along with their Citation metrics are in Table 4.

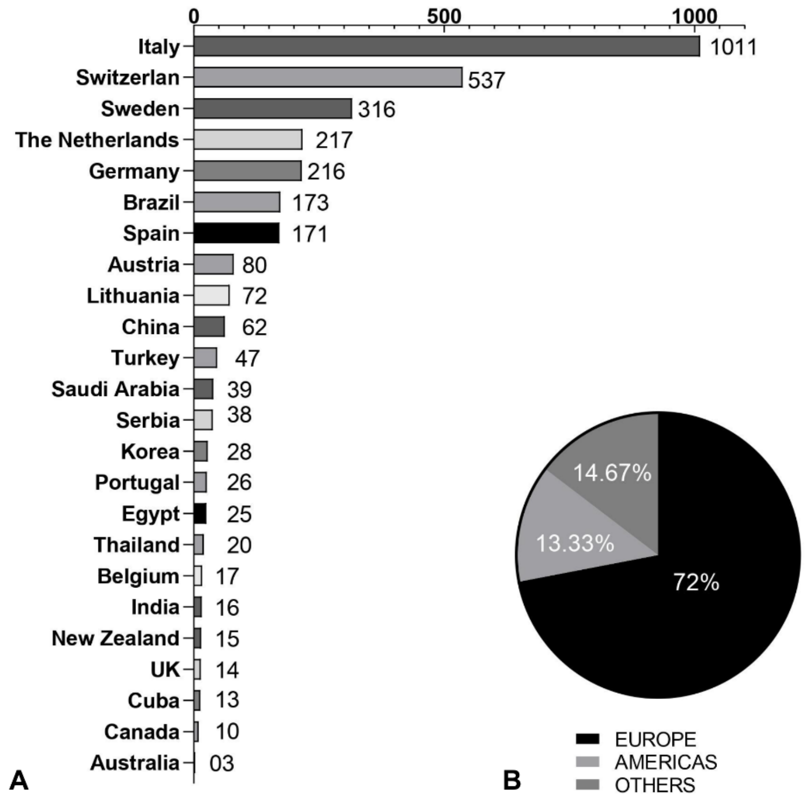

Figure 2: Citations per first author country (A) and the distribution of most cited RCTs per continent (B)

Table 4: Characteristics and Impact Indicators of Randomized Controlled Trials (RCTs) in dental implant

Characteristics of publications	Number of RCTs (%)	Median	Mean (SD)	[Min.-max.]	Total Citation Count
First author gender					
Female	42 (28)	16.5	18.4(12.1)	[4 – 71]	774
Male	108 (72)	20	24.8 (20.6)	[1 – 104]	2678
Study funding					
No	56 (37.3)	18	20.1 (14.3)	[2 – 72]	1123
Yes	94 (62.7)	18	24.8 (20.9)	[1 – 104]	2329
Open access designations					
No	130 (86.7)	16.5	21.3 (17.6)	[1 – 104]	2768
Yes	20 (13.3)	26.5	34.2 (23.0)	[6 – 90]	684
Protocol registration characteristics					
No	113 (75.3)	17	22.6 (18.9)	[1 – 104]	2554
Yes	37 (24.7)	22	24.3 (18.7)	[3 – 90]	898

Period of follow-up (months)					
0-6 months	40 (26.7)	17.5	22.8 (22.0)	[1 – 104]	913
7-12 months	54 (36)	18	19.6 (13.6)	[2 – 60]	1060
13- 24 months	13 (8.6)	16	22.0 (16.4)	[6 – 63]	286
25-36 months	13 (8.6)	24	27.3 (19.9)	[4 – 82]	355
37-60 months	21 (14)	23	29.9 (24.2)	[3 – 79]	628
> 60 months	9 (6)	17	23.3 (18.4)	[11 – 71]	210
Primary outcome clearly described?					
No	70 (46.7)	16	19.7 (14.4)	[1 – 63]	1377
Yes	80 (53.3)	20	25.9 (21.7)	[2 – 104]	2075
Primary outcome statistically significant?					
Yes	100 (66.7)	16	20.2 (17.1)	[1 – 90]	2018
No	50 (33.3)	23	28.7 (21.0)	[5 – 104]	1434
Number of self-referencing					
0-5	95(63.3)	16	20.9 (17.4)	[1 – 104]	1982
6-10	36 (24.0)	22	27.8 (23.2)	[3 – 90]	999
>11	19 (12.7)	22	24.8 (15.4)	[4 – 63]	471
Sample size calculated depends on the primary outcome					
No	104 (69.3)	18	23.0 (19.1)	[1 – 104]	2390
Yes	46 (30.7)	20	23.1 (18.5)	[2 – 90]	1062
RCT design					
Parallel	145 (96.7)	18	22.7 (17.8)	[1 – 90]	3292
Cross-Over	5 (3.3)	10	32.0 (41.8)	[5 – 104]	160

3.2. Factors Influencing the citation number, views, and Mendeley reads.

Sixteen explanatory variables were tested using univariable negative binomial regression analyses, results of the univariable analyses are reported in Table S3. Variables with a p-value <0.25 in the univariable screening were entered into an adjusted negative binomial regression model one at a time. Variables were retained in the final multivariable model if they remained significantly associated with the outcome at $p<0.05$ after adjusting for the other explanatory variables already in the model. This forward selection process was continued until no additional variables met the criteria for entry into the model. The multivariable analyses results are presented in Table 5. Interactions were explored, but no significant associations were found.

Table 5: Negative binomial regression analysis of the number of citations (SCOPUS), Mendeley reads count, and the number of views with independent variables in multivariable analysis.

Independent Variables	**The number of Citations**		**Mendeley Reads Count**		**Scopus Views Count**	
	IRR (95 % CI)	**p value***	**IRR (95 % CI)**	**p value***	**IRR (95 % CI)**	**p value***
Continent (Ref.: Europe)						
The Americas	0.81 (0.59 - 1.11)	0.195	NS	NS	0.82 (0.66-1.02)	0.076
Africa, Asia, Oceania	0.51 (0.37 - 0.72)	<0.0001*	NS	NS	0.76 (0.60-0.96)	0.022*
Open Access (Ref.: No)						
Yes	1.60 (1.16 - 2.20)	0.004*	1.23 (1.02 - 1.47)	0.023*	NS	NS
Primary outcome statistically significant (Ref.: No)						
Yes	1.46 (1.16 - 1.84)	0.001*	1.14 (1.00 - 1.29)	0.044*	NS	NS
Altmetric Score (quantitative variable)	NS	NS	1.17 (1.02 - 1.35)	0.019*	NS	NS
H-index First Author (quantitative Variable)	NS	NS	NS	NS	1.01 (1.01-1.01)	0.0001*

IRR = Incidence ratio ratios; 95% CI = 95% confidence interval)
* Association statistically significant ($p < 0.05$). NS = non- significant. Ref= Reference Variable

3.3. Risk of bias analysis

Figure 3 presents the overall bias assessment of the included studies. Among all the included papers, only one (0.7%) was identified as having a low risk of bias in all five domains of the RoB2 tool. The majority of the studies (73.3%) had at least one domain with "some concerns", while 26% of the studies were classified as high risk of bias. A detailed breakdown of the Risk of Bias assessment results, including the distribution and frequencies per domain is provided in Table S4. Among the five domains, domain three, "missing outcome data," had the best evaluation, with 74% of the studies being classified as low risk of bias. Conversely, domain five, "selection of the reported result," had the worst results, with 97.4% of the studies evaluated showing at least some concerns, and only two studies classified as low risk of bias. No statistically significant correlation was observed between the risk of bias and the number of citations in the analyzed studies.

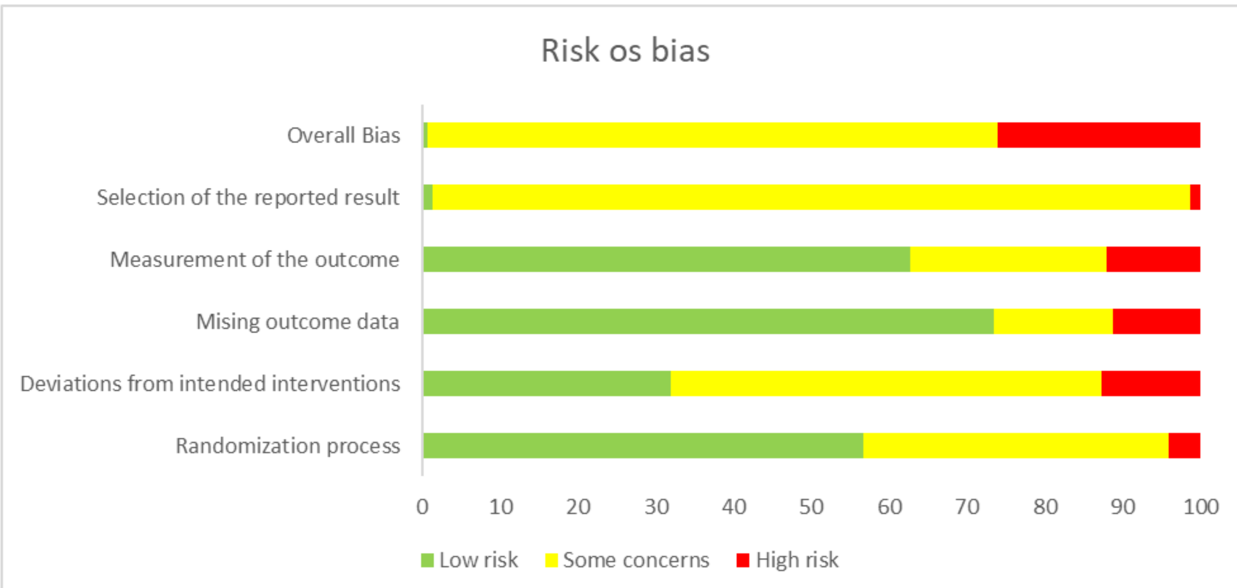

Figure 3: Risk of bias of the included studies, according to RoB2 tool

DISCUSSION

Our study, being the most recent investigation in this area, aimed to explore the factors that influence citation rates, Mendeley reads, and Scopus view counts for dental implant RCTs published in high-impact factor journals. The study conducted a comprehensive analysis of 150 randomized controlled trials (RCTs) in the field of dental implants. We found a correlation between citation numbers and variables such as geographical region and open access status, as well as the significance of the primary outcome. Bibliometric metrics have gained significant popularity as a means of evaluating the productivity and impact of academic publications (Radicchi et al., 2008; Susarla et al., 2015; Tahamtan et al., 2016). In implant dentistry, where advances occur rapidly, it is crucial to ensure the methodological reporting quality of the most frequently cited RCTs is reliable for informed decision-making by specialists (Kiriakou et al., 2014).

Our study emphasizes the importance of Open Access (OA) in increasing the visibility and citation rates of dental implant RCTs. The findings revealed that dental implant RCTs published with OA had a 60% higher citation rate than those published in non-OA journals. This can be attributed to the fact that OA enables readers to access the full text of the article without any fees or subscriptions, facilitating wider dissemination and subsequent citation. This findings are in line with previous study showing that OA papers received more citations, regardless of whether they were published in an OA journal or a subscription journal with OA options (Gargouri et al., 2010). Another study investigated over 1.3 million articles across 10 different fields over 12 years, found that OA papers have a 172% higher citation prevalence than non-OA papers (Hajjem et al., 2006). When only the abstract is accessible, the clinicians might build their treatment decision on an incomplete piece of scientific evidence, potentially jeopardizing patient care (Boutron et al., 2014; Xie et al., 2022), further highlighting the importance of OA for ensuring access to comprehensive scientific information. We did not observe a significant correlation between the Altmetric score and citation rate, contrary to a previous study (Azer & Azer, 2019) that reported a significant correlation for articles for articles published in 2007 and onwards.

We observed that dental implant RCTs that reported a significant primary outcome received 46% more citations. While we found a positive correlation between dental implant RCTs reporting a significant primary outcome and increased citation rates, it is important to note that statistical significance does not necessarily indicate clinical significance. Clinically meaningful treatment differences require evaluating the treatment effect on both a relative scale (e.g., by calculating the relative risk or hazard ratio) and an absolute scale (e.g., by calculating differences in event rates during follow-up and in the number needed to treat) (Pocock & Stone, 2016). Reporting of significant outcomes is a common issue in scientific publishing regardless of whether the primary outcome was the pre-registered or pre-defined , as researchers strive to publish their results in high-ranked journals (Hopewell et al., 2009; Gadde et al., 2018; Sendyk et al., 2019; Elagami et al., 2023). However, the attainment of statistical significance for the primary outcome should align with a rigorous reporting methodology and well-designed RCTs to ensure the accuracy and reliability of reported outcomes. Therefore, caution should be exercised when interpreting the citation rates of RCTs based solely on reported primary outcomes significance.

Our study revealed that the factors significantly correlated to Mendeley reads were almost identical to those correlated to citation counts, except for Altmetric scores. This finding is consistent with a previous study by Didegah et al., (2018), which also demonstrated a similarity between the significant factors for citation count and Mendeley reads. This suggests that Mendeley reads could serve as a promising complementary metric to citation counts in measuring research impact , as they detect the impact evidence at an earlier stage (Ruan et al., 2018). However, contrary to a study by Ruan et al. (2018), our findings showed a significant correlation between articles shared on social media platforms, such as Facebook, Twitter, and YouTube(as measured by the altmetric score) and a 17% increase in Mendeley reads. This discrepancy highlights the complexity of the relationship between social media activity and Mendeley reads, and further research is needed to fully understand this association.

A higher h-index of first author (≥18) can attract views as equal as articles published by first author with h-index less than 18. In addition, we identified a significant negative correlation between view counts and authors from Africa, Asia, Oceania. Specifically, articles from these continents received 24% less views on Scopus database in addition to a 49% decrease in expected citation number than RCTs from Europe.

Most of the RCTs (n=109) included in this study were found to have an unclear risk of bias with some concerns. Specifically, 22 of these trials were assessed to have a low risk of bias in all domains except for domain 5 (Selection of the reported result) due to a lack of registration or retrospective registration of the protocol. It is important to note that pre-registration of clinical trials on recognized online platforms such as clinicaltrials.gov or national trial registration platforms provided by the International Committee of Medical Journal Editors (ICMJE) website (http://www.icmje.org/about-icmje/faqs/clinical-trials-registration/) has been mandatory since 2005. According to

ICMJE regulations, failure to register trials in advance on an open-access platform before the enrollment of the first participant constitutes a violation (De Angelis et al., 2004).

The risk of bias assessment revealed that most of the other unclear items have been reported mostly for domain 1 (Randomization process) and domain 2 (Deviations from intended interventions) for the non-registered trials. Given the poor quality of these RCTs published between 2016-2017, it is essential to improve their methodological quality. This study's findings are consistent with other previous studies (Esposito et al., 2001; Vere & Joshi, 2011), which also demonstrated that RCTs published by the end of 1999 and between 2004-2008 have low quality with limited unbiased evidence to support the clinical decision-making.

This study has several strengths. Firstly, we have performed the risk of bias analysis by two reviewers independently, which was recommended by the tool to enhance the reliability of the evaluation. In cases of disagreement, a third reviewer was involved to reach a consensus. Secondly, the citation rate was collected citation rates after a suitable time frame of 4-5 years from the publication of the RCTs, allowing sufficient time for citations to accumulate. However, the study also had a limitation in identifying the protocol registry of 126 RCTs, which required contacting corresponding authors by email. In response to our inquiries about trial registration, 62 authors indicated that their trial was unregistered. Additionally, 15 authors provided us with the registry number, while 49 authors did not respond after the second contact, leading us to consider their trial as non-registered. Although this limitation highlights the challenges in identifying protocol registry, it emphasizes the importance of transparent reporting and adherence to trial registration requirements. Furthermore, The study lacked an analysis of potential differences in factors influencing citation rates between specific topics of RCTs (e.g., peri-implantitis treatment vs. implant therapy). The limited number of RCTs in each subtopic precluded adequately powered comparisons. Citation metrics by study topic are summarized on Table S5. Future larger-scale studies should investigate variations in citation factors between different RCT topics, the potential improvement in prospective trial protocol registration and the overall risk of bias analysis for RCTs published in subsequent years.

CONCLUSION

Within the limitation of the study, Factors such as open access, statistically significant results, and country influence the number of citations received by the RCTs on dental implants.

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