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Lívia da Rosa Oliveira, Thaís Marchezini Reis, Marina Letícia de Paula, Rokaia Ahmed Elagami, Tamara Kerber Tedesco, Rodolfo Carvalho Oliveira, Daniela Prócida Raggio

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SPIN in systematic reviews on the management of caries lesions in children and adolescents: a meta-research

Lívia da Rosa Oliveira[1]
ORCID: https://orcid.org/0000-0001-7432-943X.

Thaís Marchezini Reis[1]
ORCID: https://orcid.org/0000-0002-7127-918X.

Marina Letícia de Paula[1]
ORCID: https://orcid.org/0009-0003-9012-7119.

Rokaia Ahmed Elagami[1]
ORCID: https://orcid.org/0000-0002-7238-4598.

Tamara Kerber Tedesco[1]
ORCID: https://orcid.org/0000-0003-0794-1578.

Rodolfo Carvalho Oliveira[1]
ORCID: https://orcid.org/0000-0001-7473-6529.

Daniela Prócida Raggio[1]*
ORCID: https://orcid.org/0000-0002-0048-2068.
* Corresponding author: Daniela Prócida Raggio — danielar@usp.br.

[1] Orthodontics and Pediatric Dentistry Department, School of Dentistry, University of São Paulo (FOUSP), São Paulo, SP, Brazil.

Abstract

SPIN, or distortion bias, is the intentional or unintentional interpretation of research results in a way that suggests favorable or unfavorable conclusions without adequate justification, which can compromise the validity of the evidence and mislead clinical recommendations. This meta-research assessed the presence, prevalence, and nature of SPIN in systematic reviews on the management of caries lesions in children and adolescents (0–18 years), and its association with journal endorsement of the PRISMA guidelines. The protocol was registered on the Open Science Framework (OSF) on 30 October 2024 (https://doi.org/10.17605/OSF.IO/6Y4EM). MEDLINE (PubMed), Embase, Cochrane Library, ProQuest, and LILACS were searched without restriction. Two independent, calibrated reviewers selected the studies and extracted data on bibliometric, methodological, guideline-conformity, and conflict-of-interest characteristics. Following the criteria of Yavchitz et al. (2016), adapted by Sensever et al. (2022), SPIN was identified separately in the abstract and full text and graded as low, moderate, or high according to the failure to acknowledge non-significant results, the absence of uncertainty, and the lack of a recommendation for further studies. The SPIN–PRISMA association was tested with the chi-square test ($\alpha = 5\%$). Fifty-three systematic reviews were included. SPIN was identified in 66% of abstracts and 54.7% of full texts, with no significant association with PRISMA endorsement. The interpretive component of SPIN assessment and the restriction to caries-management reviews limit generalization. SPIN is frequent in systematic reviews, especially in abstracts, suggesting that formal PRISMA endorsement alone does not ensure unbiased reporting and reinforcing the need for rigorous methodology, transparent reporting, and critical appraisal in the management of carious lesions in children and adolescents.

Keywords: Dental caries; Pediatric dentistry; Systematic review; Distortion bias; SPIN bias.

1. Introduction

Systematic reviews synthesize scientific evidence to answer specific clinical questions, minimizing bias and guiding evidence-based practice [1]. When combined with meta-analyses, which estimate the magnitude of effects and resolve inconsistencies across studies [2,3], they become fundamental tools for decision-making in health care [4]. To ensure methodological quality, it is recommended to follow the guidance in the Cochrane Handbook [7], to prospectively register the protocol in order to increase transparency and reduce bias [8–10], and to use the PRISMA guidelines to ensure clear and complete reporting [11,12]. Well-conducted systematic reviews are essential for reliable conclusions and for the safe application of evidence in clinical practice [13,14].

Dental caries remain highly prevalent worldwide, especially in children and adolescents [15,16]. Despite well-established preventive strategies [17,18], social and economic factors influence its distribution [19,20]. Several therapeutic strategies are available for lesion management, ranging from non-invasive approaches to extensive restorative interventions, aiming to prevent pain, preserve tooth structure, and maintain function and esthetics [21]. The choice among non-invasive, micro-invasive, invasive, or mixed treatments must be supported by a comprehensive diagnosis, patient (or caregiver) acceptance, and robust scientific evidence [22], which requires methodologically rigorous systematic reviews to support reliable conclusions [23].

However, distortions in the interpretation of results can compromise this purpose. The term SPIN, also called distortion bias, is defined as the intentional or unintentional interpretation of research results that, without justification, points toward favourable or unfavourable conclusions and presents findings as more favourable, significant, or impactful than they truly are, which can mislead readers and introduce bias. [24, 25]. It refers to the biased presentation of findings so as to make them appear more favorable, thereby influencing decision-making [26]. It is more frequent in studies with non-significant results, in which authors may emphasize statistically significant secondary outcomes or suggest benefits without adequate support, including interpreting non-significant primary outcomes as therapeutic equivalence [27]. It should be noted that distorted interpretations can also occur in statistically significant studies [28].

The investigation of SPIN began in randomized controlled trials [29] and was later extended to other designs, including non-randomized and observational studies [30,31]. Evidence shows that interpretive distortions are frequent, especially in the conclusions of abstracts [32]. Despite the central role of systematic reviews in the hierarchy of evidence [33] and the existence of strategies to reduce bias [34,35], inadequate interpretation of their results can still occur. When present, these distortions can influence clinical recommendations and, consequently, affect therapeutic decisions and clinical outcomes. Therefore, investigating the occurrence of SPIN in systematic reviews on the management of caries lesions in children and adolescents is relevant for understanding its potential impact on clinical recommendations and on the quality of care provided.

The aim of this meta-research was to investigate the presence, prevalence, and nature of distortion bias (SPIN) in systematic reviews on the management of caries lesions in children and adolescents (0 to 18 years). As a secondary aim, the association between the presence of SPIN, in the abstract and in the full text, and journal endorsement of the PRISMA guidelines was assessed.

2. Materials and methods

2.1 Protocol, registration, data sharing and reporting

The protocol of this study was registered on the Open Science Framework (OSF) platform on 30 October 2024, available at doi: https://doi.org/10.17605/OSF.IO/6Y4EM. The protocol addressed the following question: what is the prevalence and nature of SPIN in systematic reviews related to the management of caries lesions in children and adolescents aged 0 to 18 years? Data is shared under the CC-BY Attribution 4.0 International license.

This meta-research was reported using guidelines for reporting meta-epidemiological methodology research. [36]

2.2 Information sources and search strategy

MEDLINE (via PubMed), Embase, Cochrane Library, ProQuest (using the "Anywhere except full text – NOFT" filter), and LILACS were searched to identify systematic reviews, with or without meta-analysis, on the management of caries lesions in children and adolescents, with no restriction on publication date or language. The research question was structured according to the PICO(T) framework: P (population) — children and adolescents (0 to 18 years) with caries lesions; I (intervention) — caries lesion management by any approach (non-invasive, micro-invasive, invasive, or mixed); C (comparator) — any intervention, including no treatment or placebo; O (outcome) — outcomes related to caries management (lesion progression or need for restorative treatment), as defined in each included review; T (type of study) — systematic reviews with or without meta-analysis.

The search strategy, conducted in September 2024, combined two main axes (population and intervention), together with a filter for study type, using Boolean operators (AND/OR), free terms, and related descriptors. The complete strategies, adapted for each database, are provided in Supplementary Material 1.

2.3 Eligibility criteria and selection

Systematic reviews with or without meta-analysis, involving children and adolescents aged 0 to 18 years and interventions for dental caries management without pulp involvement, were included. Studies that assessed cost-effectiveness, that assessed the accuracy of diagnostic tests, that assessed qualitative studies, that included patients with special needs, or that included children and adults without separate presentation of the data were excluded.

A preliminary inter-reviewer agreement test was performed: a random sample of 10% of the initial records was independently reviewed by two assessors, and Cohen's Kappa coefficient was calculated (substantial agreement between 0.61 and 0.80, and almost perfect

between 0.81 and 1.00) [37]. The studies were analyzed by two independent reviewers (LRO and TMR), dentists with experience in pediatric dentistry and research methodology, previously calibrated. Disagreements were resolved by consensus and, when necessary, by a third reviewer (DPR). The Rayyan platform was used for screening and record management, with prior removal of duplicates. Selection occurred in two phases: title and abstract screening and, subsequently, full-text analysis of potentially eligible studies.

2.4 Data extraction

Extraction was performed by two independent reviewers using a standardized form, preceded by joint calibration to standardize the interpretation of the variables. The information was organized into four domains: bibliometric data, methodological characteristics, guideline conformity, and conflicts of interest. Disagreements were resolved by consensus or by a third reviewer.

Bibliometric data: year of publication; name and country of the corresponding author; journal name; impact factor (Journal Citation Reports, 2025; dichotomized by the sample median, with values equal to or above the median classified as high impact and values below it as low impact); number of citations (Web of Science); and open-access status. Methodological characteristics: objective or hypothesis; type of intervention (assessed according to the Delphi consensus [22]); number of included studies; existence and word limit of the abstract, with compliance with the limit; number and distinction of primary and secondary outcomes; explicit identification of outcomes; risk-of-bias assessment; presence of a published protocol (prospective or retrospective) and registration number; and use of the GRADE tool. Guideline conformity: reported adherence to the PRISMA guidelines. Conflicts of interest: type of declared funding and authors' conflict-of-interest declaration.

2.5 SPIN identification

SPIN was assessed based on the criteria of Yavchitz et al. (2016) [38], using the adaptation by Sensever et al. (2022) [39]. The following items were examined: (1) conclusions with clinical recommendations not supported by the findings; (2) a title suggesting an unproven beneficial effect; (3) no mention of adverse events; (4) omission of non-significant primary results; (5) emphasis on statistically significant secondary results; and (6) overinterpretation of primary outcomes. Identification was performed separately in the abstract and in the full text.

The severity of SPIN was classified based on the presence of three characteristics: (a) no acknowledgment of statistically non-significant results for the primary outcome; (b) no expression of uncertainty; and (c) no recommendation for future studies. SPIN was considered low severity when only one of these characteristics was present, moderate when two were present, and high when all three were identified [40].

2.6 Data synthesis and statistical analysis

Statistical analysis was performed in the Jamovi software. Study characteristics were described using descriptive statistics, with absolute and relative frequencies for categorical variables and means and standard deviations for numerical variables. The association

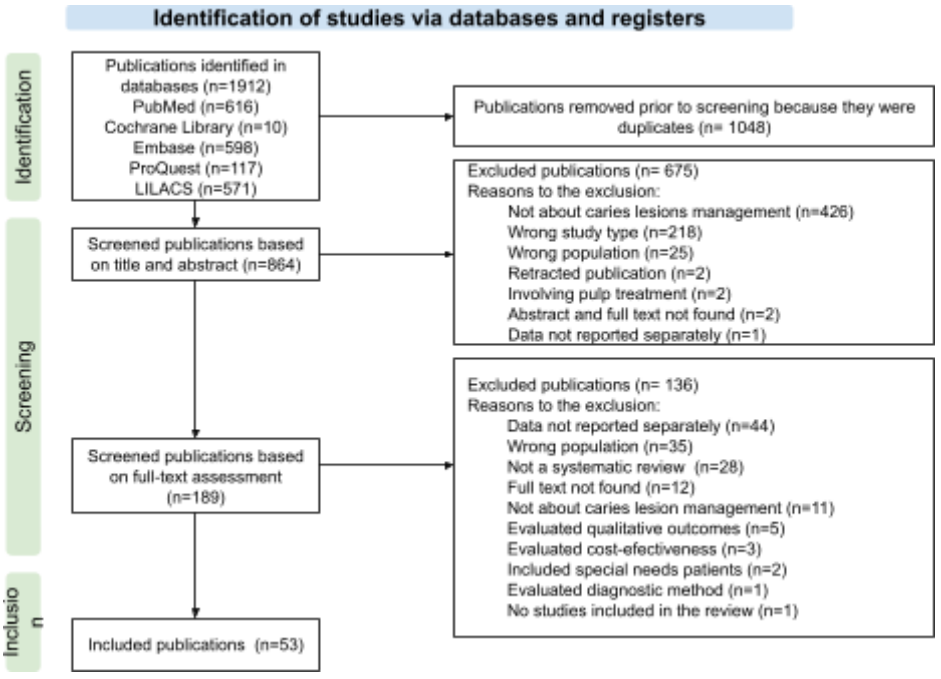
between the presence of SPIN (in the abstract and in the full text) and journal endorsement of the PRISMA guidelines was assessed using the chi-square test. A significance level of 5% was adopted.

3. Results

The initial search identified 1,912 articles, published between 2004 and 2024, in the databases consulted: 616 in PubMed, 10 in the Cochrane Library, 598 in Embase, 117 in ProQuest, and 571 in LILACS. A total of 1,048 duplicate records were removed. Subsequently, 864 articles were screened by title and abstract, independently by two researchers, with substantial inter-reviewer agreement (overall agreement = 84.88%; free-marginal kappa = 0.70; 95% CI, 0.55–0.85), resulting in the exclusion of 675 publications. It should be noted that, among the studies excluded for not addressing caries lesion management, there were also reviews that combined prevention and management without presenting the data separately, which made it impossible to extract the outcomes of interest in isolation.

The remaining 189 articles were assessed in full. At this stage, the eligibility criteria had to be reassessed for some studies, since essential information — such as the age range of the included population and the separation of data between preventive and management outcomes — was not available in the title and abstract and became identifiable only upon reading the full text. In the end, 136 publications were excluded. One review was excluded because it did not include any primary study in its synthesis, which made the assessment of SPIN in the results and conclusions unfeasible, as there were no findings to interpret. Thus, 53 studies made up the final sample (Figure 1).

Figure 1. Flow diagram of study identification and selection.



There was a predominance of research conducted by authors based in Asia (34%), followed by South America (30.2%) and Europe (22.6%); North America (11.3%) and Africa

(1.9%) had a more modest participation, and no study originated in Oceania. The articles were published in 35 different journals. Regarding impact factor, 58.4% of the studies were published in high-impact journals and 41.6% in lower-impact journals. Among treatment types — with some reviews addressing more than one type — non-invasive methods were the most investigated (52.8%), followed by invasive methods (39.6%); micro-invasive strategies (15.1%) and mixed approaches (13.2%) were less frequent, and a smaller group covered cavity preparations (11.3%). Regarding funding, 35.8% of the studies received institutional support, 1.9% institutional and commercial support, 34% declared no funding, and 28.3% did not declare it; no study was funded exclusively by industry.

Regarding methodological quality, 88.7% of the studies included a risk-of-bias assessment; half (49.1%) reported protocol registration, 65.4% of which were prior registrations; 77.4% declared following the PRISMA guideline; and the GRADE tool was observed in only 28.3% of the studies. The main characteristics of the included studies are described in Table 1.

Table 1. Main characteristics of the 53 included systematic reviews.

Characteristic	n
Location of the principal researcher	
Africa	1
Asia	18
South America	16
North America	6
Europe	12
Journal impact factor (JCR) — median = 2.2	
High (≥2.2)	31
Low (<2.2)	22
Treatment type	
Non-invasive	28
Micro-invasive	8
Invasive	21
Mixed	7
Cavity preparation	6
Funding type	
Institutional	19
Institutional and commercial	1
No funding	18
Not declared	15
Risk-of-bias assessment	
Yes	47
No	6
Protocol registration	
Prospective	17
Retrospective	7
Not found	2

No	27
Declares PRISMA use	
Yes	41
No	12
GRADE assessment	
Yes	15
No	38

Source: the authors.

SPIN was present in 35 abstracts (66%) and in 29 full texts (54.7%), occurring concomitantly in 27 articles (50.9%). In the abstracts, high SPIN was observed in 4 reviews, moderate in 17, and low in 14; in the full texts, the classification was 3 high, 10 moderate, and 16 low. In the abstracts, the most prevalent causes were clinical recommendations not supported by the findings and overinterpretation of primary outcomes as effective (n = 25; 47.2%) (Table 2).

Table 2. SPIN characteristics in the abstracts of the included reviews (total = 53).

Abstract characteristic	n
Publications with SPIN	
High	4
Moderate	17
Low	14
No	18
Clinical recommendations not supported by the findings	
Yes	25
No	28
Title suggests an unproven benefit	
Yes	1
No	52
Excessive emphasis on efficacy / analysis favoring a beneficial effect	
Yes	5
No	48
No mention of adverse events	
Yes	9
No	44
Omission of non-significant primary results	
Yes	3
No	50
Focus on significant results that were not primary	
Yes	2
No	51
Overinterpretation of primary outcomes as effective	
Yes	25
No	28

In the full texts, the most frequent aspect was also the presence of clinical recommendations not supported by the findings (n = 22; 41.5%), followed by overinterpretation of primary outcomes as effective (n = 14; 26.4%) (Table 3). The detailed characterization of SPIN by study is available in Supplementary Material 2.

Table 3. SPIN characteristics in the full texts of the included reviews (total = 53).

Full-text characteristic	n
Publications with SPIN	
High	3
Moderate	10
Low	16
No	24
Clinical recommendations not supported by the findings	
Yes	23
No	30
Title suggests an unproven benefit	
Yes	1
No	52
Excessive emphasis on efficacy / analysis favoring a beneficial effect	
Yes	7
No	46
No mention of adverse events	
Yes	1
No	52
Omission of non-significant primary results	
Yes	1
No	52
Focus on significant results that were not primary	
Yes	1
No	52
Overinterpretation of primary outcomes as effective	
Yes	15
No	38

Source: the authors.

Table 4 presents the association between the presence of SPIN (in the abstract and in the full text) and journal endorsement of the PRISMA guidelines. No statistically significant association was found between SPIN in the abstract and journal endorsement of PRISMA ($p = 0.495$), nor between SPIN in the full text and the same variable ($p = 0.930$).

Table 4. Association between SPIN (abstract and full text) and journal endorsement of the PRISMA guidelines.

SPIN in the abstract	Journal endorses PRISMA			p-value (chi-square)
	No	Yes	Total	
Yes	13	22	35	
No	5	13	18	p = 0.495
Total	18	35	53	
SPIN in the full text	**No**	**Yes**	**Total**	**p-value (chi-square)**
Yes	10	19	29	
No	8	16	24	p = 0.930
Total	18	35	53	

Chi-square test; significance level of 5%. Source: the authors.

4. Discussion

SPIN has previously been assessed in randomized controlled trials in dentistry and pediatric dentistry [41,42] and in systematic reviews restricted to restorative dentistry [39], with the prevalence of this bias observed in all these contexts. Accordingly, the present study extended this investigation by assessing the occurrence of SPIN in systematic reviews on the management of caries lesions in children and adolescents.

These findings reinforce the need for greater rigor and attention from the scientific community regarding how research results are presented and interpreted [43]. Considering that dental practice must be grounded in robust scientific evidence, distortions in the presentation or interpretation of results can influence clinical recommendations and therapeutic decision-making, leading to overestimation of benefits, underestimation of risks, or the adoption of practices based on insufficient evidence, which highlights the importance of critical reading of the literature and careful appraisal of published findings [44–46]. It was also observed that many studies did not adequately consider the risk of bias when drafting abstracts, recommendations, and conclusions, which can contribute to distorted interpretations and amplify the impact of SPIN on clinical practice.

PRISMA, a reporting guideline published in 2009 to help authors report the methodology, results, and conclusions of systematic reviews transparently [47], was declared by 77.4% of the included studies. It was also possible to observe that there was no statistically significant association between the presence of SPIN and journal endorsement of the PRISMA guidelines, either in the abstracts or in the full texts. The presence of SPIN even in studies that adhered to the guideline suggests that formal endorsement of PRISMA, on its own, is not sufficient to prevent interpretive distortions in published manuscripts, since reporting guidelines are frequently used inappropriately [48]. This reinforces that the nominal adoption of reporting guidelines does not, by itself, guarantee the quality of the communication of findings. Beyond the formal adoption of PRISMA, greater training of

researchers in the correct use of these tools is needed to ensure rigor and transparency in scientific communication.

The editorial process and peer review are fundamental parts of publication, and the identification of bias in the literature is essential. Peer review evaluates manuscripts through qualified researchers with respect to methodological competence, relevance, and originality before publication [49]. Reviewers and editors are responsible for critically evaluating not only methodological quality but also the coherence among results, interpretations, and conclusions, providing assessments that improve the manuscript [50]. The identification of interpretive distortions, such as SPIN, becomes an important step in scientific evaluation, helping to prevent the publication of overly optimistic interpretations or interpretations not supported by the evidence. Nevertheless, the process has limitations, such as possible biases related to authors, institutions, or research fields, and difficulties in identifying methodological flaws or distorted interpretations [51].

SPIN was present more often in abstracts than in full texts, which deserves special attention, since the abstract is usually the reader's first contact with the results and conclusions of a study, serving as an invitation to full reading and influencing interpretation even without reading the complete manuscript [52]. This aspect is even more relevant when considering that abstracts of health studies frequently show low reporting quality and inconsistencies relative to the full text, especially in the results and conclusions sections [53].

Therefore, in addition to the review of the quality and integrity of articles by researchers, training in critical reading of the scientific literature is an essential skill for all professionals, so as to enable evidence-based dentistry [54]. During clinical training, preparation to incorporate evidence into patient care includes mastery of scientific fundamentals and the development of critical-appraisal skills, with attention to methodology, bias, and study quality [55,56]. Strengthening these competencies throughout training can contribute to more careful interpretations and better-founded clinical decisions.

As a limitation, SPIN assessment, although supported by a validated tool and conducted after calibration of the assessors, involves an interpretive component that can generate variation among examiners. In addition, the analysis restricted to systematic reviews on the management of caries lesions in children and adolescents may limit the generalization of the findings to other areas of dentistry. As in any meta-research based on the published literature, the findings may also be subject to reporting and publication bias, since reviews with distorted or overly optimistic interpretations may be more likely to be published and indexed, potentially influencing the observed prevalence of SPIN. As strengths, the clinical relevance of the topic and the independent assessment of the abstract and the full text stand out, which allowed a more detailed analysis of interpretive distortions.

5. Conclusion

This meta-research showed that distortion bias (SPIN) is frequent in systematic reviews on the management of caries lesions in children and adolescents, occurring with greater prevalence in abstracts and manifesting through different forms of distortion in the interpretation of results. No significant association was found between SPIN and journal

endorsement of the PRISMA guidelines. These findings reinforce the need for greater methodological rigor, appropriate use of reporting guidelines, and the development of critical-appraisal skills, in order to ensure more reliable interpretations and support evidence-based practice in pediatric dentistry.

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Disclosure statement

The authors report there are no competing interests to declare.

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Declaration on the use of Artificial Intelligence (Declaração de uso de Inteligência Artificial)

During the preparation of this preprint, the authors used the generative artificial intelligence tools Claude and ChatGPT to improve the clarity and style of the language. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the final version.

Data availability statement

The data that support the findings of this study are openly available on the Scielo at, under the CC-BY Attribution 4.0 International license.

Author contributions (CRediT)

LRO: conceptualization, methodology, investigation, formal analysis, data curation, and writing (original draft). TMR: data extraction, investigation, writing, review and editing. MLP: study selection (inclusion and exclusion screening) and investigation. RAE: conceptualization, methodology, writing, review and editing. TKT: methodology (search strategy), writing, review and editing. RCO: writing, review and editing. DPR: conceptualization, methodology, supervision, writing, review and editing.

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