

General

Pain Catastrophizing in Orthopedic Surgery: A Bibliometric Analysis of Global Research Trends, Collaborative Networks, and Clinical Implications (2001–2026)

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Importance

Pain catastrophizing is a pain-related cognitive construct involving persistent rumination about pain, magnification of pain threat, and feelings of helplessness. In musculoskeletal and perioperative contexts, higher catastrophizing is associated with greater pain intensity, disability, distress, delayed recovery, opioid use, and healthcare utilization. Within orthopedic populations, preoperative psychological status is increasingly recognized as relevant to postoperative pain and patient-reported outcomes.

Objective

To analyze worldwide research patterns on pain catastrophizing from 2001 to 2026 in orthopedic surgery, including publication growth, document types, subject categories, journals, institutions, funding bodies, and co-authorship networks.

Methods

A bibliometric analysis was performed using Web of Science Core Collection records related to pain catastrophizing and orthopedic or musculoskeletal surgery. Records were exported and analyzed through VOSviewer network mapping.

Results

The dataset was dominated by original articles (1,173 visible records), followed by review articles (95). Annual output was modest in the early 2000s, increased after 2008, and showed sustained growth through the early and mid-2020s, with lower 2026 counts reflecting incomplete indexing. The most visible subject categories were Neurosciences/Neurology, Orthopedics, Anesthesiology, Rehabilitation, and General/Internal Medicine. The leading journals included *Pain*, *Journal of Pain*, *Clinical Journal of Pain*, *European Journal of Pain*, and *Pain Medicine*. Institution and author maps showed visible collaboration hubs, including major contributions from Harvard-affiliated institutions and investigators such as David Ring, Steven Z. George, Mira Meeus, Mark P. Jensen, Michael J. Sullivan, Jo Nijs, Robert R. Edwards, and Lars Arendt-Nielsen.

Conclusions

Pain catastrophizing research in orthopedic surgery has become a sustained, interdisciplinary literature. The field is strongly rooted in pain science, but its clinical meaning is closely tied to psychiatry and behavioral health because catastrophizing connects fear, mood, coping, opioid use, rehabilitation behavior, and surgical recovery.

INTRODUCTION

Pain catastrophizing is defined as a magnified negative mental set brought to bear during actual or anticipated painful experience.¹ The mental set comprises three components: rumination, or persistent focus on pain; magni-

fication, or amplification of the threat value of pain; and helplessness, or the perceived inability to cope effectively with pain.^{1,2} Since the development and validation of the Pain Catastrophizing Scale (PCS), catastrophizing has become one of the most frequently studied psychological predictors of pain-related outcomes.

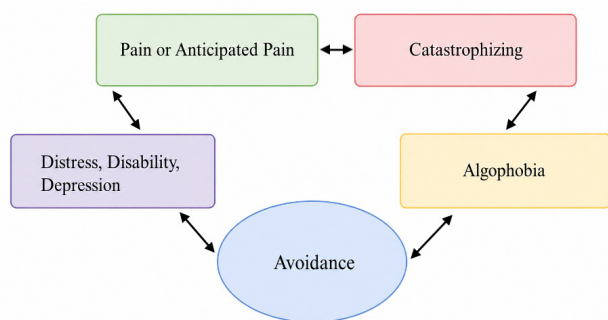


Figure 1. The fear avoidance model of musculoskeletal pain, adapted from Leeuw et al (4).

The theoretical roots of catastrophizing are closely tied to the fear-avoidance model of chronic musculoskeletal pain (Figure 1).

Figure 1 shows this fear-avoidance model, where pain, or even expecting pain, can lead someone to catastrophize, meaning they think about the pain in an overly fearful or negative way. That catastrophizing can then create fear of pain (algo-phobia) and cause the person to avoid movement or activity. Over time, that avoidance can worsen disability, depression, and distress, which then feeds back into the pain cycle.^{3,4} Subsequent reviews have generally supported the view that catastrophizing is associated with higher pain severity, greater emotional distress, and worse functional outcomes, although the strength of these associations varies across populations and study designs.⁵

Neurobiological literature points to catastrophizing being linked with atypical processing in brain regions concerned with salience, affect, and pain modulation, such as the anterior cingulate cortex, anterior insula, thalamus, and dorsolateral prefrontal cortex.⁶ Goodin et al. (2009) associated catastrophizing with a deficit in endogenous pain-inhibitory processing. Other studies have, however, suggested that individuals with higher levels of catastrophizing tend to report higher levels of nociceptive pain response for fixed levels of nociceptive input.⁵ Edwards et al. (2008) observed that interleukin-6-mediated responses to immediate pain were amplified in individuals exhibiting higher levels of catastrophic thinking. In other words, there is an association between maladaptive pain cognitions and pro-inflammatory stress responses.⁷⁻⁹

Across orthopedic populations, higher level of preoperative catastrophizing have been associated with worsened post-operative pain, poorer function, lesser satisfaction, and poor patient-reported outcome measures.¹⁰ Specifically, surgery presents a vital context to examine catastrophizing because the success of post-operative recovery relies on more than just simply the technical success of surgery. This is the case for persistent pain, dissatisfaction, poor function, or delayed rehabilitation reported in some patients after surgeries that on average, have

efficacy. Burns et al. (2015) found moderate evidence for pain catastrophizing as an independent predictor of chronic post-operative pain in total knee arthroplasty, and

Patel et al. (2022) demonstrated that interventions focused on combating catastrophizing after knee replacement remain an actively investigated topic despite the currently available studies being methodologically heterogeneous.^{11, 12}

The same trend is observed in other orthopedic subspecialties. Lumbar spine surgery the same pattern in findings has been noted across orthopedic subspecialties, where pain catastrophizing and pain sensitivity were reported to be associated with persistent pain and disability after surgery,¹³ whereas more recently Kumar et al. (2024)¹⁴ evaluated pain catastrophizing scale thresholds as a potential basis for referral to perioperative pain psychology in spinal surgery patient populations. In further mixed orthopedic surgical populations with spine and lower-extremity surgeries, Rhon et al. (2022)¹⁵ found that presurgical catastrophizing predicted subsequent opioid use and surgery-related healthcare use.

Arthroplasty and hip-preservation studies further support the clinical relevance of this construct. In a systematic review of total hip arthroplasty outcomes, O'Connor and colleagues found that preoperative psychological factors, especially depression and anxiety, were relevant to postoperative pain and function.¹⁶ In pre-arthritis hip disease and hip arthroscopy, elevated catastrophizing has been linked to poorer postoperative patient-reported outcomes, and recent literature on femoroacetabular impingement has emphasized both catastrophizing and resilience as psychosocial determinants of recovery.¹⁷⁻¹⁹

Trial data have shown that targeted cognitive behavioral approaches have been able to reduce catastrophizing in some orthopedic populations and improve some aspects of recovery, but only when the interventions are designed for the high-risk populations.^{10,20}

With pain catastrophizing in orthopedic surgery spreading across neurology, anesthesiology, rehabilitation, psychology, pain medicine, and surgery, the bibliometric approach best studies its growth.

METHODS

DATA SOURCE AND SEARCH STRATEGY

A bibliometric analysis was conducted using the Web of Science (WoS) Core Collection database, selected for its comprehensive indexing of high-impact, peer-reviewed literature and compatibility with bibliometric mapping software. A structured Boolean search strategy was developed to capture publications related to pain catastrophizing within orthopedic and musculoskeletal surgery:

TS = ("pain catastrophizing" OR "pain catastrophization" OR "pain catastrophisation")
AND
TS = ("orthopedic" OR "orthopaedic" OR "musculoskeletal" OR "joint replacement" OR "arthroplasty" OR "spine surgery" OR "fracture" OR "sports injury")

The search encompassed publications from January 1, 2001 through December 31, 2026. Results were limited to

English-language records. All document types indexed in WoS were eligible for initial inclusion.

ELIGIBILITY CRITERIA AND SCREENING

Studies were included if they (1) addressed pain catastrophizing as a primary or relevant secondary construct and (2) were situated within the context of orthopedic or musculoskeletal surgery. Publications were excluded if they were unrelated to surgical orthopedic practice or did not substantively evaluate pain catastrophizing.

Duplicate records were removed prior to screening. Two-stage screening (title/abstract followed by full-text review when necessary) was performed to ensure relevance and methodological consistency. Clearly irrelevant studies were excluded during this process.

DATA EXTRACTION AND BIBLIOMETRIC ANALYSIS

Bibliographic data were exported from WoS in a compatible format and analyzed using VOSviewer (version 1.6.20) for network visualization and mapping. The following bibliometric indicators were assessed:

- Annual publication output
- Document types
- Web of Science subject categories
- Leading journals
- Most productive institutions and countries
- Co-authorship networks

NETWORK MAPPING AND THRESHOLDS

To ensure meaningful visualization and reduce noise, pre-defined thresholds were applied:

- Author co-authorship analysis: minimum of 5 publications per author, yielding 135 qualifying authors included in the final network
- Keyword co-occurrence analysis: minimum occurrence threshold of 10, with a secondary sensitivity analysis at 20 occurrences
- Country and institutional collaboration networks: minimum of 5 publications per entity

Network maps were generated using VOSviewer's fractional counting method, with clustering based on association strength to identify thematic and collaborative structures within the literature.

SENSITIVITY ANALYSIS

A sensitivity analysis was performed by increasing the keyword co-occurrence threshold from 10 to 20 to evaluate the robustness and stability of identified thematic clusters.

RESULTS

ANNUAL OUTPUT

The annual output suggests a field that has been growing gradually during the observed periods. Lower publication

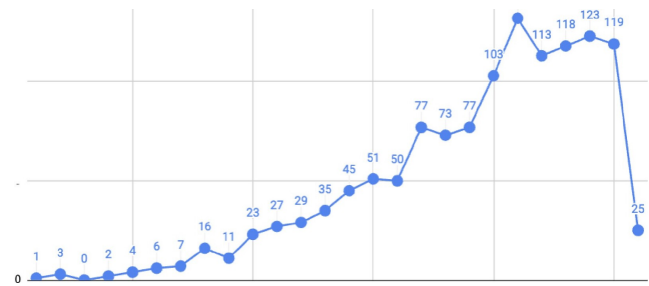


Figure 2. Annual Publication Output on Pain Catastrophizing in Orthopedic Surgery (2001-2026)

Final Publication Year

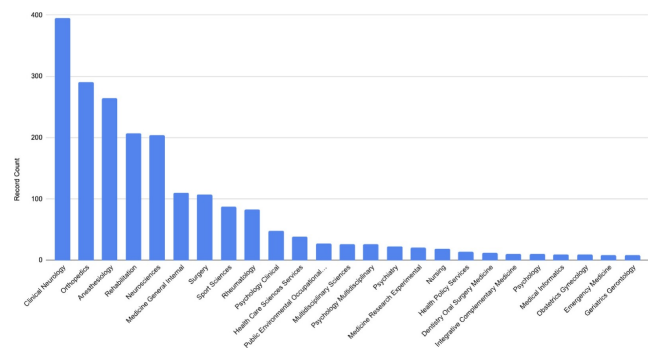


Figure 3. Top Subject Categories in Pain Catastrophizing and Orthopedic Surgery Research

Subject category

counts observed in 2026 likely reflect incomplete indexing of an ongoing publication year (Figure 2).

DOCUMENT TYPE

The document-type tree map (Figure 2) shows that the field is dominated by original articles (1,173 visible records), followed by review articles (95). More smaller categories include early access records (16), editorial materials (7), meeting abstracts (7), proceedings papers (6), letters (2), corrections' publications (2), and retracted ones (2). Commentary and pre-conference or conference-based records are less driving in total visible literature than original empirical research. This figure also indicates that the field has developed a substantial enough evidence base to sustain growing body of review literature.

SUBJECT CATEGORY

The subject-category figure shows that the literature is interdisciplinary to a great extent (Figure 3). The highest bar is "Neurosciences Neurology", followed by "Orthopedics", "Anesthesiology", "Rehabilitation", and "General Internal Medicine". General/Internal Medicine, Surgery, Sport Sciences, Rheumatology, Psychiatry and Clinical Psychology are comparatively minor, yet still present.

Table 1. Top 10 articles with the highest citation counts

Title	Authors	Journal	Year of Publication	DOI	Total Citations	Average per Year
The fear-avoidance model of musculoskeletal pain: Current state of scientific evidence	Leeuw, Maaike; Goossens, Marielle E. J. B.; Linton, Steven J.; Crombez, Geert; Boersma, Katja; Vlaeyen, Johan W. S.	JOURNAL OF BEHAVIORAL MEDICINE	2007	10.1007/s10865-006-9085-0	1635	81.75
Pain catastrophizing and kinesiophobia: Predictors of chronic low back pain	Susan, H; Picavet, J; Vlaeyen, JWS; Schouten, JSAG	AMERICAN JOURNAL OF EPIDEMIOLOGY	2002	10.1093/aje/kwf136	544	21.76
Cut-Off Points for Mild, Moderate, and Severe Pain on the Numeric Rating Scale for Pain in Patients with Chronic Musculoskeletal Pain: Variability and Influence of Sex and Catastrophizing	Boonstra, Anne M.; Stewart, Roy E.; Koke, Albert J. A.; Oosterwijk, Rene F. A.; Swaan, Jeannette L.; Schreurs, Karlein M. G.; Schiphorst Preuper, Henrica R.	FRONTIERS IN PSYCHOLOGY	2016	10.3389/fpsyg.2016.01466	492	44.73
Pain, catastrophizing, and depression in the rheumatic diseases	Edwards, Robert R.; Calahan, Christine; Mensing, George; Smith, Michael; Haythornthwaite, Jennifer A.	NATURE REVIEWS RHEUMATOLOGY	2011	10.1038/nrrheum.2011.2	480	30
Pain catastrophizing predicts pain intensity, disability, and psychological distress independent of the level of physical impairment	Severeijns, R; Vlaeyen, JWS; van den Hout, MA; Weber, WEJ	CLINICAL JOURNAL OF PAIN	2001	10.1097/00002508-200106000-00009	466	17.92
Preoperative Anxiety and Catastrophizing - A Systematic Review and Meta-analysis of the Association With Chronic Postsurgical Pain	Theunissen, Maurice; Peters, Madelon L.; Bruce, Julie; Gramke, Hans-Fritz; Marcus, Marco A.	CLINICAL JOURNAL OF PAIN	2012	10.1097/AJP.0b013e31824549d6	419	27.93
Psychological Factors Affecting the Outcome of Total Hip and Knee Arthroplasty: A Systematic Review	Vissers, Maaike M.; Bussmann, Johannes B.; Verhaar, Jan A. N.; Busschbach, Jan J. V.; Bierma-Zeinstra, Sita M. A.; Reijman, Max	SEMINARS IN ARTHRITIS AND RHEUMATISM	2012	10.1016/j.semarthrit.2011.07.003	359	23.93
Pain Neuroscience Education for Adults With Chronic Musculoskeletal Pain: A Mixed-Methods Systematic Review and Meta-Analysis	Watson, James A.; Ryan, Cormac G.; Cooper, Lesley; Ellington, Dominic; Whittle, Robbie; Lavender, Michael; Dixon, John; Atkinson, Greg; Cooper, Kay; Martin, Denis J.	JOURNAL OF PAIN	2019	10.1016/j.jpain.2019.02.011	317	39.63
Preoperative Pain Catastrophizing Predicts Pain Outcome after Knee Arthroplasty	Riddle, Daniel L.; Wade, James B.; Jiranek, William A.; Kong, Xiangrong	CLINICAL ORTHOPAEDICS AND RELATED RESEARCH	2010	10.1007/s11999-009-0963-y	308	18.12
Are 20% of Patients Actually Dissatisfied Following Total Knee Arthroplasty? A Systematic Review of the Literature	DeFrance, Michael J.; Scuderi, Giles R.	JOURNAL OF ARTHROPLASTY	2023	10.1016/j.arth.2022.10.011	296	74

PUBLICATIONS, AUTHORS & INSTITUTIONS

The journal tree map identified Pain (59 publications) and Journal of Pain (58) as the most prominent outlets in the uploaded dataset. They are followed by Clinical Journal of Pain (55), European Journal of Pain (45) and Pain Medicine (42). This pattern suggests that the topic is more often published in pain-based journals rather than only in orthopedic journals.

In terms of institutions, Harvard University and its affiliates hold first place. [Table 1](#) lists the top 10 most cited articles.

Prominent authors in the author network are David Ring, Steven Z. George, Michael JL Sullivan, Johan WS

Vlaeyen, Mira Meeus, Jo Nijs, Mark P Jensen, Robert R Edwards, Claudia M Campbell, Francis J Keefe, and Lars Arendt-Nielsen ([Figure 4](#)).

The country collaboration map shows the United States as the largest visible node, with links to Australia, Canada, the Netherlands, England, Belgium, Denmark, Spain, and other countries ([Figure 5](#)). This pattern suggests that the research is international.

KEYWORD ANALYSIS

The keyword co-occurrence map revealed several interconnected thematic clusters within the pain catastrophizing literature. A central cluster was dominated by terms such

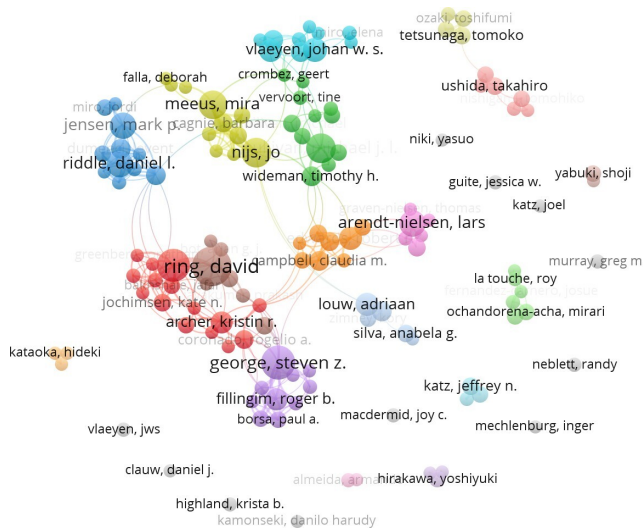


Figure 4. VOSViewer map demonstrating collaborations between authors

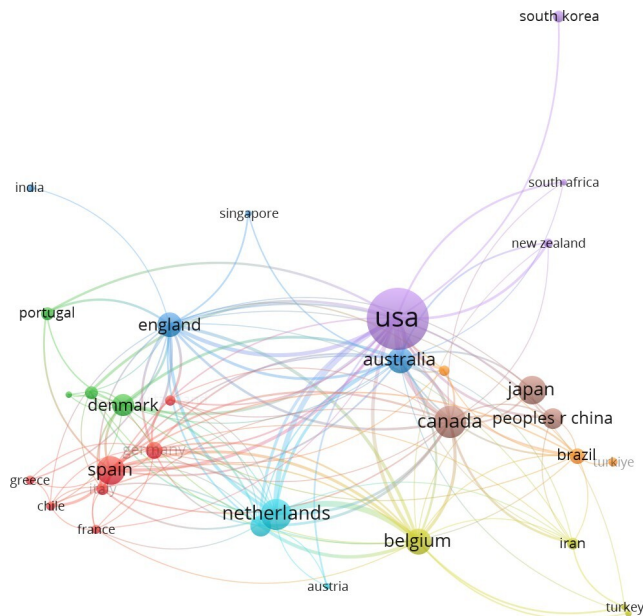


Figure 5. VOSViewer map demonstrating collaboration between countries

as pain catastrophizing, disability, low back pain, chronic pain, anxiety, and depression, highlighting the strong relationship between catastrophizing and psychological distress, functional impairment, and chronic musculoskeletal pain conditions. A second cluster centered on rehabilitation, exercise, kinesiophobia, central sensitization, and management, reflecting the growing emphasis on behavioral and rehabilitation-based approaches to pain recovery. A third cluster focused on orthopedic outcomes, with prominent terms including osteoarthritis, arthroplasty, knee arthroplasty, replacement, postoperative pain, quality of life, and patient satisfaction, demonstrating the increasing integration of pain catastrophizing into perioperative and joint replacement research. Additional clusters involved psychometric evaluation and measurement science,

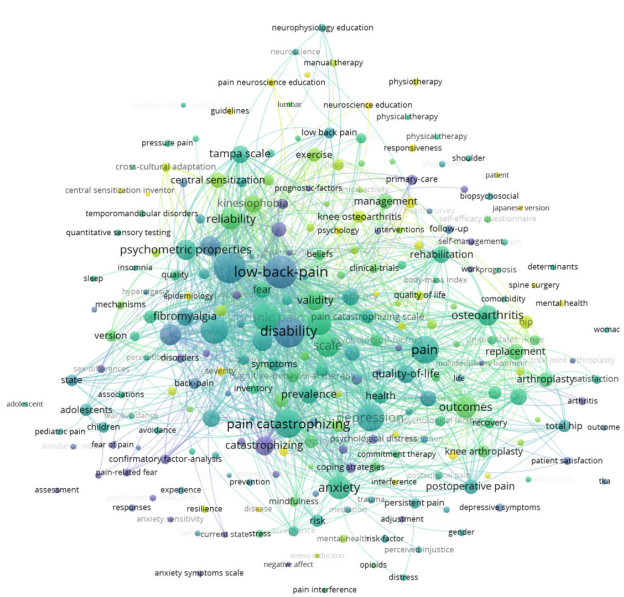


Figure 6. VOSviewer visualization of keyword co-occurrence.

characterized by terms such as Pain Catastrophizing Scale, validity, reliability, psychometric properties, and cross-cultural adaptation, indicating substantial efforts to validate catastrophizing assessment tools across diverse populations. Collectively, these findings suggest that contemporary research on pain catastrophizing has evolved from a primarily psychological construct toward a multidisciplinary field encompassing pain neuroscience, rehabilitation medicine, and orthopedic surgical outcomes.

DISCUSSION

The first major finding of this analysis is that research on pain catastrophizing in orthopedic surgery appears to have experienced sustained expansion rather than episodic growth. This is clinically plausible; psychological and psychiatric realities have been more frequently studied over the last decade. Within this larger movement, evidence increasingly recognizes catastrophizing as one of the most relevant pain-specific constructs.^{5,10}

The second major finding is that the field is structurally anchored in pain science rather than in clinical psychology alone. The strongest categories are Clinical Neurology, Anesthesiology, Rehabilitation, and Neurosciences, with Psychiatry and Clinical Psychology being relatively minor but still present. Catastrophizing refers to more than just emotional distress in the literature; it also relates to central sensitization, fear of movement, opioid consumption, and the consumption of healthcare services.^{9,15}

From a psychiatric perspective, this is an important opportunity. Catastrophizing is not the same thing as depression or anxiety, but it commonly exists in the same clinical realm. Pain can worsen recognition and treatment of depression,²¹ and orthopedic teams should therefore view high PCS scores as a signal for support. Preoperative pathways that include brief screening, expectation-setting, and

referral to pain psychology or psychiatry may make the literature more actionable.

The collaboration map is in line with this perception. Some leading investigators are in rehabilitation, pain neuroscience, perioperative pain, and behavioral medicine, so the hubs visible are not all orthopedic surgeons. This also helps explain why journals such as *Pain*, *Journal of Pain*, *Clinical Journal of Pain*, *European Journal of Pain*, and *Pain Medicine* are so prominent in the dataset.

Notably, the prominence of keywords such as *osteoarthritis*, *arthroplasty*, *postoperative pain*, and *quality of life* suggests that pain catastrophizing has become increasingly relevant within value-based orthopedic care, where patient-reported outcomes and recovery trajectories are now considered essential measures of surgical success.

A further implication is for intervention-based research. The field is evidently large enough now to warrant moving beyond observational prognostic studies. Systematic review evidence for total knee replacement suggests that interventions that target catastrophizing remain promising but methodologically uneven.¹² This suggests the next phase of the literature may rely on better intervention timing, standardized outcome measures, and integrated pain-psychology and psychiatry expertise into orthopedic pathways, rather than merely demonstrating that catastrophizing matters.²⁰

The prominence of arthroplasty, spine, and hip preservation literature suggests that pain catastrophizing has be-

come increasingly relevant to modern orthopedic practice. As value-based care increasingly emphasizes patient-reported outcomes, psychological constructs such as catastrophizing may represent modifiable risk factors that influence postoperative satisfaction, rehabilitation adherence, opioid utilization, and return to function.

LIMITATIONS

At the record level, some of the visible counts in Web of Science figure outputs, including document types and subject categories, overlap. That is a known limitation of bibliometric reporting and one reason why these counts should never be naively summed to infer unique publication totals. The second limitation is methodological, as the project is limited to a single database, which is Web of Science. That is common in bibliometric research, but it excludes records indexed to Scopus, PubMed-only sources, Embase, Dimensions, or regional databases. A third limitation is temporal, whereby the 2026 counts are partial-year and hence not comparable outright to completed years. Bibliometric analysis, therefore, can provide information about productivity, structure, and visibility only, but not evidentiary quality or risk of bias.

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