Characteristics of retracted publications related to pain research: a systematic review

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Summary

The number of retracted pain publications is increasing over time and research misconduct is not uncommon in pain research.

Abstract

Retraction is a mechanism for correcting the scientific record and alerts readers when a study contains unreliable or flawed data. Such data may arise from error or research misconduct. Studies examining the landscape of retracted publications provide insight into the extent of unreliable data and its effect on a medical discipline. We aimed to explore the extent and characteristics of retracted publications in pain research. We searched the EMBASE, PubMed, CINAHL, PsycINFO and Retraction Watch databases to 31 December 2022. We included retracted articles that (i) investigated mechanisms of painful conditions, (ii) tested treatments that aimed to reduce pain, or (iii) measured pain as an outcome. Descriptive statistics were used to summarise the included data. We included 389 pain articles published between 1993 and 2022 and retracted between 1996 and 2022. There was a significant upward trend in the number of retracted pain articles over time. Sixty-six percent of articles were retracted for reasons relating to misconduct. The median (interquartile range) time from article publication to retraction was 2 (0.7 to 4.3) years. The time to retraction differed by reason for retraction, with data problems, comprising data falsification, duplication, and plagiarism, resulting in the longest interval (3 (1.2 to 5.2) years). Further investigations of retracted pain articles, including exploration of their fate post-retraction, are necessary to determine the impact of unreliable data on pain research.

1. Introduction

When an empirical scientific publication is found to have unreliable data and/or conclusions, it may be retracted. Retraction is an essential mechanism for correcting the scientific record and alerting readers when issues of conduct or reporting raise questions as to the veracity of the findings [56]. Retractions may arise from honest error, naïve mistakes, or fraud or other intentional misconduct, with more than one reason often cited [6,46,48]. The Committee on Publication Ethics (COPE) [56] and the International Committee of Medical Journal Editors (ICMJE) [25] have issued guidelines for retracting publications and the form retraction notices should take.

Retractions in the scientific, and more specifically, medical literature are rising, attributed to the increased rate of publication, and changes in institutional policy and author behaviour [20,36,47,48]. Retraction of medical publications can have direct implications for patient care and outcomes [44,57]. When problematic papers are not retracted, erroneous findings proliferate throughout the literature and may influence systematic review results [19], clinical guideline recommendations [27], and policy decisions. Failure to retract also undermines scientific development [7,45]. Unfortunately, many medical articles continue to be cited long after their retraction, usually without referencing the retraction notice [2,35].

Studies examining the landscape of retracted publications may provide insight into the extent of data that are flawed or fraudulent and their effect on altering a field of practice [32]. The characteristics of retracted articles have been explored in several specialty areas, including anaesthesiology [34], cardiology [1], surgery [28], rehabilitation [4], obstetrics [3], and oncology [21]. Factors such as reason for retraction, time to retraction, and author host countries are known to vary across disciplines. For example, in anaesthesiology, 76% of all retractions were due to misconduct, a rate almost 15% higher than in the wider biomedical literature [20,34]. It is unclear whether, like anaesthesiology, the wider pain field is vulnerable to field-specific phenomena that influence retractions. To date, no investigation of retracted articles in pain research has been conducted. The aim of this review was to explore the extent and characteristics of retracted publications in the pain literature.

2. Methods

We prospectively registered a protocol for this review on the Open Science Framework https://osf.io/fx26u/. This study did not require institutional review board approval because it did not use patient-level data.

2.1 Searches

We searched the EMBASE (Ovid), PubMed (Medline), CINAHL (EBSCO) and PsycINFO databases from inception to 31 December 2022. The bibliographic search strategy was developed in collaboration with information specialists and combined medical subject headings and text terms relating to ‘pain’, ‘headache’, and ‘migraine’, with ‘retraction’ and ‘withdraw’. We also searched the Retraction Watch Database [50] from inception to 31 December 2022 using keywords for painful conditions. Retraction Watch is a publicly available database of retracted scientific publications. The database tracks and aggregates retracted articles through a range of sources

including publisher websites, user submissions and social media. Information included in retraction notices are used to assign one or more reason for retraction for every article. The complete search strategy is provided in Supplementary Appendix 1.

2.2 Study selection and data extraction

Two authors (MCF, NOC) independently screened records for inclusion. For records identified via bibliographic database searches, we screened titles and abstracts followed by full texts. We screened records identified via Retraction Watch using the database information and, where necessary, by referencing full texts. We included clinical and preclinical experimental or observational studies that (i) investigated mechanisms of painful conditions, (ii) tested treatments that aimed to reduce pain, or (iii) measured pain as an outcome; and (iv) had a notice of retraction or withdrawal. We excluded published study protocols.

Two authors (MCF, NOC) independently extracted data using a piloted data extraction form. For each included record, we extracted data on study characteristics (title, authors, first affiliation of first and last authors, country of first author, year of publication, funding body of the study, number of participants, study design, painful condition, number of citations [Google Scholar]) [22], journal, publisher, 2021 Journal Citation Reports™ journal impact factor, impact factor quartile, and journal category [26], and retraction characteristics (reasons and description of retraction, number of retraction reasons, date of retraction, issuer of the retraction notice, type of retraction notice [linkage or watermark]). Disagreements in the screening and extraction processes were resolved through discussion with a third reviewer.

2.3 Study classification

For each record, two authors (MCF, NOC) assigned a primary reason for retraction using adapted criteria from the Retraction Watch database and recent publications [41,43,53]. We grouped retraction reasons into seven categories: data problems, ethical problems, other misconduct, authorship problems, error, publishing problems, and all other reasons. These reasons corresponded to either misconduct (data problems, ethical problems, other misconduct) or non-misconduct (authorship problems, error, publishing problems, all other problems). We provided a detailed description for each primary reason for retraction and reported the total number of reasons for each retracted article. Where included articles had multiple reasons for retraction, we cross-referenced the retraction reason from the Retraction Watch database with the information provided in the article's retraction notice to assign a primary reason. In cases where insufficient information was provided in the retraction notice, we selected that which was considered to be the most egregious. For reasons corresponding to misconduct, this generally used the following hierarchy: data problems, ethical problems, other misconduct. We classified articles for which there was no reported retraction reason under all other problems. Definitions adapted from the Retraction Watch User Guide Appendix B [39] for each retraction description are provided in Supplementary Table 1.

2.4 Statistical analysis

We used descriptive statistics to summarise the included data. Categorical variables were presented as counts and percentages. Following visual inspection of

continuous variables for normality they were presented as median and interquartile range. We calculated time to retraction by subtracting the original publication date from the retraction date. We explored trends of absolute frequencies over time by examining plotted timeseries and tested statistical significance using the Mann Kendall test. All analyses were conducted in R version 4.1.2 [38].

2.5 Sensitivity analysis
We conducted sensitivity analyses to assess the influence of the lag between article publication and retraction on total retractions and time to retraction trends by repeating analyses but excluding articles published after 2019.

2.6 Deviations from protocol
We made two changes from the planned protocol during the conduct of this review. We searched databases from inception instead of from 1982, and we did not search Google Scholar due to the absence of search filters with adequate specificity.

3. Results

The bibliographic database searches returned 5054 records and an additional 1141 records were identified on the Retraction Watch database. After removing 408 duplicate records, we screened 5787 records for inclusion. We excluded 5363 ineligible records, and 35 records could not be retrieved. A total of 389 records were included in the review. The PRISMA [37] study selection flowchart and checklist are presented in Figure 1 and Supplementary Appendix 2, respectively.

3.1 Study characteristics
Our searches identified 389 pain articles published between 1993 and 2022 and retracted between 1996 and 2022 (Figure 2). There was a significant upward trend in the number of retracted pain publications over time (Mann-Kendall, tau = 0.70, two-sided $p < 0.001$). This trend remained significant after restricting the analysis to articles published before 2020. In 2009 and 2020 there were large spikes in total retractions, with 29 and 62 articles retracted, respectively.

Table 1 shows the study design and clinical areas of retracted articles. Clinical observational studies represented the most retracted study design, followed by clinical randomised studies, preclinical studies and clinical reviews. The five most frequently retracted clinical areas were peri- and post-operative pain, osteoarthritis, spinal pain, rheumatoid arthritis and neuropathic pain. Peri- and post-operative pain were the most common clinical areas in observational and randomised clinical studies, whereas osteoarthritis and rheumatoid arthritis were most common in preclinical studies (Supplementary Table 2).

3.2 First author countries and affiliations
First author countries and affiliations are presented in Table 2. First authors of retracted publications were affiliated with institutions from 37 countries, most commonly China, Japan, the United States, South Korea, and Germany. Retracted studies from China were mostly preclinical, whereas the majority of retracted studies from Japan, South Korea, the United States and Germany had clinical observational or randomised designs (Supplementary Figure 1).

Three-quarters of first authors were affiliated with clinical institutions, predominantly hospitals, followed by academic institutions and industry. Clinical affiliations were most common for authors of retracted articles from China (n = 107, 88%), Japan, (n = 55, 86%), the United States (n = 35, 67%), South Korea, (n = 13, 65%) and Germany (n = 16, 84%).

3.4 Authors

Twelve authors were critically involved in three retracted articles or more, with a single author (Hironobu Ueshima) responsible for 8.5% (n = 33) of all retracted publications (Supplementary Table 3). Of these twelve authors, seven were practising clinicians in the anaesthesiology field.

3.5 Study funding

Funding information was reported for 54% (n = 211) articles (Supplementary Table 4). National and state (n = 84, 22%) grants were the most common reported sources of public funding. Industry funding accounted for 4.1% (n = 16) of all disclosed funding. National or state grants were the most frequently reported funding source for all retracted studies from institutions in China (n = 48, 39%), Japan (n = 4, 6.2%), South Korea (n = 6, 30%) and Germany (n = 2, 11%), whereas industry and internal funding were most common for studies conducted by institutions in the United States (n = 9, 17% each).

3.6 Reasons for retraction

Reasons for retraction and their descriptions are provided in Table 3. Of all articles, 66% (n = 258) were retracted for reasons relating to misconduct. There were significant upward trends over time in total retractions for both misconduct (Mann-Kendall, tau = 0.60, two-sided p <0.001) and non-misconduct (Mann-Kendall, tau = 0.67, two-sided p <0.001) (Supplementary Figure 2).

Almost half (n = 186, 48%) of all articles were retracted for data problems, comprising falsification, duplication, and plagiarism. Ethical problems represented 10% (n = 39) of all retractions, with most retracted specifically because they lacked appropriate ethical approval. For non-misconduct, error (unreliable or erroneous data) accounted for the majority of total retractions. Only 12 (3.1%) of studies reported no specific reason for retraction. Articles commonly had multiple reasons for retraction, with 40% (n = 153) retracted for two or more reasons.

Across all study designs, articles were mostly retracted for reasons relating to misconduct, representing 69% (n = 187) and 56% (n = 59) of clinical and preclinical studies, respectively. Retraction rates for misconduct varied across the most commonly retracted author host countries, ranging from 61% for China (n = 74) to 92% for Japan (n = 59) (Supplementary Figure 3).

3.7 Time to retraction

Data to calculate the interval between publication and retraction were available for 376 articles (97%). The median (interquartile range (IQR)) time from publication to retraction was 2 (0.7 to 4.3) years. There was a significant downward trend (Mann-Kendall, tau = -0.36, two-sided p <0.001) in the time to retraction over time (Figure 3). The extent of increased speed of retraction was dramatic, falling from a mean of about 5 years before 2010, to under 1 year more recently. The trend remained

significant after restricting the analysis to articles published before 2020. The time to retraction varied by retraction reason, with data problems and ethical problems resulting in the longest intervals (Table 4 & Supplementary Figure 4).

3.8 Journal and publisher characteristics

Journal Citation Reports impact factor and impact factor quartile data were available for 335 articles (86%). The median (IQR) impact factor for journals of retracted articles was 3.8 (2.9 to 6.5), published across 41 different journal categories. Articles were mostly published in Q1 impact factor journals (n = 118, 30%), followed by Q2 (n = 95, 24%), Q3 (n = 93, 24%), and Q4 (n = 29, 7.5%). Retracted articles had 72 unique publishers (Supplementary Table 5).

3.9 Article citations

Citation data were available for 386 articles (99%). Retracted articles were cited a median of 13 (4 to 36) times, with 36% (n = 139) of articles cited between 1 and 10 times, and 16 % (n = 64) of articles cited between 11 and 20 times (Supplementary Figure 5).

3.10 Retraction notices

Supplementary Table 6 shows the types of retraction notices and their issuers. Three-quarters of retracted articles were labelled with a retraction watermark and had a retraction notice linked to the original article, and around a quarter of articles had a linked retraction notice alone. Retraction notices were mostly issued by the journal editors, either alone, or in conjunction with the authors and/or publisher (n = 256, 65%).

4. Discussion

We present a comprehensive summary of the character and consequence of retracted publications in the pain literature. Our searches identified 389 publications retracted over a 26-year period. We observed an upward trend in the number of retractions over time. More than half of all retracted articles were retracted for reasons relating to misconduct, including data falsification, duplication, plagiarism, and ethical violations. The interval between publication and retraction is decreasing over time though longer intervals were observed for articles retracted for misconduct. First authors of retracted articles were most frequently based in China and almost three-quarters of authors were affiliated with clinical institutions. To our knowledge, this is the first study to assess the extent and characteristics of retracted publications in the pain literature.

Our findings show a sharp rise in the number of retracted pain articles over time, in line with other medical disciplines [1,21,34]. It has been demonstrated that such trends are not merely a consequence of increases in scientific publications [14,48]. Growing retraction rates may be influenced by academic culture, author behaviour, changes to institutional policy, expansion of criteria for retraction, willingness of journal editors to retract, and the rising impact of post-publication peer review [14,29,48]. Because pain articles are published widely across journal categories, we were unable to reliably measure the total number of pain publications over time. It is therefore uncertain whether factors other than increases in total publications are driving the observed trend.

As with the wider biomedical literature [20], more than half of all retracted pain articles were retracted for reasons relating to misconduct. While we found a lower retraction rate for error compared with all biomedical studies [53] (20% vs 32%), we suspect that the true error rate in our sample was lower. We observed many instances where retraction notices for error or unreliable data were ambiguous or contained euphemisms for misconduct [16,18]. Many such retractions were initiated by study authors, a practice reported to occur when misconduct investigations are initiated [13]. Ambiguously worded retraction notices may reflect editorial reluctance to communicate that they had published fraudulent results, or caution regarding the publication of statements that attract legal challenge.

Decreasing intervals between article publication and retraction have been previously reported [1,20,41] and may represent improved practices of identifying and retracting untrustworthy articles. The strength of the trend in our investigation is likely overestimated in recent years due to the lag between publication and retraction. The time to retraction varied by retraction reason, with longer intervals for articles retracted for misconduct. This phenomenon has been previously reported [1,33,55] and may be explained by the delays involved in investigating and establishing misconduct. We did not investigate whether the potential impact of this lag was minimised through the publication of an ‘expression of concern’ statement for the period during which misconduct allegations were investigated, as recommended by COPE guidelines [56].

We found that clinical and preclinical studies were each dominated by different clinical areas. Preclinical studies mostly investigated osteoarthritis and rheumatoid arthritis. Many such studies were retracted for image manipulation or duplication, often identified by independent data-integrity investigators [42]. Preclinical studies, especially those containing images, may be especially prone to systemic production of falsified research via ‘paper mills’ [8,52]. Most clinical studies involved interventional peri- and post-operative analgesic procedures. Misconduct in anaesthesiology research has been well documented [52], attributed to both the opportunities to rapidly generate large sets of clinical data [12] and improved fraud detection methods arising from a longstanding acknowledgement of misconduct within the field [9,54]. That clinical studies were more frequently retracted for misconduct than preclinical studies may be explained by the finding that seven anaesthesiologists, all found to have committed misconduct, contributed to almost a third of all retractions [5,49].

Retracted publications are authored widely across the globe but individual countries contribute disproportionately [23,40]. The dominance of authors from China, Japan, the United States and Germany in our study is unremarkable considering they comprise four of the top five most retracted countries in the biomedical literature [20]. Furthermore, matched-control data show that China, South Korea and Germany are more likely to host authors of retracted publications, with this variation largely driven by national research integrity policies [15]. While it is suggested that retractions, especially those arising from misconduct, are more likely to occur in research conducted in countries where publication performance determines career progression [11], there is some evidence that authors working in such countries are less likely to produce retracted publications, and more likely to correct them [15].

Authors from leading universities produce fewer retracted articles, particularly those arising from misconduct [49]. We found that almost three-quarters of authors of retracted pain articles were affiliated with clinical institutions, primarily hospitals, rather than academic institutions. Hospital affiliations are especially common for retractions from China [58]. We also found many retracted articles did not report a funding source [31] and those that did were mostly funded by national and state grants. More than half the included articles from China with funding information were funded by government grants. It is unclear whether the funding source of a study drives retraction or is simply an artefact of the most common sources of research funding.

It is difficult to measure the degree to which retractions distort scientific knowledge. For meta-analyses specifically, the impact of retractions been shown to be modest, although likely depends on the retraction reason and other context-specific factors [17]. We found that around half of all retracted pain articles had fewer than 20 citations. While citation does not necessarily represent endorsement, previous investigations suggest that retracted publications are often cited positively [51]. Critically, our analyses did not investigate how many citations occurred post-retraction. Almost half the systematic reviews and clinical practice guidelines that cite retracted randomised controlled trials are published after retraction has occurred [27]. Researchers may contribute to this problem unknowingly; a recent survey of 417 anaesthesiologists found 89% were unaware of having cited a retracted article [10]. This issue may be mitigated by ascertaining whether retraction statements have been published for studies that may be eligible for inclusion in a systematic review, as recommended by the Cochrane Handbook [30]. Formal searches of the Retraction Watch database and enabling automated retraction alerts in reference management software will aid this process. It would be valuable describe the characteristics of retracted articles within a systematic review.

We found that retracted pain articles were most commonly published in Q1 impact factor journals, however this may have been affected by the addition of early access citations into 2021 impact factor calculations. Retractions occur most frequently in high impact journals, especially when misconduct is involved [18,47,49]. This may be a result of the reward for publishing in such journals, or simply because of the resources and expertise they dedicate to ensuring integrity of published data [9]. While journal editors and publishers are encouraged to follow COPE [56] and ICMJE [25] guidelines for retractions, there is currently no legal obligation for them to ensure the veracity or reliability of the data they publish [24]. The magnitude of this task may be too great for editors or peer reviewers to address alone.

This review has some limitations. First, because MEDLINE is the only database with a retraction filter, and retractions are not always appropriately indexed, it is possible that some eligible records were excluded. We attempted to mitigate this issue by using a sensitive search strategy designed by information specialists. Second, the Retraction Watch database lacks subject headings for pain. We used a range of specialty-related keywords but acknowledge our criteria for classifying pain studies may be overly broad. Third, there was a degree of subjectivity in assigning retraction reasons and descriptions. Classifications were informed by retraction notices that had varying levels of detail. Primary retraction descriptions were often selected from

several related descriptions. This may have led to imprecise classifications for some records. Fourth, we were unable to evaluate overlap with previous reviews from related fields such as anaesthesiology due to the absence of included study lists. However, by including preclinical studies, comprehensively reporting retraction reasons, and conducting up-to-date searches our scope was substantially broader.

In summary, an increasing number of publications in the pain field are being retracted. This trend may reflect a growing number of publications in the pain literature, but also increased editorial and post-publication scrutiny, and positive changes to journal policy. Editors and publishers should aim to adhere to COPE and ICMJE guidelines for retracted articles to increase the speed and transparency of the retraction process. Retraction notices should clearly report retraction reasons, who is retracting the article and how matter came to the journal's attention. Our results suggest that research misconduct is not uncommon in pain research. Vigilance to misconduct in the authoring, editing and peer review processes will lead to retraction. However, there remains a need for robust methods to ensure that retractions are identifiable and do not influence the scientific literature despite their withdrawal.

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Table 1. Study design and clinical areas of included studies (n = 389).

	Number (%)
Study design	
Clinical observational	120 (31)
Clinical randomised	113 (29)
Preclinical	106 (27)
Clinical review	50 (13)
Clinical area	
Peri- and post-operative pain	117 (30)
Osteoarthritis	44 (11)
Spinal pain	43 (11)
Rheumatoid arthritis	37 (9.5)
Neuropathic pain	32 (8.2)
Musculoskeletal pain	19 (4.9)
Mechanistic pain models	13 (3.3)
Chronic pain	10 (2.6)
Headache & migraine	9 (2.3)
Cancer pain	8 (2.1)
Osteoporosis	6 (1.5)
Pelvic pain	6 (1.5)
Spondyloarthritis	6 (1.5)
Analgesic pharmacology	5 (1.3)
Dental pain	4 (1)
Fibromyalgia	4 (1)
Visceral pain	4 (1)

Craniofacial & orofacial pain	3 (0.77)
Complex regional pain syndrome	2 (0.51)
Post-stroke pain	2 (0.51)
Other	15 (3.9)

Table 2. First author countries and affiliations (n = 389)

	Number (%)
Country	
China	122 (31)
Japan	64 (16)
United States	52 (13)
South Korea	20 (5.1)
Germany	19 (4.9)
India	18 (4.6)
Italy	16 (4.1)
Egypt	8 (2.1)
United Kingdom	7 (1.8)
Netherlands	6 (1.5)
Turkey	6 (1.5)
Australia	5 (1.3)
Canada	5 (1.3)
Other	41 (11)
First author affiliation	
Clinical	290 (75)
Academic	93 (24)
Industry	5 (1.3)
Other	1 (0.26)

Table 3. Reasons and descriptions of retracted articles (n =389).

Reason for retraction		**Number (%)**
Misconduct		**258 (66)**
Data problems	Data falsification (including doctored images)	91 (23)
	Duplication (data, text, image, article)	56 (14)
	Plagiarism	39 (10)
Ethical problems	Lack of IRB approval	33 (8.5)
	Violation of ethical norms	3 (0.77)
	Lack of participant consent	2 (0.51)
	Deviation from IRB approved protocol	1 (0.26)
Other misconduct	Fraudulent peer review	18 (4.6)
	Statement confirming misconduct	8 (2.1)
	Undeclared conflict of interest	4 (1)
	Paper mill	3 (0.77)
Non-misconduct		**131 (34)**
Error	Unreliable/erroneous data	75 (19)
Publishing problems	Editorial/publisher errors	15 (3.9)
	Copyright issues	8 (2.1)
	Breach of journal policy	3 (0.77)
Authorship problems	Author disputes	10 (2.6)
	Listing authors who were not involved	4 (1)
	Author unresponsive	1 (0.26)
All other problems	Other problems	3 (0.77)
	No reported reason	12 (3.1)

Where articles had more than one retraction reason and description only the primary reason is presented.

Table 4. Time to retraction by reasons for retraction (n = 376).

Retraction reason	Number	Median time (years)	IQR
Data problems	183	3	1.2 to 5.2
Ethical problems	39	2.7	1.8 to 4.1
Other misconduct	33	1.5	0.7 to 2.7
Error	73	1.1	0.4 to 3.4
Authorship problems	15	0.7	0.3 to 1.8
Publishing problems	24	0.6	0.3 to 1.9
All other problems	9	0.7	0.6 to 1.7

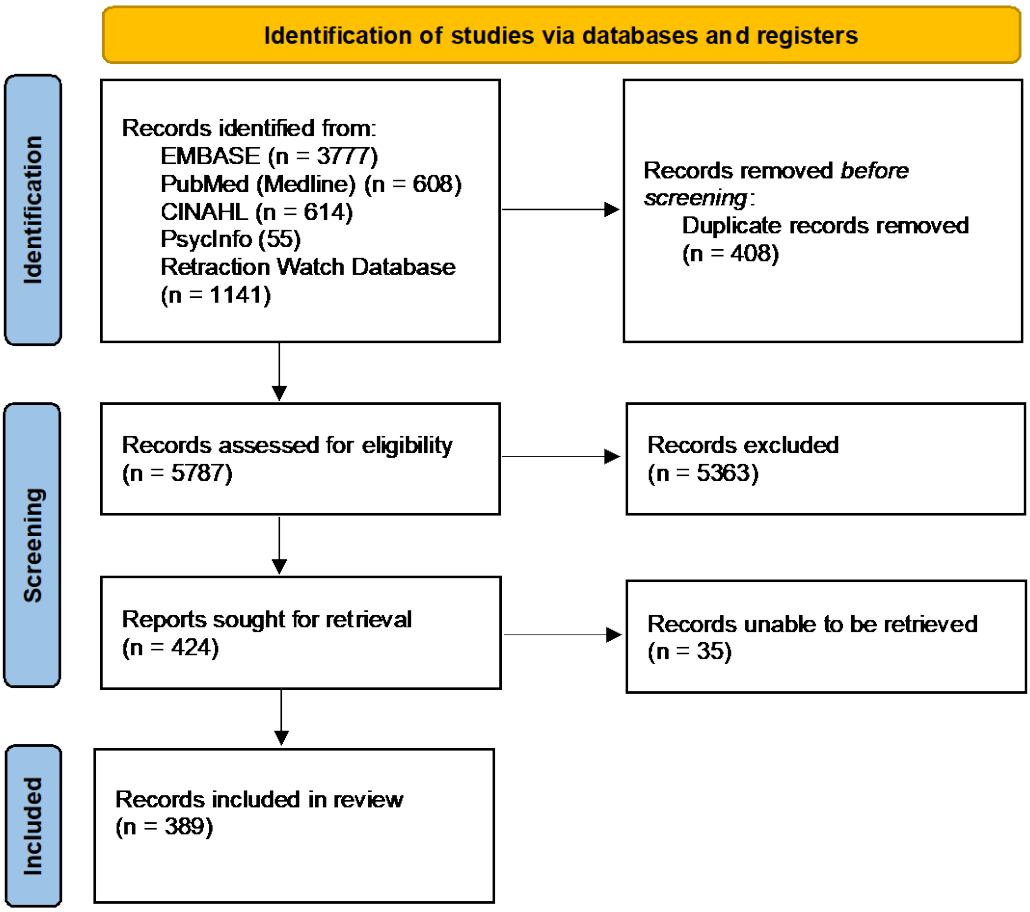

Figure 1. PRISMA flowchart.

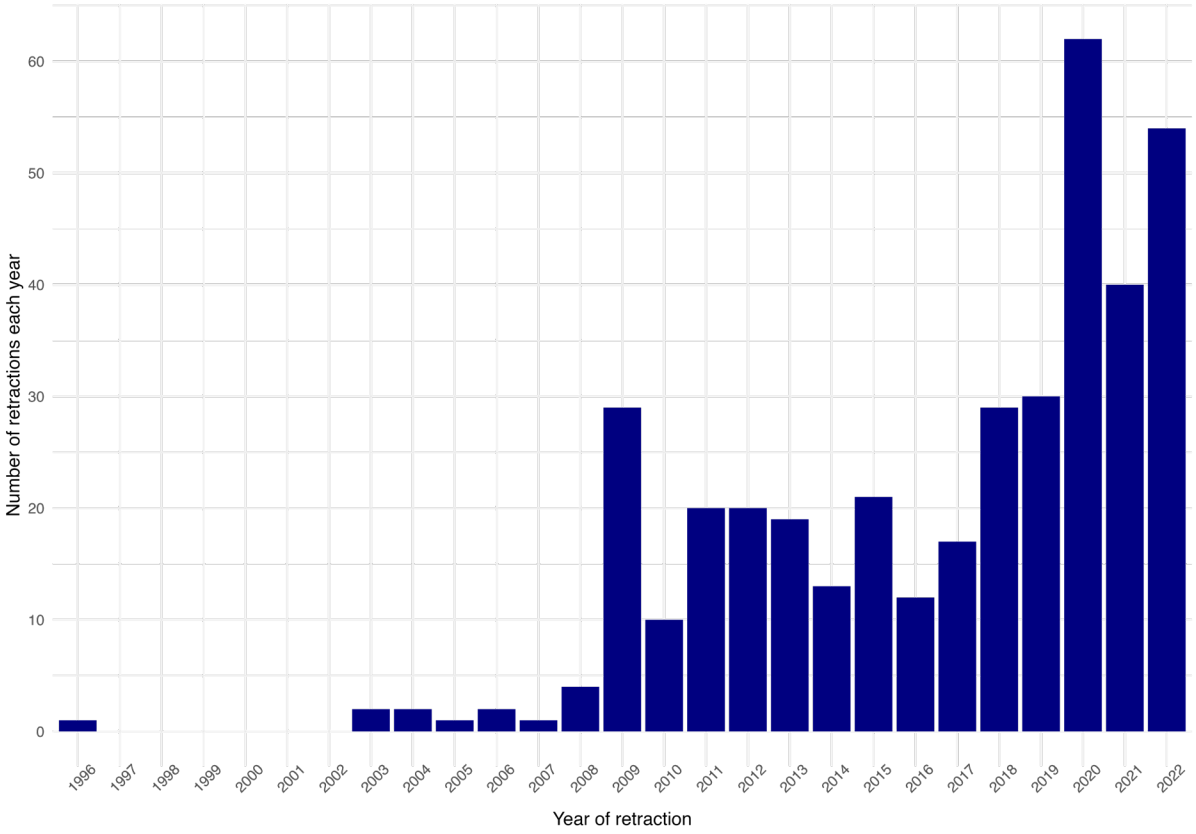

Figure 2. Number of retracted pain articles over time.

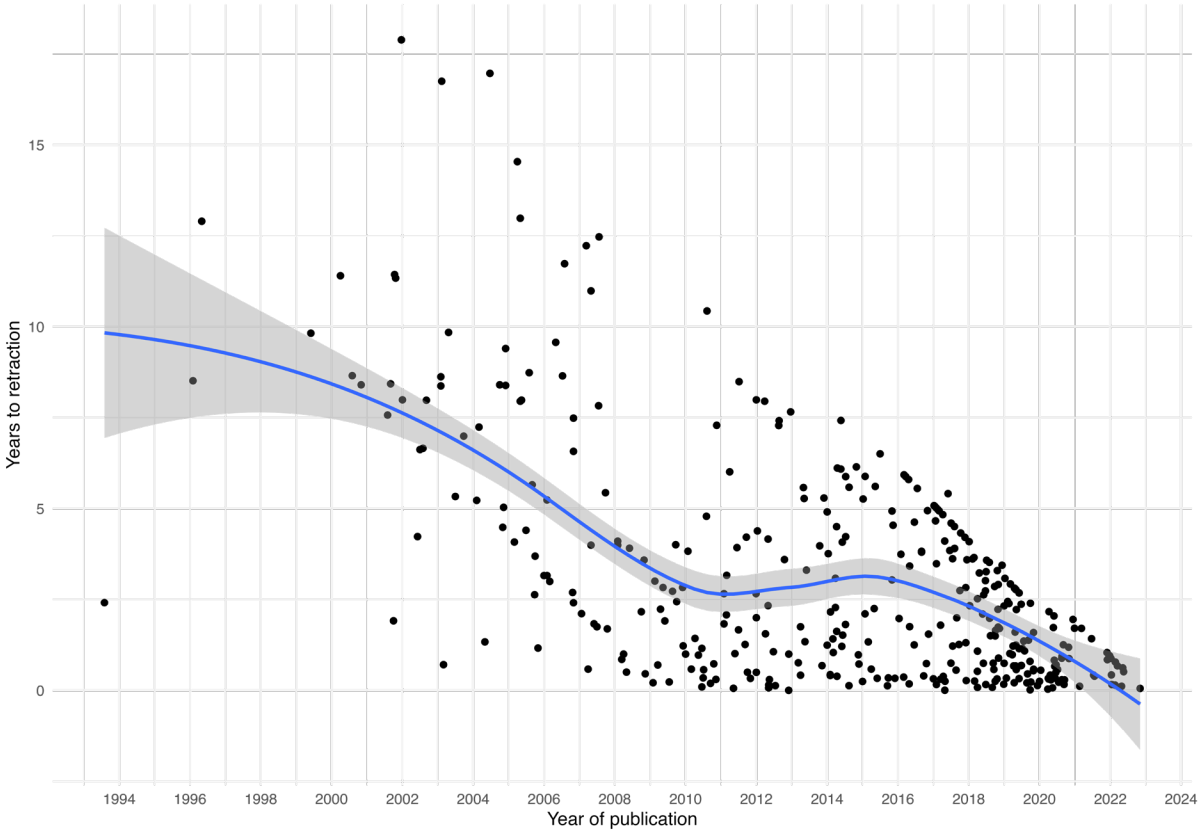

Figure 3. Time to retraction over time. Blue regression line and grey 95% confidence bands fit using locally estimated scatterplot smoothing (LOESS).