Gender imbalances of retraction prevalence among highly cited authors and among all authors

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KEY POINTS

Question

Are there gender disparities in the likelihood of having retracted publications among highly cited scientists and the broader scientific population?

Findings

In this cross-sectional bibliometric analysis of over 10 million authors with at least 5 publications, including 217,097 top-cited scientists, retraction rates were slightly lower in women than in men. Gender differences were modest compared with disparities by country, field, and citation volume, but varied across disciplines and publication age cohorts.

Meaning

Gender is a minor correlate of retraction, and structural or contextual factors likely drive retraction patterns in science.

ABSTRACT

Importance Retractions are rare but increasingly common in scientific publishing. Understanding whether gender disparities exist in retraction rates, especially among top-performing scientists, may inform broader efforts to promote equity and research integrity.

Objective To assess gender disparities in the likelihood of having retracted publications among highly cited and all other authors, and to explore how these vary across scientific fields, countries, and publication age cohorts.

Design Cross-sectional bibliometric analysis incorporating retraction data into Scopus-based databases of top-cited scientists (top 2%) and all authors with ≥5 publications. Retraction data were obtained from Retraction Watch and linked with author-level citation metrics.

Setting Global, science-wide analysis using data from authors in all disciplines indexed in Scopus.

Participants A total of 10,361,367 authors with ≥5 publications were included; 217,097 were among the top 2% most-cited authors. Gender was confidently assigned using NamSor for 8,267,888 authors. Authors with uncertain gender were excluded from gender-specific analyses.

Main Outcomes and Measures Gender-specific retraction rates and the relative propensity (R) of women vs men to have at least one retraction, overall and stratified by citation status, field, country income level, publication age cohort and publication volumes.

Results Among highly cited authors, retraction rates were 3.3% in men and 2.9% in women; among all authors, rates were 0.7% for both genders. Differences varied by field: women's rates were at least one-third lower than men's (R < 0.67) in Biology, Biomedical Research, and Psychology (R < 0.67), but higher (R > 1.33) in Economics, Engineering, and Information and Communication Technologies. Among highly cited authors, younger cohorts showed increasingly higher rates among men (4.2% men vs. 3.0% women in those starting to publish in 2002–2011; 8.7% men vs. 4.9% women in those starting post-2011). Country-level differences among highly

cited authors were pronounced in some countries, as in Pakistan (28.7% men vs. 14.3% women). Among all authors, country-level gender differences were small.

Conclusions and Relevance Gender differences in retraction rates exist but are modest. Field, country, and publication volume are stronger correlates. Structural and contextual factors likely drive retraction patterns and warrant further investigation.

INTRODUCTION

Gender disparities in science have been noted in various areas, including recruitment, tenure, funding, authorship, and citation impact. While some of these differences may be narrowing over time, the patterns and changes over time differ among scientific disciplines, environments, and countries[1]. Citations play a crucial role as academic influence indicators and contributors to inequalities, particularly among the most-cited scientists, impacting academic career trajectories. A previous study reported that among the 2% top-cited authors for each of 174 science subfields (Science-Metrix classification) of a science-wide author database of standardized citation indicators, men outnumbered women by 1.88-fold [2]. Considering 4 publication age cohorts (first publication pre-1992, 1992–2001, 2002–2011, and post-2011), this value decreased from 3.93-fold to 1.36-fold over time.[2]

Recently, the 2% top-cited authors database has been expanded to incorporate retraction data [3]. Results show that among 217,097 top-cited scientists in career-long impact and 223,152 in single-year (2023) impact, 7,083 (3.3%) and 8,747 (4.0%), respectively, had at least one retraction. Scientists with retractions had younger publication age, higher self-citation rates, and larger publication volume than those without. No information, however, was available on gender. Notably, in a study examining gender imbalance among retracted biomedical science papers, women comprised 27% of first authors and 24% of last authors, slightly underrepresented compared to estimated general authorship rates of 30–40% for first authors and 25–30% for last authors[4]. However, that study did not stratify scientists by publication age cohort or country income level.

In this study, we evaluated gender distribution in retractions among highly cited and all authors worldwide with at least 5 publications, using comprehensive publication and citation data from Scopus and Retraction Watch databases, and tested differences across countries and scientific subfields.

METHODS

We have generated a comprehensive database of the top 2% most-cited scientists in each of the 174 scientific subfields defined by the Science-Metrix classification (RRID:SCR_024471) [5]. This selection was based on a composite citation index, following a methodology similar to our previous studies [6,7]. The database also includes scientists who are among the top-100,000 in the composite indicator regardless of their ranking in their primary subfield. The subfields encompass all branches of science, technology, and (bio)medicine, as well as disciplines within the humanities and social sciences. Following a previously established approach [3], we linked Scopus author entries to the Retraction Watch database (RWDB, RRID:SCR_000654), which is the most reliable database of retractions available to date. This linkage allowed us to track the number of retractions associated with each author ID in the Scopus database. Expressions of concern and corrections without retraction, retraction with republication, and retractions where it is explicit that they are due to publisher/journal error rather than author error were excluded.

As in a previous study [2], we employed NamSor (RRID:SCR_023935)[8], a gender-assignment software, to infer the gender of authors in the Scopus database (RRID:SCR_022559). The NamSor algorithm assigns gender based on an author's first and last name, as well as their country of origin, with a specified confidence level. To determine an author's country, we used the location of their earliest published paper. We retained only gender assignments with a confidence score above 85%.

We focused on the highly cited scientists in the career-long ranking, including self-citations, and compared also to all Scopus authors with ≥ 5 publications. We categorized authors into four cohorts based on the year of their first publication year:

- Pre-1992
- 1992–2001
- 2002–2011

- Post-2011.

In each age cohort, we classified authors based on their scientific field, using the 20 major fields defined by the Science-Metrix classification[5]. We categorized authors by countries of residence, grouping into high-income and other incomes according to the public data from the World Bank [9]. We then calculated the absolute number and proportion of scientists with at least one retracted paper for each gender category. Specifically, we distinguished men with retractions (MR), men without retractions (MWR), women with retractions (WR) and women without retractions (WWR). This analysis was conducted across the four age cohorts, all countries, and all scientific fields.

We examined whether the proportion of retracted authors differed by gender within each subgroup and across different scientific domains. We also calculated the relative propensity R of women versus men to have a retraction among top 2% most-cited scientists and among all authors in each subfield. If there are WR + WWR total number of women and MR + MWR total men in a given subfield, and WR and MR of them have at least one retraction, then **R = (WR × (MR + MWR)) / (MR × (WR + WWR))**. To explore potential drivers of observed differences in retraction rates, we considered overall publication volume**.** We stratified authors into tertiles based on their total number of publications, comparing patterns across low, middle, and high publishing groups. We examined the mean and median number of publications in each tertile and across all tertiles and then assessed whether differences in retraction rates varied by publication volume.

Data were generated and analyzed centrally at Elsevier Research Intelligence. Since Scopus is a subscription database, the full raw data cannot be shared. Accuracy and precision for Scopus have been presented before [6,7,10]. We favored presentation of descriptives rather than formal statistical significance testing. Given the large number of authors, statistical significance could have been reached even for minute differences when the entire scientific workforce is considered. The

study is reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement[11]

RESULTS

Overall data on authors and retraction rates in men and women

Out of 10,361,367 authors with at least five full publications, 8,267,888 could be classified for gender (5,295,929 men and 2,971,959 women), while gender was uncertain for 2,093,479 (20.2%). Among the top 2% most-cited authors, gender was confidently assigned for 186,466 individuals: 155,321 men and 31,145 women, while 61,672 (24.9%) had uncertain gender. These entries were excluded from subsequent analyses. Most authors in the overall database came from high-income countries (6,454,557), while 3,482,436 were from middle- or low-income countries. The remaining authors were affiliated with countries that do not have an income classification from the World Bank, such as small territories, and therefore remained unclassified. Uncertain gender was less frequent in high-income countries (12.7%) than in others (28.8%).

Retraction patterns by citation level and gender are summarized in Table 1. The proportion of authors with at least one retraction was higher among the highly cited scientists (3.3%) than non-highly cited authors (0.7%), a consistent pattern across genders. Among highly cited authors, retraction rates were 2.9% in women and 3.1% in men. Among non-highly cited authors, the rates were identical (0.7%). The rates of authors with retractions were several-fold higher in authors from non-high-income countries than in high-income countries: 7.3% among highly cited authors and 1.4% among non-highly cited, compared to 2.8% and 0.4%, respectively, in high-income countries. After stratifying by income, men had slightly higher retraction rates than women in both country groups.

Highly cited authors had far more publications than non-highly cited ones, with a median of 163 vs. 11 for all authors regardless of gender (data not shown), and the same pattern across income strata (Supp. Tab 1). Men had modestly more publications than women (median 14 vs. 11), a pattern also observed across strata. Authors from non-high-income countries who were highly cited had slightly more publications than their high-income counterparts (median 190 vs. 160, data not shown). In non-high-income countries, median publication count was slightly higher in women than men (189 versus 176), whereas the opposite was true in high-income countries (162 vs. 137; Supp. Tab. 1). The majority of authors with at least one retraction (66.2%) were in the first tertile of publication counts (Supp. Tab. 2).

Retraction rates in men and women across scientific fields

Table 2 presents retraction rates across scientific fields by gender for all authors, and separately for highly cited and not highly cited authors. While gender differences were generally small, some patterns emerged. Excluding fields with fewer than 50 authors with retractions and thus high uncertainty, women had retraction rates at least one-third lower than men ($R<0.67$) in Biology, Biomedical Research, and Psychology & Cognitive Sciences. Conversely, in Economics & Business, Engineering, and Information & Communication Technologies, retractions appeared more frequently among women ($R>1.33$). R values for non-highly cited authors closely matched those for all authors. Highly cited authors, however, showed different patterns, with highest R values in Mathematics & Statistics ($R = 3.06$) and Engineering ($R = 1.78$), indicating higher retraction likelihood among women. In contrast, lower R values among highly cited authors were found in Biomedical Research ($R = 0.64$), Built Environment & Design ($R = 0.65$), and Economics & Business ($R = 0.68$), suggesting relatively lower retraction rates among women.

Retraction rates in men and women across publication age cohorts

As shown in Figure 1, when different publication age cohorts were considered, men had consistently slightly higher retraction rates than women among all authors (Fig. 1A), although the

difference was negligible in percentage terms. Among highly cited authors, men and women had similar rates in the two older cohorts (Fig. 1B). However, men had higher rates in the 2002–2011 cohort (4.2% vs. 3.0%), with the difference widening in the youngest cohort (8.7% vs. 4.9%). Supplementary Tables 3–5 break down retraction rates by cohort for highly cited, non-highly cited, and all authors. Among highly cited scientists (Suppl. Tab. 3), retraction rates for men and women were relatively close in earlier cohorts but diverged across specific fields. In Clinical Medicine, the gender difference widened: women had retraction rates of 3.9% (pre-1992) and 4.6% (1992–2001), dropping to 3.0% (2002–2011) and 0% (post-2011). In contrast, men's rates rose over time (4.5%, 5.4%, 5.5%, and 6.5%). In Enabling & Strategic Technologies, both genders showed rising retraction rates. Among women, rates increased from 2.6% to 3.8%, 3.6%, and 6.3%. Men followed a similar pattern: 1.8%, 3.7%, 4.8%, and 8.4%. In Information & Communication Technologies, women had higher rates in the first cohort (2.1%), followed by a decline to 0.8%, 1.6%, and 0%. Men's rates, by contrast, rose steadily from 0.8% to 8.9%. In Engineering, women's rates increased from 2.2% to 4.6% in the first two cohorts; men's rose from 1.2% to 3.5%. Rates were higher in women until the post-2011 cohort, when men surpassed them (3.3% vs. 8.9%). Most other fields had too small numbers of highly cited authors in the youngest (post-2011) cohort to make any meaningful inferences.

Among non-highly cited authors (Suppl. Tab. 4), retraction rates increased over time for both genders. In Clinical Medicine, where absolute numbers were highest, the gender difference remained roughly constant: men's rates rose from 0.5% to 1.2%, women's from 0.4% to 1.0%. In Engineering, the gender difference narrowed: in 1992–2001, rates were 0.7% for women and 0.4% for men; in 2002–2011, 1.1% vs. 0.7%; and in post-2011, 0.3% vs. 0.2%. In contrast, Information & Communication Technologies showed a persistent difference with higher rates in women, especially in 2002–2011 (1.8% vs. 1.1%), dissimilar to patterns in the highly cited group. When all fields were combined, there was virtually no gender difference across cohorts among non-highly cited authors.

When all authors were combined (Suppl. Tab. 5), trends closely mirrored those in the non-highly cited group, with no substantial differences in rates or gender patterns by cohort.

Retraction rates in men and women across different countries

Among the 40 countries with the highest number of authors (Table 3), the highest retraction rates for women among highly cited authors were observed in Pakistan (14.3%), Egypt (13.8%), Iran (9.3%), China (8.1%), India (6.6%), Taiwan (6.5%), Italy (5.7%), and the Czech Republic (5.5%), although in most of these countries absolute numbers were small. The gender difference was particularly notable in Pakistan, where highly cited men had a markedly higher retraction rate than women (28.7% vs. 14.3%). A similar pattern, though attenuated, was observed in Iran (12.4% vs. 9.3%) and India (9.2% vs. 6.6%). Conversely, retraction rates among women were higher than those of men in Italy (5.7% vs. 3.7%), Taiwan (6.5% vs. 4.2%), the Czech Republic (5.5% vs. 3.3%), and Egypt (13.8% vs. 9.0%). In most other countries, gender differences were small. For example, in the United States (2.5% vs. 2.7%), United Kingdom (1.9% vs. 1.9%), and Canada (2.2% vs. 2.6%), rates were nearly identical.

Among all authors, regardless of citation level, gender differences remained limited. Women had lower retraction rates than men in India (1.1% vs. 1.6%), Pakistan (2.0% vs. 3.8%), and Iran (1.3% vs. 2.1%). In contrast, countries where women had slightly higher rates included Italy (0.7% vs. 0.6%) and South Africa (0.4% vs. 0.3%), though differences were small. In most countries, gender differences remained limited in this broader analysis. Patterns for non-highly cited authors were similar (not shown).

DISCUSSION

Our analyses show that, overall, retraction rates are slightly lower in women than in men across all authors and among highly cited authors. Similar small gender differences are seen in both high-income and non-high-income countries. However, retraction rates are much higher in non-high-income countries. Upon examining scientific fields separately, most show no major gender differences. Exceptions occur in both directions: some biomedical fields and psychology and cognitive sciences show higher rates for men, while engineering, economics, and information/communication technologies show higher rates for women. When analyzing publication age cohorts, we noted widening differences in younger cohorts, with higher retraction rates in men than women, especially among highly cited authors. Several countries with high retraction rates among highly cited authors also show substantial gender differences, favoring men in some countries and women in others.

Retractions may be shaped by a complex set of factors [12–14]. Beyond fraudulent or erroneous work, likelihood of retraction may depend on how intensely a paper is scrutinized and whether editorial bias affects decisions. Authors with more publications face a higher chance of retraction. This likely explains why highly cited authors, who publish more, have higher retraction rates than non-highly cited ones, who publish less and draw less scrutiny. Publication volume may also explain most of the small gender difference overall, as women publish slightly fewer papers on average. Higher retraction rates in non-high-income countries may reflect lower quality, higher output among top authors, potential editorial bias or a lower threshold for retracting papers. Fraudulent practices such as paper mills [15–18], cartels [19–21], extreme publishing behavior [22] and precocious citation impact [23] may also be more prevalent in these countries. Local incentive structures could drive these patterns [24,25]. Whether such incentives disproportionately affect men is unclear. It may be that such perverse incentives exist more frequently in countries where there is still a large gender difference disfavoring women from publishing and reaching highly cited status.

The gender differences observed in some fields may also have complex roots. Fields where women have substantially higher retraction rates (engineering, economics, mathematics, Information & Communication Technologies) tend to be those where women have historically had limited presence, especially among highly cited authors, and where gender differences in authorship remain large [2]. Conversely, fields where women now have lower retraction rates (biology, biomedical science, psychology and cognitive sciences) are those where gender differences have largely disappeared. Bias or gender disadvantages may exist across diverse microenvironments in specific fields.

Younger cohorts of highly cited scientists show a substantial gender difference in retraction rates, with much higher rates in men. However, across many fields, data for the post-2011 cohort are too sparse for meaningful interpretation. This difference appears driven by fields such as Clinical Medicine, Biomedical Research, and Information & Communication Technologies. In Clinical Medicine and Biomedical Research, women are now better represented, especially among younger cohorts. In contrast, Information & Communication Technologies remains male-dominated. Its fast pace and competitiveness may increase risks of error or misconduct [26].

Overall, author country appears a much stronger correlate of retractions than gender. Prior work [3,27] highlighted the importance of country in retraction rates, with high retraction rates in countries that have witnessed very massive increases [28,29]in their productivity over the last 20 years, e.g. China, India, Iran, Pakistan, Saudi Arabia, and other non-high income countries. Our gender analysis shows that several of these countries also exhibit higher retraction rates among men, in particular among the group of highly cited authors. Pakistan shows the largest disparity, which persists, though less stark, among non-highly cited authors. Nevertheless, several other countries show the opposite pattern, with higher retraction rates in women than men. This group of countries includes some high-income ones such as Italy, Taiwan and Czech Republic.

We must acknowledge some limitations of this work. First, a sizeable number of authors could not have their gender assigned confidently and were excluded. This was more common in non-high-income countries. However, gender assignment issues are unlikely to bias the gender–retraction association. Second, some retracted work could not be mapped to Scopus [30], leading to underestimation of retraction proportions, although this probably also would not affect gender associations. Third, our analysis used large-scale entities (countries, major fields), but retraction patterns may be driven by small teams or microenvironments and occasionally they tend to be clustered. Specific single or few individuals may be primarily responsible for the retractions in such smaller units, but the role of gender, if any, in these occurrences is unclear. Fourth, we did not distinguish between honest error and misconduct. This is precarious to attempt, since retraction notes are often short and vague, and reasons are inconsistently reported [31,32]. However, most retractions appear to stem from misconduct [33].

Acknowledging these caveats, our analysis offers a science-wide view of gender differences and similarities in retraction rates among highly cited and all authors. Gender seems to be a weak modulator of retraction risk, if at all, but may interact with specific fields, countries, or environments, warranting further investigation.

Competing interests:

JB and RG are Elsevier employees. Elsevier runs Scopus, which is the source of these data, and also runs the repository where the database of highly cited scientists is now stored.

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REFERENCES

1. *De Kleijn, M, Jayabalasingham, B, Falk-Krzesinski, HJ, Collins, T, Kuiper-Hoyng, L, Cingolani, I, Zhang, J, Roberge, G, et al: The Researcher Journey Through a Gender Lens: An Examination of Research Participation, Career Progression and Perceptions Across the Globe (Elsevier, March 2020). Retrieved from Https://Www.Elsevier.Com/Insights/Gender-and-Diversity-in-Research/Researcher-Journey-2020* .
2. Ioannidis JPA, Boyack KW, Collins TA, Baas J. Gender imbalances among top-cited scientists across scientific disciplines over time through the analysis of nearly 5.8 million authors. *PLoS Biol*. 2023;21(11):e3002385. doi:10.1371/journal.pbio.3002385
3. Ioannidis JPA, Pezzullo AM, Cristiano A, Boccia S, Baas J. Linking citation and retraction data reveals the demographics of scientific retractions among highly cited authors. *PLoS Biol*. 2025;23(1):e3002999. doi:10.1371/journal.pbio.3002999
4. Pinho-Gomes AC, Hockham C, Woodward M. Women's representation as authors of retracted papers in the biomedical sciences. *PLoS One*. 2023;18(5):e0284403. doi:10.1371/journal.pone.0284403
5. Archambault É, Beauchesne OH, Caruso J. Towards a Multilingual, Comprehensive and Open Scientific Journal Ontology. In: ; 2013. https://api.semanticscholar.org/CorpusID:85557623
6. Ioannidis JPA, Baas J, Klavans R, Boyack KW. A standardized citation metrics author database annotated for scientific field. *PLoS Biol*. 2019;17(8):e3000384. doi:10.1371/journal.pbio.3000384
7. Ioannidis JPA, Boyack KW, Baas J. Updated science-wide author databases of standardized citation indicators. *PLoS Biol*. 2020;18(10):e3000918. doi:10.1371/journal.pbio.3000918
8. NamSor. Available from: https://NamSor.app.
9. World Bank. World Bank country and lending groups. Available from: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.
10. Baas J, Schotten M, Plume A, Côté G, Karimi R. Scopus as a curated, high-quality bibliometric data source for academic research in quantitative science studies. *Quantitative Science Studies*. 2020;1(1):377-386. doi:10.1162/qss_a_00019

11. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *J Clin Epidemiol*. 2008;61(4):344-349. doi:10.1016/j.jclinepi.2007.11.008

12. Steen RG, Casadevall A, Fang FC. Why has the number of scientific retractions increased? *PLoS One*. 2013;8(7):e68397. doi:10.1371/journal.pone.0068397

13. Lievore C, Rubbo P, Dos Santos CB, Picinin CT, Pilatti LA. Research ethics: a profile of retractions from world class universities. *Scientometrics*. 2021;126(8):6871-6889. doi:10.1007/s11192-021-03987-y

14. Li M, Shen Z. Science map of academic misconduct. *Innovation (Cambridge (Mass))*. 2024;5(2):100593. doi:10.1016/j.xinn.2024.100593

15. Candal-Pedreira C, Ross JS, Ruano-Ravina A, Egilman DS, Fernández E, Pérez-Ríos M. Retracted papers originating from paper mills: cross sectional study. *BMJ*. Published online November 28, 2022:e071517. doi:10.1136/bmj-2022-071517

16. Stone R. In Iran, a shady market for papers flourishes. *Science (1979)*. 2016;353(6305):1197-1197. doi:10.1126/science.353.6305.1197

17. Abalkina A. Publication and collaboration anomalies in academic papers originating from a paper mill: Evidence from a Russia-based paper mill. *Learned Publishing*. 2023;36(4):689-702. doi:10.1002/leap.1574

18. Hvistendahl M. China's Publication Bazaar. *Science (1979)*. 2013;342(6162):1035-1039. doi:10.1126/science.342.6162.1035

19. Qiu S, Steinwender C, Azoulay P. *Paper Tiger? Chinese Science and Home Bias in Citations*.; 2024. doi:10.3386/w32468

20. Plevris V. From Integrity to Inflation: Ethical and Unethical Citation Practices in Academic Publishing. *J Acad Ethics*. Published online April 21, 2025. doi:10.1007/s10805-025-09631-1

21. Catanzaro M. Citation manipulation found to be rife in math. *Science (1979)*. 2024;383(6682):470-470. doi:10.1126/science.ado3859

22. Ioannidis JPA, Collins TA, Baas J. Evolving patterns of extreme publishing behavior across science. *Scientometrics*. 2024;129(9):5783-5796. doi:10.1007/s11192-024-05117-w

23. Ioannidis JPA. Features and signals in precocious citation impact: a meta-research study. Published online October 15, 2024. doi:10.1101/2024.10.14.618366

24. Quan W, Chen B, Shu F. Publish or impoverish. *Aslib Journal of Information Management*. 2017;69(5):486-502. doi:10.1108/AJIM-01-2017-0014

25. Abritis A, McCook A. Cash incentives for papers go global. *Science (1979)*. 2017;357(6351):541-541. doi:10.1126/science.357.6351.541

26. Memon SA, Makovi K, AlShebli B. Characterizing the effect of retractions on publishing careers. *Nat Hum Behav*. 2025;9(6):1134-1146. doi:10.1038/s41562-025-02154-0

27. Sebo P, Sebo M. Geographical Disparities in Research Misconduct: Analyzing Retraction Patterns by Country. *J Med Internet Res*. 2025;27:e65775. doi:10.2196/65775

28. Thelwall M, Sud P. Scopus 1900–2020: Growth in articles, abstracts, countries, fields, and journals. *Quantitative Science Studies*. 2022;3(1):37-50. doi:10.1162/qss_a_00177

29. Bornmann L, Wagner C, Leydesdorff L. The geography of references in elite articles: Which countries contribute to the archives of knowledge? *PLoS One*. 2018;13(3):e0194805. doi:10.1371/journal.pone.0194805

30. Baas J, Schotten M, Plume A, Côté G, Karimi R. Scopus as a curated, high-quality bibliometric data source for academic research in quantitative science studies. *Quantitative Science Studies*. 2020;1(1):377-386. doi:10.1162/qss_a_00019

31. Hwang SY, Yon DK, Lee SW, et al. Causes for Retraction in the Biomedical Literature: A Systematic Review of Studies of Retraction Notices. *J Korean Med Sci*. 2023;38(41). doi:10.3346/jkms.2023.38.e333

32. Vuong Q. The limitations of retraction notices and the heroic acts of authors who correct the scholarly record: An analysis of retractions of papers published from 1975 to 2019. *Learned Publishing*. 2020;33(2):119-130. doi:10.1002/leap.1282

33. Fang FC, Steen RG, Casadevall A. Misconduct accounts for the majority of retracted scientific publications. *Proceedings of the National Academy of Sciences*. 2012;109(42):17028-17033. doi:10.1073/pnas.1212247109

FIGURES AND TABLES

Table 1: Number of authors with at least one retraction across countries of different income level.

		Highly cited		**Non highly cited**		**All citation groups**	
		All authors	With retraction	All authors	With retraction	All authors	With retraction
All income levels							
	All Genders	217,097	7,083 (3.3%)	10,144,270	72,887 (0.7%)	10,361,367	79,970 (0.8%)
	Women	31,145	896 (2.9%)	2,940,814	19,693 (0.7%)	2,971,959	20,589 (0.7%)
	Men	155,321	4,752 (3.1%)	5,140,608	33,816 (0.7%)	5,295,929	38,568 (0.7%)
High income levels							
	All Genders	193,694	5,439 (2.8%)	6,260,863	23,030 (0.4%)	6,454,557	28,469 (0.4%)
	Women	28,009	696 (2.5%)	1,902,994	6,559 (0.3%)	1,931,003	7,255 (0.4%)
	Men	141,680	3,865 (2.7%)	3,558,687	13,338 (0.4%)	3,700,367	17,203 (0.5%)
Other income levels							
	All Genders	22,181	1,628 (7.3%)	3,460,255	49,645 (1.4%)	3,482,436	51,273 (1.5%)
	Women	2,981	198 (6.6%)	999,655	13,079 (1.3%)	1,002,636	13,277 (1.3%)
	Men	12,724	876 (6.9%)	1,462,790	20,361 (1.4%)	1,475,514	21,237 (1.4%)

Table 2: Number of women and men with at least one retraction by subfield.

	Highly Cited		R	Non Highly Cited		R	All Authors		R
Field	Women	Men		Women	Men		Women	Men	
Agriculture, Fisheries & Forestry	15 (1.4%)	60 (1.1%)	1.19	382 (0.3%)	827 (0.5%)	0.69	397 (0.3%)	887 (0.5%)	0.68
Biology	33 (2.7%)	151 (2.3%)	1.17	567 (0.4%)	1,239 (0.7%)	0.67	600 (0.5%)	1,390 (0.7%)	0.65
Biomedical Research	92 (3.2%)	609 (5.1%)	0.64	2,123 (0.6%)	3,087 (0.9%)	0.72	2,215 (0.7%)	3,696 (1.0%)	0.65
Built Environment & Design	3 (1.6%)	21 (2.5%)	0.65	40 (0.3%)	111 (0.3%)	0.87	43 (0.3%)	132 (0.4%)	0.79
Chemistry	52 (3.1%)	284 (2.7%)	1.16	850 (0.4%)	1,558 (0.4%)	0.95	902 (0.4%)	1,842 (0.5%)	0.87
Clinical Medicine	441 (4.0%)	2,289 (4.7%)	0.85	10,438 (1.0%)	16,358 (1.1%)	0.91	10,879 (1.0%)	18,647 (1.2%)	0.85
Communication & Textual Studies	1 (0.3%)	1 (0.2%)	1.63	12 (0.1%)	23 (0.1%)	0.59	13 (0.1%)	24 (0.1%)	0.62
Earth & Environmental Sciences	16 (2.0%)	91 (1.6%)	1.21	464 (0.5%)	822 (0.5%)	1.11	480 (0.5%)	913 (0.5%)	1.05
Economics & Business	6 (1.0%)	44 (1.4%)	0.68	337 (0.6%)	465 (0.4%)	1.49	343 (0.6%)	509 (0.4%)	1.41
Enabling & Strategic Technologies	71 (3.4%)	384 (3.1%)	1.10	1,029 (0.6%)	2,240 (0.5%)	1.23	1,100 (0.6%)	2,624 (0.5%)	1.14
Engineering	52 (3.6%)	247 (2.0%)	1.78	847 (0.6%)	1,720 (0.4%)	1.68	899 (0.7%)	1,967 (0.4%)	1.58
Historical Studies	0 (0.0%)	0 (0.0%)	-	7 (0.0%)	28 (0.1%)	0.45	7 (0.0%)	28 (0.1%)	0.45
Information & Communication Technologies	22 (1.4%)	186 (1.7%)	0.81	1,558 (1.1%)	3,159 (0.7%)	1.48	1,580 (1.1%)	3,345 (0.7%)	1.43
Mathematics & Statistics	6 (4.0%)	28 (1.3%)	3.06	94 (0.4%)	308 (0.4%)	0.99	100 (0.4%)	336 (0.4%)	0.99
Philosophy & Theology	0 (0.0%)	0 (0.0%)	-	8 (0.1%)	13 (0.1%)	1.79	8 (0.1%)	13 (0.1%)	1.80
Physics & Astronomy	30 (2.3%)	252 (1.6%)	1.43	431 (0.3%)	1,326 (0.3%)	1.14	461 (0.3%)	1,578 (0.3%)	1.05
Psychology & Cognitive Sciences	24 (2.3%)	65 (2.6%)	0.89	166 (0.3%)	217 (0.4%)	0.68	190 (0.3%)	282 (0.5%)	0.62
Public Health & Health Services	28 (1.6%)	27 (1.6%)	0.96	177 (0.2%)	124 (0.2%)	0.73	205 (0.2%)	151 (0.3%)	0.71
Social Sciences	4 (0.3%)	13 (0.4%)	0.66	162 (0.2%)	191 (0.2%)	1.00	166 (0.2%)	204 (0.2%)	0.97
Visual & Performing Arts	0 (0.0%)	0 (0.0%)	-	1 (0.0%)	0 (0.0%)	N/A	1 (0.0%)	0 (0.0%)	N/A
All Fields	896 (2.9%)	4,752 (3.1%)	0.94	19,693 (0.7%)	33,816 (0.7%)	1.02	20,589 (0.7%)	38,568 (0.7%)	0.95

Figure 1A: Proportion of retractions by Gender and Career Age (Year of First Publication) across All Citation Groups

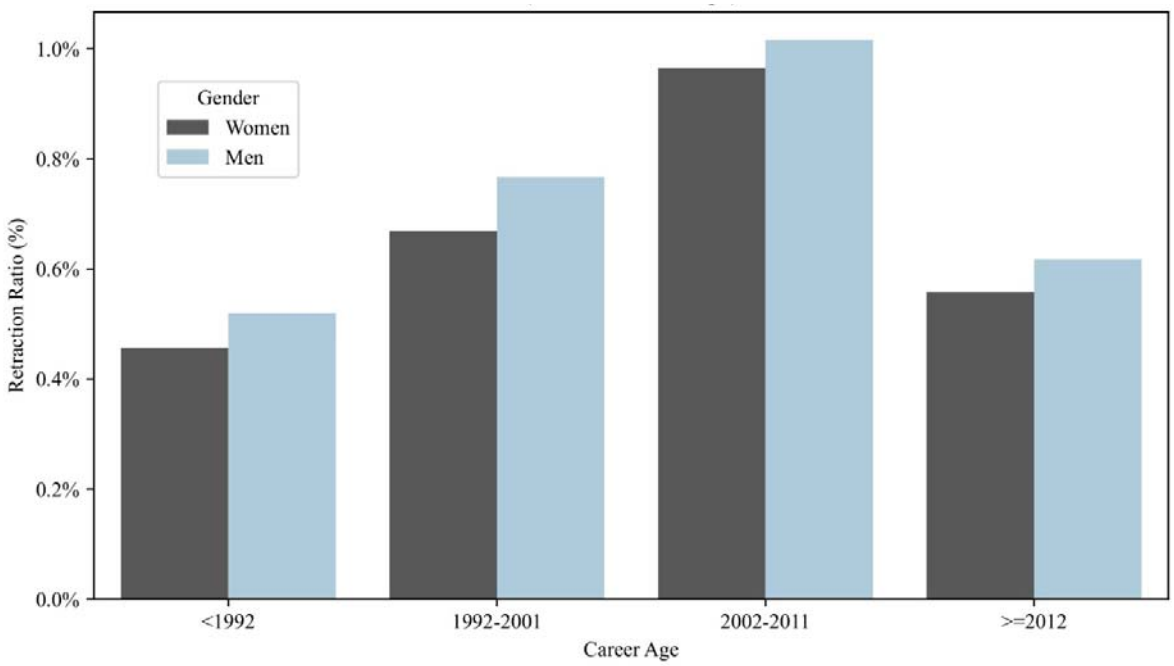

Figure 1B: Proportion of Retractions by Gender and Career Age among Highly Cited Scientists

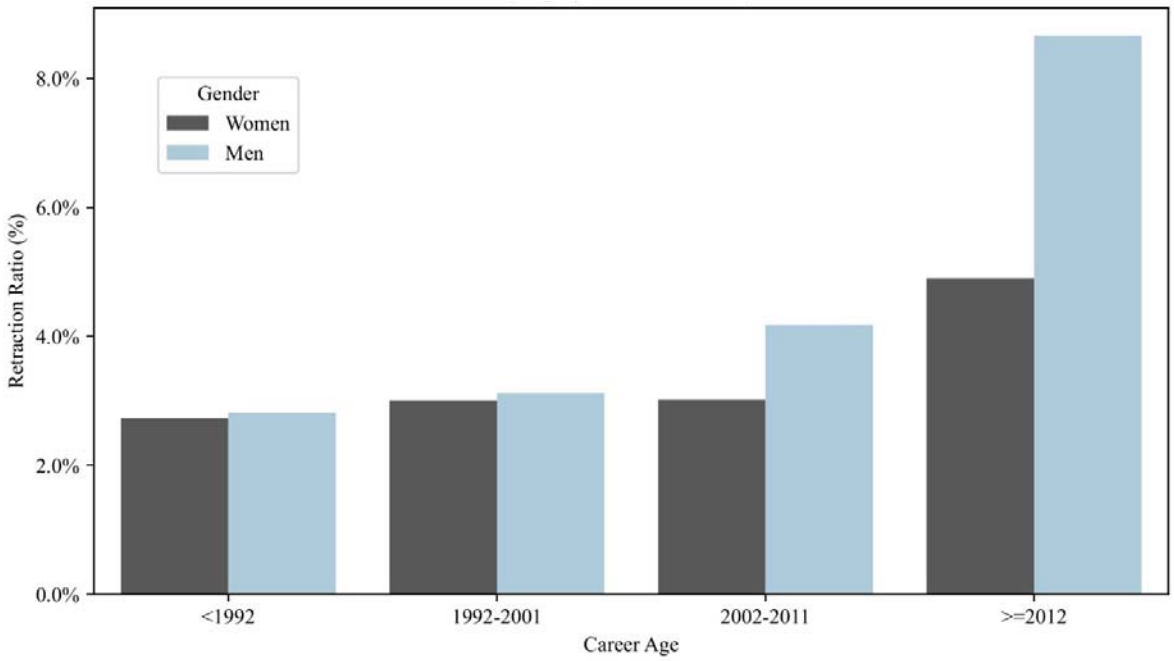

Table 3: Number of women and men with at least one retraction by country among the 40 countries with the highest number of authors with ≥ 5 publications

	Highly Cited		**Not Highly cited**		**All authors**	
Country	Women	Men	Women	Men	Women	Men
United States	340 (2.5%)	1,688 (2.7%)	2,180 (0.4%)	3,946 (0.3%)	2,520 (0.4%)	5,634 (0.5%)
China	148 (8.1%)	325 (7.7%)	10,148 (2.1%)	12,452 (2.1%)	10,296 (2.1%)	12,777 (2.2%)
Japan	8 (2.3%)	238 (4.1%)	288 (0.3%)	1,749 (0.4%)	296 (0.4%)	1,987 (0.5%)
Germany	33 (3.2%)	259 (2.7%)	307 (0.3%)	796 (0.3%)	340(0.3%)	1,055 (0.3%)
United Kingdom	60 (1.9%)	284 (1.9%)	300 (0.2%)	644 (0.3%)	360 (0.3%)	928 (0.4%)
India	16 (6.6%)	195 (9.2%)	893 (1.1%)	2,783 (1.5%)	909 (1.1%)	2,978 (1.6%)
France	12 (1.3%)	111 (2.2%)	336 (0.3%)	517 (0.3%)	348 (0.3%)	628 (0.4%)
Italy	62 (5.7%)	172 (3.7%)	785 (0.6%)	812 (0.5%)	847 (0.7%)	984 (0.6%)
Russia	1 (1.4%)	11 (1.3%)	180 (0.3%)	208 (0.2%)	181 (0.3%)	219 (0.2%)
Canada	34 (2.2%)	167 (2.6%)	233 (0.3%)	390 (0.3%)	267 (0.3%)	557 (0.4%)
Spain	4 (0.7%)	71 (2.8%)	274 (0.3%)	410 (0.4%)	278 (0.3%)	481 (0.4%)
South Korea	6 (3.6%)	56 (4.6%)	182 (0.6%)	788 (0.8%)	188 (0.6%)	844 (0.8%)
Brazil	4 (2.5%)	18 (2.4%)	205 (0.2%)	276 (0.3%)	209 (0.3%)	294 (0.3%)
Australia	27 (2.1%)	124 (2.4%)	189 (0.3%)	315 (0.4%)	216 (0.3%)	439 (0.5%)
Netherlands	17 (3.0%)	84 (2.4%)	107 (0.2%)	187 (0.3%)	124 (0.3%)	271 (0.4%)
Poland	6 (2.7%)	13 81.6%)	92 (0.2%)	95 (0.2%)	98 (0.2%)	108 (0.2%)
Turkey	2 (1.4%)	22 (2.6%)	167 (0.5%)	418 (0.7%)	169 (0.5%)	440 (0.7%)
Switzerland	2 (0.5%)	72 (2.7%)	83 (0.3%)	181 (0.3%)	85 (0.3%)	253 (0.4%)
Taiwan	14 (6.5%)	27 (4.2%)	187 (0.8%)	258 (0.7%)	201 (0.8%)	285 (0.7%)
Sweden	8 (1.7%)	65 (2.6%)	94 (0.3%)	173 (0.3%)	102 (0.3%)	238 (0.5%)
Iran	5 (9.3%)	103 (12.4%)	355 (1.2%)	1,081 (2.0%)	360 (1.3%)	1,184 (2.1%)
Belgium	7 (3.0%)	32 (2.1%)	42 (0.2%)	93 (0.2%)	49 (0.2%)	125 (0.3%)
Mexico	1 (2.2%)	5 (1.7%)	43 (0.2%)	90 (0.3%)	44 (0.2%)	95 (0.3%)
Austria	1 (0.7%)	19 (1.7%)	33 (0.2%)	80 (0.2%)	34 (0.2%)	99 (0.3%)
Denmark	6 (2.1%)	37 (2.3%)	35 (0.2%)	86 (0.3%)	41 (0.2%)	123 (0.4%)
Indonesia	0 (0.0%)	2 (8.0%)	31 (0.2%)	80 (0.3%)	31 (0.2%)	82 (0.4%)
Israel	1 (0.4%)	27 (1.7%)	73 (0.4%)	109 (0.4%)	74 (0.4%)	136 (0.5%)
Czech Republic	3 (5.5%)	14 (3.3%)	64 (0.4%)	124 (0.4%)	67 (0.4%)	138 (0.5%)
Malaysia	3 (7.1%)	27 (11.1%)	141 (1.0%)	273 (1.1%)	144 (1.0%)	300 (1.2%)
Finland	5 (1.6%)	25 (2.6%)	25 (0.1%)	38 (0.2%)	30 (0.2%)	63 (0.2%)
Egypt	4 (13.8%)	37 (9.0%)	174 (1.7%)	514 (1.8%)	178 (1.7%)	551(1.9%)
Portugal	6 (4.6%)	8 (1.8%)	41 (0.2%)	52 (0.2%)	47 (0.2%)	60 (0.3%)
Ukraine	0 (0.0%)	1 (1.2%)	18 (0.1%)	28 (0.2%)	18 (0.1%)	29 (0.2%)
Greece	3 (2.6%)	23 (2.7%)	54 (0.4%)	121 (0.5%)	57 (0.4%)	144 (0.5%)
Norway	0 (0.0%)	21 (2.0%)	45 (0.3%)	55 (0.2%)	45 (0.3%)	76 (0.3%)
Argentina	0 (0.0%)	5 (2.8%)	61 (0.3%)	52 (0.3%)	61 (0.3%)	57 (0.3%)
Thailand	0 (0.0%)	6 (4.3%)	52 (0.4%)	63 (0.5%)	52 (0.4%)	69 (0.5%)
Pakistan	2 (14.3%)	52 (28.7%)	199 (2.0%)	868 (3.6%)	201 (2.0%)	920 (3.8%)
Romania	1 (2.6%)	5 (4.1%)	70 (0.4%)	79 (0.5%)	71 (0.4%)	84 (0.5%)
South Africa	5 (3.6%)	8 (1.4%)	43 (0.4%)	56 (0.3%)	48 (0.4%)	64 (0.4%)