



A Comprehensive Analysis of Articles Retracted Between 2004 and 2013 from Biomedical Literature – A Call for Reforms

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ABSTRACT

Science is a dynamic subject and it was never free of misconduct or bad research. Indeed, the scientific method itself is intended to overcome mistakes and misdeeds. So, we aimed to assess various factors associated with retraction of scientific articles from 2004 to 2013. Data were retrieved from PubMed and Medline using the keywords retraction of articles, retraction notice, and withdrawal of article in April 2014 to detect articles retracted from 2004 to 2013. Statistical analysis was carried out using *t*-test and Karl Pearson's correlation coefficient. Results showed that a total of 2343 articles were retracted between 2004 and 2013, and original articles followed by case reports constituted major part of it. Time interval between submission and retraction of article has reduced in recent times. Impact factor and retraction do not have any significant correlation. We conclude that although retraction of articles is a rare event, its constant rise in scientific literature is quite worrisome. It is still unclear whether misconduct/mistakes in articles are increasing hastily or the articles are retracted at a rapid rate in recent times. So, it should be considered as an urgent issue and it is the responsibility of journal editors to track misconduct by following Committee on Publication Ethics (COPE) guidelines and making an effective strategy.

Key words: Duplication of article, Plagiarism, Retraction of articles, Self-correction

INTRODUCTION

Retraction refers to an article in its entirety that is the result of a pervasive error, non-reproducible research, scientific misconduct, or duplicate publication. Retractions identify an article that was previously published and is now retracted through a formal issuance from the author, editor, publisher, or other authorized agent.^[1] The number of articles retracted has increased rapidly in recent years.^[2]

The number of retractions in journals covered by the Science Citation Index Expanded has increased 20 times between 1990 and 2008.^[3] So, we aimed to study various factors governing retraction of scientific articles by analyzing all the retracted articles between 2004 and 2013.

SELECTION OF DATA

Data were retrieved using PubMed and Medline, a bibliographic database of biomedical literature, using the keywords retraction

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of articles, retraction notice, and withdrawal of article in April 2014 to detect articles retracted from 2004 to 2013, and were spread over Microsoft Excel sheet. We assessed all the factors associated with retraction of articles where the text was available in English. For each retraction, we recorded the article type (e.g. original research, review article, case report, letter) and the reason for the retraction (e.g. data fabrication or falsification, suspected fraud, scientific error, unethical, plagiarism, duplicate publication, or other causes like publisher error, authorship disputes, copyright infringement, or unknown causes). We also noted the time interval between publication and retraction of a particular article. We also selected the 15 journals with 2012 Institute for Scientific Information (ISI) impact factor (IF) more than 15 given by Thomson Reuters, and analyzed the number of articles retracted in these journals and also the time period between publication and retraction of the article. Results obtained were analyzed statistically by *t*-test and Karl Pearson's correlation coefficient applying Statistical Package for the Social Sciences (SPSS) software. *P* value less than 0.05 is considered as statistically significant.

A total of 2343 articles were retracted between 2004 and 2013 and were considered for evaluation [Table 1]. Table 1 shows that in both 2004-2008 and 2009-2013 periods, original articles followed by case reports and reviews constituted maximum percentage of total retracted articles.

Various reasons for retraction of articles

In Table 2 are presented the various reasons for retraction of articles, which shows the most cited reasons as mistakes, plagiarism, and duplicate submission over the period of 10 years [Table 2]. While determining whether the use of plagiarism detection software may have increased the detection of plagiarism in published articles, we found that the time interval between publication and retraction of articles had reduced significantly in 2009-2013 as compared to 2004-2008 [Table 3]. Table 3 shows that the time interval between publication and retraction has reduced significantly in recent times (2009-2013) as compared to previous years (2004-2008).

Impact factor and retraction of articles

Correlation was determined between the number of articles retracted and the time between retraction and publication for all journals having an IF more than 15 using Pearson's correlation coefficient [Table 4]. Table 5 shows that there was statistically nonsignificant relation between the IF, the number of articles retracted, and the time between retraction and publication.

Committee on publication ethics described retraction as a mechanism for correcting the literature and alerting readers to publications that contain such seriously flawed or erroneous data that their findings and conclusions cannot be relied upon.^[4] A total of 2343 retracted articles were found between 2004 and 2013. Corbyn *et al.*^[3] evaluated the retracted articles in 1990-2008 and Cokol *et al.*^[2] in 1950-2007, and found nearly 10-fold increase in the incidence of retraction.

Type of articles retracted

We observed that most of the articles retracted in scholarly literature are original articles followed by case reports and review

articles [Table 1]. So, we can say that there is more potential of fraudulent data in experimental studies than in other types of articles. Fraudulent data are not new in science. Gregor Mendel, the father of genetics, may have selectively modified his data in support of his results, and statistics suggested that Mendel's data are biased in the direction of agreement with expectation.^[5]

Present study revealed that mistakes and plagiarism are the major reasons cited for article retractions than other reasons such as plagiarism, duplicate submission, fabricated data, or ethical disputes [Table 2]. Similar findings were also obtained in a previous study by Nath *et al.*,^[6] who evaluated retractions listed in Medline between 1982 and 2002. They observed that misconduct attributed to 27% of retracted articles and errors constituted 62% of retrac-

Table 1. Various types of retracted articles and the time mean time interval between publication and retraction of articles

Year	Number of retractions	Original	Review	Case reports	Others	Mean time interval between publication and retraction (in months)
2004	69	24	14	29	2	40
2005	71	26	08	35	2	38
2006	133	60	15	54	4	28
2007	140	56	26	52	6	22
2008	235	86	50	91	8	18
2009	270	114	54	94	8	16
2010	258	116	42	94	6	14
2011	377	174	71	120	12	14
2012	388	192	82	106	8	10
2013	402	208	76	108	10	8
Total	2343	1056	438	783	66	208

Table 2. Reasons for retraction of articles from 2004 to 2008 and from 2009 to 2013

Reason for retraction	Number of articles retracted	
	2004-2008	2009-2013
Mistakes (honest errors)	204	474
Plagiarism	144	440
Duplicate publication	116	390
Fabricated data	86	187
Author dispute	12	51
Ethical issues	13	17
No reason	74	136
Total articles	648 articles	1695 articles

Table 3. Mean time interval between publication and retraction (in months)

Year	Number of retracted articles	Post publication to retraction		<i>P</i> value
		Mean±SD	Standard error	
2004-2008	648	31.2±10.35	4.63	0.01273
2009-2013	1695	12.4±3.28	1.47	(Significant)

SD: Standard deviation

Table 4. Journals with 2012 ISI impact factor more than 15 in relation to retraction of articles assessed between 2 April and 18 April 2014

Name of journal	Impact factor	Mean time interval between publication and retraction (months)	No. of articles retracted
JAMA- J Am Med Assoc	31.718	28.33	3
Nature	31.434	39	16
Cell	31.253	26.17	12
Nat Genet	30.259	40	1
Science	28.103	31.91	34
Nat Med	27.553	21.85	8
Nat Immuno	25.113	13.5	2
Nat Rev Genet	24.185	25	1
Immunity	20.579	83.83	6
Nat Cell Biol	17.774	53.33	3
Ann Intern Med	17.457	48	2
J Clin Oncol	17.157	46	8
J Clin Invest	16.559	45.28	7
Cell Metab	16.107	10	3

ISI: Institute for Scientific Information

Table 5. Correlation between the number of articles retracted in 2004-2013 and the time between retraction and publication in 15 journals having an impact factor more than 15

Publication characteristic	Correlation value (R value)	Coefficient of determination	Inference
Time between retraction and publication	-0.3038	0.0923	Weak correlation
Number of articles retracted	0.3243	0.1052	Weak correlation

tion. However, they failed to provide more descriptive categorization of the reasons for retractions. Wager *et al.*^[7] also found honest errors (28%), redundant publication (17%), and plagiarism (16%) as the major reasons behind retraction of articles. This is a serious issue since it is a disgraceful act in scientific writing and represents one of the biggest challenges faced by the scholarly world. So, we strongly believe that academic misconduct must be recognized at the earliest and significant reduction can be brought by awareness, objective check methods, and stringent punishment.

Why journal editors have not declared reason for retraction

Present study showed that in 11% of the articles retracted in 2004-2008 and in 8% of the articles retracted in 2009-2013, no reason for retraction was stated or the language was so unclear that the reason could not be determined [Table 2]. Similarly, in previous year, a study conducted by Wager *et al.*^[7] on the articles retracted between 1988 and 2008 showed that 5% of retracted articles did not state the reason for retraction. Journal editors may be reluctant to print retractions with sufficient information as they fear legal action by the authors. This shows some discomfort on the part of authors and journals in admitting mistakes.^[6] According to Committee on Publication Ethics (COPE), authors usually would not have grounds for taking any legal action if it follows a suitable investigation and proper procedures.^[4] Retractions may be

due to genuine mistakes by authors, so it is important to mention the reason for retraction in retraction notices. Authors who have acted honestly and responsibly informed the journal editors about flaws of their work should not be stigmatized along with others who commit gross misconduct. This has also been emphasized in COPE guidelines.^[4,8] The National Library of Medicine (NLM) adopted a new policy according to which they chose to link the notice of retraction to the original article rather than delete the citation of the retracted article, because they felt that removal might affect historical perspective.^[9]

Quantity increased but quality decreased

In regard to quantity of publications worldwide, the first and second positions are bagged by the US and UK with 22,969 and 8069 publications, respectively, and India represents 2296 publications. In terms of quality of research, Switzerland occupies the highest position followed closely by the US (based on the number of citations received). Hence, we can say that mere upsurge in the quantity of publications does not indicate increased quality of research work in the country.^[10] This goes in accordance with one famous saying, "You can put millions of farmers to cultivate, but you need some real scientists to make green revolution."

Time between retraction and publication

Unfortunately, retraction notices take a long time to reach the target readers after the article is published and it remains a chronic problem. Present study showed that the time interval between publication and retraction has reduced significantly in recent times (2009-2013) as compared to previous years [Table 3]. Steen *et al.*^[11] also observed that among 714 retracted articles published between 1973 and 2002, retraction took an average of 49.82 months and among 1333 retracted articles published after 2002, retraction required 23.82 months, and thus concluded that retraction may be occurring more quickly now than in the past.

Is there any relation between high impact factor journals and frequency of retraction of articles

The IF is a bibliometric parameter based on the number of times that papers in a particular journal are cited by all journals. It is considered a parameter of the scientific quality of a journal. IF is a reasonable surrogate for peer scrutiny as high-IF journals are cited more widely because they are seen more widely. When all retractions were scrutinized in all journals having 2012 ISI IF more than 15, no correlation was observed between time to retraction and journal IF. Only 15 journals having an IF more than 15, listed in Table 4, showed retraction notices, whereas the other 60 journals did not reveal any retraction notice. Similar results have also been obtained by Fang *et al.*,^[12] who observed retractions in 64% of all research journals with an IF of 9.000 or greater. Some authors have noticed an association between IF and the reasons for retraction being published in higher-IF journals. This could be explained by the fact that some authors might hurry to publish in a prestigious journal without taking enough time to check their data. When a paper deals with a hot topic, journals tend to publish special issues very rapidly.^[13]

Citation and retraction of articles

Editors of few journals resist in retracting articles, even when proved with gross evidence of fraud, as the fact remains that flawed research has slipped through the peer-review process of most of the top journals in science and medicine and such a publication besmirches the image of a journal and sullies the ethical standards of scientific publication.^[12] In our study we were surprised to find that an article published by Bezouska *et al.* (1994) in *Nature* was retracted after a long time of 19 years in 2013 as they failed to reproduce the results and it has been cited 255 times according to Thomson Scientific's Web of Knowledge.^[14] Retracted articles still continue to be cited as valid studies years after retraction notices had been issued.^[11,15] There is not sufficient evidence available that retraction notices make much difference to the citation behavior of authors, while there is evidence that articles receive fewer citations after retraction compared to a control group and highly cited articles continue to be frequently cited after retraction.^[9]

Perspectives and future direction

Scientific misconduct should not be tolerated and the journal editor should be alert and make an effective strategy to curb this menace at the root level by ensuring implementation of COPE guidelines. The main objective of retractions is to rectify the literature and ensure its academic and research integrity rather than punishing any authors. We believe that "naming, shaming, and blaming" does not seem to be appropriate for handling unintentional or honest errors, but rather it should be an opportunity for learning and improvement.^[16,7,11] It is still unclear whether misconduct/mistakes in articles are increasing hastily or the articles are retracted at a rapid rate in recent times. This study has a limitation that it is restricted to the retractions indexed in the Medline database and, therefore, reflects a biomedical bias to its generalization.

We conclude that retractions represent small fraction of a percent among all publications for any given field in any year. So, we suggest that editors should evolve some strategy by implementing COPE guidelines in order to reduce such misconduct as

it adversely affects not only the scientific community but also the general public. Original articles should remain freely available with a clear mention of the retraction, which should not only be mentioned on the journal website or in notes at the beginning or end of the article.

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