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Scientific integrity and fraud in radiology research

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ABSTRACT

Purpose: To investigate the view of radiologists on the integrity of their own and their colleagues' scientific work.
Materials and methods: Corresponding authors of articles that were published in 12 general radiology journals in 2021 were invited to participate in a survey on scientific integrity.
Results: A total of 219 (6.2 %) of 3,511 invited corresponding authors participated. Thirteen (5.9 %) respondents reported having committed scientific fraud, and 60 (27.4 %) witnessed or suspect scientific fraud among their departmental members in the past 5 years. Misleading reporting (32.2 %), duplicate/redundant publication (26.3 %), plagiarism (15.3 %), and data manipulation/falsification (13.6 %) were the most commonly reported types of scientific fraud. Publication bias exists according to 184 (84.5 %) respondents, and 89 (40.6 %) respondents had honorary authors on their publications in the past 5 years. General confidence in the integrity of scientific publications ranged between 2 and 10 (median: 8) on a 0–10 point scale. Common topics of interest and concern among respondents were authorship criteria and assignments, perverse incentives (including the influence of money, funding, and academic promotions on the practice of research), and poorly performed research without intentional fraud.
Conclusion: Radiology researchers reported that scientific fraud and other undesirable practices such as publication bias and honorary authorship are relatively common. Their general confidence in the scientific integrity of published work was relatively high, but far from perfect. These data may trigger stakeholders in the radiology community to place scientific integrity higher on the agenda, and to initiate cultural and policy reforms to remove perverse research incentives.

1. Introduction

The field of radiology keeps on evolving rapidly. Scientific research is crucial to validate, question, or reject the potential benefits of medical imaging technology and applications to patient care. Radiologists rely on research performed in their field for clinical decision making and to invest in further studies. Therefore, it is of vital importance that this research is trustworthy.

Unfortunately, however, many research investigations that are publicly presented (with peer-reviewed publications as the most important vehicle of knowledge transfer) may not be reliable. False research claims may be due to two reasons, one of them being poor study designs and settings, which has been extensively addressed in the literature [1,2]. The other reason is scientific misconduct or fraud, which has been defined as fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results [3]. Scientific fraud has been present for many centuries and still exists today [3,4]. Its exact prevalence remains unclear [5].

Fraud in radiology research has occasionally been discussed in the literature [6–10]. Investigations into this topic have otherwise been lacking. More research is necessary to understand if scientific fraud is a relevant issue in the field of radiology.

The purpose of this study was to investigate the view of radiology researchers on the integrity of their own and their colleagues' scientific

Abbreviations: ICMJE, International Committee of Medical Journal Editors; MD, Medical doctor; SSPSS, Statistical Package for the Social Sciences.

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work.

2. Materials and methods

2.1. Ethical review board approval

This prospective survey study was approved by the institutional review board of the University Medical Center Groningen.

2.2. Participants

All corresponding authors of all articles that were published in the top twelve general radiology journals according to impact factor (based on the 2020 Journal Citation Reports [11]) in 2021 (i.e. *Radiology*, *Investigative Radiology*, *Journal of the American College of Radiology*, *European Radiology*, *Diagnostic and Interventional Imaging*, *American Journal of Roentgenology*, *European Journal of Radiology*, *Korean Journal of Radiology*, *Academic Radiology*, *British Journal of Radiology*, *Japanese Journal of Radiology*, and *Clinical Radiology*), were potentially eligible for participation in this survey. Corresponding authors whose e-mail addresses could not be retrieved, corresponding authors from the authors' own research group, and corresponding authors with e-mails that proved to be undeliverable, were excluded. Eligible participants received an e-mail with a brief explanation of the purpose of the study and a request to participate using a weblink. Participation was voluntary and anonymous. No financial or other rewards were given. The first e-mail was sent on 23 February 2022, and reminders were sent on 9 March and 23 March 2022. Access to the survey was closed on 30 March 2022.

2.3. Survey

The survey questions were composed by two radiologists (R.M.K. and T.C.K., both with >6 years of post-residency clinical radiology experience and both with >15 years of medical imaging research experience). The survey questions collected information on the respondent's characteristics, scientific fraud by the respondent or respondent's departmental workers in the past 5 years, respondent's view on publication bias [12], respondent's experience with honorary authorship practices in the past 5 years [13,14], and general confidence of the respondent in the integrity of scientific publications. Respondents could leave any comments in an open text field at the end of the survey. The complete questionnaire is displayed in Table 1. The survey was digitalized and made available online through a weblink using Qualtrics Core XM survey software (Qualtrics LLC, Provo, Utah). The survey software was set to prevent respondents from taking the survey multiple times.

2.4. Data analysis

Respondents' characteristics and answers to the survey questions on scientific integrity were descriptively summarized. Scientific fraud was considered to have occurred if the participant disclosed either data fabrication, data manipulation/falsification, misleading (e.g. selective) reporting, plagiarism, duplicate/redundant publication, or any other type of publication fraud in the survey. Respondents' comments in the open text field at the end of the survey were qualitatively analyzed.

3. Results

3.1. Eligible participants

A total of 4,924 articles were published in the aforementioned top twelve general radiology journals in 2021. Of the 4,924 corresponding authors on these articles, 1,164 were duplicates, 168 were sent an e-mail that proved to be undeliverable, 75 had no retrievable e-mail address, and 6 were from the authors' own research group. The remaining 3,511 unique corresponding authors were invited to participate in the survey.

Table 1
Survey with questions and answer options.

No.	Question	Answer options
1	How old are you?	<18, 18–24, 25–34, 35–44, 45–54, 55–64, or > 65 years old
2	What is your gender?	Male, female, or other
3	In which country do you work?	List of 30 countries, and open text field to indicate another country
4	What is your academic degree?	Medical doctor (MD), doctor of philosophy (PhD), master of science (MSc), bachelor of science (BSc), master of public (MPH), and open text field to indicate another academic degree[a]
5	Which academic position do you hold?	None, fellow/resident, instructor/lecturer, assistant professor, associate professor, full professor, and open text field to indicate another academic position
6	How many years of research experience do you have?	<5, 5–10, or > 10 years
7	Have you committed any of the following in the past 5 years?	Data fabrication, data manipulation/falsification, misleading (e.g. selective) reporting, plagiarism, duplicate/redundant publication, other type of publication fraud (open text field), none of the above[a]
8	Have you witnessed or do you suspect that anyone from your department committed any of the following in the past 5 years?	Data fabrication, data manipulation/falsification, misleading (e.g. selective) reporting, plagiarism, duplicate/redundant publication, other type of publication fraud (open text field), none of the above[a]
9	Do you think that a study with positive results is more likely to be accepted by a journal than a similar study with negative results?	Yes, no, or undecided
10	Please indicate your confidence in the integrity of published work in your scientific field	0–10 point linear scale, with 0 indicating no confidence and 10 indicating high confidence
11	Is there a co-author on any of your publications in the past 5 years who actually did not deserve this co-authorship based on the International Committee of Medical Journal Editors (ICMJE) criteria?	Yes, no, or undecided
12	Please feel free to add any narrative comments	Open text field

[a] Multiple answers possible.

3.2. Respondents

A total of 219 (6.2 %) of 3,511 invited corresponding authors filled in the questionnaire. Characteristics of the respondents are displayed in Table 2. Most respondents were aged 35–44 years (32.0 %) and male/female distribution was 163 (74.4 %)/53 (24.2 %).

3.3. Scientific fraud

Thirteen (5.9 %) of 219 respondents reported having committed scientific fraud, and 60 (27.4 %) reported having witnessed or to suspect scientific fraud among their departmental members in the past 5 years (Table 3).

3.4. Publication bias

One hundred eighty-five (84.5 %) of 219 respondents indicated that a study with positive results is more likely to be accepted by a journal than a similar study with negative results, whereas 21 (9.6 %) indicated this not to be the case and 13 (5.9 %) remained undecided.

Table 2
Characteristics of the 219 survey respondents.

Variable	Category	Count	Percentage
Age	<18 years	1	0.5 %
	18–24 years	2	0.9 %
	25–34 years	30	13.7 %
	35–44 years	70	32.0 %
	45–54 years	50	22.8 %
	55–64 years	40	18.3 %
	>65 years	26	11.9 %
Gender	Male	163	74.4 %
	Female	53	24.2 %
	Other	3	1.4 %
Country of work[a]	Argentina	1	0.5 %
	Austria	1	0.5 %
	Belgium	2	0.9 %
	Brazil	3	1.4 %
	Canada	8	3.5 %
	Chile	2	0.9 %
	China	7	3.2 %
	Denmark	2	0.9 %
	Egypt	1	0.5 %
	France	8	3.7 %
	Germany	7	3.2 %
	Greece	3	1.4 %
	India	4	1.8 %
	Indonesia	1	0.5 %
	Iran	1	0.5 %
	Israel	1	0.5 %
	Italy	23	10.6 %
	Japan	3	1.4 %
	Korea	6	2.8 %
	Malaysia	1	0.5 %
	Moldova	2	0.9 %
	Oman	2	0.9 %
	Poland	1	0.5 %
	Portugal	1	0.5 %
	Russia	1	0.5 %
	Slovenia	1	0.5 %
	Spain	4	1.8 %
	Sweden	1	0.5 %
	Switzerland	5	2.3 %
	The Netherlands	20	9.2 %
	Turkey	3	1.4 %
	United Kingdom	15	6.9 %
	United States	77	35.3 %
Academic degree	Medical doctor (MD)	148	67.6 %
	Other degree(s)	71	32.4 %
Academic position	None	19	8.7 %
	Fellow/resident	14	6.4 %
	Instructor/lecturer	14	6.4 %
	Assistant professor	40	18.3 %
	Associate professor	37	16.9 %
	Full professor	71	32.4 %
	Other	24	11.0 %
Years of research experience	<5 years	27	12.3 %
	5–10 years	152	69.4 %
	>10 years	40	18.3 %

[a] Not filled in by one respondent.

3.5. Honorary authorship

Eighty-nine (40.6 %) of 219 respondents had honorary authors on their publications in the past 5 years, 101 (46.1 %) were not confronted with honorary authorships, and 29 (13.2 %) remained undecided.

4. General confidence in the integrity of scientific publications

General confidence of respondents in the integrity of scientific publications ranged between 2 and 10 (median: 8) on a 0–10 point scale (Fig. 1).

Table 3
Reported scientific fraud by survey respondents and witnessed or suspected scientific fraud among departmental members in the past 5 years.

Type of scientific fraud	Survey respondents (n = 13)[a]	Departmental members (n = 60)[b]	Total (%, with 95 % confidence intervals)
Data fabrication	1	6	7 (5.9 %; 2.9 %–11.7 %)
Data manipulation/ falsification	3	13	16 (13.6 %; 8.5 %–20.9 %)
Misleading (e.g. selective) reporting	6	32	38 (32.2 %; 24.5 %–41.1 %)
Plagiarism	3	15	18 (15.3 %; 9.9 %–22.8 %)
Duplicate/ redundant publication	5	26	31 (26.3 %; 19.2 %–34.9 %)
Other	1[c]	7[d]	8 (6.8 %; 3.5 %–12.8 %)

[a] Four respondents indicated to have committed multiple types of scientific fraud.
[b] Twenty-five respondents indicated to have witnessed or to suspect multiple types of scientific fraud among departmental members.
[c] Other type of reported scientific fraud:"Included non-contributing authors".
[d] Other types of reported scientific fraud: "Included non-contributing authors", "Numerous authors who don't contribute", "Blocking of someone – so they could publish first", "Getting credits for publication as senior author without and merit", "Ghost author", "No inclusion of student's name who actually worked on the subject, in the list of authors", "Redundant publications with modifications of the existing material. It is quite aptly conveyed that "copying from multiple journals is research"".

4.1. Qualitative analysis narrative comments

Thirty-nine respondents provided comments in the open text field at the end of the survey, which are shown in Supplemental Table 1. Common topics of interest and concern were authorship criteria and assignments, perverse incentives (including the influence of money, funding, and academic promotions on the practice of research), and poorly performed research without intentional fraud.

5. Discussion

The reported scientific fraud percentages can be considered concerning. Altogether, the most common types of scientific fraud were misleading reporting (32.2 %) and duplicate/redundant publication (26.3 %), followed by plagiarism (15.3 %) and data manipulation/ falsification (13.6 %). Publication bias (i.e. studies with positive results are more likely to be published than studies with negative results [15]) and honorary authorship (i.e. the intentional misrepresentation of credit to an individual whose contributions to a biomedical article do not meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship [16,17]) were also commonly experienced by respondents, and the latter was a leading topic in the narrative comments. General confidence in the scientific integrity of published work was relatively high, but not perfect. This observation is in line with the amount of scientific fraud that was reported in this survey study. Some degree of distrust may also reflect the consequences of poorly performed research without intentional fraud, as also indicated by several of the respondents in the narrative comments.

Scientific output is a major criterion for academic promotions and prestige [18]. Furthermore, studies with positive results are more frequently accepted for publication and cited than those with negative results [19,20]. This imbalance has increased over the years [21], and may be fueled by medical journal publishers and editorial boards who have an interest to increase the visibility and readership of their journals. Finally, research grants, which are used to generate scientific

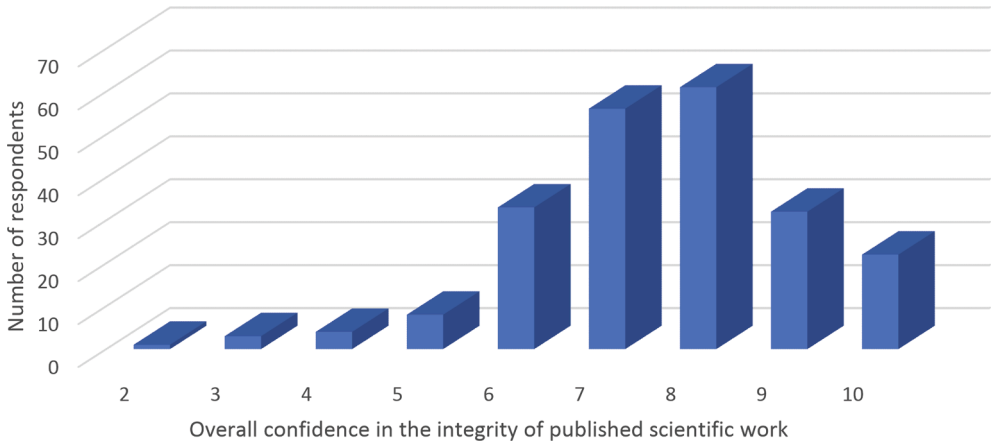

Fig. 1. Distributions of scores assigned by survey participants to their overall confidence in the integrity of published scientific work (0–10 point scale).

output and to advance on the academic ladder, are frequently awarded to those who have previously shown positive results on the topic that is submitted for funding. Overall, the current system creates perverse incentives that may seduce researchers into scientific fraud [22], which was also commonly indicated by the respondents in the narrative comments. Of interest, >15 years ago, when a focus group of 51 scientists was confronted with the fact that a small percentage of scientists admitted to have fabricated research data (0.3 %) and committed plagiarism (1.4 %) in a survey published in *Nature*, it was revealed that most of them "were uncomfortable with these behaviors but said they must do them to survive in their work" [22].

There is a limited number of previous studies related to scientific integrity in radiology research. According to a study by Rosenkrantz [23], 42 retracted PubMed articles between 1983 and 2013 were published in a radiology journal, corresponding to only 0.011 % of 398,323 publications within radiology journals. Some of these retractions may be attributed to scientific misconduct. In another study by Taylor [24], a sample of 110 (6.8 %) of 1,610 manuscripts submitted to the *American Journal of Roentgenology* in 2014 in the categories of "Original Research" or "Review" were evaluated for plagiarism. Twelve manuscripts (10.9 %) contained plagiarism [24].

The issue of publication bias has been addressed in previous work. Treanor et al. [12] reported that 246 (74 %) of 337 abstracts with a positive conclusion that were presented at the 2011 or 2012 Radiological Society of North America annual meeting resulted in full-text publications, compared with 26 (54 %) of 48 abstracts with a neutral conclusion and 5 (33 %) of 15 abstracts with a negative conclusion. A positive conclusion significantly increased the likelihood of full-text publication, with an odds ratio of 3.6 [12]. In other studies on honorary authorships in radiologic research articles by Eisenberg et al. [13,14], honorary authorship practices were experienced by 165 (50.3 %) of 328 respondents in 2011, and by 159 (54.3 %) of 293 respondents in 2016. The results of the present study underline the (perceived) omnipresence of publication bias and honorary authorship practices.

The present study had some limitations. First, the response rate of 6.2 % was relatively low. This could be explained by lack of time and survey burden among physicians [25], and the sensitivity of the subject. Consequently, the respondents may not have been representative of the entire population of interest. Importantly, however, scientific fraud was committed by 13 respondents, and suspected or witnessed among 60 departmental members in this survey with a total of 219 participants. Therefore, even though the response rate was relatively low, the absolute numbers on scientific fraud that emerged from this relatively small sample are sufficient reasons for concern. Second, the respondents' views on publication bias remain subjective because it may be impossible for a single person to say, based on individual experience, whether positive results are more likely to be published. Third, the specific questions on scientific fraud only applied to the past 5 years.

In conclusion, radiology researchers reported that scientific fraud and other undesirable practices such as publication bias and honorary authorship are relatively common. Their general confidence in the scientific integrity of published work was relatively high, but far from perfect. These data may trigger stakeholders in the radiology community to place scientific integrity higher on the agenda, and to initiate cultural and policy reforms to remove perverse research incentives.

6. IRB statement

- This prospective survey study was approved by the institutional review board of the University Medical Center Groningen.
- This study has been performed in accordance with the ethical standards in the 1964 Declaration of Helsinki.
- This study has been carried out in accordance with relevant regulations of the US Health Insurance Portability and Accountability Act (HIPAA).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejrad.2022.110553.

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