EVOLUTION AND CHARACTERIZATION OF RETRACTIONS DUE TO MISCONDUCT IN BRAZIL AND PORTUGAL

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EVOLUTION AND CHARACTERIZATION OF HEALTH SCIENCES PAPER RETRACTIONS IN BRAZIL AND PORTUGAL

ABSTRACT

The retraction of health sciences publications is a growing concern. To understand the patterns in a particular country-context and design specific measures to address the problem, it is important to describe and characterise retractions. We aimed to assess the evolution of health science retractions in Brazil and Portugal and to describe their features. We conducted a cross-sectional study including all health sciences retracted articles with at least one author affiliated to a Portuguese or Brazilian institution identified through Retraction Watch database.

A total of 182 retracted articles published in 129 journals were identified. The number of retractions increased over time, but the proportion related to the whole of publications remained stable. A total of 50.0% and 60.8% of the Portuguese and Brazilian retracted articles, respectively, were published in first and second quartile journals. Scientific misconduct accounted for 60.1% and 55.9% of retractions in Brazil and Portugal, respectively. In both countries, the most frequent cause of misconduct was plagiarism. 61.8% and 53.4% of the Portuguese and Brazilian retracted articles, respectively, included a funding declaration and, of those, 90.3% and 88.6% received funding. The time from publication to retraction decreases as the journal quartile increases. Articles retracted for misconduct received more citations than those retracted for error.

The retraction of health sciences articles did not decrease over time in Brazil and Portugal. There is a need to develop strategies aimed at preventing, monitoring and managing scientific misconduct according to the country context.

Keywords: retractions, scientific misconduct, Brazil, Portugal.

INTRODUCTION

The retraction of scientific articles is an increasing phenomenon at a global level [1,2]. It is necessary to distinguish between the two main causes of retraction, as they do not have the same consequences or implications. On the one hand, a retraction may be due to an error that occurs unintentionally. It should be borne in mind that all researchers can make mistakes. The other cause of retraction is scientific misconduct. In this case, the unethical practice is intentional. Scientific misconduct includes multiple unethical practices such as the fabrication, falsification and plagiarism of data and images, among other practices [3].

It has been estimated that each retracted article has an associated cost of over 360,000 euros [4]. The economic impact is even higher in the case of publicly funded studies. Moreover, in health sciences errors or misconduct have a potential health and social impact. Fraudulent results and unreliable conclusions may lead to incorrect decisions by physicians or decision makers, causing potential harm for the health and well-being of the population [5].

Although it is a global phenomenon, retraction of articles, specifically due to misconduct, has been associated with specific countries, such as China, Iran or Brazil. In fact, the country of author affiliation is an important predictor of retraction [6]. This could be explained by the educational model and the national scientific policy context in each country. Countries that assumed the German model of higher education (hierarchical and less liberal) present a higher risk of committing misconduct than those with the Anglo-American model (prone to critical thinking) [6,7]. In addition, sociocultural conditions are one of the main determinants of misconduct in scientific research.

Different studies have shown that the most frequent cause of scientific misconduct varies by country. Chen et al concluded that the principal cause of retraction in China was error, followed by plagiarism [8]. A study conducted in 2019, showed that plagiarism was the main cause of retraction in India [9]. However, studies conducted at a global level have shown a higher prevalence of fabrication/falsification compared to plagiarism [1]. In order to understand the different patterns of retractions due to errors and scientific misconduct in a particular country, it is important to describe and

characterise the retractions. This is an important first step to design specific measures to address this problem. In addition, it is important to monitor how retraction trends evolve over time.

Brazil and Portugal are responsible for an important part of the scientific publications in the biomedical field, and they share relevant cultural and economic ties in addition to language. A previous study showed that the publication patterns of Brazil are similar to those of Portugal [10].

Regarding research investment, Brazil and Portugal invested 1.16% and 1.35% of GDP in 2018 respectively [11]. Although these figures are lower than in other countries, investment in research is expected to increase globally. Research investment in Portugal has been on an upward trend since 2012, although it is still below the European average (2.23% of GDP) [12], while Brazil announced that by 2022 it would increase its research investment by 110% compared to 2021 [13]. The increase in research funding increases the number of researchers and the competitiveness among them and consequently the pressure to publish [14,15]. Although the pressure to publish is a global phenomenon, it is more important in countries where the evaluation system for researchers is based on the number of publications to get a job [16].

To our knowledge and despite of the consequences and implications of retractions, especially on the health sciences, there is no study that has analyzed this phenomenon in Portugal. To date, two studies have analyzed retractions in Brazil [17,18]. The first study reviewed retractions until 2017 and used a small sample size [18]. The most recent study included retractions in all knowledge areas, but not focusing on the health sciences [17]. Therefore, we aimed to assess the evolution of health science retractions in Brazil and in Portugal and to describe their features.

METHODOLOGY

Study design and data collection

A cross-sectional study was conducted. Publications retracted for any cause between 1st January 2000 and 26th September 2021 were included in this study. To be included, publications must have at least one author affiliated with an institution in Brazil or Portugal. Communications to congresses, corrections and abstracts were excluded.

The included publications were extracted from the Retraction Watch database [19] (www.retractiondatabase.org) selecting "Brazil" and "Portugal" in the field "Author country" and "Retraction" in the field "Nature of retraction". Using this search strategy, all retractions whose authors were affiliated to Brazilian or Portuguese institutions were retrieved.

In order to include health sciences retractions, we selected retracted publications categorised as "Basic Life Sciences (BLS)" and/or "Health Sciences (HSC)" in the field "Subject". The category "Basic Life Sciences (BLS)" includes subjects such as biology, microbiology, toxicology, environmental sciences, biochemistry, or virology. The category "Health Sciences (HSC)" includes all medical specialties (general medicine, oncology, endocrinology, etc).

The information of interest for each included retracted publication has been collected from Retraction Watch database, Journal Citation Reports (JCR) (Clarivate Analytics) and Web of Science.

From Retraction Watch database, the total number of retractions and the number of retractions within the health sciences scope were collected by country and year. The proportion of health science retractions in relation to the total number of retractions was calculated for each country and year.

For each included publication the following variables were collected: title of the article; type of publication (original article, systematic review, meta-analysis, letter, guideline, case report); date of publication; date of retraction; journal where the article was published; JCR category of the journal; journal impact factor (JIF); quartile of the journal; type of journal (Open Access, Subscription); total number of authors; country of the authors (Brazil, Portugal); number of countries in affiliation field; citations received by the retracted publication until 15/10/2021. In the case where the journal was included in more than one category, we chose the most favourable according to the JIF. When the journal was hybrid (publishing open access and by subscription), that journal was categorised as "subscription". In addition, time in days elapsed between publication and retraction was calculated.

The cause of retraction for each article was extracted from Retraction Watch database. In order to verify the cause of retraction of the included articles, the notice of retraction

was accessed. In the case where we couldn't access the notice of retraction of an article, we used the reason for retraction given by Retraction Watch database. In the case where one article was retracted for several reasons, the most prominent was selected. Causes of retractions were categorized as follow:

- Error: including errors made by authors and by the journal.
- Scientific misconduct: fabrication/falsification of data and/or images; plagiarism (including self-plagiarism and duplication); data not reliable; results not reliable; ethical issues (including authorship issues, copyright, informed consent, or conflict of interest).

Funding and conflict of interest related variables were included: inclusion of a funding statement in the articles (yes/no); declared funding (yes/no); source of funding (public/private); name of the funding source; inclusion of a conflict-of-interest statement (yes/no); declared conflicts of interest (yes/no).

The name and institution from each author affiliated with a Portuguese or Brazilian institution was collected, as well as the number of retracted papers in which each is listed as an author. The institution of the author was categorised in the following categories: hospital, university, research centre, others (including industry, associations, and governmental institutions).

Statistical analysis

A descriptive analysis was performed, expressing categorical variables as an absolute and relative frequency, and quantitative variables as a median, 25th and 75th percentile.

First, the evolution of retractions was analysed in absolute terms; then the proportion of health sciences retractions in relation to the whole of retractions was calculated for each year and country.

The characteristics of the retracted publications were analysed and broken down by country (Brazil or Portugal). The time elapsed between publication and retraction was calculated, as well as its correlation with the journal's quartile and the cause of retraction for each country. Since the data do not follow a normal distribution, the Spearman correlation was used. For each country, the period elapsed between

publication and retraction and citations were compared by cause of retraction and by journal quartile, using the Kruskal-Wallis test.

Finally, it was performed a specific descriptive analysis of those authors affiliated with Portuguese or Brazilian institutions who have committed any type of scientific misconduct.

Statistical significance was established at $p<0.05$. All statistical analysis were performed using Stata v.17.

RESULTS

A total of 182 retracted articles published in 129 different journals were identified: 34 articles of authors affiliated to a Portuguese institution; and 148 of authors affiliated to a Brazilian institution. The number of retractions of articles by Portuguese and Brazilian authors accounts for 0.58% of the total number of retractions. The first article was published in 1997 and the first retraction took place in 2000. The type of publications were original articles (n=140), systematic reviews (n=26), meta-analysis (n=6), case reports (n=6), guidelines (n=2) and letters (n=2).

- **Retraction time trends, 2000-2021**

As shown in Figure 1, a rise in the absolute number of retractions was observed over time. This increase is reflected both in Portugal and Brazil, in total retractions (dashed line) and in health sciences retractions (solid line). A peak in the number of retractions was seen in both countries, between 2013 and 2018 in Portuguese articles and between 2012 and 2020 in Brazilian articles. Nevertheless, the relative number of retractions in relation to the whole of publications remained stable during the study period, varying between 2 and 4 retractions per 10,000 publications in both countries.

Health sciences retractions are accountable for a substantial percentage of the total retractions in both countries (Figure 2). In Portugal, health sciences retractions account for 20% to 75% of all retractions since 2012. In Brazil, this proportion is even higher as shown in Figure 2.

- **Characteristics of the retracted publications, 2000-2021.**

Table 1 shows the main publication characteristics broken down by country. In Portugal, the great majority of retracted articles (61.8%) included 5 or less co-authors. By contrast, in Brazil 53.7% included 6 or more co-authors. Collaboration of Portuguese and Brazilian authors with foreign authors was not very frequent as many of the articles only included authors from the same country. A total of 50.0% and 60.8% of the Portuguese and Brazilian articles, respectively, were published in first and second quartile journals. Most of the articles were published in non-Open Access journals.

The cause of retraction is shown in table 2. Regardless of the authors' country of origin, most retractions were due to some form of scientific misconduct. In the case of Portuguese authors, most retractions for misconduct were due to plagiarism. Similarly, in Brazil, retractions due to plagiarism exceeded 50% of retractions due to scientific misconduct. It should be noted that 16.2% of the retraction notices didn't state the cause of retraction in Brazilian articles.

The median number of days between publication and retraction because of misconduct was higher in Brazilian publications compared to Portuguese publications across all quartiles. This period was higher in the case of articles retracted for misconduct compared with those retracted due to error. This pattern is observed in both countries. However, as shown in table 3, the differences are statistically significant only for Brazilian articles published in first quartile journals ($p=0.002$).

In general, the median number of days from publication to retraction was higher in the case of articles published in first quartile journals, compared to other journals. However, in the case of Portuguese articles retracted due to misconduct, this period was longer in fourth quartile journals. Overall, the time from publication to retraction decreases as the journal quartile increases.

Publications retracted because of misconduct received more citations than those retracted because of error (table 4). This was mostly observed in Portuguese publications in first quartile and journals without impact factor. However, these differences are not statistically significant. In the case of Brazil, there are no major variations between the number of citations received as of the cause of retraction, except for those published in second quartile journals ($p=0.025$). However, it should be noted

that the sample size in these groups is very small, especially in the case of Portuguese articles.

In addition, a positive association between the journal IF and the number of citations received by publications was observed both in Portugal (rho 0.50; p=0.01) and Brazil (rho=0.60; p<0.001).

- **Funding**

The 61.8% and 53.4% of the Portuguese and Brazilian articles, respectively, included a funding declaration in the text of the article. Of those, 90.3% and 88.6% received funding (Table 5).

Of the Portuguese funded retracted articles due to misconduct, 33.3% received funding from one source. In contrast, 54.4% of Brazilian articles obtained funding from two different sources. In addition, most articles retracted for misconduct received funding from public sources. In Portugal, 8 (33.3%) of the publicly funded articles received funding from Fundação para a Ciência e a Tecnologia (FCT), 4.2% from Conselho Nacional de Desinvolvimento Científico e Tecnológico (CNPq) and 62.5% from other public sources. In the case of Brazil, 42.3% received funding from Fundação de Amparo à Pesquisa (FAP), 40.5% from Conselho Nacional de Desinvolvimento Científico e Tecnológico (CNPq) and 17.2% from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

- **Conflicts of interest**

Of the retracted articles 45.6% have not included a conflicts of interest (COI) statement. These proportions are similar in both countries, as shown in table 7. Of the 73 papers including a statement, 5 declared a COI, all in Brazilian publications.

- **Authors who committed scientific misconduct**

This analysis was restricted only to articles retracted for scientific misconduct (108 articles). The great majority of authors who committed misconduct had one retraction (Brazilian authors: 75.0%; Portuguese authors: 88.1%) (table 6). Two authors affiliated to Brazilian institutions have 16 and 17 retracted articles. Most authors with retracted publications were affiliated with universities.

In Portugal, the highest number of authors who committed misconduct were affiliated to Universidade de Lisboa and Universidade do Porto, followed by Universidade de Coimbra and Universidade Técnica de Lisboa. In Brazil, a quarter of the authors of articles retracted for scientific misconduct were affiliated to Universidade Estadual de Campinas, followed by Universidade de Sao Paulo, with the 18.3% of the retractions (table 7).

DISCUSSION

The study findings show that health science misconduct is frequent in Brazil and Portugal being the leading cause of health sciences retraction in both countries. Although the absolute number of retractions has grown in the last two decades in both countries, the proportion of retractions regarding the total publications remains stable. To our knowledge, this is the first study which analyses the phenomenon of retractions in Portugal and the study with the largest sample size describing retractions in the health sciences in Brazil.

Previous works conclude that retractions and specifically those due to scientific misconduct have increased in recent decades [1,2,18,20]. In the case of Brazil and Portugal the increase in the number of retractions could be attributed to an increase in the number of publications, as shown in this study. Some authors argue that the increase in scientific misconduct has been driven in part by the system through which researchers are currently evaluated, which is based on the number of publications a researcher has in high impact journals [21,22]. This system increases the pressure to publish, and might result in researchers deciding to commit scientific misconduct in order to achieve the publication quotas imposed to gain funding and promotions [23,24].

Scientific misconduct includes multiple questionable practices. Although its definition refers mainly falsification, fabrication and plagiarism [3], other unethical behaviors are also considered scientific misconduct, such as authorship issues or non-declaration of conflicts of interest, among others. Previous studies have shown an overall higher prevalence of falsification and fabrication [1], however our results identified plagiarism as the main cause of retraction. Our results are in line with other studies conducted in Brazil and Latin America [17,18,25]. Different cultural perceptions of plagiarism may

play a role in the prevalence of this type of scientific misconduct, as well as the national policies against research fraud [7,25]. In addition, the lack of training of students and researchers in scientific integrity is a possible reason why plagiarism is so prevalent in Brazil and Portugal, as it is not usually recognized as scientific misconduct. A study showed that only 25% of medical students in Brazil recognized plagiarism as a type of scientific misconduct [26]. Our results show that the vast majority of authors who committed scientific misconduct was affiliated with universities, regardless of the country of affiliation. Thus, there is a need to improve training in ethics and scientific integrity at the undergraduate and graduate levels, especially in health sciences.

Citation analysis works as a proxy for the visibility and influence of an article. Retracted articles should not receive citations after the retraction. However, a recent study concluded that the retraction of articles has no impact on the citations they receive after the retraction. In addition, articles retracted for scientific misconduct receive more citations after they have been retracted than before [27]. The results of our study show that retracted publications from Portuguese and Brazilian authors receive many citations. It is observed that those published in first and second quartile journals receive more citations in comparison to those published in low impact journals. This result is in line with previous works [28,29]. Although citing retracted articles is currently a valid procedure, researchers should bear in mind that it may lead to the persistence of unreliable results in the literature and should therefore be avoided. Scientific journals should vet articles set to be published to ensure that no retracted articles have been cited and, if so, act accordingly. There are also resources available for authors to avoid the citation of retracted publications. For example, some reference management tools, such as EndNote or Zotero, alert the researcher if a cited reference has been retracted [30,31].

Another worrying fact is that many retracted publications of authors affiliated to Portuguese or Brazilian institutions receive funding from public sources. The results of our study are in line with those from the study conducted by Santos-D'Amorín et al [17]. The most common source of funding varies from country to country. The most frequent source of funding in the case of portuguese articles was the Fundação para a Ciência e a Tecnologia (FCT) while for Brazilian articles it was the Fundação de Amparo à Pesquisa (FAP), followed by the Conselho Nacional de Desinvolvimento Científico e Tecnológico (CNPq) and the Coordenação de Aperfeiçoamento de Pessoal

de Nível Superior (CAPES). These are public institutions and consequently the funds used to support research are also public.

The fact that most of the retracted articles were publicly funded is problematic for several reasons. Most publicly funded retractions in this study were due to scientific misconduct, including various types of fraud. Although the percentage of funding invested in research which was eventually retracted is low, many fraudulent articles have not yet been identified. Therefore, the economic impact of research misconduct might be higher than previously though [1]. Civil society is accountable for public funds invested in research. The trust that society places in research and scientists has been recently undermined by multiple scandals like those perpetuated by Andrew Wakefield and John Darsee, among many others [32,33].

Funding institutions should have specific policies and procedures to handle allegations of scientific misconduct of researchers that they fund. This is especially important in the case of publicly funding sources, like governmental institutions. In addition, before providing funding, such institutions should check that researchers have not committed misconduct in the past or at the current time. Moreover, specific organisms should be created to deal with scientific misconduct at the national level. Such an organism does not currently exist in Portugal. In Brazil, FAPESP updated in 2014 their Code of Good Scientific Practices and included sanctions to deal with retractions (invalidation of degrees, copyrights, loss of positions, etc.). However, this code is only applied to investigations funded by FAPESP [34]. A study conducted by Fanelli et al [6] concluded that having such a national organization greatly prevents scientific misconduct. This organization should be responsible for investigating suspected scientific misconduct and imposing appropriate sanctions which depend on the seriousness of the problem.

The main strength of this study lies in the use of the Retraction Watch database [19] as a data source. The Retraction Watch database was created in 2010 and contains more than 30,000 retractions between 1940 and 2022. Other studies analysing retractions reported difficulties in identifying retracted publications using traditional methods (such as Medline or Web of Science) [18]. However, the Retraction Watch database includes retracted publications both indexed in main databases and those that have not

been indexed. Therefore, we consider the number of retracted publications missed in this study to be minimal.

This study also has limitations. One of them could be the lack of a comparison group. The selection of a comparison group could be very difficult. For example, if we match articles by journal, we could not compare the journals' characteristics. It should be noted that many of the studies analysing retractions do not have a comparison group. There are authors affiliated with more than one institution. In this study, the first institution of affiliation of each author was collected in order of appearance. In addition, we analyzed the articles that have already been retracted, we are unaware of the total number of flawed publications present in the scientific literature. Regarding the citation analysis, this study didn't differentiate between citations received before retraction and citations received after retraction.

The increase of health sciences retractions overtime in Portugal and Brazil is worrying, especially considering that most retractions are due to scientific misconduct and many of them have received funding from public sources. Considering the results of this study, it is necessary to establish mechanisms to prevent, detect, monitor, and deal with scientific misconduct. These mechanisms may include the promotion of students' training and engagement in scientific integrity by universities; the systematic use of plagiarism software by scientific journals; or the establishment of measures to prevent researchers who committed scientific misconduct from receiving funding by funding institutions. In addition, at the national level, the creation of a specific organism which would handle and sanction misconduct may help to deter researchers who are thinking of engaging in research misconduct [35,36].

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Table 1. Main publication characteristics, according to the cause of retraction, by country.

	Portugal (n=34)	**Brazil (n=148)**
Article type		
Original article	27 (79.4%)	113 (76.4%)
Systematic review	1 (2.9%)	25 (16.9%)
Meta-analysis	2 (5.9%)	4 (2.7%)
Case report	2 (5.9%)	4 (2.7%)
Letter	1 (2.9%)	1 (0.7%)
Guideline	1 (2.9%)	1 (0.7%)
Number of authors		
1-5	21 (61.8%)	56 (46.3%)
>5	13 (38.2%)	65 (53.7%)

Number of countries		
1	21 (61.8%)	116 (78.4%)
2	8 (23.5%)	16 (10.8%)
3	3 (8.8%)	10 (6.8%)
4 or more	2 (5.9%)	6 (4.1%)
Journal quartile		
Q1	9 (23.5%)	63 (42.6%)
Q2	6 (26.5%)	27 (18.2%)
Q3	7 (20.6%)	19 (12.8%)
Q4	4 (11.8%)	15 (10.1%)
No IF	8 (23.5%)	24 (16.2%)
Type of journal		
Open Access	6 (17.6%)	43 (29.1%)
Subscription	28 (82.4%)	105 (70.9%)
Journal category		
Genetics and heredity	3 (11.5%)	1 (0.8%)
Environmental sciences	2 (7.7%)	1 (0.8%)
Medicine, General and Internal	2 (7.7%)	21 (16.9%)
Microbiology	2 (7.7%)	2 (1.6%)
Endocrinology and Metabolism	1 (3.9%)	12 (9.7%)
Other	24 (61.5%)	111 (70.2%)

Table 2. Publications retracted for any cause of scientific misconduct, by country.

	Portugal	**Brazil**
Reason of retraction		
Error	12 (33.3%)	35 (23.7%)
Misconduct	19 (55.9%)	89 (60.1%)
Falsification/Fabrication	3 (13.6%)	9 (8.0%)
Plagiarism	9 (40.9%)	57 (50.4%)
Data not reliable	3 (13.6%)	7 (6.2%)
Results not reliable	1 (4.6%)	5 (4.4%)
Ethical issues	2 (9.1%)	10 (8.9%)
No cause of misconduct is stated	4 (18.2%)	25 (22.1%)
No cause of retraction is stated	3 (8.8%)	24 (16.2%)

Table 3. Time elapsed from publication to retraction (misconduct and error) by journal quartile and country, expressed in days (median, 25th percentile and 75th percentile).

	Portugal			Brazil		
Q	**Misconduct**	**Error**	**p-val**	**Misconduct**	**Error**	**p-val**
Q1	821 (664-923) n=5	81 (48-114) n=2	0.137	1831.5 (748.5-3292) n=32	448 (177-980) n=14	**0.002**
Q2	303 (252-519) n=5	69 (69-69) n=1	0.143	1513 (396-2223) n=21	246 (0-1575) n=5	0.078
Q3	135.5 (80.5-1,525.5) n=4	0 (0-126) n=3	0.154	384 (60-1004) n=14	158 (0-590) n=3	0.131
Q4	1,578.5 (154-3,003) n=2	30 (30-30) n=2	0.102	372.5 (210.5-522.5) n=8	128 (92-366) n=5	0.379
No IF	518 (441-939) n=3	7.5 (3.5-50.5) n=4	0.054	90 (62-212) n=14	322.5 (72.5-496.25) n=8	0.309

*Q: quartile; IF: Impact Factor; p-val: p-value; n=number of papers in each category and quartile.

Table 4. Publication citations by cause of retraction and quartile journal, and by country. Median, 25th and 75th percentiles and p-value.

	Portugal			Brazil		
	Misconduct	**Error**	**p-value**	**Misconduct**	**Error**	**p-value**
Q1	46 (7-127)	1.5 (1-2)	0.108	8.5 (2-74.5)	8 (2-48)	0.321
Q2	3 (0-24)	2 (2-2)	0.766	17 (6-28)	4 (1-5)	**0.025**
Q3	0 (0-8)	2 (0-5)	0.817	2 (1-7)	3 (0-36)	0.589
Q4	4.5 (2-7)	7 (3-11)	0.439	0 (0-9)	0 (0-1)	0.717
No IF	27 (11-43)	1 (0-2)	0.171	1 (1-6)	3 (1-4)	0.591

Table 5. Funding and conflicts of interest.

	Portugal		Brazil	
	Misconduct	**Error**	**Misconduct**	**Error**
Included funding statement				
Yes	13 (68.4%)	5 (41.7%)	51 (57.3%)	22 (62.9%)
Received funding				
Yes	12 (92.3%)	5 (100%)	46 (90.2%)	18 (81.8%)
Number of sources				
1	4 (33.3%)	4 (80.0%)	11 (23.9%)	6 (33.3%)
2	4 (33.3%)	1 (20.0%)	25 (54.4%)	4 (22.2%)
3 or more	4 (33.3%)	0	10 (21.7%)	8 (44.5%)
Type of funding source				
Public source	10 (83.3%)	4 (80.0%)	45 (97.8%)	18 (100%)
Private source	2 (16.7%)	1 (20.0%)	1 (2.2%)	0

Table 6. Number of retractions for scientific misconduct per author and type of author's institution, by country.

	Portugal	**Brazil**
Number of retractions per author		
1	52 (88.1%)	201 (75.0%)
2	7 (11.9%)	35 (13.1%)
3	-	15 (5.6%)
4-9	-	13 (4.9%)
10-15	-	2 (0.8%)
>15	-	2 (0.8%)
Type of author's institution		
University	38 (65.4%)	242 (90.3%)
Hospital	15 (25.4%)	9 (3.4%)
Research Center	6 (10.2%)	11 (4.1%)
Other	-	6 (2.2%)

Table 7. Main authors' institutions of affiliation of authors who committed misconduct, by country.

Institution	Number and percentage of retracted articles because of misconduct
PORTUGAL	
Universidade de Lisboa	8 (13.6%)
Universidade do Porto	8 (13.6%)
Universidade de Coimbra	6 (10.2%)
Instituto Politécnico de Lisboa	4 (6.8%)
Universidade Nova de Lisboa	3 (5.1%)
BRAZIL	
Universidade Estadual de Campinas	71 (26.5%)
Universidade de São Paulo	49 (18.3%)
Universidade Estadual Paulista	19 (7.1%)
Universidade Federal da Bahia	14 (5.2%)
Universidade Federal do Rio Grande do Sul	14 (5.2%)
Universidade do Extremo Sul Catarinense	11 (4.1%)
Universidade de Brasília	7 (2.6%)
Universidade Cruzeiro do Sul	6 (2.2%)
Universidade Federal de Viçosa	6 (2.2%)

Figure 1. Evolution of total retractions (dashed line) and health sciences retractions (solid line) in Brazil and Portugal.

Figure 2. Proportion of health sciences retractions in relation to total retractions.