UNIVERSIDADE DE BRASÍLIA

FACULDADE DE CIÊNCIAS DA SAÚDE

DEPARTAMENTO DE ENFERMAGEM

RAFAELLY STAVALE

"Research misconduct among health and life sciences research: A systematic review of bad science at emerging institutions"

BRASÍLIA

2018

RAFAELLY STAVALE

"RESEARCH MISCONDUCT AMONG HEALTH AND LIFE SCIENCE RESEARCH: A SYSTEMATIC REVIEW OF BAD SCIENCE AT EMERGING INSTITUTIONS"

Trabalho de Conclusão de Curso apresentado ao Departamento de Enfermagem da Faculdade de Ciências da Saúde, *campus* Darcy Ribeiro, Universidade de Brasília para a obtenção do grau de Bacharel em Enfermagem Aluna: Rafaelly Stavale. Área de Concentração: Gestão dos Sistemas e dos Serviços em Saúde e Enfermagem

Linha de Pesquisa: Bioética e integridade em pesquisa: Aspectos da integridade de pesquisa em saúde: Uma revisão sistemática de retratações.

Orientadora: Profa. Dra. Dirce Bellezi Guilhem
Coorientadora: Dda Graziani Izidoro Ferreira

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DEDICATÓRIA

Dedico este trabalho de conclusão de curso a todos pacientes e familiares que confiaram em mim nos momentos de maior fragilidade, vulnerabilidade. Sem vocês tudo seria em vão. Aos pesquisadores que buscam qualidade no seu trabalho por saber que, assim, afetam positivamente práticas em saúde, políticas publicas e, principalmente, pessoas.

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A Fit Family. Vocês são pessoas, profissionais, estudantes, amigos muito especiais, que deixam saudade;

A minha orientadora Dirce e a Grazi pelo apoio durante a realização deste e de futuros projetos;

Por fim, a todos que contribuíram com o meu crescimento durante estes anos de UnB: funcionários, professores, alunos, pacientes e suas famílias, profissionais de saúde...

Muito obrigada!

SUMÁRIO

RESUMO

Introdução: Medidas para garantir integridade em pesquisa são amplamente discutidas devido ao seu impacto social, economico e científico. Nos últimos anos, houve um crescimento no suporte financeiro para pesquisa em saúde resultando em um aumento no numero de publicações. Contudo, estas conquistas foram acompanhadas de um aumento no numero de retratações, levando a precopações quanto a qualidade e confiabilidade destas pesquisas. **Objetivos:** Esta revisão sistemática, tem por objetivo investigar o perfil das pesquisas retratadas em saúde e vida de autoreas afiliados a universidades brasileiras. Dados quanto a diferença entre ano de publicação e retratação, numero de publicações retratadas por autor e instituição, motivos para retratação, padrão de citação pós retratação e tipo de estudo. Adicionalmente, foram coletadas informações quanto a qualidade, disponibilidade e acessibilidade das informações em relação a publicação de retratações. **Metodologia:** Dois revisores, independents, coletaram informações nas bases de dados PUBMED, Web of Science, BVS and Google Scholar. Para tal, usaram descritores do MeSH e DeCS em Português, Espanhol e Inglês. Data foi coletada do website Retraction Watch (www.retractionwatch.com). O protcolo desta revisão sistemática foi registrado na PROSPERO (CRD42017071647). **Resultados:** Obteu-se uma amostra final de 65 artigos, de 55 periodicos com fator de impacto variando entre 0 e 32.86, com mediana de 4.40 e media de 4.69. Foram encontradas erratas (1); artigos retratados (3); artigos retratados com nota de retratação (5); nota de retratação com errata (3); nota de retratação (45). O uso do website Retraction Watch como base de dados, adicionou 8 artigos não identificados pela estratégoa de busca nas bases bibliográficas. Os artigos retratados selecionados foram de diversos tipos de estudo: estudos experimentais (40) e revisão de literatura (15) representaram 84.6% das publicações selecionadas. Considerando as subáreas de conhecimento das ciências da saúde e vida, Medicina foi o campo com maior número de retratações (34), seguida das Ciências Biológicas (17). Alguns artigos foram retratados por pelo menos dois motivos (13). Destre os artigos selecionados, plagio foi o principal motivo de retratação (60%). Ausência de informações foi encontrada em 57% das notas de retratação. Essa foi uma limitação para o estudo. Adicionalmente, 63% foram citados após serem retratados. **Conclusão:** Retratação de artigos não ocorre somente por má conduta científica mas, também, por erro honesto. Apesar disso, considerando autores afiliados a instituições brasileiras, essa revisão concluí que a maioria das retratações ,nas areas de ciências da saúde e vida, são devido a má conduta científica. Sabe-se que o número de publicações é o indicador mais valorizado de produção

científica para progressão na carreira, aquisição de funanciamentos de pesquisa. Por isso, é necesssário um esforço sistematico dos conselhos nacionais de pesquisa, agencias de financiamento, universidades e periodicos para evitar uma progressão de práticas de má conduta científica. Mais investigações sobre o tema devem ser realizadas para maior compreensãod os fatores que norteam a má conduta cientifica e sua crescent manifestação.

Palavras chave: má conduta científica; integridade científica; retratação de publicação; revisão sistemática.

ABSTRACT

Background: Measures to ensure research integrity has been widely discussed due to its social, economic and scientific impact. In the past few years, financial support for health research in emerging countries has steadily increased resulting in a growing number of scientific publications. These achievements, however, have been accompanied by a rise of retracted publication followed by concerns about quality and reliability of such publications. **Objective:** This systematic review aimed to investigate the profile of medical and life science research retractions of authors affiliated to Brazilian academic institutions. Chronological trends between publication and retraction date, reasons for it, existence of citation afterwards, study design, number of retracted publications by author and affiliation were assessed. Additionally, quality, availability and accessibility to data regarding retracted papers from the publishers are described. **Methods:** Two independent reviewers searched for retracted articles since 2004 at PUBMED, Web of Science, BVS and Google Scholar databases. Indexed keywords from MeSH and DeCS in Portuguese, English or Spanish were used. Data was also collected from the Retraction Watch website (www.retractionwatch.com). This study was registered at PROSPERO systematic review database (CRD42017071647). **Results:** A final sample of 65 articles was retrieved from 55 different journals with reported impact factor ranging from 0 to 32.86, with a median value of 4.40 and mean of 4.69. The types of documents found were erratum (1); retracted article (3); retracted article with a retraction notice (5); retraction notice with erratum (3); retraction notice (45). The assessment of Retraction Watch website added 8 articles not identified by the search on the bibliographic databases. The retracted publications covered a wide range of study designs. Experimental studies (40) and literature reviews (15) accounted for 84.6% of the articles. Within the knowledge area of health and life sciences, Medical Science was the field with the largest number of retractions (34) followed by Biological Sciences (17). Some articles were retracted for at least two distinct reasons (13). Among the retrieved articles, plagiarism was the main reason for retraction (60%). Missing data were found in 57% of the retraction notices. It was a limitation to this review. In addition, 63% of the articles were cited after its retraction. **Conclusion:** Publications are not retracted essentially for research misconduct but also for honest error. Nevertheless, considering authors affiliated to Brazilian institutions, this review has concluded most of the retractions of health and life science were retracted due to research

misconduct. As the number of publications is the most valued indicator of scientific productivity for funding and career progression purposes, a systematic effort from the national research councils, funding agencies, universities and scientific journals is needed to avoid an escalating trend of research misconduct. More investigations are needed to comprehend the underlying factors of research misconduct and its increasing manifestation.

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Research misconduct among health and life sciences research: A systematic review of bad science at emerging institutions

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Abstract

Background: Measures to ensure research integrity has been widely discussed due to its social, economic and scientific impact. In the past few years, financial support for health research in emerging countries has steadily increased resulting in a growing number of scientific publications. These achievements, however, have been accompanied by a rise of retracted publication followed by concerns about quality and reliability of such publications.

Objective: This systematic review aimed to investigate the profile of medical and life science research retractions of authors affiliated to Brazilian academic institutions. Chronological trends between publication and retraction date, reasons for it, existence of citation afterwards, study design, number of retracted publications by author and affiliation were assessed. Additionally, quality, availability and accessibility to data regarding retracted papers from the publishers are described.

Methods: Two independent reviewers searched for retracted articles since 2004 at PUBMED, Web of Science, BVS and Google Scholar databases. Indexed keywords from MeSH and DeCS in Portuguese, English or Spanish were used. Data was also collected from the Retraction Watch website (www.retractionwatch.com). This study was registered at PROSPERO systematic review database (CRD42017071647).

Results: A final sample of 65 articles was retrieved from 55 different journals with reported impact factor ranging from 0 to 32.86, with a median value of 4.40 and mean of 4.69. The types of documents found were erratum (1); retracted article (3); retracted article with a retraction notice (5); retraction notice with erratum (3); retraction notice (45). The assessment of Retraction Watch website added 8 articles not identified by the search on the bibliographic databases. The retracted publications covered a wide range of study designs. Experimental studies (40) and literature reviews (15) accounted for 84.6% of the articles. Within the knowledge area of health and life sciences, Medical Science was the field with the largest number of retractions (34) followed by Biological Sciences (17). Some articles were retracted for at least two distinct reasons (13). Among the retrieved articles, plagiarism was the main reason for retraction (60%). Missing data were found in 57% of the retraction notices. It was a limitation to this review. In addition, 63% of the articles were cited after its retraction.

Conclusion: Publications are not retracted essentially for research misconduct but also for honest error. Nevertheless, considering authors affiliated to Brazilian institutions, this review has concluded most of the retractions of health and life science were retracted due to research

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55   misconduct. As the number of publications is the most valued indicator of scientific

56   productivity for funding and career progression purposes, a systematic effort from the

57   national research councils, funding agencies, universities and scientific journals is needed to

58   avoid an escalating trend of research misconduct. More investigations are needed to

59   comprehend the underlying factors of research misconduct and its increasing manifestation.

60   **Key words:** scientific misconduct; scientific integrity; retraction of publication; systematic

61   review.

Introduction
62

63   Research integrity relies on rigorous methodological approaches during planning, conduction,

64   documentation and study report[1]. Practices known to harm these steps are known as research

65   misconduct[2,3]. More often studies addressing the impact of misconduct have been published

66   as a warning to the scientific community[4,5,6].

67   Research misconduct occurs when plagiarism, data manipulation, poor study report, lack of

68   transparency are part of the scientific production. These acts are found to compromise

69   validity and reliability of research results[7,8,9]. In many occasions these faults lead to a

70   retraction notice. The publication of retraction notices intents to alert readers to serious errors

71   - unintentional or of misconduct nature - that implies unreliable conclusions[7]. Its purpose is

72   also to avoid these studies to be used as basis for future investigations, except for research

73   about scientific integrity itself.

74   Misconduct has scientific, social and economic impact[5,8,10]. Economically, it has been

75   estimated the cost of billions of dollars wasted to fund studies based on retracted

76   publications[11]. Socially, it affects Evidence Based Medicine by exposing study volunteers

77   and the population as a whole to wrong medical decisions. Scientifically, further

78   investigations based on unreliable findings and unethical research leads to untrustworthy

79   conclusions compromising the advances of scientific knowledge[9,12]. Therefore, corrupted

80   research conducts may generate a chain of misconduct[6,10].

81   Financial support for health and life science research steadily increased in Brazil, followed by

82   a rising number of scientific publications. Simultaneously, there were a growing number of

83   retracted publications, raising concerns about quality and reliability of these articles. The first

84   retraction reported in health and life science was a paper in nursing published in 2004[13]. At

85   the time, the author admitted plagiarism. Since then, other cases of research misconduct were

86   brought to attention generating apprehensions about scientific advances in the country.

3

87   Despite the relevance of research misconduct awareness, the analysis of retracted

88   publications is a new interest in Brazil. In this context, this systematic review was proposed

89   to address the theme considering health and life science publications.

90   This review intended to characterize the underlying causes of retraction, to assess the extent

91   of research misconduct, to support discussions of possible solutions, ultimately, to promote

92   further investigations. For it, data was collected regarding reasons for retraction, temporal

93   trends from publication to retraction, citation pattern after retraction, as well as journals

94   impact factor and ethical guidelines endorsement. Additionally, it evaluated the quality of

95   retraction notices considering if complete information was provided in accordance to COPE

96   guidelines[1] – a fundamental aspect for research transparency.

Materials and Methods

Protocol and registration

99   This review protocol was registered at PROSPERO (CRD42017071647).

Information source

101   Screening of eligible publications was performed from late July to early August 2017 in

102   accordance with the pre-approved registered protocol.

Search Strategy

104   Details   of   the   search   strategy   are   available   at:

105   https://www.crd.york.ac.uk/PROSPEROFILES/71647_STRATEGY_20170610.pdf.

Study selection

107   This review selected retraction notices published from January 2004 until August 2017, of

108   articles with, at least, one author affiliated to a Brazilian institution regardless of the

109   publication year of the original article. The start date used was the year of the first retracted

110   article in nursing science written by authors affiliated to a Brazilian institution was

111   published[13].

112   Studies of life and health sciences following the *Brazilian National Council for Scientific and*

113   *Technological Development* – CNPq (from the Portuguese, Conselho Nacional de

114   Desenvolvimento Científico e Tecnológico) classification[14], published in English, Portuguese

115   or Spanish at national or international journals were eligible for this review.

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116 Despite of their study design, all retracted articles, with complete or incomplete retraction
117 notice information according to the Committee of Publication Ethics (COPE) guidelines[2],
118 were eligible for this review when in accordance to the protocol. Retraction notices, articles
119 with retraction notice attached or any sort of information indicating a retraction were
120 considered for data collection. Studies regarding research integrity were excluded, as well as
121 the ones related to others field of scientific knowledge.

Sampling and data collection process

123 Two independent reviewers searched for retracted articles in PUBMED, Web of Science and
124 Brazilian Virtual Library of Health (BVS) databases. Google Scholar and the Retraction
125 Watch[15] website were searched to identify additional publications and grey literature. The last
126 database is an open access portal reporting retracted papers worldwide. The results were
127 compared, and a consolidated list of retracted articles was produced according to the
128 protocol.

129 Data were collected and analyzed according to reason for retraction, time trend from
130 publication to retraction, citation pattern after retraction, journals impact factor, quality of
131 retraction notices information, author's affiliation and adherence to either COPE or
132 CONSORT guidelines on ethics and standard reporting.

Data collection rationale

134 a) **Publication year and Retraction year trend:** The time trend between date of publication
135 and retraction was calculated in years. Articles published and retracted at the same
136 year were considered to have a time trend of 0. Publications without complete
137 information regarding these dates were labeled as "not applicable" for this analysis.
138 b) **Author's affiliation:** Analysis was limited to one author per paper. In order to select a
139 higher number of retracted publications by author, data was collected mainly from last
140 authors.
141 c) **Journal's name and Impact factor (IF):** The impact factor over the last 5 was collected
142 from Thompson and Reuters´s indicators. Previous research showed a positive
143 influence on the citation of retracted papers when it was published at high impact
144 journals[9]. This review investigated whether the same pattern is observed in Brazilian
145 publications.

5

146   **d) Ethical and reporting guidelines endorsement:** It was assumed that journals endorsed by
147   either CONSORT or COPE guidelines followed ethical guidelines.

148   **e) Area of knowledge:** Health and life sciences were categorized into the following sub
149   groups: Medical Science, Biological Science, Nutrition, Dentistry, Sports Science,
150   Nursing Science, Physiotherapy, and Pharmacology Science.

151   **f) Retraction indicator:** The presentation of retractions notices or retracted articles
152   reflected how editors and databases facilitated or not their visibility. Transparency is
153   ensured when retraction notices are attached to the original article and have a clear
154   warning of retraction/withdrawn.

155   **g) Reasons for retraction:** Reasons for retractions were classified as: a) error
156   (inappropriate study design, data collection or report); b) fraud (data or image
157   manipulation); c) author's dispute (publications without consent or recognition of all
158   authors or sponsor or industry manufacture of the tested product); d) duplicated
159   publication (when authors or editors conduct publishes more than once the same
160   article); e) irregular citation pattern (artifice used to upgrade journals impact factor);
161   f) unknown (not mentioned by the retraction); g) plagiarism (image or text or
162   unspecified forms of plagiarism); h) no informed consent applied for the use of
163   participants images for publication and i) unknown - reason for retraction not
164   mentioned.

165   **h) Retracted by:** Retraction notices are expected to acknowledge who retracted the
166   article. Retractions by authors indicate good faith, being considered a retraction for
167   honest mistake. Retractions by editors, depending on the reason, may indicate honest
168   mistakes from the editorial board or misconduct from authors.

169   **i) Retraction endorsement by authors:** Authors usually participate and/or agree with the
170   wording of the retraction. Report of participation of authors and their endorsement
171   indicates transparency of the retraction process.

172   **j) Citations pattern of retracted articles:** The number of times an article is cited reflects
173   its visibility and possible impact to the scientific community[16]. Therefore, the citation
174   pattern before and after retraction was analyzed by calculating the mean citation per
175   year from date of publication to retraction for each article. Similarly, the mean
176   citation per year from date of retraction to 2017 was also calculated. For comparison
177   purposes, articles with a higher mean of citation per year before its retraction were
178   considered to have a *positive-citation pattern,* whilst those with a higher mean of
179   citation per year after retraction were considered to have a *negative-citation pattern*.

6

180   **k) Quality of retraction notices:** According to COPE recommendations[2,7] retraction
181   notices must contain: date of retraction, motives for it, endorsement by authors or not,
182   retracted by the request of whom, proper citation of the original article by the
183   retraction notice. A complete report of these information accounts for a high-quality
184   retraction notice.

Statistical analysis

186 Shapiro-Wilk normality test was conducted for citation pattern after retraction and journal
187 impact factor of the journals. Spearman correlation test and a descriptive analysis were
188 performed using R programming and Excel for Mac 2011, version 14.4.3.

Results

Retraction notices selection

191 A final sample of 65 retracted articles was retrieved (Fig 1) from 55 different journals with an
192 impact factor range of 0 – 32.86 and mean of 4.7. The types of documents found were
193 erratum (n=1), retracted article (n=3), retracted article with its retraction notice attached
194 (n=5), retraction notice with erratum (n=3) and retraction notice (n=45). The Retraction
195 Watch Blog[13] added 8 articles not identified by the search strategy in the bibliographic
196 databases.

Fig.1: Flowchart of study identification and eligibility of retracted articles

197
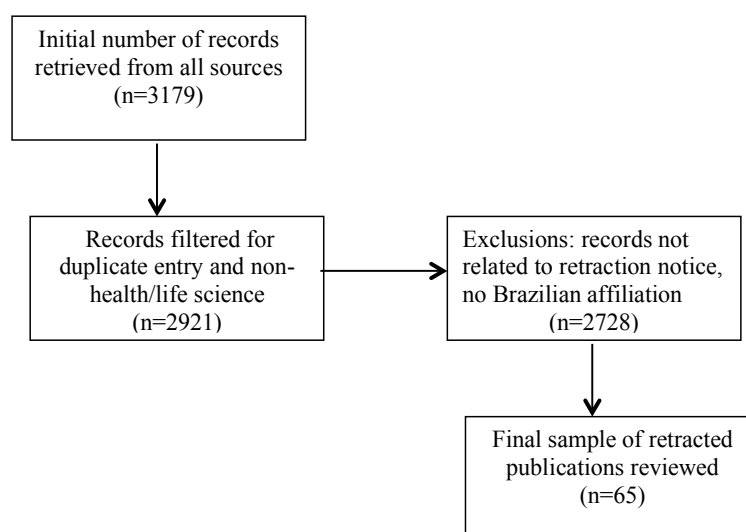
The retracted publications covered a wide range of studies. Experimental studies (n=40) and literature reviews (n=15) accounted for 84.6% of the included articles (Table 1). Medical Science was the field with the largest number of retractions (n=34) followed by Biological Sciences (n=17).

Table 1. Type of study according to area of knowledge	
Study type/area	N
Case study	2
Nutrition	1
Dentistry	1
Experimental	40
Biological Sciences	14
Medical Sciences	19
Nutrition	1
Dentistry	3
Physiotherapy	1
Sports Sciences	2
Literature review	15
Biological Sciences	1
Medical Sciences	12
Pharmacology Sciences	2
Meta-analysis	1
Medical Sciences	1
Observational	6
Biological Sciences	2
Medical Sciences	2
Nursing Sciences	1
Dentistry	1
Systematic review	1
Medical Sciences	1

Total	**65**

202

203 **3.4 Ethical and standard reporting guidelines**: Out of the 65 journals with published

204 retracted notices, only 7 clearly stated compliance with COPE and CONSORT guidelines.

205 41.5% of the selected journals were not endorsed either by COPE or CONSORT. Although

206 these two main ethical and reporting guidelines were not endorsed by all journals, reference

207 to it was found at their *Guide for Authors*.

208

209 **3.5 Authors affiliation and number of retractions:** University of Campinas was the

210 institution with the highest number of retracted publications (n=15) followed by the

211 University of São Paulo (n=14). Both are the top Brazilian academic institutions with highest

212 scientific productivity (Table 2). University of Campinas also accounted for the higher

213 number of retractions by author (Table 2).

214

Table 2. Distribution of life and health sciences retracted publications by affiliation and author			
Relation of Brazilian Institutions and Last Authors	Number of retractions	Relation of Brazilian Institutions and Last Authors	Number of retractions
Universidade Estadual do Norte Flumenense	**1**	**Universidade de São Paulo**	**14**
Gomes VM	1	Oliveira MN	1
Universidade Federal de Viçosa	**1**	Soares AM	1
Silva VE	1	Gomes A	2
Capital Medical University	**1**	Gomes AM	2
Shangjin C *	1	Miguel EC	1
Centro Universitário de Várzea Grande	**1**	Marchini JS	1
Ravagnani FCP	1	Pereira L V	1
Escola Bahiana de Medicina e Saúde Pública	**2**	Rocha e Silva M	2
Ladeia AM	1	Curi R	2
Pazos RMA	1	SVerjovski-Almeida S	1
Faculdade de Ciências Médicas da Santa Casa de São Paulo	**1**	**Universidade do Vale do Itajaí**	**1**
Alli LAC	1	Menezes JT	1
Faculdade de Medicina de Marilia	**1**	**Universidade Estadual de Campinas**	**1**
Stefano EJ	1	Reis SF	1
Heart Institute (INCOR)	**1**	**Universidade Estadual de São Paulo**	**3**
Hajjar LA	1	Zuben CJV	1
Hospital do Servidor Público Estadual de São Paulo	**1**	Mendonca MR	1
Rotta JM	1	Santo D. S.	1
Hospital Israelita Albert Einstein	**1**	**Universidade Estadual Paulista "Júlio de Mesquita Filho"**	**1**

Gamarra LF	1	Valenti VE	1
Hospital Universitário da Universidade Estadual do Rio de Janeiro	**2**	**Universidade Federal da Bahia**	**1**
Gomes MB	2	Portela RW	1
Leiden University Medical Centre	**2**	**Universidade Federal da Fronteira Sul**	**1**
Janson M *	2	Mossi AJ	1
Project "Avulsos Malacológicos - AM"	**1**	**Universidade Federal de Campina Grande**	**1**
Agudo-Padrón AI	1	Campos JHBC	1
Universidade de Brasília	**1**	**Universidade Federal de Pernambuco**	**1**
Teixeira ARL	1	Rolim Neto, P.J.I	1
Universidade de Campinas	**15**	**Universidade Federal do Maranhão**	**1**
Carvalheira JBC	3	Oliveira AE	1
Franchini KG	1	**Universidade Federal do Paraná**	**2**
Velloso LA	3	Reichembach MT	1
Saad MJA	8	Antoniuk SA	1
Universidade Federal do Triângulo Mineiro	**2**	**Universidade Federal do Rio de Janeiro**	**2**
Etchebehere RM	1	Farias MLF de.	2
Patrizzi LJ	1	**Universidade Federal Rural do Semi-Árido**	**1**
Universidade Paulista de Goiania	**1**	Costa LLM	1
Botelho TL	1		
Grand Total			**65**

* As for these article, only the first author was affiliated to a Brazilian Institution. Nevertheless, it was considered for analysis.

One author had 8 retractions during the studied period. Plagiarism was the main cause for retractions related to the two authors with most retractions affiliated to this university (Table 3).

Author/institution	DOI	Journal	IF	Reason for retraction
Table 3. Bibliographical references and reasons for retraction of the foremost retracted authors				
	10.2337/ diab.46.12.1950	Diabetes	8.512	Image Plagiarism
	10.2337/db06-1595	Diabetes	8.512	Image Plagiarism/ Fraud
	10.1590/S0004 27302013000900014	Arquivos Brasileiros de Endocrinologia e Metabologia	1.045	Plagiarism
	10.2337/db09-1907	Diabetes	8.512	Image Plagiarism
	10.1186/s13054-016-1453-8	Critical Care	5.406	Image Plagiarism
Mario J. A. Saad **UNICAMP**	10.1371/journal.pbio.1002479	Plos Biology	10.731	Image Plagiarism
	10.2337/db17-rt03a	Diabetes	8.512	Image Plagiarism
	10.1371/journal.pone.0159283	Plos One	3.535	Plagiarism
	10.2337/db05-1622	Diabetes	8.512	Image Plagiarism
José B. Cavalheira **UNICAMP**	10.2337/db17-rt03b	Diabetes		Image Plagiarism/ Fraud
	10.1053/j.gastro.2012.05.045	Gastroenterology	16.825	Image Plagiarism

It's important to highlight, that Figure 3 accounts for retracted articles, predominantly, of last authors. Hence, it is plausible to assume these authors may have more retracted articles when in different authorship position of a retracted publication.

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3.6 Time trend between publication and retraction: Time to retraction varied from 0 to 19 years. Five retraction notices, 3 from 2011 and 2 from 2012, did not specify the year of retraction. In 2017, one article was retracted with less than a year after its publication (Fig 2).

Fig. 2. Total of retracted articles by publication year and time to retraction
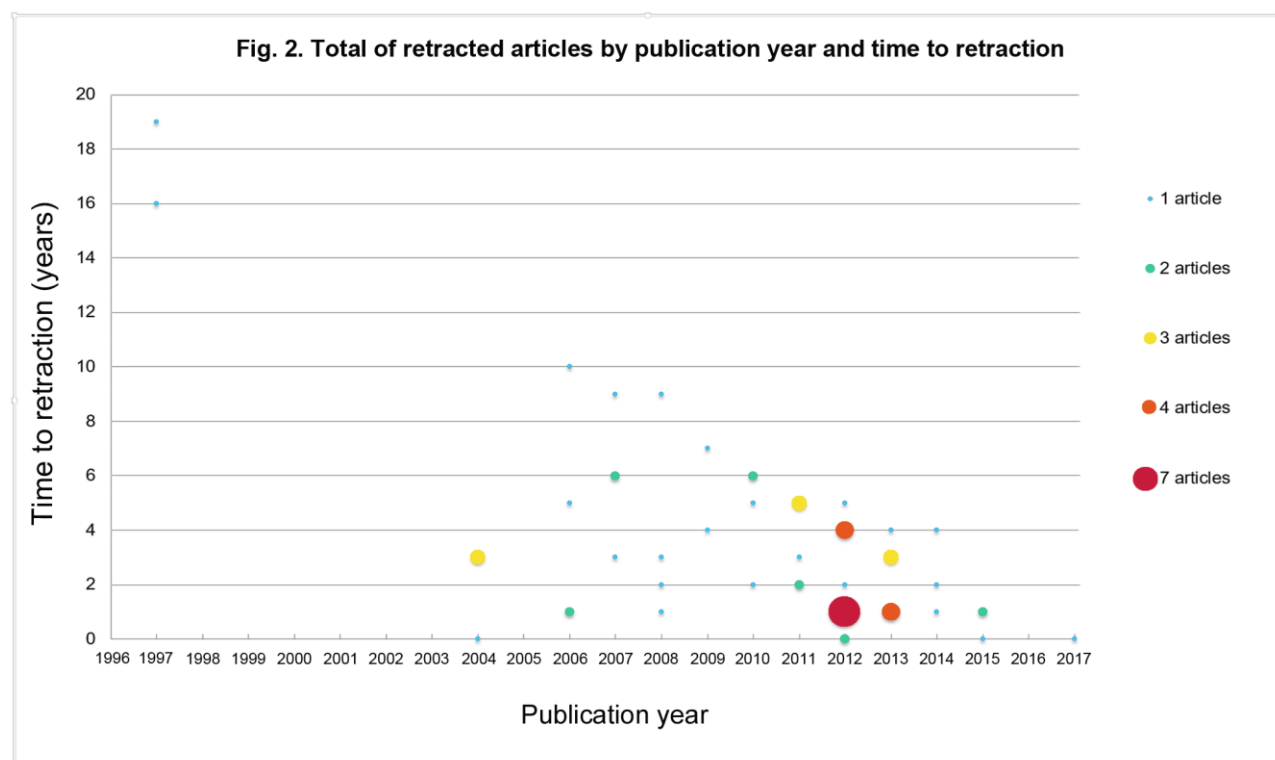
The overall mean time to retraction was 3,36 years. Most articles (55%) took from one to three years from its publication to be retracted. Data showed the number of retraction increased significantly from 2012, the start point of this review.

3.7 Number of citation after retraction:

The analysis of post-retraction citations is a proxy assessment of the existence influence of articles on scientific activity despite of their retraction. A total of 37% of the retrieved articles had a *positive-citation pattern* meanwhile 63% had a negative-citation pattern. The most cited article with *negative-citation-pattern* was published in 2007 and retracted in 2016[17]. Thus far, it received a total of 490 citations, of it, 58 were after its retraction.

### 3.7.1 Association between Impact Factor and post retraction citation number:

There was a strong positive correlation between the number of citation/year of an article after its retraction and the impact factor of the respective journal responsible for its retraction notice (Spearman rho=0.69, p<0,05). The majority of the articles cited after their retraction was published at a high impact factor journal.

3.8 Quality of data from retraction notices:

Retraction notices are supposed to cite the original article article[7.] However, our results showed proper citation of the original article in 22 retraction notices; 42 retraction notices did not cite the original article; 1 article was cited three times by its retraction implying more than one publication of retraction notice. Missing data were found in 57% of the retraction notices retrieved. Missing information of retraction notices was mainly about: date of retraction (7%), reason for retraction (7%), retracted by whom (3%) and endorsement by authors (38.4%). Retraction warnings such as withdrawn/retracted red sign over the article were also inexistent (37%).

3.10 Reasons for retraction

The identified reasons for retraction are illustrated at Fig 3. Thirteen articles were retracted for at least two distinct reasons. Fraud caused the retraction of three articles: two were retracted for image manipulation[18,19] and one for data manipulation. Errors were attributed to inappropriate statistical analysis (n=4), study design (n=2) and inadequate data collection (n=6). Duplicated publications were attributed to authors in 71%4 of the cases and to editors in 4,6%. Although author's dispute should not lead to a retraction[6,] two articles accounted for it. However, there is no additional information available for these retractions therefore, it is not possible to assume this was the only reason for retraction.

Fig. 3. Count of articles by reason for retraction
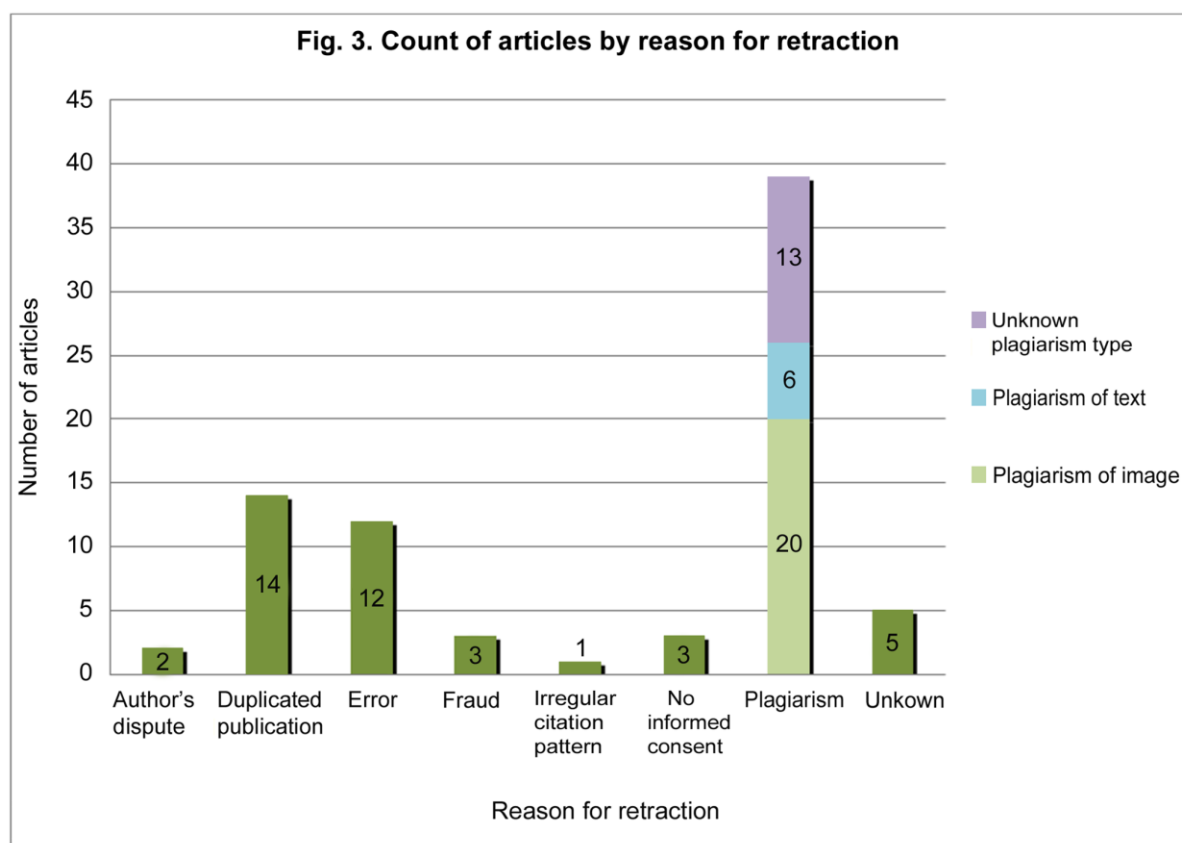
Discussion:

Comprehension of research integrity and consequences of misconduct varies between different cultures[18,19,20]. This may explain, to some extent, the disparities when taking measures to prevent this behavior. For this review, the traditional bibliographic sources did not provide a complete picture of retracted articles. Only eight (15%) of the articles were identified from the *Retraction Watch* website, highlighting poor transparency in reporting retraction.

Another obstacle to research transparency is the diversity of journals policies to deal with this subject. For instance, the use of footnotes or comments from readers as an alert of retraction[21,22] or the absence of any type of warning at database or at the article available by the journal reflects how some journals policies disregard faults to research integrity. On the other hand, legal threats to publishers have an influence on their positions regarding misconduct and therefore, on the issue of retractions[7]. Notwithstanding concern over litigation, this review found complete information, transparency and clarity at others retraction notices, supporting the existence of

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disparities between editors and publishers attitudes towards handling of errors or misconduct.

In this review, the two institutions with the highest number of retracted publications (University of Campinas and University of São Paulo) have a leading scientific role in the country. As such, their publications were more likely to be accepted by high impact international journals with greater rigor to identify flaws. Consequently, due to their larger scientific production, the number of recognizable flaws may also be greater in comparison to others Brazilian academic institutions. Nevertheless, more investigation is needed to assess the rate of retraction in different areas and to explore other reasons for the apparent increase of misconduct among high-qualified scientists.

Reasons for retraction

In 2013, a Brazilian citation scheme artifice used to increase journals impact factor was revealed[23]. The scheme was responsible for taking major journals off *Qualis Classification.* Despite of the considerable number of retractions lead by this scheme, this review search strategy was able to identify a unique paper retracted for irregular citation pattern[24]. This fact addresses, once more the difficulties to find retracted articles[25,26] and therefore, warrants the necessity of efforts to maintain transparency in every step of scientific assembly.

Although error and fraud accounted for most of the retractions of biomedical studies[4,27], the present study revealed a larger number of retractions due to plagiarism, a possible consequence of the academic pressure for a fast career progression and access to research funding.

What is a retraction for if not to be used to avoid more scientific misconduct?

A recent publication explored the nature of retracted articles[9]. The authors classified the citations as positive, neutral or negative. An interesting aspect of this study was the evaluation of proper citation of retracted articles. Otherwise, a retracted article is cited as legit and hence, reliable. In most cases, it is not possible to assess whether a retracted article served as basis for a new scientific investigation despite of its

retraction or whether it was cited without careful attention. Our result regarding post-retraction citation pattern showed how often retracted articles continued to receive positive citations without accurate retraction identification.

Further investigations are needed to understand why unreliable researches still are cited as legit[28]. Nevertheless, it is important to address that retracted publications might be used for new scientific production. A proper citation of retracted publications brings awareness of the causes involving its withdrawn and assists authors not to ignore it. It gives the tools for researchers to make decisions in accordance to obvious ethical purposes.

Specifying the main reason for retraction is relevant and has distinctive impact on future investigations. A retraction for plagiarism has a different impact compared to error and fraud. Plagiarism does not invalidate results but the plagiarized article. Additionally, its citation should acknowledge the real author of the publication. Whereas error and fraud completely invalidate the results of an investigation therefore, these studies shouldn't be used as basis for further research, except for those about research integrity and misconduct.

Everybody's role for the publication of retractions:
Retractions are published at the request of an author, publisher, editor, or community[4,7,8,9]. The intention is to promote transparency and clarity over research misconduct or honest error that lead to flawed articles[4,6,7]. Thus, in accordance to *COPE Guidelines for Retractions*, retractions should be published as soon as possible to avoid new citations of the unreliable work, researchers to act on its findings, or draw more erroneous conclusions. Because the main goal is to minimize a chain of flaws, retractions should be transparent regarding the reason for it, existence of endorsement by authors, provide the date of retraction, reference of the retracted article, have a DOI, be attached to the original article and be visible[7,29].

This review encompassed a wide range of retraction policies through different journals from the retraction wording to how the article was *red-flagged* [6,7]. As for wording, the reason for retraction were sometimes vague or absent. Information regarding retraction date and citation of the retracted article were also non-existing for

some publications. As for methods to signal a retraction to readers, a variation from a big red note of *withdrawn/retracted* (*red-flag*) to a simple footnote was found. A possible explanation for the difficulties to retrieve articles for this review was the lack of a standardized publication of retraction notices. Furthermore, these practices are completely against the purpose of publishing retractions: transparency.

Endeavors to promote transparency are a caveat to unethical practices involving all parts in the scientific activity: scientists, publishers, editors, and academic institutions [20,28,29]. Each part has a specific role and may contribute to minimize misconduct or not. Everybody has a role.

Limitations and strengths

Incomplete information on the retraction notice reduced the accuracy of our analysis. In addition, results obtained may underestimate the reality due to restrictions of our search strategy, level of transparency of published retractions and their availability in the bibliographic databases.

Additionally, our analysis did not include an assessment of the original paper's quality and, therefore, it is not possible to draw conclusions regarding its relation to retraction. Further investigations should be performed on this purpose since it's known that a retraction not necessarily indicates a completely invalid research[1].

Since research integrity is a worldwide concern, despite of this review had considered only Brazilian's institutions, its findings provide useful insights and could serve as basis for future investigations.

Conclusion

Retraction notices does not account only for research misconduct, it is also an alert of honest mistakes during scientific practices[6]. Still, these incidents compromise quality and validity of research results. Considering authors affiliated to Brazilian

institutions, this review have concluded most of the retractions of health and life science were retracted for research misconduct.

Journals and academic institutions have an important educational and surveillance role to play against research misconduct. The enforcement of disciplinary and educational measures is fundamental to reduce the incidence of corrupted science. In addition, the creation of standard instrument for reporting retraction notices would assure the discussion of ethical policies and would promote a uniform publication of retraction.

This study attempted to emphasize the importance of research transparency and the positive impact of good practices when conducting, reporting and publishing retraction notices. The underlying factors involving research misconduct remains unclear [5].

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