Artículo en revisión: Lrrores y mala práctica en publicaciones científicas en las ciencias biomédicas: una revisión narrativa

Review article: Errors and Misconduct in Scientific Publications in the Biomedical Sciences: A Narrative Review

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Aesumen: Los errores metodológicos y la mala práctica en publicaciones científicas afectan la validez y utilidad de la investigación en ciencias biomédicas. La falta de rigor en el diseño, análisis y reporte de resultados contribuye a sesgos y conclusiones erróneas, lo que compromete la toma de decisiones en la práctica clínica. Este artículo presenta una revisión narrativa estructurada de la literatura científica sobre los principales errores metodológicos, estadísticos y éticos en publicaciones científicas, diferenciando entre errores involuntarios, negligentes y aquellos que implican fraude. Se analizan los factores que influyen en la calidad de una publicación, incluyendo la adecuada planificación del estudio, la correcta selección del tamaño muestral y el uso apropiado de herramientas estadísticas. Se aborda el problema del sesgo de publicación y la diferencia entre significancia estadística y clínica, enfatizando que la validez de un estudio no depende únicamente de la presencia de valores p significativos. Asimismo, se examinan las prácticas fraudulentas más comunes, como la falsificación de datos y el plagio, y su impacto en la credibilidad de la ciencia. Finalmente, se destaca la importancia de la lectura crítica de la literatura científica y el desarrollo de habilidades para evaluar la calidad y aplicabilidad de los hallazgos en la práctica médica.

Palabras clave: Bioestadística, Ética en la Publicación Científica, Mala Conducta Científica, Artículo de Revista, Investigación Biomédica.

Abstract: Methodological errors and malpractice in scientific publications compromise the validity and utility of research in the biomedical sciences. A lack of rigor in study design, data analysis, and result reporting contributes to bias and erroneous conclusions, ultimately affecting clinical decision-making. This article presents a structured narrative review of the scientific literature on the main methodological, statistical, and ethical errors in scientific publications, distinguishing between unintentional mistakes, negligence, and fraudulent practices. Key factors influencing publication quality are analyzed, including proper study planning, appropriate sample size determination, and the correct application of statistical tools.

The issue of publication bias and the distinction between statistical and clinical significance are discussed, emphasizing that a study's validity is not solely dependent on the presence of statistically significant p-values. Additionally, common fraudulent practices such as data fabrication and plagiarism are examined, along with their impact on the credibility of science. Finally, the importance of critical reading of scientific literature is highlighted, as well as the development of skills to evaluate the quality and applicability of research findings in clinical practice.

Keywords: Biostatistics, Scientific Publication Ethics, Scientific Misconduct, Journal Article, Biomedical Research.

Introduction

Biomedical journals are the primary source of information used by health professionals and the primary vehicle for communicating the results of research. These publications often serve both informational and educational purposes, helping to form opinions and providing a discussion forum for the scientific and medical communities. However, one aspect that distinguishes these journals from others is that they are primarily read by professionals who are not necessarily dedicated to research or who lack sufficient knowledge of methodological and statistical aspects (Jiménez & Argimon, 2016; Smith, 2006). In the context of evidence-based medicine, the best available evidence is used in an informed, clear, and rational way to make decisions about the care of individual patients (Djulbegovic & Guyatt, 2017). This is not limited to reading scientific articles, but implies selecting the appropriate article at the appropriate time and adapting clinical behaviors according to the relevant findings (Greenhalgh, 2014). A critical analysis of various biomedical publications concluded that most scientific studies yield false results and are useless. In a first article, it is argued that this statement is based on the way in which research is planned and executed, which affects its internal validity, as well as on the interests of researchers and funding entities (Ioannidis, 2005). In a second article, it is argued that research must meet certain criteria to be considered useful, although, according to the analysis, these are rarely met (Ioannidis, 2016). On the other hand, studies aimed at identifying and systematizing errors in biomedical publications have shown that it is difficult to distinguish when these events are or are not due to malicious decisions (Silva Aycaguer, 2018). The objective of this review is to analyze the errors and bad practices present in scientific publications within the field of biomedical sciences. To this end, a structured narrative review of the scientific literature related to methodological, statistical, and ethical errors in biomedical publications was carried out. The selection of sources was made in a targeted manner, including textbooks, original articles, previous reviews, methodological guides, and regulatory documents. The sources were identified through searches in databases such as PubMed, SciELO, and Google Scholar, as well as through the direct consultation of widely recognized academic literature in the fields of biostatistics, epidemiology, research ethics, and scientific publishing. No formal inclusion or exclusion criteria were applied, nor were restrictions on the language or period of publication. The information collected was organized thematically, grouping the contents around three main axes: involuntary errors, errors due to negligence, and deliberate bad practices. Likewise, elements related to the critical reading of scientific literature were incorporated. The structure of the article is organized into four main sections. First, the notion of error in the context of scientific research and the publication process is examined. Secondly, the most frequent errors observed in the biomedical literature are described, with special attention to those of a methodological and statistical nature. Subsequently, the practices that constitute scientific misconduct are analyzed, illustrating their impact through documented examples. Finally, the skills necessary for the critical reading of scientific evidence are addressed, and strategies aimed at the development of these skills among health professionals are presented.

Content

Errors in scientific activity. Error is implicit in all human activity, and, therefore, the systematic search for knowledge is also susceptible to the existence of errors. The error can be random or systematic (commonly called bias): the random error is attributed to sampling and biological variability, the variability of the measurement instrument and the variability due to the observer; while the systematic error is related to the design of the study, either by an inadequate selection of the sample units or by problems in the measurement of the variables (Argimon & Jiménez, 2019; Barraza et al., 2019). In addition, from a statistical point of view, we can speak of type I error, when it is affirmed that there is an effect when in reality it does not exist, and type II error, when it is stated that there is no effect, when in reality it does exist (Barton & Peat, 2014; Indrayan & Holt, 2016; Zar, 2014). On the other hand, science does not aspire to the absolute and totally conclusive explanations of the phenomena, and, therefore, it is convenient to remember that all scientific results must be considered error-prone (Elliott & Resnik, 2015). Honest errors are those that occur involuntarily, despite following good scientific practices, such as errors in data analysis or misinterpretations without the intention of distorting the truth. On the other hand, errors due to negligence result from a lack of care or rigor in the application of scientific methods, such as the improper use of statistical techniques or the omission of essential experimental controls. Errors that involve deliberate deception include the manufacture of evidence, data falsification, or plagiarism (National Academy of Sciences Engineering and Medicine, 1995). In any case, the degree to which the results of an investigation are correct for the study subjects, the so-called internal validity, is threatened by both random and systematic error (Fletcher et al., 1998; Hulley et al., 2014), and it is unquestionable to affirm that honesty is an essential element in scientific work (Shapin, 1995). Errors in scientific publications. In a non-systematic review of 196 reports of clinical trials on drugs for rheumatoid arthritis, it was found that 76% of the investigations presented conclusions or summaries with invalid or dubious statements. In addition, in 81 of the analyzed trials, selection biases were identified that could favor, from the beginning, the experimental group (Gøtzsche, 1989). An investigation investigated the causes of errors in research reports by analyzing a random sample of high and low-impact psychology journals. Of the 281 articles reviewed, 18% had errors in the report of statistical results, and 15% included at least one incorrect conclusion, generally aligned with the expectations of the researchers (Bakker & Wicherts, 2011). In another research, 15 common errors were identified in clinical research, which occur during the design, collection, and analysis of data, as well as in the publication of manuscripts. Errors related to selection and information biases, and with the analysis and presentation of data, such as: lack of specification of selection criteria, absence of sample size calculation, deficiencies in bias control, failures in the evaluation of statistical assumptions and the management of lost data, and lack of strategies to address follow-up losses or identify the weaknesses of the study (Clark & Mulligan, 2011). Other studies have found lower quality in publications in low-impact journals than in high-impact journals (Fleming et al., 2014; Goldkuhle et al., 2018); In addition, some research has analyzed in greater detail the common statistical errors in medical publications. In one study, these errors were classified into 47 categories, highlighting the importance of the statistical professional participating in the research design phase to prevent errors that may compromise the validity of the studies (Strasak et al., 2007). A common error that must be highlighted is the belief that research gains prestige or validity solely by applying complex statistical methods. However, it is argued that these methods cannot compensate for deficiencies in the design of the study or in the sampling method. Likewise, the importance of using them to bring objectivity to the analysis is emphasized, preventing the preconceived expectations of the researcher from influencing the conclusions (Lemus et al., 2013). Until these point it is

convenient to be present at all times, that Statistics is a tool, and that it contemplates at all times the possibility of error, and, therefore, it is neither the source of an absolute truth, nor a resource to give per se value (and validity) to an investigation (Tong, 2019). Also, it is convenient to discern at this point between statistical significance and clinical significance. A statistically significant result is obtained when the p-value of a hypothesis test is lower than the significance level, this must be interpreted as follows: if the null hypothesis is true and all other assumptions are valid, there is a 5% chance of obtaining a result at least as extreme as the one observed (Baker, 2016; Pagano et al., 2022). Clinical significance, on the other hand, refers to those results obtained in research that provide a clear improvement in a patient's health and quality of life. Statistically significant results do not necessarily mean that the results are clinically or biologically relevant (Greenberg et al., 2006; Sharma, 2021) and lead to an improvement in people's quality of life. Therefore, many of the results may be statistically significant, but not clinically relevant; and therefore, doctors and researchers must base their decisions on the joint estimation of clinical and statistical significance (Armijo-Olivo, 2018; Barkan, 2015). The publication of "The tests of statistical significance: six decades of fireworks" is a good resource in Spanish to understand what the limitations of the application of statistical significance tests are, and why their indiscriminate use (and the way in which these resources are used, above all) is pernicious for scientific knowledge (Silva-Aycaguer, 2016). Among the most common methodological errors in clinical research, inappropriate generalizations in publications and the negative impact of the biased selection of patients have been described (Silva Aycaguer, 2018; Weigmann, 2005). In addition, two topics have not been addressed so often in this type of publication: First, there is no consensus to determine a suitable sample size, so generalized evaluations on insufficient sample sizes often lack real support (Prieto & Herranz, 2010). Second, magazines tend to favor the publication of articles based on their findings, rather than the possible validity of these (Silva Aycaguer, 2018; Weigmann, 2005), which is known as publication bias (Argimon & Jiménez, 2019; Slutsky, 2013). Generally, more studies are published that present significant differences than those that do not (Ruiz & Morillo, 2004), which affects the publication of only part of the knowledge that is actually available on a particular topic (Martínez González et al., 2020; Nair, 2019). Regarding the above regarding the clinical significance, it is worth adding that the smaller the sizes of the effect investigated, the less likely it is that the findings of the research are true, it is important to indicate that the size of the effect is directly related to the statistical power (Fritz et al., 2012; Ioannidis, 2005), a term that is defined as the probability of detecting in a study a predefined clinical significance during the calculation of the sample, a value that must be high to provide conclusions with sufficient statistical validity (Indrayan & Holt, 2016; Suresh & Chandrashekara, 2012). A review of various meta-analyses on different diseases estimated the power a posteriori based on the size of the effect reported in the original studies. The findings indicated that approximately half of the studies had a statistical power between 0% and 20%. (Dumas-Mallet et al., 2017). Although the a posteriori power calculation will always indicate a low power (<50%) when the difference is not significant, this approach is misleading and of limited utility. Therefore, the statistical power should be calculated only during the planning of the study, ensuring an adequate design to detect effects of interest (Goodman, 1994). A study analyzed trends in effect sizes in scientific publications between 1990 and 2015, observing a decrease in the median of statistically significant effects. This phenomenon could be due to the use of larger samples, characteristics of multicenter research, which allow the detection of even small effects, or the publication of studies whose results lack clinical relevance. These findings highlight the importance of strengthening the credibility of biomedical research and optimizing the use of available resources

(Baker, 2016; Monsarrat & Vergnes, 2018). What has been exposed up to this point is framed within those errors that have been described as "honest" or "due to negligence." Next, it will be contributed on those that deliberately involve a deception to the audience. Misconduct in scientific publications Bad behavior in scientific publications can be classified into the following modalities: (a) sending false, incomplete or improperly processed data, (b) violation of patient confidentiality or results, (c) falsification of authorship, (d) duplicity or redundancy in publication, (e) plagiarism, (f) self-citation or coercive citation and (g) conflict of scientific or economic interests. Although it is assumed that in most of the published research there was no misconduct, there is a perception, on the part of the journals, that the number of publications in which bad behavior can be identified has increased (Pascual & Martínez, 2016). A review of studies published between 2000 and 2011 showed that, in that period, the retraction notices in scientific journals increased tenfold, while the number of publications increased by only 44%. Approximately half of the retractions were attributed to bad practices, being more frequent in high-impact journals. However, the largest increase in retractions was observed in low-impact journals. (Van Noorden, 2011). In another investigation, it was concluded that only a fifth of a total of 2.047 retractions registered in PubMed were due to errors, and, therefore, the rest could be attributed to misconduct or suspicion of these (Fang et al., 2012). Another study reviewed 57 clinical trials conducted between 1998 and 2013 in which the Food and Drug Administration (FDA) identified objectionable practices. Data falsification was found in 39% of cases, protocol violations in 74% and security or surveillance problems in 53%. Despite these irregularities, no corrections, retractions, or expressions of concern were issued by the authors or reviewers (Seife, 2015). Other reports have been more optimistic, as is the case of a study in which it was determined that of 395 articles retracted and published between 1982 and 2002, retractions were more than twice as likely to be the result of unintentional errors than of misconduct (Nath et al., 2006). Bad research practices negatively affect patients by influencing clinical practice and can lead future research down unproductive paths. To prevent these problems, collaboration between magazine editors, research councils, educational institutions, the government, and funders is necessary. (Pascual & Martínez, 2016). Critical reading skills of the health professional. Given the increasingly frequent existence of malicious publications, it is necessary that readers have the critical skills to evaluate such publications (Subramanyam, 2013). Some studies have evaluated the skills of health professionals to interpret and evaluate scientific publications. In a systematic review in which 29 studies on knowledge and critical evaluation of scientific literature were analyzed, it was found that doctors with training in epidemiology, biostatistics and research had greater knowledge and skills. In addition, the size of the effect in the publications influences the perception of the effectiveness of the treatments and the intention to prescribe drugs (Kahwati et al., 2017). On the other hand, a study whose objective was to evaluate the effectiveness of different teaching methods in critical evaluation skills in medical students. A group that completed a training and a multimedia workshop was compared with a control group, finding that the former showed significantly superior skills, with a moderate difference according to Cohen's statistician D (Sasannia et al., 2022). In qualitative research, the perceptions of emergency physicians about the barriers and motivations for learning critical assessment skills were explored to design effective training strategies in this area. The findings indicated that the lack of time, the perception of difficulty, and disinterest were the main barriers to carrying out a critical evaluation of scientific literature (Wood et al., 2022).

Professionals should also be able to evaluate the usefulness and relevance of research. A series of criteria have been listed to evaluate the usefulness of research: (a) those related to the basis of the problem, (b) the location of the context, (c) the obtaining of information, (d) pragmatism, e) the focus on the patient, (f) the value for money, (g) the feasibility, and (h) transparency (Ioannidis, 2016). Among the skills that the health professional must develop to critically evaluate scientific publications include: (a) the evaluation of the suitability of the study design for the research question, (b) the evaluation of the methodological quality of each research design and the identification of possible biases, (c) the adequacy of the statistical methods used and their subsequent interpretation, (d) the identification of possible conflicts of interest, (e) the relevance of the research for the practice itself and (f) the use of critical evaluation tools, such as checklists of the elements that must be included in a publication or report (Buccheri & Sharifi, 2017; Greenhalgh, 2014; Young & Solomon, 2009). In addition to the collation guides used to evaluate the evidence, such as The Champ Statement (Mansournia et al., 2021), the tools of the Critical Appraisal Skills Program (CASP) (Ma et al., 2020), and others widely recognized, such as Consolidated Standards of Reporting Trials (CONSORT), the Reporting of Observational Studies in Epidemiology (STROBE), Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Grech & Eldawlatly, 2024) and Statistical Analyses and Methods in the Published Literature (SAMPL) (Lang & Altman, 2015), there are textbooks widely recognized by professors and scientists. These texts offer, systematically, the knowledge necessary to develop critical reading skills (Greenhalgh, 2014; Riegelman & Hirsh, 1992), as well as for the practice and teaching of evidence-based medicine (Straus et al., 2019).

Conclusions

The publication of scientific articles, as well as the research process, is not exempt from various methodological, statistical, and ethical errors; these errors can be attributed to equivocal ideas, ignorance on certain topics, or negligence. It is more worrying when it comes to malicious errors by researchers, which, in general, arise from clear conflicts of interest. Whether or not it is misconduct, it is clear that the health professional must develop individually and during his training within the academy and health institutions, the skills that allow him to critically evaluate all the publications that reach his hands; so that the negative impact of these errors is minimal for the health of the patients he treats and for the cost of health care and research.

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