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SCIENTIFIC PRODUCTION ON COMPUTER-ASSISTED NUMERICAL ANALYSIS IN HEALTH

*Produção científica sobre análise numérica assistida por computador em saúde**Producción científica sobre análisis numérico asistido por computadora en salud***José Guilherme Berenguer Flores¹** **Romero de Melo Silva²** **Daniel Aragão Machado³** **Alexandre Sousa da Silva⁴** 

ABSTRACT

Objective: to evaluate the scientific production on computer-assisted numerical analysis in health, based on bibliometrics.**Method:** bibliometric research with a quantitative approach. The data were treated in the light of descriptive statistics, with the biblioshiny tool of the RStudio software. The terms used were "management, hospital material" and "barcode". **Results:** 459 documents were recovered, in 274 titles, 445(96.95%) articles, 2458 authors, 81(3.30%) as sole authors. Age average number of documents was 8.91 years, co-authorship per document was 6.15. **Conclusion:** journals in zone 1 cannot be considered the most devoted to the subject. It was not possible to identify an elite group of authors.**DESCRIPTORS:** Computer-assisted numerical analysis; Patient transport; Bibliometrics.

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RESUMO

Objetivo: avaliar a produção científica sobre análise numérica assistida por computador em saúde, a partir da bibliometria. **Método:** pesquisa do tipo bibliométrica com abordagem quantitativa. Os dados foram tratados à luz da estatística descritiva, com a ferramenta biblioshiny do software RStudio. Os termos utilizados foram "management, hospital material" e "barcode". **Resultados:** recuperou-se 459 documentos, em 274 títulos, 445(96,95%) artigos, 2458 autores, 81(3,30%) como autoria única. A idade média dos documentos foi de 8,91 anos, a coautoria por documento foi de 6,15. **Conclusão:** os periódicos da zona 1 não podem ser considerados os mais devotados ao assunto. Não foi possível identificar um grupo de elite de autores na temática analisada.

DESCRITORES: Análise numérica assistida por computador; Transporte de pacientes; Bibliometria.

RESUMEN

Objetivos: evaluar la producción científica sobre análisis numérico asistido por computadora en salud, con base en la bibliometría. **Método:** investigación bibliométrica con enfoque cuantitativo. Los datos fueron tratados a la luz de estadísticas descriptivo, con la herramienta biblioshiny del software RStudio. Los términos utilizados fueron "management, hospital material" y "barcode". **Resultados:** se recuperaron 459 documentos, en 274 títulos, 445 (96,95%) artículos, 2458 autores, 81 (3,30%) como autor único. La edad promedio de documentos fue de 8,91 años, la coautoría por documento fue de 6,15. **Conclusión:** las revistas de la zona 1 no pueden considerarse las más dedicadas al tema. No fue posible identificar un grupo élite de autores.

DESCRIPTORES: Análisis numérico asistido por ordenador; Transporte de pacientes; Bibliometría.

INTRODUCTION

In health, electronic tools that optimize inventory controls aim to better distribute inputs and reduce supply and resupply costs in Units. In this context, the involvement of system arrangements, tools and procedures add details to the construction of software that has as reference a Computer Assisted Numerical Analysis, interfacing directly with different health sectors, whether inside hospital institutions or in Mobile Urgency and Emergency Units.

Administrative management in electronic form can enable, in a simple, macro, dynamic and immediate design, the control of materials used in hospital units. It is essential to have tools that help in decision making that will eliminate excess stock, waste or misplacement.

Managing stocks is part of a vital process for excellence in business management, seeking to improve the efficiency of its processes to keep the company competitive in the market.¹

In this context, it is necessary to know how countries work on this theme that brings technological evolution as a background for various solutions that minimize health costs. Thus, the objective of this article is to answer the following research question: What is the profile of scientific production on computer-assisted numerical analysis in health?

Due to the importance attributed to the health supply chain, it is possible that researchers from different areas of knowledge have directed their research to present and develop technological solutions that would assist health institutions.

Bibliometric analysis, which consists of the application of statistics to bibliography, has three classically recognized laws: Bradford's Law (law of dispersion of scientific knowledge - 1934), Lotka's Law (law of productivity of authors - 1926) and Zipf's Law (word frequency).²

It is important to note that the main difference between bibliography and bibliometrics is that the latter uses more quantitative methods than discursive ones, which gives greater objectivity in

the evaluation of scientific production. Bibliometrics is not only concerned with the quantitative aspect. It is also concerned with verifying the relevance and impact of authors, journals, institutions, groups or countries in the most diverse areas of knowledge.²⁻³

The objectives were: to evaluate the scientific production on Computer-Assisted Numerical Analysis in health in an online database from the perspective of bibliometric analysis and to analyze the scientific production from the Bradford and Lotka Laws.

METODOLOGY

This is a bibliometric study, of descriptive and exploratory type and of quantitative nature, which because it is a study carried out exclusively with secondary data in the public domain, its approval by the Research Ethics Committee (CEP) was not necessary, according to recommendations of the National Health Council (CNS) in its Resolution No. 466/2012.

To obtain bibliometric data, the World Wide Web was used as a source, from the Pubmed database. The search terms were used in English, aiming at the greatest scope of works related to the theme.

The Pubmed database was accessed via the Journal Portal of the Coordination for the Improvement of Higher Education Personnel (CAPES), through the CAFE network, which corresponds to an identity management federation, whose main objective is to allow its users to access web services from the most different sources using the login and password of their own institution.

The terms "management, hospital material" and "barcode" were previously consulted and validated in the controlled vocabulary of the Health area DeCS. These terms correspond to the Portuguese descriptors - management, hospital material and barcode, respectively. The time frame comprised the period from 1990 to 2023.

Regarding the preparation of the environment for data analysis, the "R" software (version 4.0.3 - Windows 32/64 bits) was down-

loaded and installed. Then, download and installation of RStudio® (version 1.3.1093 - Windows). After the installation of such software, they were started, and to access the web interface, proposed in R language to support the bibliometric and scientometric analysis, the commands were entered in the RStudio® software console: library (bibliometrix), and then (biblioshiny), so that the biblioshiny web interface was activated. Once started, biblioshiny was used through the browser defined as standard, using the direct search for the biblioshiny Application Programming Interfaces (API).³

Data analysis and interpretation of the results were carried out in the light of the theories of Bradford, Lotka and Price.² In order to classify the activity of scientific production about the object, with the aid of the biblioshiny web interface, tables and graphs were generated that allowed the analysis and interpretations under the aegis of descriptive statistics. By considering the descriptive and exploratory bias, we sought to perform analyzes that allow us to learn various aspects of the object as a scientific field.

RESULTS AND DISCUSSION

The research sought to present a bibliometric analysis under different aspects related to the theme of multidisciplinary interest, but with emphasis on health professionals.

From the documents retrieved, the results found follow (Table 1). A total of 459 documents were retrieved, of which

445 (96.95%) were articles, 4 (0.87%) were full studies, 3 (0.65%) were evaluation studies, 2 (0.44%) were clinical trials, and the other types totaled 5 (1.1%) documents.

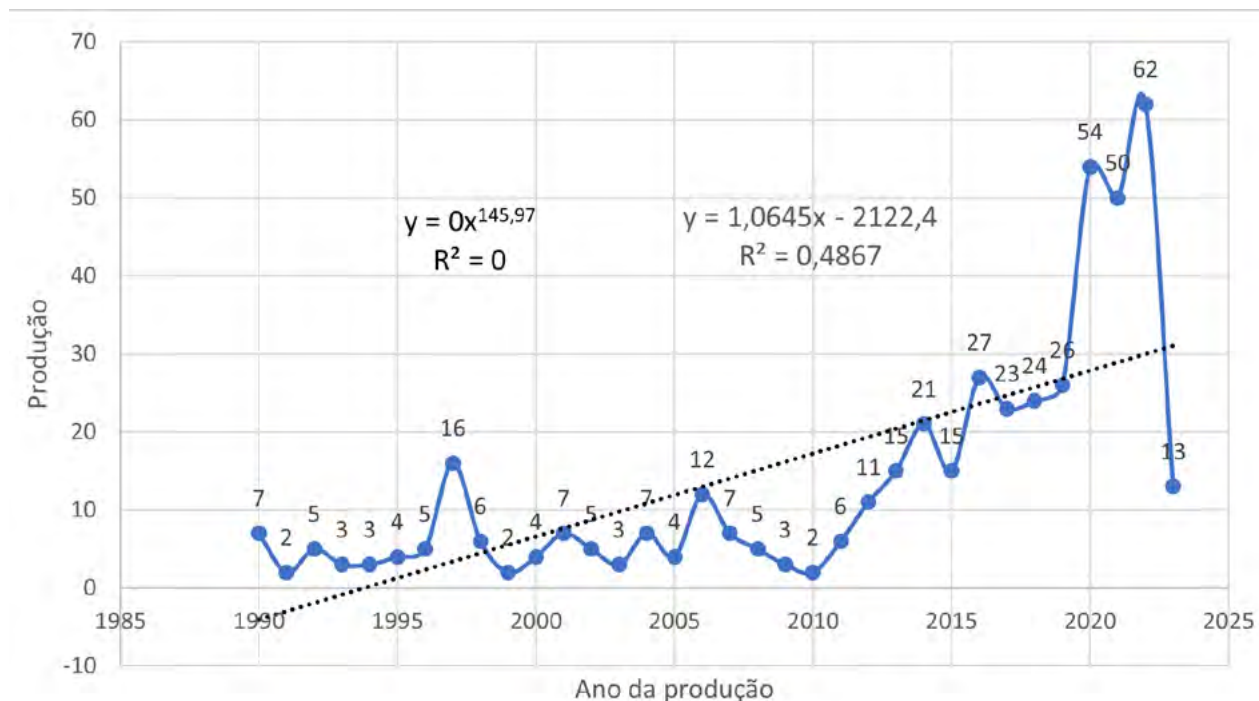
A total of 2458 authors were attributed, 90(3.66%) of which were single authors. The co-authorship per document was 6.15(0.25%) authors, while the number of single-authored documents was 81(3.30). The average number of documents per author was 0.186, considering that the authorship count was performed in its entirety, without discriminating main authorship, therefore.

The predominant language was English, present in all publications. Authors submit their articles in any language, depending on the policy of each journal, however, the vast majority determines the translation of the manuscript into English if it is accepted for publication. In Brazilian postgraduate programs, proficiency, which until recently could be attested only by a letter from the advisor, now needs to be proven by tests.

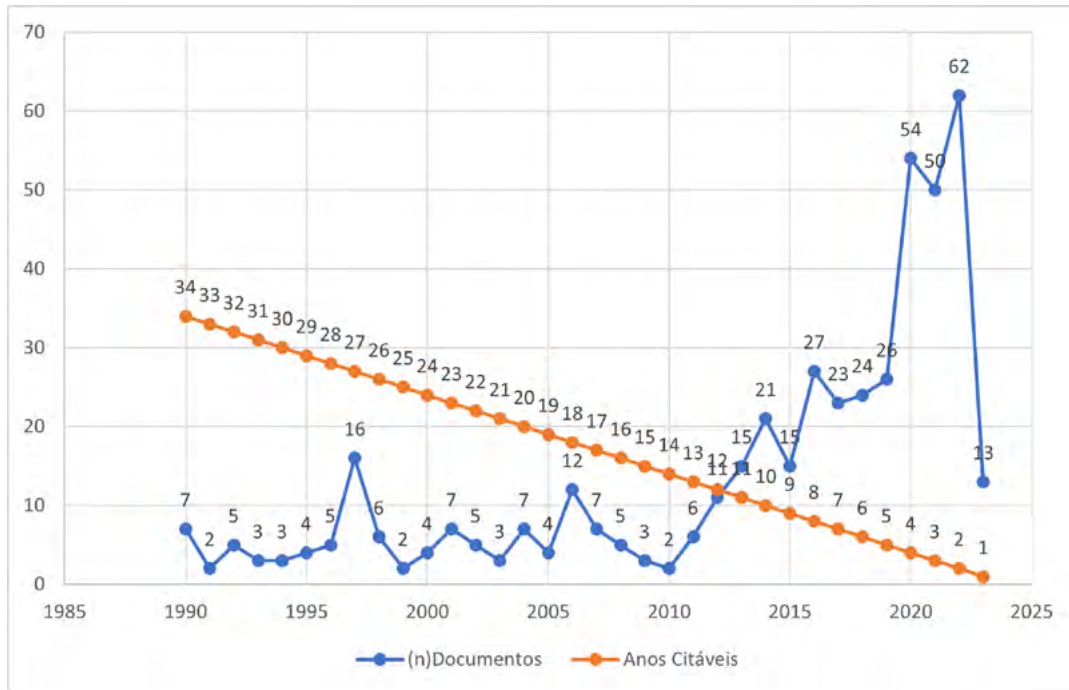
The distribution of the production corresponding to the period from 1990 to 2023, therefore 33 years, is shown in Graph No. 1. The annual growth rate was 1.89%. There were seven documents on the subject in 1990, with the highest production peak in 2022 (n=62 - 13.5%). Perhaps this growth portrays the advancement of interest in rescue and scientific research on the subject, since computer science is an important component.

Graph 1 allows us to evaluate whether the growth of scientific production follows the exponential growth law of Price

Graph 1 - Annual distribution of scientific production



Source: Survey data. Rio de Janeiro, 2023.

Graph 2 - Citations per article, year and citable years


Source: Survey data. Rio de Janeiro, 2023.

(1986), for this purpose, a linear adjustment was performed with the data acquired, according to the equation $y = 1.0645x - 2122.4$, whose R^2 value was 0.4867, showing some dispersion of productivity during the years studied, an adjustment for an exponential curve was performed, however, the R^2 was zero, with the equation $y = 0x^{145.97}$, not being possible to adjust the model with the exponential function.

The average age of documents per year was 8.91 documents, while the average citation per document was zero citations, the annual growth rate was 1.89%. A total of 988 keywords were counted.

Table No. 1 describes the average number of citations received per article, per year and citable years of the retrieved documents. In the quadrennial evaluation of the Stricto Sensu Graduate Programs carried out by CAPES, scientific journals are considered important sources of scientific communication, whose main characteristics are the regularity and veracity of the published documents in which they will qualify the Intellectual Production of the professors and students of these Programs.

Considering the annual growth rate was 1.89% and the average age of the document was 8.91 years, it may induce the reader to think that, as time passes, the use of scientific literature is expected to suffer a natural decrease, the literature obsolesces. This phenomenon may explain the fact that, in health journals, it is very common to require a minimum of 80% of references with up to five years of publication to compose the references of original articles. The authors and readers are the main responsible for the obsolescence or not of the article, if these individuals refer to these articles citing

them continuously, they keep it alive and durable, therefore, still useful and current area of knowledge.

It is imperative to consider that the concept of obsolescence, when employed outside the context of scientific production, can lead to a literature being discarded and therefore replaced. In linguistics, for example, when a concept is considered obsolete, it is often said that it has been superseded by a new one, usually more efficient and with greater capacity for generalization. Thus, the obsolescence of literature refers to a decrease in its citation, but not to its definitive discarding.⁴

Studies on obsolescence, the life and death of publications, are important bibliometric indicators, especially after the publication of the work of Price (1986), who in turn suggested that each year approximately 10% of all articles "die", not being cited again. The death of scientific information can be attributed to the fact that this information is never cited again in other documents. The 459 documents retrieved are published in 274 scientific communication vehicles, with an average productivity per vehicle of 1.67 documents.⁵⁻⁶

Table 1 was constructed based on the Bradford Law. For this purpose, 3 zones were considered, each containing approximately 1/3 of the production of documents retrieved from the Pubmed indexing database, as described in the methodology.

The application of Bradford's law also makes it possible to know the value of mB (Bradford multiplier), resulting from dividing the number of journals in a zone by the previous one), and the value of XmB (average value of the Bradford multiplier, disregarding the value of the first zone). Therefore,

Table 1 - Zone 1 periodicals in the classical Bradford Table

Vehicle/Source	Rank	Freq.	Accum. Freq.	Zone
Materials Management in Health Care	1	24	24	Zone 1
Plos One	2	13	37	Zone 1
Hospital Material[Dollar Sign] Management	3	10	47	Zone 1
Sensors (Basel, Switzerland)	4	9	56	Zone 1
Acs Applied Materials & Interfaces	5	8	64	Zone 1
Applied Optics	6	7	71	Zone 1
Hospital Materiel Management Quarterly	7	7	78	Zone 1
Journal of the American Medical Informatics Association	8	7	85	Zone 1
Journal of Biomedical Informatics	9	6	91	Zone 1
Healthcare Financial Management	10	5	96	Zone 1
International Journal of Medical Informatics	11	5	101	Zone 1
Journal of Medical Internet Research	12	5	106	Zone 1
Or Manager	13	5	111	Zone 1
Scientific Reports	14	5	116	Zone 1
Studies in Health Technology and Informatics	15	5	121	Zone 1
ACS Nano	16	4	125	Zone 1
Health Management Technology	17	4	129	Zone 1
Healthcare Informatics	18	4	133	Zone 1
International Journal of Pharmaceutics	19	4	137	Zone 1
Jmir Medical Informatics	20	4	141	Zone 1
Journal of Healthcare Resource Management	21	4	145	Zone 1
Journal of the Optical Society of America	22	4	149	Zone 1
Modern Healthcare	23	4	153	Zone 1

Source: Survey data. Rio de Janeiro, 2023.

the greater the oscillation of mB between zones, the greater the difference in productivity between journals (Table 2).

As can be seen, the result of the Bradford Multiplier does not allow us to affirm, in this study, that the journals in Zone 1 are those devoted to the subject studied. Supposedly, the journals of higher quality and/or relevance to the areas studied are located in Zone 1 or Core.^{5,7}

Bradford's Law postulates that as the first articles on a new topic are written, they are submitted to a small selection, by journals related to the topic or area of knowledge, and if accepted for publication, these journals tend to receive more

Table 2 - Bradford multiplier - mB

Zone	No. of Sources	mB	XmB
Zone 1	23	-	
Zone 2	100	4,34	2,92
Zone 3	151	1,51	

Source: Prepared by the authors (2023).

and more articles. In this dissertation, all the recovered production was divided into three zones, each with 1/3 of the production. In Zone 1 we counted 23(8%) journals, in Zone 2 there were 100(36%) and, finally, in Zone 3, 151(55%). These results show the maxim of Bradford's Law⁹, in which few journals publish a greater volume of documents, while many journals publish little.⁵⁻⁶

The degree of relevance of the 274 journals that served as vehicle/source for the dissemination of 459 documents, the first in the Ranking in Zone 1, we have the journal *Materials Management in Health Care* (ISSN: 1059-4531), published by American Hospital Publishing, Inc.[®], online from 1992 - 2010, covering the area of Medicine. Its metrics are: H-Index = 8 and, SJR 2013 = 0.115.

Opening Zone 2, we have the periodical *Optics express* (ISSN: 1094-4087), published by Optica Publishing Group[®], is online since 1997, covering the areas of Physics, Astronomy, Atomic and Molecular Physics and Optics. Its metrics are: H-Index = 297 and, SJR 2022 = 1.14.

Zone 3 has *Fluids and Barriers of the CNS*. (ISSN: 2045-8118), published by BioMed Central Ltd.[®], has been online since 2011, covering the areas of Medicine, Cellular and Molecular Neuroscience and Neurology. Its metrics are: H-Index = 67 and, SJR 2022 = 1.657. None of these vehicles is included in the *Qualis Referência* of CAPES 2017-2020, Nursing Area.

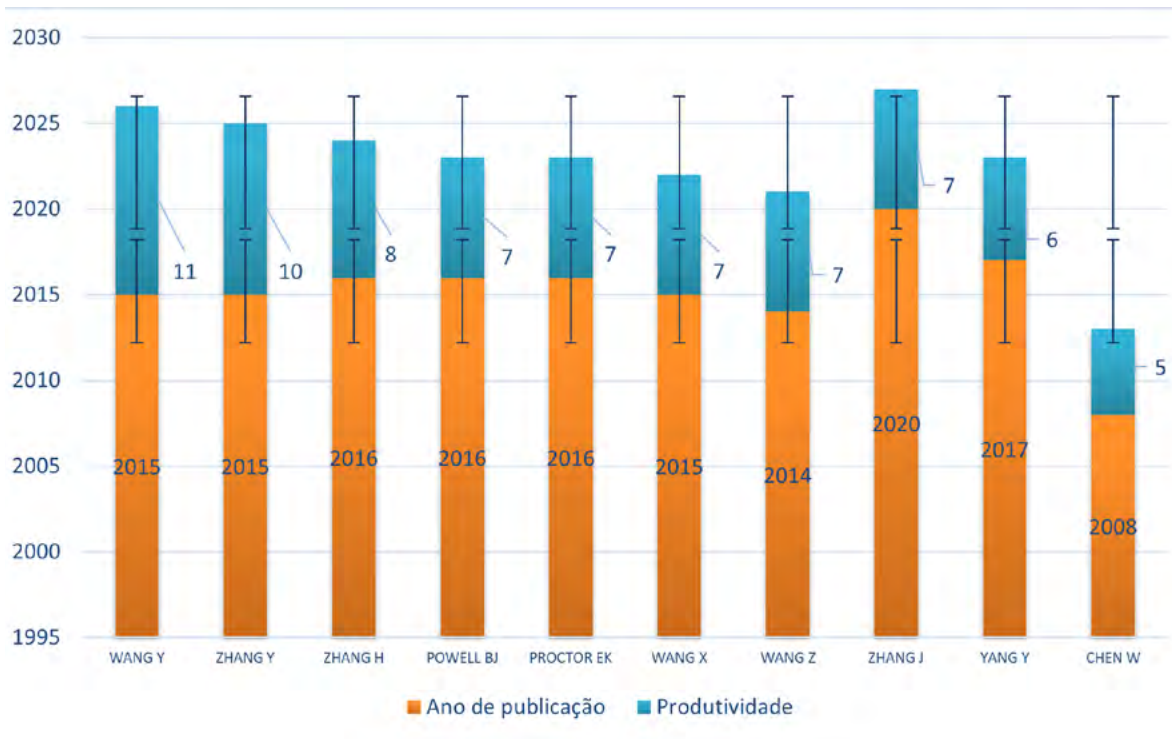
SCImago Journal Rank (SJR) measures the weighted citations received by the journal. The citation weighting depends on the subject field and the prestige (SJR) of the citing journal. These three journals, even though they are not classified in *Qualis* 2017-2020, can still be considered prestigious vehicles.

The evaluation process of *stricto sensu* postgraduate studies conducted by CAPES has several instruments for organizing and directing the work that is done by ad-hoc committees within the 49 evaluation areas. One of these instruments is *Qualis Periodicals*, which consists of the indirect qualification of intellectual production in the form of scientific articles based on the analysis of the quality of the dissemination vehicles, that is, the journals. As a result, it provides a list with the classification of the vehicles used by postgraduate programs to disseminate their production.

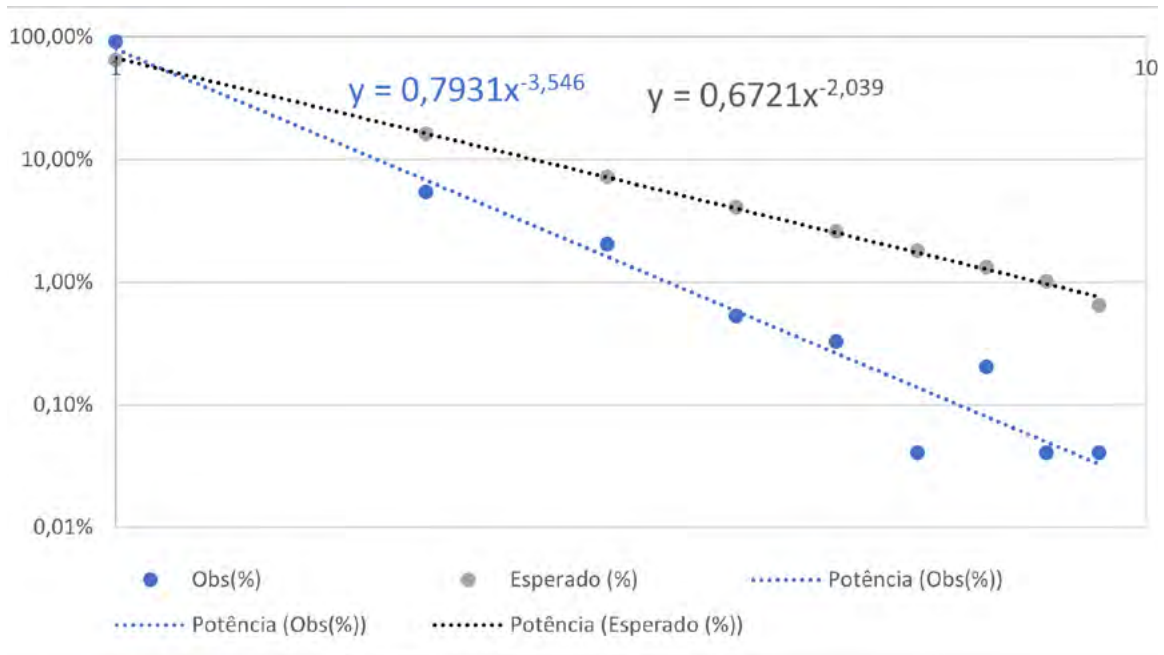
It is important to note that only journals that have received production in the evaluation period are listed and classified; therefore, it is not an exhaustive list of journals, but a list of those effectively used by postgraduate programs in the period under analysis.

The list of journals is always an a posteriori portrait, since it refers to previous years, whose data have already been reported to CAPES through the *Sucupira* Platform. The journals are classified into quality strata, A1 being the highest, followed in descending order by A2, A3, A4, B1, B2, B3, B4 and C, the latter having zero weight in the evaluation.

Graph 3 - Most relevant authors in number of documents published



Source: Prepared by the authors (2023).

Graph 4 - Representation of empirical findings and the expected in Lotka

Source: Prepared by the authors (2023).

The h-index is a source/journal-level metric that attempts to measure the productivity and citation impact of publications from a scientific/academic source/journal. The index is based on the set of the most cited documents of the source/journal and the number of citations they received in other publications.

Graph 3 shows the distribution of the productivity of the most relevant authors. For a more precise analysis of the relevance of authors who have published at least 5 (five) documents.

To verify the estimation of the coefficient of Lotka's Law, which is possible to estimate its coefficients for scientific productivity, we consider the frequency of publication of all authors on the subject in any field, we consider the Constant "c" = 1000, that is, for the Health Area, we admit that 1000 authors published only 1 article, then we apply the equation $y=c*x^{-2}$, where "y" = variable that indicates the number of authors, "c" = constant of the area, "x" = number of articles/production. Therefore, the number of authors (y) will be equal to the constant (c) x square of the production (x-2).⁴⁻⁵

For this reason, this is known as the inverse square law, where the number of authors publishing a certain number of papers is a fixed ratio to the number of authors publishing a single paper.³⁻⁴

This assumption implies that the theoretical beta coefficient of Lotka's law is equal to 2. Therefore, using the Lotka function, it is possible to estimate the beta coefficient of the bibliographic collection on the studied subject retrieved from Pubmed and to evaluate, by means of a statistical test, the similarity of this empirical distribution with the theoretical one.

Price's (1986) studies make it possible to determine the elite of the most cited authors in a given journal, increasing the credibility of publications that use the works of this elite. In 1976, the physicist, historian of science and information scientist, who became known as the father of scientometrics, Derek John de Solla Price, conjectured, based on Lotka's Law, that a criterion for separating the most prolific authors (elite) from the least prolific in a given field of knowledge would be given by the square root of the total number of authors, which was titled Price's Law of Elitism or Law (\sqrt{k}).³⁻⁶

That said, applying the Law of Elitism is an integral part of the quantification of scientific productivity, especially measured in terms of published works from which the calculations necessary for measuring this productivity of the authors originate, in this dissertation it was no different.⁶

Graph No. 4 and the numerical result of the square root of the total number of authors counted in this dissertation was 49.56 (full authorship), $\sqrt{2457} = 49.56$. Because it generated a non-integer number. It is suggested that this value be rounded, so the value considered here will be 50 authors. To affirm an Elite Group in this research, it would be necessary that the 50 most productive authors had contributed at least 60% of the total production, so it was not possible to determine this Group, since 91.33% of the authors produced a single document, which classifies them as occasional authors.⁷⁻⁹

CONCLUSION

There was a marked annual dispersion of outputs. The peak of production occurred between 2022, which accounted for 62 documents. Regarding the productivity of authors, the study showed that there is no elite group of authors who are publishing articles on the topic. The high number of occasional authors, those who published a single document on the topic, was evident. It was not possible to demonstrate the direct relationship with the quality of the journals metrified by the SJR, with the journals stratified in the Qualis Referência 2017-2020 for the nursing area.

This research used one of the most reputable databases, however, it does not exempt it from being a research limitation. Future research is suggested in other databases and mining using other descriptors that also describe the research topic, in addition to delving into a specific area. It is emphasized that the study of the theme in and of itself constitutes a research gap, which can be researched and developed, since it was found that there are several related works that can be used to support these studies. Therefore, this work contributes to new research to be carried out in order to better clarify the bibliometric relationship involving the use of computer-aided numerical analysis for input control in mobile units.

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