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Bibliometric analysis of scientific production on Coronavirus and Covid-19

Análisis bibliométrico de la producción científica en Coronavirus y Covid-19

Análise bibliométrica da produção científica sobre Coronavírus e Covid-19

ABSTRACT
Objective: to analyze the intellectual production on Coronavirus and COVID-19, made available on the Web of Science base. Method: bibliometric study that addressed the production recorded electronically, from 2016 to 2020, with descriptive statistical analysis. Results: 1697 documents published in 500 journals, The average production per author was 1.652730752. The Nursing category contributed four (0.238%) documents, with Virology making the largest contribution 320 (19%), The USA led with 479 articles (28.5%). Conclusion: the data presented demonstrate the high level of interest of the scientific community on the subject. It was possible to identify 82 authors composing an Elite group of Authors, whose productivity was 66.1%. The United States, China and Saudi Arabia are the countries that most formed Collaboration Networks.
DESCRIPTORES: COVID-19; Coronavirus; Bibliometry; Infectious diseases; Medicine; Virology.

RESUMEN
Objetivo: analizar la producción intelectual sobre Coronavirus y COVID-19, disponible en la base de datos de Web of Science. Método: estudio bibliométrico que abordó la producción registrada electrónicamente, de 2016 a 2020, con análisis estadístico descriptivo. Resultados: se recuperaron 1697 documentos publicados en 500 revistas y la producción promedio por autor fue de 1.652730752. La categoría de Enfermería contribuyó con cuatro (0.238%) documentos, siendo Virology la mayor contribución 320 (19%), EE. UU. Lideró con 479 artículos (28.5%). Conclusión: los datos presentados demuestran el alto nivel de interés de la comunidad científica en el tema. Fue posible identificar 82 autores que componen un grupo Elite de Autores, cuya productividad fue del 66,1%. Estados Unidos, China y Arabia Saudita son los países que más formaron Redes de Colaboración.
DESCRITORES: COVID-19; Coronavirus; Bibliometría; Enfermedades infecciosas; Medicina; Virología.

RESUMO
Objetivo: analisar a produção intelectual sobre Coronavírus e COVID-19, disponibilizada na base Web of Science. Método: estudo bibliométrico que abordou a produção registrada eletronicamente, de 2016 a 2020, com análise estatística descritiva. Resultados: recuperou-se 1697 documentos publicados em 500 periódicos, A média da produção por autoria foi de 1,652730752. A categoria Enfermagem contribuiu com quatro (0,238%) documentos, ficando com a Virologia a maior contribuição 320 (19%), Os EUA lideraram com 479 artigos (28,5%). Conclusão: os dados apresentados demonstram o alto nível de interesse da comunidade científico pelo assunto. Foi possível identificar 82 autores compondo um grupo de Elite de Autores, cuja produtividade foi de 66,1%. Os Estados Unidos, China e Arábia Saudita são os países que mais formaram Redes de Colaboração.
DESCRIPTORS: COVID-19; Coronavírus; Bibliometria; Infectologia; Medicina; Virologia.

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INTRODUCTION

Coronaviruses make up a large family of viruses, known since the mid-1960s. They can cause everything from a common cold to severe respiratory syndromes, such as Severe Acute Respiratory Syndrome (SARS) and the Middle East Respiratory Syndrome (MERS - Middle East Respiratory Syndrome). It is a family of viruses that mostly affects animals, with seven varieties known in humans, four of which had already been detected in Brazil and were responsible for minor respiratory infections[1].

The cases identified in 2020 are related to a new variant of the Coronavirus, called SARS-CoV-2, responsible for the disease called COVID-19 (from English, Coronavirus Disease-2019). It is an emerging infectious disease, first identified in the Chinese city of Wuhan, whose initial cases were diagnosed in December 2019. On 11 March 2020, the Director General of the World Health Organization (WHO), Mr, Tedros Adhanom Ghebreyesus declares pandemic caused by this new variant[1].

Situations like this, in which the whole world is on alert to fight this disease, civil society needs to trust those who have political power, but mainly, those who produce scientific knowledge accessible quickly and qualified, being the World Health Network. Computers, the preferred source for health professionals, students, researchers, as well as society in general, even though, this source may not always be considered reliable.

Due to the intervening factors of the new Coronavirus pandemic being on the multidisciplinary level, since it involves aspects of basic and applied sciences, including Virology, Microbiology, Infectology, Epidemiology, Statistics, Nursing, Psychology, Sociology, Biology, among others, it is observed that researchers from the most different areas of knowledge are focused on their research in search of an effective treatment and a vaccine capable of immunizing humans, therefore, the state of the art of such research may benefit as a result of bibliometric studies like this.

We have lived a century whose information is published and disseminated on a large scale and with unprecedented speed, making the process of incorporation by researchers increasingly easier(2), therefore, it is essential to have the minimum ability to select the best indexing bases and repositories, prospect, filter and select the most relevant information for your research, and it is precisely in this context that bibliometric studies are presented as sources of information. for different areas of research, and which are able to subsidize technological and scientific evolution[3], nevertheless, due to its characteristic of mapping scientific production[4].

Bibliometric analysis, which comprises the application of statistics to the bibliography, has three classically recognized laws: Bradford Law (law of dispersion of scientific knowledge), Lotka Law (law of productivity of authors) and Zipf Law (frequency of words). It is worth noting that the main difference between bibliography and bibliometrics is that the latter mainly uses quantitative than discursive methods, which gives greater objectivity in the evaluation of scientific production[5], not only being concerned with the quantitative aspect, but also in verify the relevance and impact of authors, journals, institutions, groups or countries in the most diverse areas[4,5].

Bibliometric studies are based on a set of empirical laws and principles, derived from information science, whose objective is to investigate the quantitative aspects of the production, dissemination and use of available and registered information, thus contributing to the evaluation of cur-

rent state of science, as well as research management[5-7].

This study is justified by researching the characteristics of scientific production on Coronavirus and COVID-19, contributing to the scientific community interested in studying this virus, as it will show the distribution of production by year, geographical area, area of knowledge, identifying the most relevant journals. devoted to the subject, the most productive authors, among other aspects. The question of this proposition is: Does the indexing of documents on Coronavirus and COVID-19 in the Web of Science database, published in the last five years, obey the laws and bibliometric principles of Lotka and Bradford?

In order to answer this question by bibliometric metrics, the objective is to analyze the production of articles on Coronavirus and COVID-19, made available on the Web of Science database.

METHODOLOGY

This is a bibliometric study that addressed the production/dissemination and use of information recorded electronically in an international database, published in the period from 2016 to 2020, a period based on the Price index[5,6] which represents the proportion in 50% of information consumption aged between zero and five years. The principle of bibliometrics includes the use of reliable indicators, which can be defined as parameters used in evaluation processes[5]. The analysis material was limited to documents indexed in the Web of Science base, for that purpose, all types of documents published between 2016 and 2020 were used as inclusion criteria, with no exclusion criteria.

The searches were carried out in the Web of Science database in April 2020, using the descriptors [Coronavirus] and [COVID-19] and with a "topical" filter. Access was via the CAPES Journal Portal, using the researcher's credentials at Rede Cafe.

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The choice of the base is due to its acceptance in the world scientific community, especially for the health area, which provides abstracts and citations of peer-reviewed scientific literature, in addition to offering a more comprehensive view of the world's research production. For the bibliometric analysis stage, the graphical interface of the VOSViewers software and the Microsoft Excel 2017 tool were used®. The descriptive analysis calculated the mean, median and standard deviation. The results obtained are presented below.

RESULTS

The search returned 1,669 documents, of which 1,017 (59.9%) received citations that totaled 9,372 with an average of 9,372 citations per document. The first analysis was aimed at surveying the number of documents per year, as well as identifying the scientific production in percentage terms. In 2020, 563 (33.53%) documents were published, 2019 286 (17.03%), 2018 253 (15.06%), 2017 251 (14.94%) and in 2016 326 (19.41%).

Six thousand seven hundred ninety-three researchers were counted among authors and co-authors. The productivity average was little more than 1.65, with median 1 and standard deviation 1.845943562. The most productive author/co-author published 34 articles (2%), while the absolute majority, 4,956 (72.9%) authors/co-authors published only a single article. The ten most productive ones are shown in Table 1. The equation $X\alpha * Y = C$, proposed in Lotka's Law, was applied to the total set of authors/co-authors, where X = number of published documents, Y = number of authors with X publi-

Table 1. The ten most productive authors/co-authors. Rio de Janeiro, RJ, Brazil, 2020.

ORDEM DE SÉRIE	AUTORES	QUANTIDADE DE ARTIGOS	% OF 1679
1	Perlman, S	**34**	**2.025**
2	Baric ,RS	30	1.787
3	Drosten, C	29	1.727
4	Yuen, KY	27	1.608
5	Shi, ZI	25	1.489
6	Memish, ZA	25	1.489
7	Haagmans, BL	25	1.489
8	Mahase, E	24	1.429
9	Gerber, Si	22	1.310
10	Al-Tawfiq, JA	22	1.310

Note: * Equivalent to the serial order.

Chart 1. Lotka constant. Rio de Janeiro, RJ, Brazil, 2020

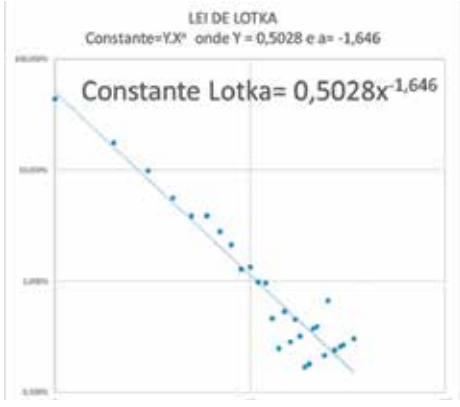
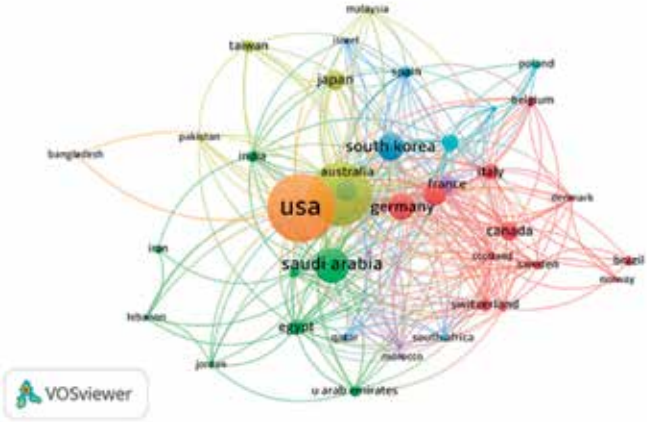


Figure 1. Map of authorial collaboration by country. Rio de Janeiro, RJ, Brazil, 2018



cations and C = constant. Graph 1 represents the equation based on the distribution of articles by the number of authors, whose Lotka constant was equal to 0.5028X-1,646.

About the recovered documents, the most frequent were the original articles 1,015 (60.4%), followed by the review articles 141 (8.3%) and editorial articles 212 (12.6%). The rest fit into other modalities.

The geographic distribution of the recovered publications had the collaboration of 100 countries. The absolute leadership was with the United States of America (USA) with 479 documents (28.5%), followed closely by China with 431 (26.6%), Brazil occupies the 21st position with 23 (1.3%). The other 97 countries together published 933 articles (44.6) of all production.

The geographic analysis of co-authorship considered the countries with at least 5 productions and 10 citations per document, representing, therefore, 41 (41%), less than half of the countries with production, while 24 (24%) countries published only a single document. Figure 1 represents this distribution, with Bulgaria, Chile, Peru, Serbia, Senegal, Venezuela, Ulkra and Zambia standing out, each contributing only 0.06% of production. In this scenario, Brazil forms a collaboration hub with only five countries: Italy, England, Canada, Sweden and Switzerland.

The language of publications is concentrated in the English language, with 1,657 (98.6) documents, followed by German six (0.3%) and only one (0.06%) document in Portuguese.

One thousand eight hundred fifty-five institutions involved in the production of recovered documents were recovered, of which 346 (19.06%) are universities and 80 (4.4%) hospitals. Table 2 highlights the 10 most productive institutions.

Among the categories, only eight of the 103 recovered, produced in the order of a hundred, Virology 320 (19.05%), Infectious Diseases 297 (17.68%), Microbiology 200 (11.91%), Internal medicine 173 (10.3%), Immunology 156 (9.29%), Veterinary 145 (8.63%) and Public En-

Table 2. Quantity of production per institution. Rio de Janeiro, RJ, Brazil, 2020.

R*	INSTITUIÇÃO	PRODUÇÃO	% OF 1679
1	University of hong kong	76	4,527
2	Chinese academy of sciences	62	3,693
3	King saud bin abdulaziz university for health sciences	42	2,501
4	Ministry of health saudi arabia	39	2,323
5	University of north carolina	39	2,323
6	National institutes of health nih usa	38	2,263
7	Seoul national university snu	38	2,263
8	University of north carolina chapel hill	38	2,263
9	Johns hopkins university	37	2,204
10	Erasmus university rotterdam	36	2,144

Note: * Equivalent to the serial order.

Table 3. Bradford Classic Table. Rio de Janeiro, RJ, Brazil, 2020

R*	NO PERIÓDICOS	NO ARTIGOS	ACUM. A	LOG (C)	ACUM. B	A*B
	A	B	C		D	
1	1	70	1	0	70	70
2	1	66	2	0,30103	136	66
3	1	40	3	0,47712	176	40
4	1	32	4	0,60206	208	32
5	1	31	5	0,69897	239	31
6	1	31	6	0,77815	270	31
7	1	29	7	0,8451	299	29
8	1	28	8	0,90309	327	28
9	1	27	9	0,95424	354	27
10	1	25	10	1	379	25
11	2	24	12	1,07918	403	48
12	1	22	13	1,11394	425	22
13	1	20	14	1,14613	445	20
14	1	19	15	1,17609	464	19
15	2	18	17	1,23045	482	36
16	1	17	18	1,25527	499	17
17	1	16	19	1,27875	515	16
18	1	15	20	1,30103	530	15
19	4	14	24	1,38021	544	56
20	1	13	25	1,39794	557	13
21	4	12	29	1,4624	569	48
22	8	11	37	1,5682	580	88
23	1	10	38	1,57978	590	10
24	7	9	45	1,65321	599	63
25	6	8	51	1,70757	607	48

vironmental Occupational Health 128 (7.62%). Nursing contributed 4 (0.23%) documents. The 1,697 documents found are distributed in 500 journals, with an average of 3.39 articles per journal. The number of journals that published a single document was 291 (58.2%).

The ten journals with the most published documents were: Journal of Virology 70 (4.16%), British Medical Journal 66 (3.93%), Viruses Basel 40 (2.38%), Emerging Microbes Infections 32 (1.9%), Emerging Infectious Diseases 31 (1.84%), Lancet 31 (1.84%), Virology 29 (1.72), Scientific Reports 28 (1.66%), Eurosurveillance 27 (1.6%) and Nature 25 (1, 48%). The mean, median and standard deviation of production were successively: 3,394, 1 and 6,435339244.

Table 3 presents the Bradford Table with distribution of journals and their production, according to the three zones, here called Bradford zones, whose wording proposed by the theorist confers with the organization of scientific journals in order of decreasing productivity of documents on a given subject, its set can be divided into a nucleus of journals more particularly dedicated to the subject and several groups or zones that must contain the same number of documents as the nucleus, so the number of journals in the nucleus and in successive zones, will be the ratio 1: n: n2: n3 ...

For purposes of distribution of the nucleus and zones, in this study, the value proposed in theory was used, thus, the nucleus and each of the two Zones accounted for approximately 1/3 of the total documents produced in the analyzed time frame, that is, approximately 566 documents in the nucleus and in each zone. The Bradford Multiplier (Bm), was also calculated to show that the number of journals contained in one zone in relation to the subsequent one, should keep oscillating, at most, 0.7 difference. Table 4 shows all of these values.

DISCUSSION

After these analyzes, it was possible to prove that the research corpus is consistent, since data mining allowed the reco-

26	9	7	60	1,77815	614	63
27	8	6	68	1,83251	620	48
28	13	5	81	1,90849	625	65
29	22	4	103	2,01284	629	88
30	32	3	135	2,13033	632	96
31	74	2	209	2,32015	634	148
32	291	1	500	2,69897	635	291

Note: * Equivalent to the serial order.

Table 4. Bradford areas. Rio de Janeiro, RJ, Brazil, 2020

ZONAS	CONTAGEM DE PERIÓDICOS	PROPORÇÃO	BM*
Núcleo	20	1	
Zona 1	83	n	4,15
Zona 2	397	n*2	4,783133

Note: Bm * Bradford Multiplier

very of documents from the main descriptors, delimiting the subject that was the focus of the research. The amount of 1,697 documents in five years of study, surpassed other bibliometric studies in the health area, such as, for example, on scientific production on moral harassment/moral harassment with 53 documents recovered from 2002 to 2012[8] and another on virtual reality in venipuncture, which analyzed the 213 documents retrieved from the same database, from 1969 to 2018 [9]. This result strongly reflects the interest of the scientific community about the pandemic, as well as its emergence on the world stage.

There was a sustainable increase in publications from 2016, with the year 2020, even though it is still ongoing, having the largest number of publications, justifying once again the emergence of the subject and the interest curve on the part of scientific community. It is undeniable that the average life(5,10) of this production has not yet reached its peak. However, due to the behavior of scientific production, this number tends to be exceeded, given that the consultation on the Web of Science took place in April 2020.

The percentage of articles that received the 9,372 (59.9%) citations, allowed to determine how extensive are the channels for transferring this knowledge, its consumption and utility, since they are being the source of information on Coronavirus and COVID-19 by researchers. It also allows us to safely state that the rate of thinning or the replacement of scientific knowledge on this subject is still far from being initiated, as well as the aging/obsolescence factor, since there was no loss greater than 50% in citations and current information[10].

Applying Lotka's law, it turns out that it is indeed possible to identify an inversely proportional relationship between the number of authors and articles produced. Nevertheless, the constant found in Graph 2, confirms the postulate that represents the thought 'many with little and few with much[7-10], since, the greater the number of articles produced, the smaller the number of authors.

When applying the Price Elitism Law[10], it was possible to identify the Elite Group of authors, considering that the square root of the total number of authors was 82, the total number of authors representing the elite of the studied area, since their production represents 66.1% of the recovered documents, far exceeding the minimum of 50% Proposed in the law of Elitism, in which weight the fact that the productivity index was very low 1.65, largely due to the excessive number of occasional authors[10].

The co-authorship analysis made it possible to verify the strength of scientific collaboration between those authors/co-authors who produced at least 5 documents with at least 10 citations, most of them being part of the Elite Group. Co-authorship analysis is an important bibliometric indicator, being one of the most researched attributes in the use of Social Network Analysis (ARS), as it provides the researcher with a broad view of the invisible colleges in which the vertices of the research are immersed, in addition to a series of other findings regarding unity relations in the scientific sphere[8-10].

In this regard, when comparing the average co-authorship with the institutions and countries of origin, it is possible to verify that Social Networks in the scientific sphere are globalized among authors, affiliation and countries, once again, led by the United States of America and Eastern countries, in particular, China and Saudi Arabia, followed by the United Kingdom and Germany. The 21st position of Brazil stands out, the only representative of Latin America. The language of publications was dominated by English, the dominance of which can be easily explained, as English is a universal language for science. This finding allows us to safely infer that the level of international interaction of Brazilian researchers is still in the consolidation phase.

Applying the Bradford Law to verify the distribution/dispersion behavior of the journals, in Table 3, it was possible to identify, from the Bradford Multiplier (Bm), a constant, since the variation between the Bm of the zones remained within the allowed oscillation[5-9], 0.7, showing a distribution very close to the ideal of - I: n: n2, as determined by the Law. The nucleus comprised 18 journals, these being the most devoted to the subject[9,10].

CONCLUSION

Titles and abstracts of articles are relevant as representative in scientific production on the topic. The results show a high production of studies, distributed in the most varied areas of knowledge, however, being restricted to Health. As it is a very current subject, when considering the time frame, it is reasonable to say that the

number of documents recovered is quite relevant when compared to other bibliometric studies in the health area.

Bibliometrics contributed to study the production record. The structuring of databases made it easier to obtain them and the software available on the market, in turn, speeds up the processing and quantitative analysis of such data.

Researchers can benefit from bibliometric analysis techniques, not only in a quantitative but also qualitative approach, as the numbers help to approximate the reality and, with the inclusion of more in-depth studies, the richness of the analysis becomes more representative. Therefore, bibliometric studies can contribute to the visualization of connections between information from different areas of knowledge,

As for the authors, the expressive number of authors per article was evidenced and, for the most productive ones, the study highlighted the periodical that published their research, the institution to which they are linked and their geographical location, in this particular, it is evident that the subject it has aroused the interest of researchers to the point of establishing intercountry and interinstitutional collaboration networks, as well as an Elite Group.

Although based on empirical facts, the laws of Bradford and Lotka, were able in this study to confirm possible theoretical hypotheses that the core of journals is formed by the most devoted and, therefore, the most productive, nevertheless, revealed that the greater the specificity the topic studied, the greater the possibility of identifying Elite groups of authors.

As the classic formulation of the Law was used, it was foreseeable that the fit would not be perfect, since n variables influence the empirical distribution of the literature, such as are not captured by Bradford's classic formula, and represent the greatest challenge for contemporary scholars. of its mathematical formulation. The nucleus pointed out from the application of the Law perfectly recognized an important aspect related to academic scientific behavior on Coronavirus and COVID-19, that is, when there is evidence that certain journals are or will have recognition in the medium, more and more publications are the for this purpose, it would be important to verify the qualitative aspect of these journals, based on the impact factor indicators, these would be the most reliable.

Another important aspect that needs to be considered refers to the cognitive institutionalization of the areas of knowledge in the domain of recovered articles and journals, which could be identified by the use of the two descriptors used. Despite the grammatical standardization of descriptors by a controlled vocabulary - Descriptors in Health Sciences (DeCS), even so, the making of unreliable inferences can be configured in a limitation of this study.

As a contribution, the results of the study and its methodological design may serve as a basis for other proposals, thus filling a gap in the list of bibliometric research in health, especially in nursing, such as the commitment to consolidate its body of knowledge, developing research that simultaneously contribute to the growth and consolidation of this knowledge. ■

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