Ministerio del Poder Popular para la Salud
Boletín de Malariología y Salud Ambiental
ISSN: 1690 - 4648

Septiembre - Octubre 2022, Vol. LXII (5), 1028-1039

Original Article

Breaking infodemic: discovering SARS-CoV-2

Rompiendo la infodemia: descubriendo el SARS-CoV-2

https://doi.org/10.52808/bmsa.7e6.625.017

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Recibido: 30/06/2022

Aceptado: 25/09/2022

ABSTRACT

By December 2019, multiple cases of unexplained pneumonia were reported in some hospitals in the city of Wuhan, China. Since then, it had been confirmed that it corresponded to an acute respiratory infection caused by a new coronavirus that spread quickly, becoming pandemic in a very short time. On the other hand, this pandemic forced confinement for months, something unprecedented. In that time, millions of people went online for entertainment, education, etc. Consequently, the use of the Internet increased, bringing, on the one hand, online education, and entertainment on the Internet, ensuring social distancing; and on the other hand, it brought new new risks to human life, among them rumors. In this way and given the large number of publications that could denote the level of misinformation about COVID-19 and the impact it could have on global public health, various scientific publications were analyzed and identified from a bibliometric point of view. Potential relationships between the descriptors obtained from the bibliometric search were identified. The results were conglomerated into 5 clusters: Cluster 1, related to studies on access to information provided on COVID-19; cluster 2 shows the list of studies that have been carried out on the information on the COVID-19 vaccine, cluster 3 analyzes the different responses given by conspiracy theories, rumors and misinformation about COVID-19, the Group 4 shows cross-sectional and longitudinal research on COVID-19 and the information it provides to the health sector, and cluster 5 represents studies on scientific production and communication that have contributed to global health during the pandemic.

Keywords: Infodemy, COVID-19, disinformation, social networks.

RESUMEN

Para diciembre de 2019, se registraron múltiples casos de una neumonía inexplicables en algunos hospitales de la ciudad de Wuhan, China. Desde ese momento se había confirmado correspondía a una infección respiratoria aguda causada por un nuevo coronavirus que se propagó rápidamente haciéndose pandémico en muy poco tiempo. Por otra parte, esta pademia obligó a un confinamiento por meses, algo sin precedente. En ese tiempo, millones de personas se conectaron en línea para entretenimiento, educación, etc. En consecuencia, el uso de Internet aumentó trayendo, por una parte, educación online y entretenimiento en Internet asegurando el distanciamiento social; y por otra parte, trajo nuevos nuevos riesgos a la vida humana, entre ellos los rumores. En ese sentido, y ante la gran cantidad de publicaciones que podrían denotar el nivel de desinformación sobre el COVID-19 y el impacto que podría tener en la salud pública mundial, se analizaron e identificaron diversas publicaciones científicas desde el punto de vista bibliométrico. Se identificaron las relaciones potenciales entre los descriptores arrojados de la búsqueda bibliométrica. Los resultados se conglomeraron en 5 clúster: El clúster 1, relacionado con los estudios sobre el acceso a la información proporcionada sobre COVID-19; el clúster 2, muestra la relación de los estudios que se han realizado sobre la información de la vacuna COVID-19, el clúster 3, analiza las distintas respuestas que dan las teorías conspirativas, los rumores y la desinformación sobre el COVID-19, el grupo 4 muestra investigaciones transversales y longitudinales sobre el COVID-19 y la información que brinda al sector salud, y el clúster 5 representa los estudios sobre producción y comunicación científicas que han contribuido a la salud mundial durante la pandemia.

***Palabras clave**: Infodemia, COVID-19, desinformación, redes sociales.*

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Ministerio del Poder Popular para la Salud
Boletín de Malariología y Salud Ambiental
ISSN: 1690 - 4648

Septiembre - Octubre 2022, Vol. LXII (5), 1028-1039

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Introduction

By december 2019, multiple cases of unexplained pneumonia began to be reported in some hospitals in the city of Wuhan, Hubei province, China. The cases had a common point, the large seafood market that operated in the city of Wuhan, Hubei province, China. Since then, it had been confirmed that such a disease corresponded to an acute respiratory infection caused by a new coronavirus that spread quickly from Wuhan to other areas of China, and then to 66 countries, becoming pandemic in a very short time. Coronaviruses (CoV), correspond to a large family of RNA of certain viruses that can infect animals and also humans, causing respiratory problems, gastrointestinal, liver and neurological diseases. As the largest known RNA viruses, CoVs are divided into four genera: alpha-coronavirus, beta-coronavirus, gamma-coronavirus, and delta-coronavirus (Yang & Leibowitz, 2015). To date, six human coronaviruses (HCoVs) have been identified, including the alpha-CoVs HCoVs-NL63 and HCoVs-229E and the beta-CoVs HCoVs-OC43, HCoVs-HKU1, severe acute respiratory syndrome-CoV (SARS-CoV) (Drosten *et al*., 2020) and Middle East respiratory syndrome-CoV (MERS-CoV) (Zaki *et al*., 2012). Already on January 30, 2020, the World Health Organization (WHO, 2020a) declared CoVID-19 a "public health emergency of international concern" (Li *et al*., 2020). As a result, millions of people have been infected and hundreds of thousands of people have died worldwide (Chakraborty & Maity, 2020). It had been confirmed that it was a highly contagious disease, being transferred to humans by inhalation of virus-laden liquid droplets or intimate relations with a sick or contaminated person.

Clinical observations in confined spaces had suggested aerosol transmission as an additional problem (Anderson *et al.*, 2020; Ge *et al.*, 2020; Zhang *et al.*, 2020a, b). At the time of the appearance of the virus, all knew about it was its potential for transmission, contagion, and death, caused by the virus, bringing fear to the general population. Scientists around the world worked tirelessly to find a prevention and treatment strategy. Until that time, there were no medications or vaccines available for COVID-19. Symptomatic treatment in mild infections and oxygen therapy in critical cases were shown to be effective treatments. Some reports gave a positive response to the use of combined single medications such as other drugs such as ritonavir, chloroquine, lopinavir, BCX-4430 (galidesivir salt form), nitazoxanide, and ribavirin (Liu *et al.,* 2020), but there was no underlying evidence or approved by any international organization such as WHO or FDA. The most urgent measures were focused on prevention such as: quarantine of travelers from infected countries, blocking transmission by maintaining high-level hygienic conditions at home (use of gels, frequent hand washing) and surroundings, prohibition of social gatherings, general awareness of the population, use of masks in the population and protective clothing by infected or healthy, elderly and immunocompromised people, consumption of a nutritious diet, especially vitamins especially C and E with physical exercises such as yoga or other type of exercises and social distancing (Srivastava & Saxena, 2020).

On the other hand, this pandemic forced a worldwide confinement for months, something unprecedented. In that time, millions of people went online for entertainment, education, etc. As a result, according to preliminary statistics, total Internet use increased by between 50% and 70%, compared to pre-lockdown scenarios, while some areas also witnessed a 100% increase in Internet use (Pandey *et al.,* al., 2020), bringing, on the one hand, online education and entertainment on the Internet (Subudhi & Palai, 2020) ensuring social distancing; and on the other hand, it brought new new risks to human life, among them rumors. Rumors are deeply embedded elements in human communication and interaction. Rumor is defined as any piece of information that is false or unverified and spreads rapidly. In other words, a rumor is a controversial and quickly verifiable statement. The rumor can become extremely dangerous by exchanging the unknown parts in the credibility of the information. Suddenly, social networks became an inexhaustible source of rumors based on the very disease of Covid-19. In this sense, great expectations were created about the impact of the virus, giving rise to myths and false reports (Barua *et al*., 2020). Recommendations such as eating garlic to prevent the spread of Covid-19 or the spread of viruses through 5G mobile networks (Al-Zaman, 2021) were some of the many infused rumours. This level of misinformation in the population generated some conspiracy theories such as the synthesis of the virus by some laboratories to be used as a biological weapon (Ferreira *et al*., 2022). In another context, the very appearance of the virus had contradictory connotations of religious origin, and in some cases it was even said that it was God's punishment (Mamani-Benito *et al*., 2020). These and other false beliefs caused the Director General of the WHO to clarify that he was not only fighting against an epidemic but also against unfounded rumors.

Social platforms had a lot to do with this fact, especially the use of the Internet. Users found an effective means to disseminate and share news of all kinds (Ashford *et al*., 2022), and thus, platforms such as *YouTube* became a source of medical information, provided and widely consumed by citizens (Li *et al.*, 2020). In thisway, and despite the current belief that social networks can play an important role as a tool for dialogue between authorities and citizens, there is a

risk of finding misleading, inaccurate or in some cases harmful information, especially on the prevention of pandemic that could generate extraordinary risks to public health (Obiała *et al*., 2021).

In a study carried out by Al-Zaman, (2021) at least 11,716 comments from 876 posts on social networks such as Facebook were analyzed, resulting in the majority of users fully trusting many of these false information, mixing with religious topics. A similar analysis, but using the YouTube platform, found that approximately 3.5% of videos and 26.37% of comments contained misinformation about COVID-19 (Röchert *et al*., 2021). In this same action, the events between December 2019 and January 4, 2021 were also analyzed, but using the Twitter platform, it was found that the ability of fact checks to reduce the spread of misinformation was quite limited (Burel *et al*., 2021). In some cases, misinformation traveled so fast using these social platforms that in some countries like Nigeria, the population panicked (Apuke & Omar, 2021).

On the other hand, the effect of this disinformation regarding COVID-19 has also been analyzed. A study carried out in Africa compiled that many pregnant women were afraid to be vaccinated against the disease due to misinformation spread by the use of social networks (Ennab *et al*., 2022); This fact also affected the general population of that country, due to conspiracy theories that claimed that the COVID-19 virus was false (Wonodi *et al*., 2022). In other research with teachers in Pakistan, misinformation was found to be positively related to anxiety and social media fatigue, which in turn had an impact on work engagement (Khan, 2021). This was also confirmed in adults in Jordan (Sallam *et al*., 2020). In the United States, the use of social media was positively associated with misinformation beliefs related to COVID-19 (Su, 2021). In Peru, the perception of fear in the population was caused to a greater extent by television and social networks (Mejía *et al*., 2020); In the same context, measurement instruments were also generated to evaluate how people who received information from the media (Mejia *et al*., 2020), in addition to initiating scientific production studies to show the progress of research against COVID -19 (Saavedra-López *et al*., 2020).

In this sense, and given the large number of publications that could denote the level of misinformation about COVID-19 and the impact it could have on global public health, various scientific publications were analyzed and identified from a bibliometric point of view.

Materials and methods

A descriptive-retrospective study was carried out, considering publications indexed in the Scopus database, during the period January 2020 to December 2021. The following search fields were used: Title of the article, Abstracts and Keywords, using the terms: "Infodemi"; "false new"; "disinformation"; "rumor"; all of them related to the terms: "SARS-CoV-2"; "COVID-19"; "2019-nCoV"; "2019 novel coronavirus" and "2019 coronavirus disease". The variables author, institution, country, and keywords were normalized. Production indicators were generated from them.

Through this search strategy, 2,824 documents were retrieved, which were subjected to a metadata normalization process and the elimination of documents that did not deal with the subject. The final sample for analysis consisted of 2,614 documents. With the results found, the database was created in Microsoft Excel and with the use of the VOSviewer software, a network was created with the main thematic axes related to the keywords.

Results

Potential relationships between the descriptors obtained from the bibliometric search were identified, co-occurrence networks were generated and visualized (Figure 1).

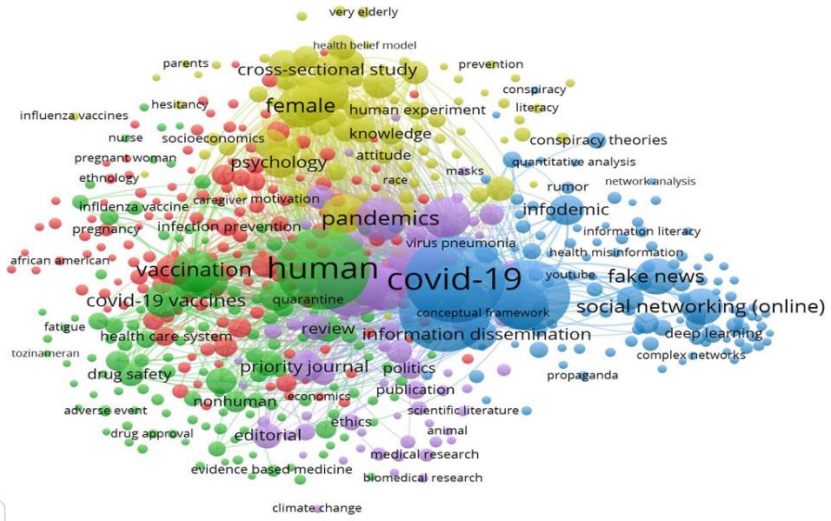

Figure 1. Co-occurrence networks

In co-occurrence networks, 574 descriptors concur, with 8676 links and a strength of 2614 retrieved documents, that is, network cohesion 0.66 with at least 15.12 average relationships per descriptor; which are conglomerated in 5 most relevant nodes (cluster). Cluster 1 (red) includes the results of studies on access to information provided on COVID-19 in different disciplines, mainly medicine, psychology, and economics. Cluster 2 (green) shows the relationship of the studies that have been carried out on the information of the COVID-19 vaccine, including the responses of the anti-vaccine movements. Cluster 3 (blue) analyzes the different responses given by conspiracy theories, rumors and misinformation about COVID-19, making use of social networks and the media. Group 4 (yellow) shows cross-sectional and longitudinal research on COVID-19 and the information it provides to the health sector, and cluster 5 (purple) represents studies on scientific production and communication that have contributed to global health during the pandemic.

For its part, Table 1 identifies the most cited publications related to misinformation-rumors about the COVID-19.

Table 1. Most cited publications related to misinformation about the COVID-19.

Document title	Author	Journal	Year of publication	Document type	Citations in Scopus
COVID-19 and mental health: A review of the existing literature	Rajkumar	Asian Journal of Psychiatry	2020	Article	1300
Response to COVID-19 in Taiwan: Big Data Analytics, New Technology and Proactive Testing	Wang *et al*.	JAMA - Journal of the American Medical Association	2020	Note	709
Suicide risk and prevention during the COVID-19 pandemic	Gunnell *et al.*	The Lancet Psychiatry	2020	Note	518
Vaccine hesitancy: the next challenge in the fight against COVID-19	Dror *et al.*	European Journal of epidemiology	2020	Article	434
Social Media Panic Pandemic Travels Faster Than COVID-19 Outbreak	Depoux *et al*	Travel Medicine Journal	2020	Editorial	361
Fighting COVID-19 misinformation on social media: Experimental evidence for a scalable precision-nudge intervention	Pennycook *et al*.	Psychological science	2020	Article	339
A comprehensive review of the COVID-19 pandemic and the role of IoT, Drones, AI, Blockchain and 5G in managing its impact	Chamola *et al.*	IEEE Access	2020	Article	332
Why inequality could spread COVID-19	Ahmed *et al.*	The Lancet Public Health	2020	Note	307
The COVID-19 infodemic on social media	Cinelli *et al.*	scientific reports	2020	Article	304

Topical relationships of co-occurrence networks to break the infodemic

Considering the potential relationships between the descriptors returned from the bibliometric search, co-occurrence networks were generated and visualized as clusters that demonstrate misinformation regarding Covid-19, as shown in Figure 1. This way, it is important to break the infodermy for each cluster in particular.

The scientific community turned to pre-prints (online repositories that publish manuscripts without peer review). (violet cluster 5): To break this condition, it is necessary to understand that open scientific communication and digital change will have consequences for disseminating, producing and storing scientific information (Gould, 2009). But, this situation can be a unique opportunity for the redesign of scientific communication, taking into account the challenges of the current system (Näder, 2010). The openness in science and research addresses the core of knowledge production and consequently affects not only science but also society as a whole (Mussell, 2013). Science and research are closely linked to norms of rapid dissemination of research results, an environment of knowledge sharing, co-authorship, and cumulative learning and innovation (Partha & David, 1994).

The scientific communication system has remained constant until now: communication formats such as monographs and journals still retain their high status, and the increasing use of digital tools has not yet led to any structural changes in science. Unanswered questions remain about to what extent an open scientific knowledge process represents a desirable step, what side effects would arise from an open knowledge production, and whether the postulated changes are a scientific revolution or minor adaptations to existing paradigms of science. Current developments are the harbingers of comprehensive change in media that opens up new opportunities, including new challenges, for science. These developments offer new possibilities for the active publication of supplements and (raw) data, help researchers to share data that can prove a dissertation to be false (and negative data), make withdrawn articles visible, and open up the the process of scientific knowledge. In this way, effective mechanisms for prosecuting scientific misconduct can be installed and existing mechanisms for self-correction can be strengthened.

New models of scientific communication must also address what new aspects of scientific reputation are becoming relevant and how networked computers and algorithms are used to increase the availability of information as a result of overcoming the forced data reduction of analog media. Support researchers to share data that can prove a false thesis (and negative data), make withdrawn articles visible and open the process of scientific knowledge. In this way, effective mechanisms for prosecuting scientific misconduct can be installed and existing mechanisms for self-correction can be

strengthened New models of scientific communication must also address what new aspects of scientific reputation are becoming relevant and how networked computers and algorithms are used to increase the availability of information as a result of overcoming the forced data reduction of analog media. Support researchers to share data that can prove a false thesis (and negative data), make withdrawn articles visible and open the process of scientific knowledge. In this way, effective mechanisms for prosecuting scientific misconduct can be installed and existing mechanisms for self-correction can be strengthened (Heise & Pearce, 2020).

Anxiety and confusion in the people receiving the information: COVID-19 became the main disease of 2020, spreading to numerous countries on almost all continents, and public authorities took necessary measures to prevent the spread of the virus. These measures were disseminated by various means, such as: television, social networks, newspapers and radio, in some cases generating fear, panic and anxiety in the population (Moreno-Montoya, 2020). Contrary to the recommendations given, many people sought information from non-medical sources, local television or media that are not prepared to report such news (Massuth, 2016). In this sense, it would be expected that adequate information received from health personnel can reduce anxiety and fear, given that these variables measure the information received from both the closest social circles and from a local area (hospitals and other health centers) (Hidalgo, 2017). In addition, they must include family and friends, who often repeat what is promulgated by other sources (Pérez & Aguilera, 2004). Complementary to this, the impact of the information provided by health professionals should also be explored in comparison with the information given by a relative/friend, which can generate suggestions for the implementation of strategies or state policies (Mejia *et al*., 2020).

Social networks and informants, and entities with competence in health (cluster 4 yellow): As the pandemic grows around the world, not only is the virus and its ability to overwhelm health institutions to deal with, but also a wave of misinformation that is costing human lives and negatively impacting those who work for health. and the well-being of the population (Merchant & Asch, 2018). This situation has shed light on the need to educate both the public and the media, and has exposed prejudice against the medical community. Various actions have already been taken to oppose the infodemic; The WHO has increased its efforts by monitoring social media platforms and has collaborated with Instagram, Facebook and Twitter to develop links to official pages whenever someone searches for "COVID-19" or "coronavirus" (Zarocosta, 2020). We are still far from an impeccable model that raises the voice of scientists and scientific associations in social networks and the media. This crisis is also an opportunity to think about how communications are and how they can be improved (Eysenbach, 2020). Health professionals can contribute to addressing the infodemic with daily actions such as sharing verified content on personal and professional social networks, listening and answering questions from patients, and educating friends and family (Carrion-Alvarez & Tijerina-Salina, 2020).

A priori results and conspiracy theories (Cluster 3 blue): Undoubtedly, the various social platforms created a rarefied atmosphere regarding Covid-19, since the information about the virus was not, in many cases, handled in the best way, hence a priori results and conspiracy theories emerged creating anxiety within of the population. However, conspiracy theories can be taken as a basis to act for the benefit of communities. First, conspiracy theories allow people to question or challenge dominance hierarchies and question the actions of powerful groups. A positive consequence of these challenges could be that governments are encouraged to be more transparent (Swami & Coles, 2010). Conspiracy theories can also reveal inconsistencies in government or official versions of events, and can open up otherwise closed topics of discussion and can even uncover actual conspiracies. Several scholars see conspiracy theories as the result of individuals and groups' attempts to understand social and political reality (Radnitz & Underwood, 2017). Furthermore, Jameson, (1992) states that conspiracy theories function as cognitive maps for people to understand social and political realities. Others go further by arguing that since elites engage in conspiracies, conspiracy theories are a critical tool for holding authorities to account (Dentith & Orr, 2017). Singh, (2016) argues that globalization has resulted in the rise in power of informal elites rather than formal networks, meaning that conspiratorial interpretations of the world order may increasingly reflect political realities.

Topical relationships of co-occurrence networks for discovering SARS-CoV-2

The scientific community launched into life-saving research on the new coronavirus, and did so with unprecedented speed (Cluster 1 red). Since the early days of the COVID-19 outbreak, WHO has brought together scientists and health professionals from around the world to understand and comprehend as quickly as possible everything related to this new virus, SARS-CoV-2, and to expedite relevant investigations. and its development with a view to finding prompt solutions to the pandemic. WHO has collected and continues to collect the latest international scientific findings and knowledge in multiple languages into a database and is conducting international solidarity trials on treatments for this disease. More than 100 countries from the 6 WHO regions have joined or expressed interest in joining this trial, that already for July 1, 2020, had enrolled more than 5,500 patients from 39 countries around the world. WHO continues to provide support to all countries in relation to authorization by health authorities and WHO's main protocol ethics committees; the selection of participating hospitals; training of hospital health professionals in the online data and randomization system and the sending of trial drugs to participating countries that request them (WHO, 2020).

Vacccines, myths and fears (cluster 2 green): In recent years, various social media platforms have been found to be riddled with false claims and conspiracy theories, this abrupt wave of false medical narratives may have made them

an unreliable source of information to the public. Numerous websites had claimed that Bill Gates planned to monitor people and keep a digital record of their COVID-19 vaccinations. This way, the World Health Organization (WHO) and its partners have worked tirelessly to filter out the noise on social media to provide reliable guidance on COVID-19. In response, for example, the African Infodemic Response Alliance (AIRA), a program of the WHO and a partner organization that began in December 2020, used social media "listening tools" to spot misinformation and track it down as it went viral (Think Global Health, 2021). In response to various rumours, a video featuring well-known vaccine specialists was quickly released to debunk misconceptions and provide accurate information. Within days, it had been viewed by millions of people and is currently in the process of being translated into Kenya's native language, Kiswahili, so that the Kenyan government can also use it (Tangcharoensathien *et al*., 2020).

In this same context, already on January 30, 2020, the World Health Organization (WHO) declared a "public health emergency of international scope" qualifying it as the "worst pandemic" that the world has seen so far since the crisis of the Spanish Flu. The virus, although less fatal, was much more contagious than its earlier congeners, causing SARS and Middle East Respiratory Syndrome (MERS) with faster transmission between humans and affecting up to 109 million people worldwide. This forced countries to cut economies, travel restrictions, border lockdowns and population quarantines as strategic social distancing measures used to contain the outbreak. On the other hand, the uncertainty of a pandemic and chronic isolation caused panic and psychological distress within communities, made worse by the bombardment of information to the masses, predominantly through social media. In this way, COVID-19 was also referred to as a "digital pandemic" due to the multitude of information in various forms that had circulated since it was first detected in Wuhan, China. As the number of cases increased, the information shared increased exponentially due to all the social media platforms competing for their speed, coverage and information penetration (Zhao *et al.*, 2020). Of the bulk of regularly processed facts, a substantial proportion were myths, rumours, pseudoscience or altered facts: contributing to disinformation. Based on health risk perception theory, fear of the “unknown” disease with no definitive cure creates uncertainty, leading to anxiety and further sharing of misinformation, unaware of the sources (Barnett *et al*., 2005, Banerjee & Meena, 2021). In response to this situation, there has been a remarkable and global response to the COVID-19 infodemic by international organizations, governments, social media technology companies, and leading scientific bodies. The United Nations (UN) responded by forming a UN coronavirus (COVID-19) portal for public access to reliable and up-to-date information (UN, 2020). The United Nations Office of Information and Communications Technology held webinars on online safety for those working remotely, away from their usual and safer workplaces. The WHO also launched a portal called “myth busters” to expose false data (WHO, 2020a). Its designers arranged for each 'myth revealed' to appear with its associated fact in a catchy infographic that could be freely downloaded and shared on social media platforms. The WHO risk communication team established the WHO Epidemic Information Network to share health information with specific target groups. The United States Centers for Disease Control and Prevention (CDC) has created a website for updates and news related to COVID-19. Governments around the world responded to both the pandemic and the infodemic. The International Monetary Fund's policy tracker reported that 193 countries took economic action and adopted policy changes in response to the pandemic. In addition to public health strategies to minimize the spread of the virus, such as enforcing lockdowns and promoting social distancing norms, government officials offered daily or weekly briefings to their constituents with major news channels covering these live events 'on air'. Officials also engaged the public through social media. Twitter, specifically, proved to be a powerful tool for sharing health information. Google established a campaign providing preventative advice to the public to help curb viral spread and authenticates information about the spread of COVID-19 on its platform (Scott, 2020). Amazon restricted and removed ads with false claims about protective equipment being offered for sale. Facebook, YouTube, Microsoft and Twitter announced the implementation of further restrictions on published content related to the pandemic and their intention to remove medically refuted claims (Sholts, 2020; Mheidly & Fares, 2020).

Discussion

The unpredictable situation of the COVID-19 pandemic brought the world to a lot of new challenges. Non-governmental organizations took various measures to overcome the problem, such as social distancing and partial or complete closure. Millions of people around the world have been forced to stay home adjusting their current lifestyle and continue their work from home. During the COVID 19 pandemic, millions of people went online for entertainment, education, etc. As a result, according to preliminary statistics, total Internet use increased by between 50% and 70%, compared to pre-lockdown scenarios, while some areas also witnessed a 100% increase in Internet use (Pandey *et al.*, al., 2020). Thus, the public around the world recognized the serious and damaging magnitude of COVID-19 due to its rapid communication and publication (Vallejo, 2020). However, COVID-19, too, was the first global social media COVID-19 pandemic, and it was not immune to the proliferation of misinformation (Rosenberg *et al*., 2020). The General Director of the World Health Organization (WHO) and Antonio Guterres (UN) declared that the COVID-19 epidemic has gone through an 'infodemic' (disinformation) (WHO, 2020 b). Furthermore, the researchers also noted that medical misinformation content related to the COVID-19 pandemic had been proliferating at a dizzying rate on social media (Frenkel *et al*., 2020). For its part, the Internet became the largest source of health information worldwide due to the use of mobile devices and the easy and relatively low-cost connectivity of the Internet. A study carried out by Li *et al.*, (2020) reported that approximately 23-26% of YouTube videos were misleading, that is, involved in spreading misinformation

about COVID-19. On the other hand, another popular social media such as Facebook reported that during March and April 2020, the agency placed warning labels on approximately 90 million pieces of content because they are allied with Covid-19 misinformation such as fake cures, anti-vaccines and conspiracy theories (BBC, 2020). Due to fear, the public showed an unusual pattern of purchasing behavior for equipment and medicines without a prescription (Addo *et al*., 2020). Disinformation in different media, including social networks, can have a threatening effect on the population.

To achieve the reliability of social media it is necessary to act at four different levels, First: The scientific community must review the way it relates to society as a whole. Now more than ever there is a clear need for transparency and the use of a language accessible to everyone. The message that rigor is essencial to research is key, even in times of urgency. Second: the scientifics publications now have the opportunity to review their business model and analyze the way in which it shapes academic production and research in general. The time has come to leave behind the vices acquired during the times when written communications were the norm. Third: Social networks must detoxify their algorithms so that they reduce the presence of disinformation, page groups and domains belonging to disinformation accelerators, and keep harmful content away from their traffic and Fourth: co-responsibility, we must all contribute to generating and spread quality information, avoiding rumors and gossip that only contribute to the parallel infodemic. One of the characteristics of the information society is the excess of data and the abundance of information (Pulido *et al*., 2020). This particularity caused a stir in the context of the COVID-19 pandemic, as false information grew rapidly and caused the dreaded infodemic (Sallam *et al*., 2020). In turn, the spread of this misinformation was mainly through social networks (Ahmed *et al*., 2020; Llewellyn, 2020), and although it is not a recent problem (Apuke & Omar, 2021), researchers were urged to inquire about disinformation related to COVID-19 (Al-Zaman, 2021). In this sense, the objective of this research was to analyze the scientific production on disinformation about COVID-19.

The results found showed that the year 2021 was plagued by misinformation about COVID-19, due to the context related to vaccines. In that sense, a lot of misinformation circulated both in social networks and in academic settings (Ennab *et al*., 2022; Wonodi *et al*., 2022). Likewise, the year 2021 showed a growth of social networks such as Reddit where users showed greater power in relation to content (Ashford *et al*., 2022) and therefore, a greater probability of sharing data or false news (Shamim, 2017; Castro-Rodriguez *et al*., 2021). Figure 1 highlights at least five clusters related to misinformation and SARS-CoV-2.

Cluster 1 highlights the studies carried out on access to information provided on COVID-19. Several studies emphasize the growth of types of electronic communication where information, ideas, and messages were shared in the midst of the pandemic (Gottlieb & Dyer, 2020). Access to a large amount of both valid and false information led to the infodemic (Pulido *et al*., 2020). This overexposure to news brought about by heavy news use and reliance on social media also built trust in scientists, doctors, and experts as trusted sources of information (Nielsen *et al*., 2020). It is important to consider that while high-level government officials have access to privileged information, several political leaders have shown vulnerability to the lure of fake news (Hartley & Vu, 2020). On the other hand, cluster 2 had to do with the issue of vaccines and anti-vaccine groups., in one particular case, the overinformation increased doubts about vaccines, even identifying it as one of the top ten threats to world health (Ennab *et al*., 2022), autism-causing vaccines (Carrion-Alvarez & Tijerina-Salina, 2020), links to conspiracy theories (Wonodi *et al*., 2022) or news that shows the uselessness of vaccines (Moscadelli *et al*., 2020). Some theories have qualified that the COVID-19 disease was a scam to sell vaccines (Galhardi *et al*., 2020). In the same order of ideas, cluster 3 seeks to highlight the different conspiracy theories about COVID-19 through social networks and the media. Several studies emphasize that exposure to digital media is associated with increased belief in conspiracy theories (De Coninck *et al*., 2021). Research reports an increase in conspiracy theories in people with psychotic experiences or with low educational level (Ferreira *et al*., 2022), as well as that conspiracy theories prevail in times of fear or uncertainty. It is important to note that issues related to COVID-19 conspiracy theories are difficult to analyze by traditional methods and new approaches are required to address them (Burel *et al*., 2021; Douglas *et al*., 2019). Cluster 4 presents the cross-sectional and longitudinal designs made on this topic. Some noteworthy studies dealt with knowledge and attitudes towards disinformation (Sallam *et al*., 2020), the impact of "fake news" (Rocha *et al*., 2021), or the psychological effects of disinformation on workers against COVID-19. (Khan, 2021), among others. In the case of longitudinal studies, although of longer duration, we highlight the study on the efficacy of psychological inoculation as a means of generating a defense against disinformation (Maertens *et al*., 2021) and finally cluster 5, analyzes the studies on science communication.

Scientific journals measure their value according to their status in scientific communication and through databases such as Scopus or Scimago Journal and Country Rank (SJR) (Zhang *et al*., 2019). It is worth mentioning that journals must promote transparency, good practices and correct scientific communication (Heise & Pearce, 2020) away from false information and myths (Pulido Rodríguez *et al*., 2020), which have multiplied since the beginning of the pandemic (Röchert *et al*., 2021; Rodríguez *et al*., 2020), which have multiplied since the start of the pandemic (Röchert *et al*., 2021). These research studies have some limitations: first, only articles from the SCOPUS database were selected; Although most of these journals are included in Web of Science, it is likely that some journals and articles have not been considered. Also, some descriptors are difficult to identify and may have been missed on sufficiently broad search terms. Finally, the time interval of two years is short and similar bibliometric studies that analyze longer times are recommended to contrast with the results reported in this research. In conclusion, 2,614 articles published in Scopus between 2020 and 2021 were

reported, the majority being original articles, where it was possible to establish at least five clusters and their relationship with COVID-19, involved in infodermy and how to get out of it.

Conflict of interests

No conflict of interest is reported.

Acknowledgments

To the researchers who made possible the dissemination of scientific knowledge about SARS-CoV-2.

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