

Anti-science disinformation about COVID-19 spread on Twitter in Hispanic America

Desinformación anticientífica sobre la COVID-19 difundida en Twitter en Hispanoamérica

Desinformação anticientífica sobre o COVID-19 espalhada no Twitter na Hispanoamérica

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ABSTRACT | This paper aims to understand the formal characteristics, the spaces of dissemination and the anti-science narratives related to COVID-19 and their engagement in Ibero-America. This type of disinformation has hardly been specifically investigated in this context; the research has been more focused on the study of fake news about this crisis from more general perspectives. A total of 238 fake contents were analyzed in two phases: a study of all verified fake contents spread in 2020 in this region and an analysis of the most propagated tweets included in the hashtag #plandemia. Quantitative results were analyzed with descriptive and inferential statistical procedures using chi-square, Kruskal-Wallis, U-Mann-Whitney tests, correlational studies, and linear regression. This research advances some of the patterns of scientific disinformation, which may be useful for future health crises: the high prevalence of fabricated content, the relevance of visual elements (although they are not predictors of engagement in this type of narrative), and the growing importance of instant messaging services as propagation spaces. It also discusses the remarkable role of fact-checkers against disinformation. These entities are proving to be effective in dismantling the denialist and conspiracy narratives circulating about the disease and to achieve a more effective communication of science.

KEYWORDS: disinformation; fake news; COVID-19; scientific denial; fact-checking; Ibero-America.

HOW TO CITE

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RESUMEN | Este estudio profundiza en las características formales, los espacios de difusión y las narrativas anticientíficas relacionadas con el COVID-19 y su engagement en el contexto hispanoamericano. Este tipo de desinformación ha sido poco investigada, específicamente por parte de la comunidad científica en Iberoamérica, más centrada en el estudio de las fake news sobre esta crisis desde perspectivas más generales. Se analizaron 238 piezas desinformativas en dos fases: un estudio de todos los contenidos falsos anticientíficos verificados en 2020 y un análisis de los tuits más difundidos con el hashtag #plandemia. Los resultados cuantitativos fueron tratados con procedimientos estadísticos inferenciales mediante pruebas de chi cuadrado, Kruskal-Wallis, U de Mann-Whitney, estudios correlacionales y regresión lineal. Este trabajo avanza algunos de los patrones de la desinformación científica que pueden resultar útiles para futuras crisis sanitarias: la alta prevalencia del contenido completamente inventado, la relevancia de los elementos visuales (aunque no son factores predictores del engagement en este tipo de narrativas) y la creciente importancia de los servicios de mensajería instantánea como espacios de propagación. Asimismo, se discute el notable rol de los verificadores frente a la desinformación, que muestran eficacia para desmontar los relatos negacionistas y conspirativos que circulan sobre la enfermedad y lograr una comunicación efectiva de la ciencia.

PALABRAS CLAVE: desinformación; fake news; COVID-19; negacionismo científico; fact-checking, Iberoamérica.

RESUMO | Este artigo aprofunda as características formais, os espaços de difusão e as narrativas anticientíficas relacionadas com a COVID-19 e o seu engajamento no contexto hispanoamericano. Este tipo de desinformação tem sido pouco pesquisado, especificamente pela comunidade científica na Iberoamérica, que está mais focada no estudo de notícias falsas sobre esta crise a partir de perspectivas mais gerais. Foram analisadas 238 peças de desinformação em duas fases: um estudo de todo o conteúdo falso verificado em 2020 e uma análise dos tweets mais difundidos da hashtag #plandemia. Os resultados quantitativos foram tratados com procedimentos estatísticos inferenciais utilizando testes qui-quadrado, Kruskal-Wallis, U de Mann-Whitney, estudos correlacionais e regressão linear. Este documento avança alguns dos padrões de desinformação científica, que podem ser úteis para futuras crises sanitárias: a elevada prevalência de conteúdo completamente inventado, a relevância dos elementos visuais (embora não sejam preditores de engajamento neste tipo de narrativas) e a crescente importância dos serviços de mensagens instantâneas como espaços de propagação. Discute também o notável papel dos verificadores diante da desinformação, que mostram eficácia no desmantelamento das narrativas negacionistas e conspiratórias que circulam sobre a doença e conseguir uma comunicação efetiva da ciência.

PALAVRAS-CHAVE: desinformação; notícias falsas; COVID-19; negacionismo científico; fact-checking; Iberoamérica.

INTRODUCTION

In February 2020, the World Health Organization (WHO) declared that the COVID-19 pandemic was also an infodemic capable of generating a huge amount of inaccurate or fabricated information and hoaxes that spread rapidly among the population. The scientific community responded immediately with the production of a large volume of publications on this matter. A large percentage of these works analyze the creation of fake news and malicious content about the virus in different areas: studies on how the pandemic has transformed the forms of information consumption by the public and the analysis of reactions to disinformation about the disease (Pérez et al., 2020; Gallotti et al., 2020; Peters et al., 2020), the impact of dubious quality content (Yang et al., 2020), and the specific measures implemented by digital platforms to combat disinformation linked to this health crisis (Bustos & Ruiz del Olmo, 2020). On the other hand, research by Pulido-Rodriguez and colleagues (2020) and Pennycook & Rand (2020) have attempted to uncover patterns that may explain how disinformation about COVID-19 spreads in social networks.

These works focus on the general disinformation linked to COVID-19, including in their analysis samples fake news of all kinds of topics (politics, economics, health, social issues, etc.). However, the literature specifically focused on scientific infodemics linked to the pandemic has been less addressed (López-Borrull, 2020).

Scientific disinformation and COVID-19

In an unprecedented global health crisis in the last century, fake news on scientific issues are particularly relevant because of their ability to hinder compliance with disease containment measures, especially when the disinformation is constructed from anti-scientific, denialist, and conspiratorial stances.

Anti-scientific disinformation is not a phenomenon unique to this crisis. Other issues such as climate change (Lewandowsky, 2020) or the consequences of tobacco on health (McIntyre, 2018) have suffered the action of movements and powerful denialist lobbies throughout history. These discourses are mainly aimed at questioning the expert consensus on a given matter (Elsasser & Dunlap, 2013), highlighting scientific uncertainty (Freudenburg & Muselli, 2013), attacking scientists to contest their credibility (Schmid-Petri, 2017), criticizing research entities and their validation processes (Dunlap & McCright, 2011), and promoting pseudoscience through an interconnected network of blogs and websites (Lewandowsky et al., 2015).

The new coronavirus crisis has led to the emergence of numerous anti-scientific theories that seek to question the pandemic's natural origin. These stories maintain the structure of classic conspiracy narratives, elaborated on the basis of three elements: a conspirator, a plan, and the means to achieve massive manipulation

(Elias, 2021). In this crisis, the conspirators would be the economic and political elites, the plan would be the disease's artificial creation to implement a new world order to control the population, while the health institutions and the prestigious media would assume the role of instruments to achieve mass manipulation.

Several approaches to scientific disinformation about COVID-19 have been made in social networks in contexts other than Ibero-America. These works have focused especially on Twitter, one of the platforms that most effectively drives anti-scientific and conspiratorial content (Theocharis et al., 2021). Although much of this disinformation identifies the disease's appearance as the result of deliberate actions for the production of a biological weapon in a laboratory in China (Stephens, 2020), the scientific community has predominantly focused its attention on false information fed by the anti-vaccine movement (Herrera-Peco et al., 2021). In this regard, Sued (2020) proved the effectiveness of information bubbles on YouTube to hide official and verified information about vaccination against the disease. Studies such as that of Thelwall and colleagues (2021) have shown that online platforms can influence the rejection of this medicine against the virus arguing that it was created too fast and therefore it is not safe nor effective.

This anti-vaccine narrative is fed by fake news originating from webpages of questionable credibility (Muric et al., 2021) that find on Twitter a vehicle for their effective propagation and support by a large volume of users (Batzdorfer et al., 2021) connected through specific hashtags such as #plandemia. This hashtag not only achieved great relevance on Twitter, but also transcended to other social networks, where it also became the most used hashtag by denialist movements. Therefore, both Facebook and Instagram banned its use in 2020 (Desinformación en español..., 2021). Likewise, the word *plandemia* gained high visibility in demonstrations against government measures in numerous Spanish-speaking countries. The hashtag is the Spanish translation of the English hashtag #plandemic, frequently used and connected to various conspiracy theories and contrary to the international scientific consensus.

This hashtag became the title of the documentary *Plandemic*, released on May 4, 2020, which took advantage of the term's relevance in the networks, which contributed to its promotion and dissemination (Kearney et al., 2020). For all these reasons, and in line with Herrera-Peco and colleagues (2021), our study includes an analysis of the hashtag #plandemic, as we will explain in the following section.

Despite the fact that a high proportion of these fake narratives come from accounts with limited reach, these types of narratives have been amplified by certain politicians, influencers, and activists on Twitter (Gruzd & Mai, 2020). In turn, users who issue messages against this anti-scientific content –through

critical tweets that repost such fake news or by producing humorous or ironic messages– unintentionally contribute to its spread, so adopting efforts to isolate opinions that are based on false content would prove essential (Ahmed et al., 2020), especially in health crisis situations such as COVID-19.

From another perspective, Jensen and colleagues (2021) analyze the predictors that trigger belief in pseudoscientific pandemic content. Their study concludes that trust in official and governmental information sources, low frequency of use of Twitter and instant messaging applications, as well as willingness to be vaccinated, are variables that hinder subjects' willingness to believe in the veracity of anti-scientific, conspiratorial and denialist content.

Unlike the research attention that this type of false information has attracted in the Anglo-Saxon context, there have not been numerous studies on anti-scientific content linked to COVID-19 in Spanish. In this area, the work of Herrera-Peco and colleagues (2021), who showed that antivaccine content is the most prominent anti-scientific narrative in Spanish on Twitter, stands out. Given this lack of specific research in the Spanish-speaking world, we focused our study on the Ibero-American context, thus overcoming the mainly Anglo-Saxon nature of the analysis of scientific fake news in this health crisis. Our work aims to identify the formats (text, video, audio, etc.), platforms and media, typologies and theories used by anti-scientific, denialist and conspiratorial disinformation (hereafter, for simplicity, it will be referred to only as anti-scientific disinformation) related to COVID-19 in the Ibero-American context (phase 1 of the research). The second phase of the fieldwork studies the engagement of these narratives on Twitter.

RESEARCH QUESTIONS, HYPOTHESES, AND METHOD

Phase 1. Study of the fake content

In this first phase, the following questions and starting hypotheses were raised:

RQ1. Which are the formats most commonly used by anti-scientific disinformation about COVID-19, verified by Hispanic American fact-checkers?

H1. Formats using images are the most prevalent in this type of disinformation, so they have been checked the most by verifiers.

RQ2. Which are the platforms where the highest volume of COVID-19-related anti-scientific disinformation, denied by them, circulates?

H2. Social networks, especially Facebook and Twitter, are the platforms where most of this type of disinformation about the virus is spread and, therefore, the most frequent in debunked stories.

RQ3. What are the types of anti-scientific disinformation about the virus with the highest number of verifications?

H3. Completely false content without any factual basis is the most frequent.

RQ4. Which anti-scientific theories about COVID-19 have been most verified by these fact-checkers?

H4. The conspiratorial narratives that allude to the artificial creation of the pandemic for economic or political reasons are the narratives with the highest number of verifications.

To address these first four questions of our research, we performed a quantitative content analysis on all anti-scientific disinformation related to COVID-19 debunked in 2020 by Hispanic American fact-checkers belonging to the International Fact-Checking Network (IFCN). The verified content was extracted from the Latam Chequea database (<https://chequeado.com/latamcoronavirus/>) included in the international alliance #CoronaVirusFacts. From January to December 2020, this database collected a total of 252 contents labeled as anti-scientific, denialist, or conspiratorial. After a first observation, in order to eliminate repeated disinformation checked by different fact-checkers, the analysis sample was set at 142 units, available at the following link: <https://cutt.ly/RAJvi2i>.

A codebook (<https://cutt.ly/bEnmqCh>) was designed to collect information on the formats, platforms, information disorders, and narratives included in these misinformative pieces. To analyze informational disorders, we used an adapted version of the Wardle (2019) and García-Marín (2020) instruments. The possible typologies of disinformation were reduced to four categories: (1) fake content (completely fabricated and without any factual basis), (2) misleading content (mixture of true facts and falsehoods), (3) fake context (use of images or audios removed from their original place or time of creation), and (4) manipulated content (true images edited to reinforce fake narratives). The different narrative categories were determined through inductive observation. All possible theories present in these narratives were reduced to the following four types:

- Type 1. Denialist narratives. Denial or minimization of the virus' effects on health and its impact (number of infections and deaths).
- Type 2. Opposition to the measures. Confrontation with the prevention, detection, and virus control measures adopted by the institutions.
- Type 3. Conspiracy theories about the virus' origin and the possible economic, political, and social interests behind.

Type 4. Fake treatments and therapies for the prevention and treatment of the disease.

The analysis of the verified fake contents included in this first phase can be consulted at: <https://cutt.ly/9AJbAgq>.

Phase 2. Twitter analysis

Once the data for the first four questions were obtained, our research approached a second stage with a triple objective: to contrast the anti-scientific narratives present in the verified content (RQ4) with the most widespread stories on social networks, specifically on Twitter, to analyze the engagement of this disinformation through the number of Likes and retweets (hereinafter, RT), and to analyze the spread of anti-scientific tweets that include visual elements, given that the results of RQ1 determined the high presence of images in this type of content. The choice of Twitter is justified because several studies such as that of Theocharis and colleagues (2021) show that this platform has a greater negative effect on anti-scientific beliefs than that of other social networks.

In this second phase, five new research questions were added, with their respective hypotheses:

RQ5. To what extent do these anti-scientific theories present on Twitter coincide with the narratives verified by Hispanic American fact-checkers?

H5. The most widespread theories and narratives on Twitter are present in the narratives verified by the fact-checkers.

RQ6. To what extent is the type of narrative of anti-scientific tweets a determining variable for their engagement (number of Likes and RTs)? To what extent are there correlations between the narratives and the number of Likes and RTs?

H6. The type of narrative of these misinformative tweets about COVID-19 is a determining variable for their engagement measured in the number of Likes and RTs. There are correlations between the presence of narratives that identify the pandemic as an instrument of population control and the number of Likes and RTs of such messages. Correlations are also established between narratives that minimize the impact of the pandemic and their number of Likes and RTs.

RQ7. Which proportion of the most propagated anti-science tweets includes images?

H7. A vast majority of the most popular tweets include visual elements.

RQ8. What is the average number of Likes and RTs obtained by tweets with images and those without images? To what extent is there a correlation between the presence of images in a tweet and its number of Likes and RTs? If there is such a correlation, to what extent is the presence of images a predictor variable of the number of Likes and RTs?

H8. Tweets with images obtain a higher number of Likes and RTs. There is a correlation between the presence of images and their number of Likes and RTs.

RQ9. To what extent are correlations established between the presence of certain narratives and the use of images in tweets? If such correlations exist, to what extent are these narratives predictor variables of the use of images in such messages?

H9. There are high correlations between the presence of narratives (on Twitter) that identify the pandemic as an instrument for population control and the use of images in such messages. Likewise, correlations are established between narratives that minimize the impact of the pandemic and the use of images.

As can be seen, this second phase will attempt to determine to which extent there are statistically significant associations between the independent variable (type of narrative) and the dependent variables (number of Likes, RTs, and use of images). Knowing this degree of statistical association is essential to establish the importance of the type of anti-scientific narrative in the degree of user attachment to these stories (Likes), their ability to be propagated (RT), and their compositional elements (use of images). Thus, the aim is to obtain a better understanding of what type of anti-scientific message about COVID-19 generates greater engagement in this social network.

At this stage, we conducted a case study of the hashtag #plandemia on Twitter. This hashtag was selected because of its relevance in the propagation of content on false science and denialist stories related to COVID-19 in Spanish, as explained above. To select the messages to be analyzed, we used an impact criterion, so that all tweets with more than 100 RT ($n=96$) as of February 1, 2021 were included in the sample. A data recording sheet was prepared with the following variables: number of Likes, number of RTs, presence of images in the message (yes/no), and

tweet's narrative. As in the previous phase, to code this last variable, we conducted an inductive observation from which the following topics were extracted: creation of a new world order of massive control, minimization of the crisis, economic interest, elimination of the population, political or ideological interest, artificial origin of the virus, anti-vaccine stories, and opposition to the measures adopted. The list of tweets that constitute the sample and their corresponding analysis is available at <https://cutt.ly/MAJnlnT>.

The data obtained were analyzed using descriptive and inferential statistics with the SPSS v.26 statistical package. The information recorded in both phases was articulated by means of complementation (Callejo & Viedma, 2005).

RESULTS

Verification of anti-scientific, denialist, and conspiratorial content

General data

The 142 pieces analyzed were verified by 19 Spanish-language fact-checking institutions from 11 Latin American countries and Spain. The country with the most verifications is Spain (n=44; 30.98%) followed by Argentina (n=21; 14.48%), Colombia (n=19; 13.38%), and Mexico (n=18; 12.67%). The most active verifiers are *Maldita* (n=35; 24.64%), *Chequeado* (n=19; 13.38%), *Animal Político* (n=16; 11.26%), *Bolivia Verifica* (n=15; 10.56%), and *Colombia Check* (n=14; 9.85%) (see complete frequencies of countries and fact-checkers at <https://cutt.ly/PEnmAh7>).

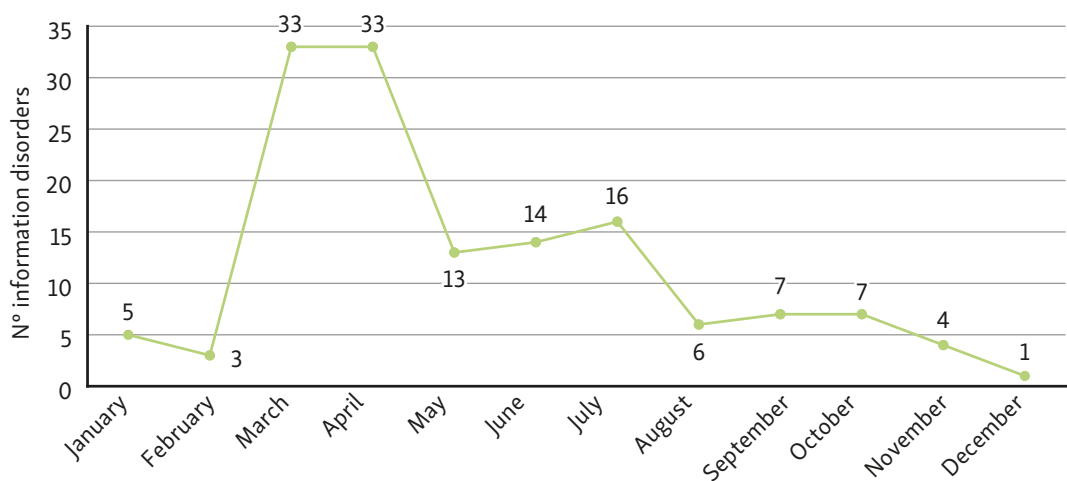


Figure 1. Number of false contents verified during 2020

Source: Own elaboration.

The period with the most verifications on aspects related to denialism and conspiracy theories were the months of March and April 2020, just at the beginning of the spread of the virus in Europe and Latin America, with a total of 33 (23.24%) informative disorders in each of these months (f1). These figures coincide with the moment when the WHO officially declared that the coronavirus had become a pandemic (March 11), and with the approval of the first state of alarm in the Spanish territory (March 14). Thus, it can be deduced that the uncertainty, confusion, and fear generated among the population during those first months of the coronavirus' spread led to the dissemination of more denialist and conspiracy-type disinformation. In these two months, *Maldita* was the fact-checker that verified the most content of this type (eight each month), coinciding with the adoption of harsh mobility restriction measures implemented by the Spanish government.

Formats and platforms

The format most used to create and disseminate this type of disinformation is video, which represents 37.32% of the total (n=53), followed by text complemented by photographs (n=38; 26.76%) (table 1). Content in textual format constituted 25.35% (n=36) of the sample. It should be noted that this textual category also includes information in visual format whose content consists exclusively of text. Audio and photographs (without text) are the least used formats, with 5.63% (n=8) and 4.92% (n=7), respectively. The formats in which, in some way, images are present account for 69.01% (n=98), so H1 is confirmed. Statistical tests using the Chi-square test (a test used in quantitative studies to observe statistically relevant deviations between a variable's categories) determined that the differences in the appearance of the different formats were highly significant [$\chi^2(4, N=142) = 57.36, p < .01$].

Social networks are the platforms where most anti-scientific content circulates. Facebook is the platform where the highest volume of disinformation of this type is propagated (n=77; 54.22%), followed by WhatsApp (n=32; 22.53%), YouTube (n=13; 9.15%), and Twitter (n=12; 8.45%). The presence of disinformation on Instagram is barely relevant. Fake content (n=3; 2.11%) published on a website, a digital magazine, and a TV channel was also detected. With these results, H2 is partially confirmed, since social networks are the platforms where this type of content is most disseminated, with Facebook, and not Twitter, being the one with the highest frequencies. As was the case with the formats, significant differences are also observed in the use of the different platforms to disseminate anti-scientific disinformation [$\chi^2(5, N=142) = 166.45, p < .01$].

	Fake content	Fake context	Misleading content	Manipulated content	p value (χ^2)		
Information disorders *	95 (66.90%)	22 (15.49%)	15 (10.56%)	15 (10.56%)	<.01***		
	Type 1. Denialism	Type 2. Opposition to the measures	Type 3. Conspiracy theory	Type 4. False treatments	p value (χ^2)		
Narratives **	25 (17.60%)	5 (3.52%)	54 (38.02%)	64 (45.07%)	<.01***		
	Text	Video	Text + picture	Picture	Audio	p value (χ^2)	
Formats	36 (25.35%)	53 (37.32%)	38 (26.76%)	7 (4.92%)	8 (5.63%)	<.01***	
	Facebook	WhatsApp	YouTube	Twitter	Instagram	Otros	p value (χ^2)
Platforms	77 (54.22%)	32 (22.53%)	13 (9.15%)	12 (8.45%)	5 (3.52%)	3 (2.11%)	<.01***

*Four pieces were labeled in more than one category, since they matched the characteristics of several profiles. Therefore, when adding the total number of each category, the sample reaches 147 instead of 142.

** Six pieces were labeled in more than one category, since they matched the characteristics of several profiles. Therefore, when adding the total number of each category, the sample reaches 148 instead of 142.

*** Highly significant differences are established when $p < .01$.

Table 1. Absolute and relative frequencies of the variables: informative disorders, narratives, formats, and platforms

Source: Own elaboration.

Information disorders

The Chi-square test also confirms the existence of very relevant differences in the occurrence frequencies of the different informative disorders: $\chi^2(3, N=147) = 123.99$, $p < .01$. Completely fabricated false content is the type with the highest prevalence ($n=95$; 66.90%). This result broadly confirms H3. Much of this disinformation has a clear economic objective based on the promotion of certain treatments with zero efficacy against coronavirus. For example, the Spanish fact-checker *Maldita* debunked on March 29, 2020 a hoax in which a website promised to send registered users an essential oil that claimed to cure COVID-19 (figure 2). After a long text, the advertisement mentioned a (false) scientific study from 2008 that claimed to demonstrate the product's efficacy against this kind of virus. It is clear that the creator of this fake content intended to direct users to his/her website for advertising purposes.

Informative disorders based on fake contexts represent 15.49% ($n=22$) of the analyzed sample. Most of these contents are of the denialist type, whose objective is to demonstrate that the pandemic is a sham or that, at least, it is much less serious

than what the health and political authorities claim. To this end, they show videos of apparently empty field tents and hospitals, contradicting the message conveyed by the media, which is focused on showing the saturation of health services. These images accompanying the denialist stories are real, but they are placed outside the context of the pandemic. A paradigmatic example of this strategy can be found in a content debunked by *Newtral* in November 2020, which shows a photograph of two people wearing protective gear carrying what appears to be a deceased coronavirus patient (figure 3). The text in the publication fuels denialist theories about the actual numbers of deceased, claiming that it is impossible to move a person's body in such a simple manner. In reality, the photograph was extracted from an online image bank, as demonstrated by the fact-checker.

The misleading contents (those that mix truthful information with falsehoods) occupy 10.56% (n=15) of the conspiracy pieces verified. The predominant stories of this type (sometimes the most difficult to debunk) are divided into three types: narratives that claim that the virus is not new, claims that COVID-19 was developed in a laboratory, and narratives that deny or minimize the disease's impact. The most commonly used strategy in manipulated content (n=15; 10.56%) is the editing of images to attribute false statements of a denialist or conspiratorial nature to high-ranking politicians, public institutions, or prestigious media outlets.

9 científicos italianos la encontraron, pero nadie les hizo caso...

UN ACEITE ESENCIAL CONTRA EL CORONAVIRUS

Consiga GRATIS esta joya de la naturaleza que ha demostrado inhibir la replicación del virus

Una crisis de proporciones mayúsculas hace temblar el mundo. Su causante es, paradójicamente, un agente minúsculo: el virus SARS-Cov-2

Ha puesto en jaque a países, gobiernos y empresas y ha paralizado la economía mundial.



Y con él aún campando a sus anchas, nos hemos tenido que familiarizar con situaciones, como los aislamientos, las cuarentenas, el cierre de fronteras o el toque de queda.

Ha convertido en cotidianas situaciones como las de ciudadanos saliendo a la calle con mascarillas o las de hospitales saturados.

Figure 2. Fake content on essential oil with healing power for COVID-19

Source: <https://maldita.es>



Figure 3. Picture from an image bank taken out of context

Source: <https://www.newtral.es>

Narratives

There are also clear differences in the number of different types of verified narratives [$\chi^2(3, N=148) = 59.08, p < .01$]. H4, regarding the most frequent discourses, is completely confirmed, since type 3 narratives (conspiracy theories that defend the artificial origin of the virus for political, economic, or ideological purposes) are the most prevalent ($n=64; 45.07\%$). Of particular note are the publications that claim that the coronavirus does not have a natural origin, but has been created in laboratories as part of a plan to establish a new world order of massive population control, in which governments, large companies and the media participate.

The second predominant narrative is type 4 ($n=54; 38.02\%$). This is disinformation that proposes false treatments and therapies of dubious efficacy. The dissemination of these messages is achieved thanks to one of the central characteristics of conspiracy theories: the simplicity of the answer to solve complex problems, such as cure, symptom reduction, or non-contagiousness of the disease.

The denialist narrative (type 1) that does not believe in the virus' existence or minimizes its impact represents 16.89% ($n=25$) of the verified content. A large part of these narratives is based on denying the existence of the virus, equating it with other diseases such as influenza and considering that the numbers of deaths due to

coronavirus have been inflated. The narrative of opposition to the health measures adopted is the least prevalent ($n=5$; 3.52%). Its aim is to ignore the efficacy of the measures implemented and deny the need for vaccination against the disease.

A mapping of the main anti-scientific narratives of COVID-19 verified in the Hispanic American context –detected in our research– is available at <https://cutt.ly/xAJjcol>.

#pandemia: anti-scientific narratives on Twitter

The 96 tweets analyzed accumulated a total of 22,226 RTs ($M=231.52$; $SD=154.01$) and 32,037 Likes ($M=333.72$; $SD=387.64$). As shown in table 2, all the narratives present in these misinformative pieces are present in the contents verified by the fact-checkers, collected in the previous section. There is no narrative in the Twitter hashtag that did not have presence in the sample extracted from the verified contents, so we can confirm H5.

Stories minimizing the impact of the disease are the most frequent ($n=41$; 42.70%), followed by those claiming that COVID-19 aims to establish a new world order of mass control ($n=30$; 31.25%).

Both narratives account for 73.95% of the sample. Therefore, we will select only these two categories for the statistical calculations that we will present later. The economic motivations that are supposedly behind the health crisis represent 7.29% ($n=7$) of the conspiratorial narratives that have circulated the most in this hashtag. There are highly significant differences between the appearance frequencies of the different narratives on this platform [$\chi^2(7, N=96) = 129.17, p < .01$].

The tweets with the highest number of likes are those alluding to the artificial origin of the virus ($M=620.33$; $SD=452.61$). They are followed by the stories that identify the pandemic as an instrument for control ($M=380.47$; $SD=632.59$), and the economic motivations for the disease's origin ($M=370.86$; $SD=299.68$). The pieces about the artificial generation of COVID-19 also get the highest number of RTs ($M=451.33$; $SD=238.81$). Political ($M=405.50$; $SD=366.99$) and economic ($M=271.00$; $SD=247.07$) motivations for the artificial generation of the virus also register high values in this variable (RTs).

Descriptive statistics allow us to know that there are differences in the average number of Likes and RTs between the different narratives, but not whether such deviations are statistically significant, in order to determine if the type of narrative is a relevant variable in the impact of these tweets. To observe whether these significant differences exist in the number of Likes and RTs by narrative category (and thus test H6), we ran the Kruskal-Wallis test (nonparametric). To decide

whether to use parametric or nonparametric tests, we first needed to know whether the sample showed normality in the distribution of both variables (Likes and RTs). To this end, we performed the Kolmogorov-Smirnov test, which demonstrated the absence of normality in both the Likes' distribution [$D(96)=.267, p<.01$] and the RTs [$D(96)=.238, p<.01$]. For this reason, we opted to run nonparametric calculations, which observed no significant differences in either the number of Likes [$H(7)=4.18, p=.0758$] or RTs [$H(7)=7.20, p<.408$] achieved by the different narratives. It is inferred, therefore, that the type of narrative is not a determinant variable of engagement (number of Likes and RTs), thus refuting H6.

On the contrary, we did observe a wide difference between the number of tweets that included images (videos or pictures) ($n=78; 81.25\%$) and those that did not [$\chi^2(1, N=96) = 37.50, p<.01$]. It should be remembered that our sample was composed only of messages with more than 100 RTs, so we can consider H7 as confirmed: a large majority of the most propagated anti-scientific messages on Twitter includes some type of visual element.

Narrative	Frequencies	Likes	RTs
Dictatorship, control	30 (31.25%)	$M=380.47$ $SD=632.59$	$M=196.83$ $SD=119.65$
Impact minimization	41 (42.70%)	$M=306.27$ $SD=171.35$	$M=240.34$ $SD=149.28$
Economic reasons	7 (7.29%)	$M=370.86$ $SD=299.68$	$M=271.00$ $SD=247.07$
Elimination of part of the world's population	5 (5.20%)	$M=252.60$ $SD=79.27$	$M=204.80$ $SD=66.53$
Political motivations	2 (2.08%)	$M=288.00$ $SD=72.12$	$M=405.50$ $SD=366.99$
Artificial origin	3 (3.12%)	$M=620.33$ $SD=452.61$	$M=451.33$ $SD=238.81$
Anti-vaccine	3 (3.12%)	$M=197.00$ $SD=47.47$	$M=149.33$ $SD=5.13$
Rejection of the measures	5 (5.20%)	$M=235.80$ $SD=67.94$	$M=186.60$ $SD=78.10$
p value (χ^2)	<.01*		

* Highly significant differences are observed when $p<.01$.

Table 2. Frequencies, mean, and standard deviation of the most disseminated narratives in the hashtag #plandemia

Source: Own elaboration.

		Likes		RTs	
		M	SD	M	SD
Tweets without images		342.50	193.88	222.94	184.12
Tweets with images		331.69	420.80	233.50	147.51
Mann-Whitney U	Statistic	-1.319		1.108	
	p value	.187		.268	

Table 3. Average and standard deviation of the number of likes and RTs according to the presence of images in the tweets

Source: Own elaboration.

It is striking that, among the tweets with the greatest impact, those that do not include images get a higher average number of Likes than those that do (table 3). On the contrary, messages with images are more propagated, achieving a higher average RT. In any case, the Mann-Whitney U tests (equivalent to the Kruskal-Wallis test performed when the variables are dichotomous) do not show significant differences in the average number of Likes and RTs depending on whether the tweets include images or not. The correlational study confirms this weak association between the presence of images in the tweets and the number of Likes ($\rho_{(94)} = -.135$, $p = .189$) and number of RT ($\rho_{(94)} = .114$, $p = .270$) that such messages achieve; this refutes, again, the relevance of the presence of images in the tweets in this type of stories for them to achieve a greater number of Likes. These data indicate that the presence of images is a more significant variable for getting RTs than Likes. All these results lead us to discard H8 almost completely, except in the case of the higher average RT for messages with images.

Likewise, there is no correlation between the appearance of narratives about the pandemic as an instrument for citizen control and the number of Likes of the tweets that tell stories ($\rho_{(94)} = -.094$, $p = .362$). This narrative also does not correlate with the number of RTs ($\rho_{(94)} = -.142$, $p = .169$). Statistical tests do not determine associations between the use of narratives minimizing the pandemic situation and the number of Likes of the tweets ($\rho_{(94)} = .061$, $p = .556$). Similarly, there is no correlation between the appearance of this type of narrative and the number of RTs ($\rho_{(94)} = .070$, $p = .501$). Therefore, H6 is again refuted.

In contrast, the narrative on the pandemic as an instrument for control has a statistically highly significant correlation with the presence of images ($\rho_{(94)} = -.266$, $p = .009$), although the intensity of the association is low, which leads us to affirm that using this type of narratives in tweets is not a highly predictive

factor for the inclusion of images in such messages ($r^2=.071$; $r^2_{\text{adjusted}}=.061$). Associations are also observed between the fact of using narratives that minimize the pandemic and the use of images, in this case in a negative sense, meaning that this type of messages tends not to be accompanied by visual elements ($\rho_{(94)}=-.233$, $p=.023$), although the degree of correlation is low. In this regard, the fact that a tweet questions the extent of the pandemic by minimizing its impact is hardly predictive of the absence of images in such a tweet ($r^2=.054$; $r^2_{\text{adjusted}}=.044$). These results lead us to reject H9 for the two types of narrative (pandemic as an instrument of control and narratives that minimize the impact of the crisis).

DISCUSSION AND CONCLUSIONS

The data collected in this work offer some clues about scientific disinformation related to COVID-19 that could be useful in future pandemics and health crises. First, our study showed that verifications of this type of disinformation were more prominent in the initial months of the pandemic, when the population may feel more vulnerable due to fear, uncertainty, and outrage caused by the new situation and the restrictive measures adopted. According to our results, the anti-scientific discourse is mostly based on false messages without any factual basis. This is relevant because the type of information clutter in these accounts differs from that used in most of the general disinformation about COVID-19, which mixes a greater proportion of truthful elements with falsehoods (Brennen et al., 2020; García-Marín, 2020). However, our study leaves the question open of whether completely fabricated fake contents are truly the majority in anti-scientific theories or are actually just more verified by fact-checkers given the complexity of checking contents that mix truthful data with falsehoods. More specific research on the action of fact-checkers is required to elucidate this question.

Although no high correlations have been proven between the use of visual elements and the engagement of this type of stories on Twitter, the image is a relevant media format due to its high presence in scientific disinformation. Our research shows that a vast majority of debunked anti-scientific content is elaborated using visual elements in any of its forms (video, photography, or photography + text). Likewise, our study on Twitter shows that the vast majority of the most propagated anti-scientific stories include visual elements (81.25% of the stories with more than 100 RTs of the analyzed hashtag had images). These results, although consistent with works such as that of Rodríguez-Pérez (2021), contrast with previous studies on general disinformation related to the new

coronavirus (Salaverría et al., 2020; García-Marín, 2020), which placed text as the most commonly used format.

The anti-scientific narratives on the new coronavirus focus mainly on two aspects: the virus and its characteristics (types 1 and 3 of our research), and the measures and treatments for its prevention and eradication (narrative types 2 and 4) (Herrera-Peco et al., 2021). This pattern can be repeated in future pandemics or health crises and can even be extrapolated to other areas such as climate change denialism or gender violence, where such problems are not only denied or minimized but, if their existence is recognized, there is an evident resistance to the measures to address them.

Likewise, we detected a great importance of instant messaging services in the dissemination of scientific disinformation. The high percentage of fake content propagated via WhatsApp is striking, an aspect that has already been noted in previous research in the context of COVID-19 (Salavería et al., 2020; García-Marín, 2021). This circumstance makes it necessary to pay special attention to these platforms that, as in the case of Telegram, are configured as environments increasingly adopted by denialist and conspiracy groups to disseminate their messages. The impact of these platforms as hoax disseminators is multiplied in contexts of confusion, when official messages cause bewilderment (Elías, 2020) or lack credibility among citizens (Elías & Catalán-Matamoros, 2020).

Although it is impossible to check every message propagated on the networks, it is certain that fact-checkers are proving effective in debunking anti-scientific stories circulating about the disease. In the same vein, studies by Kauk and colleagues (2021) and Gruzd and Mai (2020) have shown that the immediate response of fact-checking journalism is an effective mechanism to contain this false information. According to our analysis, the narratives verified by these entities coincide exactly with the most disseminated on Twitter, which demonstrates their ability to detect the most relevant false content, at least in the COVID-19 scope. In upcoming crises of this nature, fact-checking journalism must reinforce its essential role in the fight against scientific infodemics. One of its challenges would be to ensure that debunks are disseminated with the same intensity and speed as fake news in order to provide guarantees around the ideas of truth and veracity (Salvat, 2021) on complex issues that are decisive for the society's proper functioning.

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REFERENCES

- Ahmed, W., Vidal-Alaball, J., Downing, J., & López -Seguí, F. (2020). COVID-19 and the 5G Conspiracy Theory: Social Network Analysis of Twitter Data. *Journal of Medical Internet Research*, 22(5), e19458. <https://doi.org/10.2196/19458>
- Batzdorfer, V., Steinmetz, H., Biella, M., & Alizadeh, M. (2021). Conspiracy theories on Twitter: emerging motifs and temporal dynamics during the COVID-19 pandemic. *International journal of data science and analytics*, 1-19. <https://doi.org/10.1007/s41060-021-00298-6>
- Brennen J. S., Simon, F., Howard, P. N., & Kleis-Nielsen, R. (2020, April 7). Types, sources, and claims of Covid-19 misinformation. *Reuters Institute*. <https://reutersinstitute.politics.ox.ac.uk/types-sources-and-claims-covid-19-misinformation>
- Bustos, J. & Ruiz del Olmo, F. (2020). Comunicar en tiempos de crisis en las redes sociales. Estrategias de verificación e intermediación informativa en los casos de Facebook, Instagram y Twitter durante la COVID-19 (Communicating in times of crisis on social networks. Strategies for verification and information intermediation in the cases of Facebook, Instagram and Twitter during COVID-19). *Hipertext.net*, (21), 115-125. <https://doi.org/10.31009/hipertext.net.2020.i21.10>
- Callejo, J. & Viedma, A. (2005). *Proyectos y estrategias de investigación social: la perspectiva de la intervención* (Social Research Projects and Strategies: The Perspective of Intervention). McGraw Hill.
- Desinformación en español, gran problema para los demócratas (Disinformation in Spanish, a big problema for democrats). (2021, November 21). *20 Minutos*. <https://www.20minutos.com/noticia/332135/0/desinformacion-en-espanol-gran-problema-para-los-democratas>
- Dunlap R. E. & McCright A. M. (2011). *The Oxford Handbook of Climate Change and Society*. Oxford University Press.

- Elías, C. (2020). Expertos/as científicos/as y comunicación gubernamental en la era de las fake news. Análisis de la estrategia informativa del COVID-19 en España (Scientific Experts and Government Communication in the Age of Fake News. Analysis of the Information Strategy of the Covid-19 in Spain). *Prisma Social. Revista de Ciencias Sociales*, (31), 7-39. <https://revistaprismasocial.es/article/view/3945/4537>
- Elías, C. (2021). El periodismo como herramienta contra las fake news (Journalism as a Tool Against Fake News). In C. Elías & D. Teira (Eds.), *Manual de periodismo y verificación de noticias en la era de las fake news* (Journalism and News Verification Guideline in the Fake News Era) (pp. 19-57). UNED.
- Elías, C. & Catalán-Matamoros, D. (2020). Coronavirus in Spain: Fear of 'Official' Fake News Boosts WhatsApp and Alternative Sources. *Media and Communication*, 8(2), 462-466. <https://doi.org/10.17645/mac.v8i2.3217>
- Elsasser S. W. & Dunlap R. E. (2013). Leading Voices in the Denier Choir: Conservative Columnists' Dismissal of Global Warming and Denigration of Climate Science. *American Behavioral Scientist*, 57(6), 754-776. <https://doi.org/10.1177/0002764212469800>
- Freundenburg, W. R. & Muselli V. (2013). Reexamining Climate Change Debates: Scientific Disagreement or Scientific Certainty Argumentation Methods (SCAMs)? *American Behavioral Scientist*, 57(6), 777-795. <https://doi.org/10.1177/0002764212458274>
- Gallotti, R., Valle, F., Castaldo, N., Sacco, P., & De-Domenico, M. (2020). Assessing the risks of 'infodemics' in response to COVID-19 epidemics. *Nature Human Behavior*, 4, 1285-1293. <https://doi.org/10.1038/s41562-020-00994-6>
- García-Marín, D. (2020). Infodemia global. Desórdenes informativos, narrativas fake y fact-checking en la crisis de la Covid-19 (Global infodemic: Information disorders, false narratives, and fact checking during the Covid-19 crisis). *Profesional de la Información*, 29(4). <https://doi.org/10.3145/epi.2020.jul.11>
- García-Marín, D. (2021). El whatsapp de Odiseo. Potencial desinformación y estrategias retóricas del audio fake (Odysseus' WhatsApp. Disinformation and Rhetorical Strategies of Fake Audio). In C. Elías & D. Teira (Eds.), *Manual de periodismo y verificación de noticias en la era de las fake news* (Journalism and News Verification Guideline in the Fake News Era) (pp. 99-132). UNED.
- Gruzd, A. & Mai, P. (2020). Going viral: How a single tweet spawned a COVID-19 conspiracy theory on Twitter. *Big Data & Society*, 7(2). <https://doi.org/10.1177/2053951720938405>
- Herrera-Peco, I., Jiménez-Gómez, B., Romero Magdalena, C.S., Deudero, J. J., García-Puente, M., Benítez De Gracia, E., & Ruiz-Núñez, C. (2021). Antivaccine Movement and COVID-19 Negationism: A Content Analysis of Spanish-Written Messages on Twitter. *Vaccines*, 9(6), 656. <https://doi.org/10.3390/vaccines9060656>
- Jensen, E. A., Pflieger, A., Herbig, L., Wagoner, B., Lorenz, L., & Watzlawik, M. (2021). What Drives Belief in Vaccination Conspiracy Theories in Germany? *Frontiers in Communication*, 6, 678335. <https://doi.org/10.3389/fcomm.2021.678335>
- Kauk, J., Kreysa, H., & Schweinberger, S. R. (2021). Understanding and countering the spread of conspiracy theories in social networks: Evidence from epidemiological models of Twitter data. *PLoS ONE*, 16(8), e0256179. <https://doi.org/10.1371/journal.pone.0256179>

- Kearney, M. D., Chiang, S. C., & Massey, P. M. (2020). The Twitter origins and evolution of the COVID-19 “plandemic” conspiracy theory. *Harvard Kennedy School (HKS) Misinformation Review*. <https://doi.org/10.37016/mr-2020-42>
- Lewandowsky S. (2020). Climate Change Disinformation and How to Combat It. *Annual Review of Public Health*, 42(1), 1-21. <https://doi.org/10.1146/annurev-publhealth-090419-102409>
- Lewandowsky S., Cook J., Oberauer K., Brophy S., Lloyd E. A., & Marriott M. (2015). Recurrent Fury: Conspiratorial Discourse in the Blogosphere Triggered by Research on the Role of Conspiracist Ideation in Climate Denial. *Journal of Social and Political Psychology*, 3(1), 142-178. <https://doi.org/10.5964/jspp.v3i1.443>
- López-Borrull, A. (2020). Fake news e infodemia científica durante la Covid-19, ¿dos caras de la misma crisis informacional? (Fake news and the scientific infodemic during Covid-19: two faces of the same informational crisis?). *Anuario ThinkEPI*, 14, e14e07. <https://doi.org/10.3145/thinkepi.2020.e14e07>
- McIntyre, L. (2018). *Post-Truth*. The MIT Press.
- Muric, G., Wu, Y., & Ferrara, E. (2021). COVID-19 Vaccine Hesitancy on Social Media: Building a Public Twitter Data Set of Antivaccine Content, Vaccine Misinformation, and Conspiracies. *JMIR Public Health and Surveillance*, 7(11), e30642. <https://doi.org/10.2196/30642>
- Pennycook, G. & Rand, D. G. (2020). The Implied Truth Effect: Attaching warnings to a subset of fake news headlines increases perceived accuracy or headlines without warnings. *Management Sciences*, 66(11), 4944-4957. <https://doi.org/10.1287/mnsc.2019.3478>
- Pérez, J., Meso, K., & Mendiguren, T. (2020). Fake news y coronavirus: detección de los principales actores y tendencias a través del análisis de las conversaciones en Twitter (Fake news and coronavirus: Detecting key players and trends through analysis of Twitter conversations). *Profesional de la Información*, 29(3), 1-22. <https://doi.org/10.3145/epi.2020.may.08>
- Peters, M. A., Jandric, P., & McLaren, P. (2020). Viral modernity? Epidemics, infodemics, and the ‘bioinformational’ paradigm. *Educational Philosophy and Theory*, 30. <https://doi.org/10.1080/00131857.2020.1744226>
- Pulido-Rodríguez, C., Villarejo-Carballido, B., Redondo-Sama, G., Guo, M., Ramis, M., & Flecha, R. (2020). False news around COVID-19 circulated less on Sina Weibo than on Twitter. How to overcome false information? *International and Multidisciplinary Journal of Social Sciences*, 9(2), 107-128. <https://doi.org/10.17583/rimcis.2020.5386>
- Rodríguez-Pérez, C. (2021). Desinformación online y fact-checking en entornos de polarización social. El periodismo de verificación de Colombiacheck, La Silla Vacía y AFP durante la huelga nacional del 21N en Colombia (Online disinformation and fact-checking in social polarization contexts: the fact-checking journalism of Colombiacheck, La Silla Vacía and AFP during the 21N national strike in Colombia). *Estudios sobre el Mensaje Periodístico*, 27(2), 623-637. <https://doi.org/10.5209/esmp.68433>
- Salaverría, R., Buslón, N., López-Pan, F., León, B., López-Goñi, I., & Erviti, M. C. (2020). Desinformación en tiempos de pandemia: tipología de los bulos sobre la Covid-19 (Disinformation in times of pandemic: typology of hoaxes on Covid-19). *Profesional de la Información*, 29(3), e290315. <https://doi.org/10.3145/epi.2020.may.15>

- Salvat, G. (2021). El lugar del periodismo ciudadano desde la credibilidad y la confianza (The Place Of Citizen Journalism From Credibility And Trust). *Estudios sobre el Mensaje Periodístico*, 27(2), 639-648. <https://doi.org/10.5209/esmp.71039>
- Schmid-Petri, H. (2017). Politicization of science: how climate change skeptics use experts and scientific evidence in their online communication. *Climatic Change*, 145, 523-537. <https://doi.org/10.1007/s10584-017-2112-z>
- Stephens, M. (2020). A geospatial infodemic: Mapping Twitter conspiracy theories of COVID-19. *Dialogues in Human Geography*, 10(2), 276-281. <https://doi.org/10.1177/2043820620935683>
- Sued, G. (2020). El algoritmo de YouTube y la desinformación sobre vacunas durante la pandemia de COVID-19 (YouTube recommendation algorithm and vaccines disinformation during the Covid-19 pandemic). *Chasqui. Revista Latinoamericana de Comunicación*, (145), 163-180. <https://revistachasqui.org/index.php/chasqui/article/view/4335>
- Thelwall, M., Kousha, K., & Thelwall, S. (2021). Covid-19 vaccine hesitancy on English-language Twitter. *Profesional de la Información*, 30(2), e300212. <https://doi.org/10.3145/epi.2021.mar.12>
- Theocharis, Y., Cardenal, A., Jin, S., Aalberg, T., Hopmann, D. N., Strömbäck, J., Castro, L., Esser, F., Van Aelst, P., de Vreese, C., Corbu, N., Koc-Michalska, K., Matthes, J., Schemer, C., Sheaffer, T., Splendore, S., Stanyer, J., Stępińska, A., & Štětka, V. (2021). Does the platform matter? Social media and COVID-19 conspiracy theory beliefs in 17 countries. *New Media & Society*. <https://doi.org/10.1177/14614448211045666>
- Wardle, C. (2019). *First draft's essential guide to Understanding Information Disorder*. First Draft. <https://cutt.ly/ibIbZle>
- Yang, K., Pierri, F., Hui, P., Axelrod, D., Torres-Lugo, C., Bryden, J., & Menczer, F. (2020). The COVID-19 Infodemic: Twitter versus Facebook. *Big Data & Society*, 8(1). <https://doi.org/10.1177/20539517211013861>

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