

Disinformation, vaccines, and Covid-19. Analysis of the infodemic and the digital conversation on Twitter

Desinformación, vacunas y Covid-19.
Análisis de la infodemia y la conversación digital en Twitter

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RESUMEN

Introducción: El debate de sobre las vacunas contra el Covid-19 ha estado muy presente en las redes sociales desde el mismo inicio de la crisis sanitaria, en un contexto de infodemia en el que la presencia de todo tipo de informaciones ha sido un caldo de cultivo para la desinformación o las noticias falseadas. **Metodología:** En este contexto, este artículo busca medir y caracterizar la conversación sobre las vacunas contra el Covid-19 en la red social Twitter. Para ello, se han analizado 62.045 tuits y 258.843 retuits de partidarios y detractores de la vacuna entre diciembre de 2020 y febrero de 2021. **Resultados:** El inicio de la campaña de vacunación fue el punto de inflexión en el que los discursos provacunas comenzaron a ser mayoritarios frente a los antivacunas. Los grupos antivacunas se caracterizan por ser clústeres fuertemente cohesionados, con un apreciable nivel de actividad, pero con menor capacidad para viralizar contenidos. **Conclusiones y discusión:** Los discursos antivacunas tienden a apoyarse en medios alternativos o contenidos compartidos en redes sociales, lo que corrobora que la información de calidad constituye una de las principales medidas contra la desinformación. Se pone de manifiesto también el rol de los medios periodísticos de calidad (*legacy media*) y la conveniencia de ahondar en el desarrollo de políticas contra la desinformación específicas para el tipo de conversación digital que se desarrolla en Twitter.

PALABRAS CLAVE: Desinformación; vacunas; Covid-19; redes sociales; Twitter; infodemia.

ABSTRACT

Introduction: The debate on the Covid-19 vaccines has been very present on social networks since the very beginning of the health crisis, in a context of infodemics in which the presence of all kinds of information has been a breeding ground for misinformation or false news. **Methodology:** In this context, this article seeks to measure and characterize the conversation about Covid-19 vaccines on the social network Twitter. To this end, 62,045 tweets and 258,843 retweets from supporters and opponents of the vaccine were analyzed between December 2020 and February 2021. **Results:** The start of the vaccination campaign was the turning point at which pro-vaccine discourse began to take precedence over anti-vaccine discourse. Antivaccine groups are characterized by being strongly cohesive clusters, with an appreciable level of activity, but with less capacity to viralize content. **Conclusions and discussion:** Anti-vaccine discourses tend to rely on alternative media or content shared on social networks, which corroborates that quality information is one of the main measures against disinformation. It also highlights the role of quality or legacy media and the desirability of further developing anti-disinformation policies specific to the type of digital conversation taking place on Twitter.

KEYWORDS: Disinformation, vaccines, Covid-19, social media, Twitter, infodemic.

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Translation by **Paula González** (Universidad Católica Andrés Bello, Venezuela)

1. Introduction

Since mid-2020, the debate about vaccines against Covid-19 has focused much of the informational interest and debate in public opinion around the world, motivated in part by logistical and development problems that its hasty research has caused in a pandemic context. To this must be added the misgivings that part of the population has traditionally shown against vaccines, which had previously fueled the debate about the role that social networks should play in this matter (Dredze et al., 2016; Kang et al., 2017). For the World Health Organization, these reluctances are precisely one of the main global threats to public health (WHO, 2019). For this reason, the social and informative echo of the debate about vaccines has reached a special intensity during the Covid-19 pandemic.

The resistance of part of the population towards certain vaccines had already led students of communication about health and science, to fix their interest in the critical perception towards these immunizations in the environment of the Web (Zimmerman et al., 2005) and, especially, of social networks, due to their increasing use to obtain information and give opinions on health issues (Larson et al., 2016). Social media or media 2.0 allow users to create, interact, and share content in different forms or media formats, which has facilitated the transmission of data and messages that are generally short and with little context. For this reason, this type of communication has become a conducive environment to promote and expand certain positions that, on many occasions, serve to misinform (Chanel et al., 2011; Wilson and Keelan, 2013; Liu et al., 2015; Salathé, 2008; Witteman and Zikmund-Fisher, 2012).

The very use dynamics of social networks contribute to feedback ideologies, patterns, or discourses that can foster polarization around certain issues. In this regard, anti-vaccine activity on social media

is influential and causes confusion and misinformation (Wilson, Atkinson, Deeks, 2014; Huesch, Ver-Steeg & Galstyan, 2013; Getman et al., 2018).

The scientific literature on the role of social networks as communication tools in the field of vaccines has increased in recent years. And the debates on Twitter about the virtues or the ineffectiveness of vaccines have made this platform a focus of academic interest (Broniatowski et al., 2018; Pérez-Dasilva, Meso, and Mendiguren, 2020). Twitter stands out for its interest in sharing short messages (tweets) in real-time that contribute to the shaping of public discourses, based on multiple conversations, interaction networks, or nodes. As Gutiérrez-Coba, Coba-Gutiérrez, and Gómez Díaz (2020, p. 240) point out, Twitter has demonstrated its ability to generate subcommunities or “echo chambers” (Getman et al., 2018; Cardenal et al., 2019) and reproduce collectivities of “the same” that offer users information similar to what they usually consume, overexposing their opinions in accordance and causing them to choose information aligned with their ideology.

A study published in 2014 in the journal *Vacunas* showed that Twitter was in Spain one of the channels least used by Internet users to obtain information on health issues, among other reasons, due to the distrust it generated (Moorhead et al., 2013; Mena et al., 2014). Some years later, however, the study “Opinions and expectations of citizens on the use and application of ICT in the health field”, of the National Telecommunications Observatory of the Information Society (ONTSI, 2016), recognized in Spain an upward trend in the use of social networks concerning the topics of greatest interest and concern about individual health.

Because of the characteristics of Twitter and its uses, as well as the interest generated by the issue of vaccination in the context of the Covid-19 pandemic, this article focuses on the study of public discourses on vaccination, from the dialogical interrelation between different agents –pro-vaccine and anti-vaccine citizens, health experts, institutions and political class, press, etc.–. The recent study by Thelwall, Kousha, and Thelwall (2021, p. 8) on anti-vaccine tweets in English suggests the need to research the spread of this type of message in other languages and points to the possible existence of organized movements in different contexts.

Based on all these issues, this research seeks to characterize the discourse on vaccines against Covid-19 on Twitter from the premise or starting hypothesis that the actors present in the hybrid media system use Twitter to participate in the public debate, from dialogical rather than dialectical approaches, thanks to the formation of communities made up of accounts or users who share some kind of affinity (echo chambers theory). Specifically, this work has set out to examine the volume and meaning of the debate on vaccines on Twitter (RQ1). Likewise, we have sought to characterize the anti-vaccine communities (RQ2) and the media support they use for the distribution or viralization of their messages, whether they are general and specialized reference media (legacy media) or alternative platforms (alternative media). (RQ3). Finally, the impact of the measures taken against misinformation regarding vaccines against Covid-19 has been studied (RQ4).

2. Infodemic, disinformation 2.0, and anti-vaccine discourses

The study of communication for and against vaccines on social networks has milestones before the Covid-19 pandemic. Among others, Cuesta-Cambra, Martínez-Martínez, and Niño-González (2019) focus on this issue based on visual and emotional parameters on Facebook and Twitter. Their study confirms that anti-vaccine persuasion occurs mainly cognitively, through the use of heuristic strategies such as conspiracy theories, especially in those events that involve uncertainty, probability, and risk, such as the hypothetical sanitary contraindications of vaccines. Unfavorable public opinions are thus linked to globalized perceptions or influences of comments on their lack of safety, but also

of efficacy and, therefore, of interest. The lack of adequate information about vaccines is a priority factor because anti-vaccine subjects tend to consume information that reinforces their conviction regardless of scientific evidence: based on previous thoughts and stereotypes, as well as incomplete or partial data, the subjects would carry out an illusory correlation of the information, assuming non-rigorous or fake information as valid, using their own representativeness schemes (Cuesta-Cambra, Martínez-Martínez, and Niño-González, 2019, p. 13).

While information with a neutral or positive tone is detected on the web –for example, in the online versions of the legacy media– on social networks, especially on Twitter, a different trend is observed due to the presence of influencers. They tend to combine the use of different digital platforms, show intense posting activity, and remain a reference to the constant flow of information around vaccines.

Already in the framework of the academic production of the Covid-19 era, Hallin et al. (2020: 2) explain that the so-called “emerging diseases” become an object of public-media interest almost at the same time –or even before– than an object of medical and scientific interest. The need for citizens to receive updated information on these issues generates actions and media dynamics to take into account, among other reasons, because they can achieve the opposite effect, that is, promote disinformation (Bennett and Livingston, 2018; Palpan -Guerra and Munayco, 2015). This misinformation is generally accompanied by other characteristic phenomena of this type of situation, such as information oversaturation (Salaverría et al., 2020). The evidenced or assumed interest of the public for information leads the media to try to offer their best response in terms of immediacy and quantity of data, which does not always necessarily imply the quality of information or service information. According to Casero-Ripollés (2020), only quality journalistic information can reduce situations of informational stress and social fear linked to media information.

This public interest and media interest is intensified when medical-scientific issues generate a kind of "moral panic" and are presented in the form of a recognizable "threat" through the media. The recent study by Zunino (2021, p. 135) reminds us that the media occupies a decisive place in the symbolic construction of a “culture of risk” and of a “state of fear” in which the threat to life, either because of the pandemic or because of the solutions to said pandemic, guides social perceptions of permanent danger. According to this same author, these are subjective perceptions of risk that find a dynamic agent in the media.

These media outlets develop and exercise their function in a media ecosystem that currently presents distinctive characteristics (Chadwick, 2013). Synthetically, it is a hybrid ecosystem, in which different typologies and media systems coexist, besides being a liquid ecosystem, in which informational data flows between different platforms and devices, reaching the public in a simple way, anytime, anywhere. Likewise, it is a convergent and multimedia media ecosystem, in which this liquid information arrives in multiple ways adapted to all types of audiences (deep texts, short texts, videos, podcasts, television news, etc.). It is also an ecosystem with newsworthiness criteria based on immediacy and impact, in which the borders between information and entertainment -or informative spectacularisation- are sometimes blurred, contributing to a sense of disruption (Martini, 2017). In this scenario, the reference or legacy media have lost their monopoly as the sole architects of the organization of information flows and are impacted by misinformation, which is also detrimental to the extent that it manages to delegitimize the most reliable sources.

Online communication media and social networks have obtained great weight and centrality since the beginning of the Covid-19 pandemic, considered as a highly newsworthy public problem that arises unexpectedly and conditions the routines and professional processes of journalists, as well as the informational routines of the audiences. This translates into an unexpected increase in information

and an interest in multiplatform consumption, among which online consumption acquires an important weight (Masip et al., 2020; Múñiz, 2020). The figures on the use of social networks during March and April 2020 in six countries, collected by the Reuters Institute Digital News Report (Newman et al., 2020), highlight the increase in consumption to learn about the pandemic not only from traditional media but also from social networks, an area in which respondents acknowledge not always having the ability to distinguish true and false information. Citing Hallin and Mancini (2004), the Reuters Institute report (2020) indicates that Spain is a “polarized pluralist” country where there is a perceived preference for information of a centralized nature or aligned with certain ideologies. According to the specific Digital News Report Spain (Vara, Amoedo, and Negrodo, 2020), 44% of the surveyed population said they found a lot or enough misinformation about Covid-19 on social networks and blamed the hoaxes on politicians (42%), media (36%), and the Government (34%).

The pandemic generated by Covid-19 has led the World Health Organization (WHO) to resort to the term “infodemic” to refer to an excessive amount of information with an exponential growth in a short period that makes it difficult to access reliable sources and guidance from individuals. Although this definition indeed includes all kinds of information, including those that are truthful or correct, infodemic situations are a breeding ground for misinformation, fake news, or hoaxes, in general. Much of this information is based on the so-called conspiracy theories (Zarocostas, 2020). Various studies propose classifications to categorize fake news, which include satire, parodies based on news, manipulated information, or propaganda (Tandoc et al., 2018). Some authors distinguish between misinformation generated by deliberately created and distributed false information, and misinformation (Wardle, 2017; Brennen, et al., 2020).

In their analysis of disinformation in Ibero-America during the pandemic, Gutiérrez-Coba, Coba-Gutiérrez, and Gómez-Díaz (2020: 254) point out criminal actions, the generation of panic or destabilization, ideological interest, and clickbait as the main topics of fake news. For its part, the study by Salaverría et al. (2020) indicates deception, joke, exaggeration, and decontextualization as the main types of hoaxes about Covid-19. According to this analysis, in open networks such as Twitter, a notable distribution of false content is perceived, due to accounts with a pseudonym or false identity, as well as the volume of content generated by bots (Salaverría et al., 2020, p. 11). The recent research by Sharavski et al. (2020) shows precisely how trolls and bots represent powerful tools for manipulating and creating confusion in public opinion.

Regarding the deception techniques or type of hoax linked to the pandemic, Gutiérrez-Coba, Coba-Gutiérrez, and Gómez-Díaz (2020: 254) refer to the false connection, false context, manipulated content, exaggeration, and manufactured content. According to these same authors, most of the misinformation was produced with the false context technique; that is, on a piece of normally true information, modifications or reconfigurations are made to achieve an effect different from the fact that produces it. Another good part of the content was completely manufactured, which means that its creators used engagement techniques, designed to generate “emotional connection”. For their part, the same authors indicate, conspiracy theories, always alarming, take advantage of people's vulnerability and fear and uncertainty to construct messages, and ideological fake news tends to criticize government management. The ideology also involves those cases in which it is about selling anti-system ideas, such as the supposed danger of vaccines. The “echo chambers” theory provides an idea about the motives that lead people to intentionally or unintentionally share false information (Gutiérrez-Coba, Coba-Gutiérrez, and Gómez-Díaz, 2020: 258 and ss.).

In line with Puri et al. (2020), it is interesting to note how misinformation about the anti-Covid vaccine began to emerge on social networks even before the launch of an effective vaccine, threatening public trust in it. This misinformation has been identified as the main cause of social

barriers to vaccination against the SARS-CoV-2 virus (Covid-19), mainly when it comes to misinformation about benefits, therapeutic composition, and adverse effects. This phenomenon acquires special significance in the case at hand for two reasons: on the one hand, because the development and application of the vaccine against Covid-19 plays, if possible, an even more critical role regarding control efforts of planetary global scale; on the other hand, because the dynamics of social distancing established as a consequence of the pandemic have led many individuals to resort to social networks to interact, be less isolated, and inform themselves, increasing misinformation and rumors about the potential vaccination (Puri et al., 2020).

The recent study by Thelwall, Kousha, and Thelwall (2021) also deserves a particular mention. It examines a sample of almost four hundred and fifty tweets in English published between March and December 2020, reluctant to vaccinate for Covid-19. Based on content analysis, Thelwall, Kousha, and Thelwall (2021: 8) point out that anti-vaccine tweets mainly focus on issues such as conspiracies, the speed of development of the vaccine, and its safety, with 79% of the analyzed tweets aligned with a right-wing ideology. The study also points out the existence of “echo chambers” that suggest organized movements on Twitter to help spread denial and conspiracy theories against the vaccine, in line with the conclusions obtained in previous similar studies (Cafiero, Guille-Escuret, and Ward, 2020).

The reference media or legacy media have echoed this anti-vaccine phenomenon, which is clearly linked to denialism, understood as an attitude that tends to deny certain facts or realities linked to the pandemic. So much so that it has been considered an “organized disinformation”, which demands direct action on the part of social networks (Wardle and Singerman, 2021).

3. Methodology

To carry out this study, two data captures were made on Twitter between December 14th, 2020, and February 7th, 2021. To answer RQ1, that is, the volume and global meaning of the conversation about vaccines against Covid-19, the use of the hashtags #yosimevacuno and #yomevacuno compared to #yonomevacuno has been analyzed. In total, a total of 62,045 tweets and 258,843 retweets have been located.

In this first capture, to compare the data of competing hashtags, the data capture tools had to be standardized, since the tool used for this, Twitter Capture and Analysis Toolset (TCAT), is connected to the application programming interface (API) of Twitter, which returns a partial sample based on the relevance of the tweets, according to the company itself. To obtain a comparison that is as realistic as possible with the competing labels, the conversation data has been downloaded using web-scraping tools. The data obtained with this method is more accurate –the total number of publications that appear on Twitter at the time of executing the query is obtained– but they are also less rich in metadata since, for example, the number of potential impacts is lost.

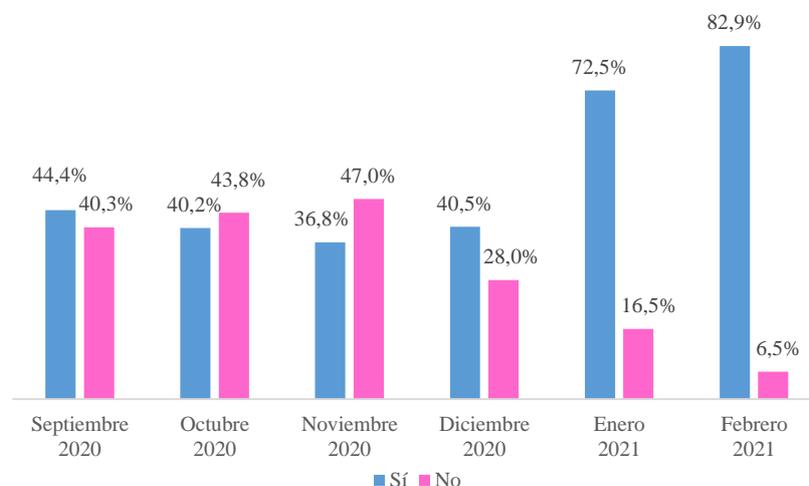
To characterize the anti-vaccine discourse and the communities that develop it (RQ2), a second data capture was carried out during the same period of the conversation with the following hashtags and keywords: yonomevacuno, noalnom, plandemia, noasoros, noabillgates, noal5g, vacunasdelamuerte, novacunas. With the TCAT tool, 15,216 tweets, 176,875 retweets, 73,972 unique authors, and 392,812,832 potential impacts have been obtained. In this case, the Modularity algorithm available in the Gephi software (Blondel, *et al.*, 2010) has been applied to identify the different clusters that segment the graph. Each cluster consists of a set of users who have preferentially interacted together and who have had less interaction with users outside the cluster. This means, according to the general model for Modularity proposed by Mark Newman (2006), that we are faced with a mathematically

significant network partition: the communities found are different from those that would be generated by mere chance and they satisfactorily capture the behavior of the nodes. These communities have been identified by the numerical code assigned by the Modularity algorithm, which in no case should be interpreted as an ordinal element, but rather as a simple qualitative label. This second data capture has also been used to measure the media base of anti-vaccine discourses (RQ3) and the direct impact of measures against misinformation (RQ4).

4. Results

4.1. Pro-vaccine vs. anti-vaccine discourse

To contextualize the impact of pro-vaccine and anti-vaccine discourses on social networks, it is first necessary to establish the evolution that both feelings have had on public opinion. From the monthly barometers carried out in Spain by the Sociological Research Center (CIS, 2021), it can be observed that there has been an important change in the opinion of society regarding vaccines against Covid-19. If at the end of 2020 the unfavorable opinions were ten points higher than the favorable ones, at the beginning of 2021 the discourse was already very mostly favorable (Graph 1). A more detailed analysis of the data reveals that the majority of opinions against vaccination were not based on denialist positions, but were based on doubts about the efficacy of these new vaccines, their possible side effects, or a preference to first see how they worked. The number of people who declared never to be vaccinated barely reached 1% (CIS, 2021). This explains why, when doubts about their effectiveness had been dispelled and the vaccination campaign had started, the general opinion quickly changed direction.

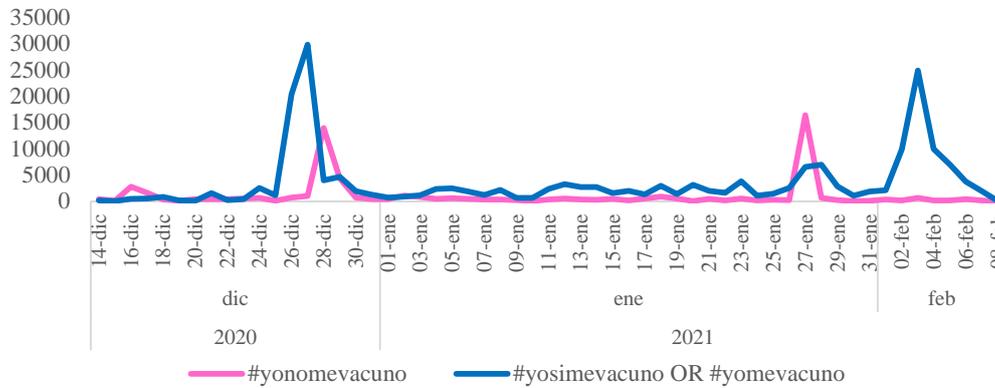


Graph 1. *Are you willing to get vaccinated against COVID-19 when your turn comes?*

Source: CIS / Self-made

The discourse on social networks has also been a reflection of this situation. At the beginning of the analyzed period, anti-vaccine discourses were dominant in the conversation on Twitter (Figure 2), although it has gradually evolved towards a greater presence of vaccination supporters. Likewise, large spikes in the conversation have been identified, around certain informational milestones. In the case of the pro-vaccine dialogue, the start of the immunization campaign on December 27th, 2020 marked the busiest moment in the conversation and reached almost thirty thousand retweets in one day. The pro-vaccine discourse also reached a significant rebound coinciding with the arrival of millions of vaccines in early February 2021. On the contrary, the anti-vaccine discourse also had one

of its high points with the start of the vaccination campaign, although its total impact did not reach half the discourse in favor of its use. The start of the dispute between the European Union and the pharmaceutical company AstraZeneca on January 27th was the time of greatest activity of the groups opposed to vaccination during the analyzed period (Graph 2).



Graph 2. Daily retweets according to the group of hashtags
 Source: Self-made

In total, the tweets that include hashtags or keywords against vaccines have had a relevant volume in the global conversation in the analyzed period, reaching 38.6% of the analyzed messages (Table 1). However, if we analyze the retweets, favorites, responses, and citations, we can see that pro-vaccine messages have been viralized more effectively, reaching levels close to 80% of the global dialogue. Thus, pro-vaccine messages have averaged 5.2 retweets, double that of anti-vaccine messages. This superior redistribution of favorable messages indicates, on the one hand, the presence of active and opinion-generating audiences among those opposed to vaccines, compared to a proportionally less active but more redistributive and majority attitude of those in favor.

Table 1. Volume of the discourse

	YoSiMeVacuno / YoMeVacuno	YoNoMeVacuno
Tweets	38,069	23,976
Retweets	199,258	59,585
Favorites	785,139	239,203
Responses	73,001	18,517
Citations	22,287	5,312

Source: Self-made

In this global conversation, it should also be noted that the data on anti-vaccine discourse is actually somewhat smaller than what is indicated by the simple counting of its use since it also includes the times in which an ironic or humorous use of the term has been identified. This would indicate that anti-vaccine communities would actually have less support in the global conversation than could be indicated by simply counting the used hashtags and keywords.

4.2. Characteristics of anti-vaccine communities

From the analysis of the most common hashtags and keywords among the groups against vaccination (yonomevacuno, noalnom, plandemia, noasoros, noabillgates, noal5g, vacunasdelamuerte, novacunas), a total of 3,011 clusters or communities have been identified in the network. Of these, only 17 meet more than 1% of the nodes, with a Modularity of 0.74.

When characterizing these communities (Image 1), we can find, on the one hand, a set of clusters (e.g., 1777, 1020, 576, 401, etc.) that occupy the central part of the conversation, with a group of users that actively broadcasts and discuss selected terms. In these groups, nodes can be represented very close to each other, since users exchange many messages on this topic. To a large extent, these are strongly cohesive groups, with a high level of activity, but with limited dissemination of their content outside their communities. The analysis of the most disseminated content in each of these clusters, as well as their main leaderships, allows us to identify that the anti-vaccine discourse prevails in these central communities.

On the other hand, the analysis of the global conversation has also made it possible to identify another series of communities that are located on the periphery (e.g., 156, 897, 963, etc.), in which users are much less cohesive and share hashtags and keywords more sporadically (Image 2). The analysis of the contents in these peripheral communities indicates that the pro-vaccination discourse prevails in them. More exceptionally, among the peripheral communities, we can also find anti-vaccine communities (1,595 and 1,611) in which there is less proximity of the nodes because they are clusters in which Polish and Portuguese are spoken.

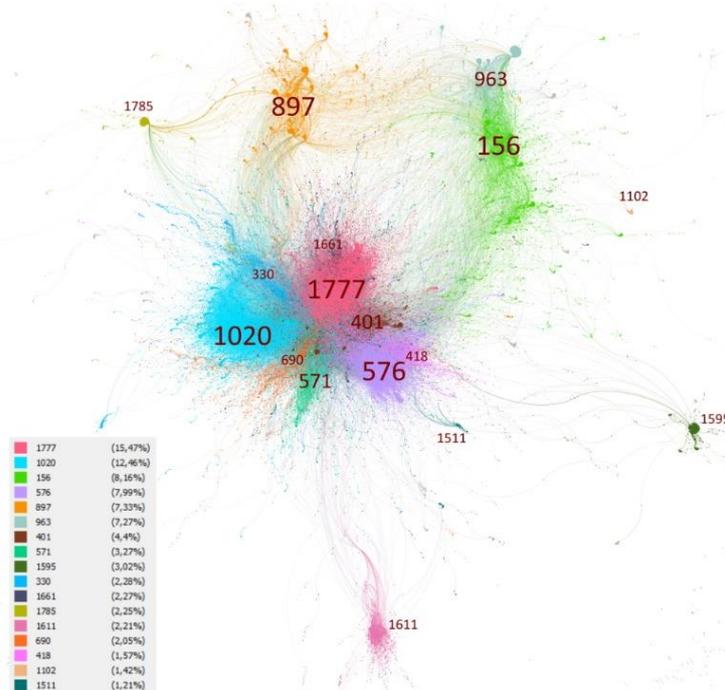


Image 1. Network of mentions segmented according to membership cluster¹

¹ From the captured conversation, a network or graph of mentions has been generated. It is a visual representation of the structure of the conversation, and also a mathematical object that allows us to identify certain structural characteristics of the conversation itself. The graph contains a total of 78,234 nodes (users) and 150,069 weighted edges (mentions between users) that take values between 1 and 272, which are the minimum and maximum number of occasions in which one user has mentioned another in the conversation. The number does not correspond exactly to the number of messages

Source: Self-made based on Gephi

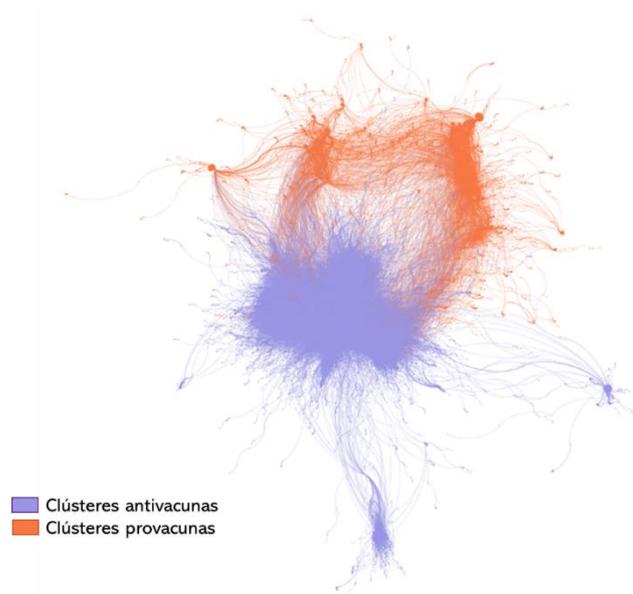


Image 2. Network of mentions segmented according to the type of cluster (anti-vaccines or pro-vaccines)

Source: Self-made based on Gephi

If we focus on the six most active identified communities, those that include more than 5% of the analyzed nodes and 58.68% of the total conversation (Table 2), and we analyze the main hashtags they have used, we can ratify the two trends previously outlined. The central groups (1777, 1020, and 576) add to their anti-vaccination discourse thematic deniers such as “plandemic” or “coronatimo” or associated claims, such as “no to the new world order”, or the resistance to comply with the measures dictated by the governments. In these forums, doubts about the effectiveness of the different companies' vaccines have also reached special diffusion. Only among these three communities have they generated 35.9% of the conversation on these topics and their geographical area covers all Spanish-speaking countries.

In the analyzed terms, it has also been possible to identify a use in which hashtags and keywords against vaccines are associated with campaigns in favor of vaccination. This indicates that they are communities in which there has been a debate between supporters and detractors, or an ironic or humorous use. As Table 2 shows, these communities are characterized by being peripheral to the anti-vaccine discourse and reach a lower percentage of the conversation (22.76% among the three main identified communities). As in the previous case, these clusters have a significant geographic dispersion throughout the Spanish-speaking area.

analyzed since in the content of the messages there may be, for example, mentions of users who are not part of the conversation.

Table 2. *Characterization of clusters with N > 5% of the network*

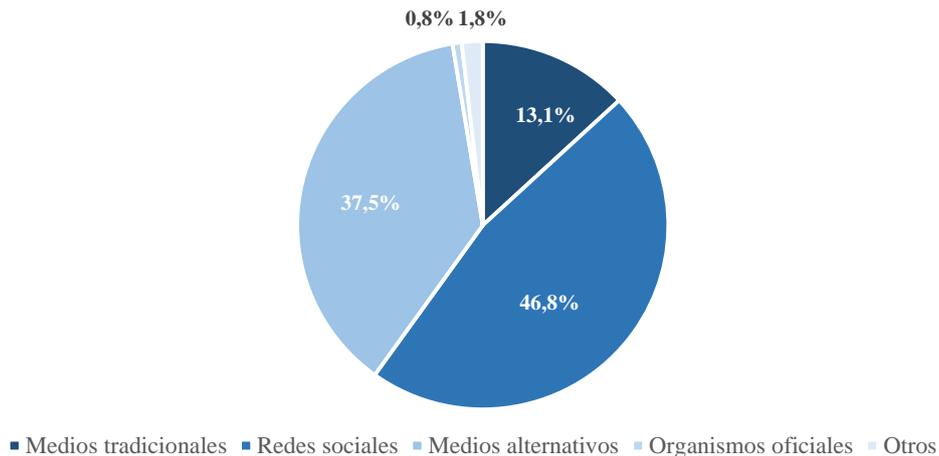
Community	Discourse type	Main location	Main hashtags
1777	anti-vaccines	Spain	plandemia, yonomevacuno, covid19, coronatimo, mironews, españa, noalnom, vacunacovid19, covid_19, slr
1020	anti-vaccines	Argentina	yonomevacuno, plandemia, covid19, censuraenlared, noalnom, desobedienciacivil, pfizer, noalnuevoordenmundial, yonomevacunoart36cn, vacunacovid19
156	pro-vaccines	Chile	yonomevacuno, plandemia, yosimevacuno, contigochv, covid19, buenosdias, frasedeldia, noalcorralitodepiñera, yomevacuno, vacunacovid19
576	anti-vaccines	Chile	plandemia, yonomevacuno, laverdadesunasola, elpultzertampoco, pcrfalsospositivos, circovid, covid19, falsapandemia, covid1984, noespandemiaesdictadura
897	pro-vaccines	Mexico	yonomevacuno, qepd, vacunateconlasaludnosejode, inocentes2020, temblor, fanbespueblo, 28dic, navarro2023, plandemia, yomevacuno
963	pro-vaccines	Mexico	yonomevacuno, yosimevacuno, covid19, yomevacuno, joda, shingekynokyojin, plandemia, vacunaadultosmayores, qepd, contigochv

Source: Self-made

4.3. The role of the media

On the other hand, in the analysis of the websites that support anti-vaccine discourse, in the 15,216 analyzed tweets, a total of 5,442 links to 993 different web resources have been identified. If we focus on the 100 most cited websites (Graph 3), we can observe that the anti-vaccine discourse finds very little support in official, institutional, or governmental sources (1.8%) or the traditional media (13.1%). On the contrary, alternative media and social networks themselves are the sources of authority attributed in 84.3% of the cases, which denotes a strong presence of anti-vaccine discourse on the margins of conventional news activity. The occasional reference to other types of applications of a more closed nature, such as Telegram, also accounts for conversations and sources that take place on the borders of social networks.

The greater marginality of anti-vaccine discourse can also be seen in the use of sources regarding the potential audiences they can reach when they are shared. In this case, the messages in which traditional media resources have been shared reach a proportionally greater number of users, because although they constitute 13.1% of the shared sources, they reach 40.3% of the potential audience analyzed. Alternative media, on the other hand, account for 37.5% of the shared links, which allows them to reach 50.3% of the potential audience analyzed. In contrast, content from social networks has a very high intensity of use in anti-vaccine communities (46.8%), but a much more limited global reach (7.7%), which indicates the presence of more closed clusters with fewer users.



Graph 3. *Distribution by type of the 100 most referenced websites*
Source: Self-made

4.4. Disinformation control

Lastly, an attempt has been made to trace the active suspension of anti-vaccine or denialist users or content on the analyzed hashtags. For this, it was based on the changes in the terms of use that the platform announced in April 2020 to limit the dissemination of this type of content (Twitter, 2020). Among the messages that the company requested to be eliminated were “those that deny the recommendations of global or local health authorities and increase the chances of contagion, those that deny the advice of experts, those that encourage the use of harmful treatments or ineffective protection measures, and misleading content posing as experts or authorities”.

Almost a year later, in March 2021, Twitter has gone one step further and announced a system for automatically tagging and deleting these messages and penalizing users who spread them. In its efforts to fight misinformation, the platform declares that it has permanently suspended 2,400 accounts and has temporarily blocked another 11.5 million until their authenticity can be confirmed (Twitter, 2021).

In the selected sample, practices that try to circumvent Twitter’s control, although with a very limited scope, have been identified. During the analyzed period, 206 profiles associated with the anti-vaccine clusters, 0.59% of the total, have modified their username (@name), for 36 cases (0.18%) in the pro-vaccine clusters. The maximum number of times a user has changed their name is 11, and it was an anti-vaccine user. The name change has been a practice used, although not very widespread, to evade Twitter’s control over content that is contrary to its terms of use.

5. Conclusions and discusión

The analysis of the conversation about vaccines against Covid-19 on Twitter has allowed, in the first place, to identify a discourse that has varied from positions mostly against vaccination to another in which favorable opinions have become dominant. The clear turning point was the start of the immunization campaign in late December 2020, which ended the uncertainty that had occurred during the vaccine development period. The rapid change in the direction of the conversation also indicates a low presence of radical or denialist anti-vaccine discourses, compared to a greater number

of skeptical positions about the effectiveness of the products developed by the different pharmaceutical companies.

Secondly, the global presence of anti-vaccine discourses is notable and reaches just over a third of the global conversation, although it intermingles openly denialist or conspiratorial positions, with more moderate skeptical positions, which do not affect vaccines in general, but those currently developed against Covid-19 in particular (Cafiero, Guille-Escuret, and Ward, 2020) or even dialogic positions with ironic or humorous purposes (Tandoc et al., 2018). The communities that most intensively dialogue about anti-vaccination hashtags or keywords are characterized by being highly cohesive groups, with a high level of message exchange among users, but with a limited capacity to redistribute content outside of their own communities. To a large extent, the anti-vaccine clusters constitute a nucleus of resonance boxes or echo chambers in which messages do not flow from or into said groups (Gutiérrez-Coba, Coba-Gutiérrez, and Gómez-Díaz, 2020), and that are usually associated with more specific political positions (Thelwall, Kousha, and Thelwall, 2021).

Thirdly, anti-vaccine discourses make very little use of institutional supports or conventional media to convey their dialogues and mostly tend to rely on content created in alternative media or shared on social networks, which affects the idea that information quality is one of the best antidotes against misinformation (Casero-Ripollés, 2020).

Lastly, this study has been able to detect a limited active impact of the policies developed by Twitter to combat misinformation, and only a few signs of username changes to circumvent them have been found. The fine line between the task of deleting accounts, suspending users, or deleting messages, and maintaining freedom of expression means that the design of the terms of use is always one step behind the conversation on social networks. The responsibility of each user in the task of creating and disseminating messages continues to be, therefore, the best antidote to misinformation in times of infodemic (Wardle and Singerman, 2021).

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