

SOCIAL MEDIA AND COVID-19 VACCINATION: ANALYSIS OF USER BEHAVIOUR IN SPAIN

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Abstract

The anti-vaccine community has on social media one of the main channels for the dissemination of fake news and disinformation. This represents a challenge for governments during health crises. This study analyzes the behavior of social media users concerning COVID-19 vaccination through a national survey including 1800 representatives of the Spanish population. WhatsApp, Facebook, and Instagram users were the most vaccinated. However, TikTok and YouTube hosted the highest percentage of the unvaccinated. In relation to the booster dose, most users show a positive attitude, with Facebook users standing out, while YouTube users show the highest rejection. In addition, users who have spent more time on social media were less vaccinated with booster doses and had a higher percentage of unvaccinated. Concrete data are provided to develop communication strategies such as segmentation and social listening to be carried out during a crisis.

Keywords: social media, vaccination, COVID-19, pandemic, WhatsApp.

1. Introduction

Spain is among the ten countries with the highest number of coronavirus deaths in Europe, reaching the mark of 116,442 deaths in 2022 (Orús, 2022). To control the pandemic, vaccination is considered the most effective strategy (Agencia Española de Medicamentos y Productos Sanitarios, 2023). Spain has a privileged vaccination status with 85.9 % of the population immunized with a full schedule as of February 2023 (Ministerio de Sanidad, 2023). However, the situation is not so rosy with booster vaccination, which is known to be essential to maintain protection against variant strains and emerging infections (Hardt *et al.*, 2022). Only 55.9 % of the adult Spanish population is vaccinated with the first booster dose, and coverage rates are quite heterogeneous depending on age and autonomous community (Ministerio de Sanidad, 2023).

Vaccine hesitancy is characterized by a negative attitude that may include refusal or hesitancy about vaccination, despite the individual having full access to vaccines. Defined in 2019 by the WHO as one of the major threats to global public health, the concern of governments and health authorities regarding vaccine hesitancy has been particularly prominent during the pandemic. Eguia *et al.* (2021) identified that, among the Spanish population, hesitancy towards vaccines was related, prior to the start of vaccination, to concerns about lack of efficacy, lack of safety and possible adverse effects. In addition, there are other factors that can influence the perception about vaccines such as, for example, conspiracy theories (Jolley & Douglas, 2014), which have spread notably in the population thanks to social media. In 2021, the number of social network users represented more than 58 % in the world population, an increase of 10 % over the previous year, and the time spent on media was almost 2.5 hours (Digital2022, 2022a). In the case of Spain, there are 40.7 million people using social media, spending almost two hours a day (Digital2022, 2022b).

The anti-vaccine community poses a great challenge to governments and public health services, especially during health crises such as COVID-19. These communities must be taken into account during the development of communication plans and strategies. The spread of false news and misinformation about vaccination can worsen the situation of a global health crisis. As is well known, one of the ingredients for fake news to achieve notoriety is that they must attract public attention. Pandemic-related facts, for example, fully meet this requirement (Fernandez-Torres *et al.*, 2021).

Previous studies show that social media have been the main transmitters of false content related to vaccines against COVID-19. Herrera-Peco *et al.* (2021), for example, when analyzing tweets in Spanish, found that the most frequent tweets were related to antivaccine content and questioned the safety of COVID-19 vaccines. Studies analyze antivaccine discourse, but this can be different from actual behavior, i.e., a person can post antivaccine discourse on their social media, but then get vaccinated, and vice versa. Moreover, in Spain, the population considers that social media are the channels that have spread the most *fake news* during the health crisis (Fernández-Torres *et al.*, 2021).

Taking into account this problem that interferes with and hinders adherence to health measures to control a pandemic, we believe that further study in this area is relevant in order to provide data that contribute to better communication in the field of health crises. In this sense, knowing the attitudes towards vaccination of social network users in a segmented way can provide data that can be easily transferred to the health departments and public health services in charge of developing communication campaigns aimed at the population to promote vaccination. To our knowledge, there are few studies on the real attitude towards vaccination of social network users in Spain. According to a survey conducted with Spanish residents (Casero-Ripollés *et al.*, 2023), misinformation had a low influence on decision making towards vaccination against COVID-19, although the presence of conspiracy theories is perceived. However, the central focus of the study was not on COVID-19 vaccines.

In addition, each social network is used by people with a similar sociodemographic profile and it is necessary to analyze this phenomenon in a segmented manner in each social network. Therefore, this study aims to investigate the association between the community of social network users and their behavior towards COVID-19 vaccines.

1.1. Hesitancy towards vaccination and the role of social media

Vaccine hesitancy is a complex global phenomenon and very present in several countries. It is defined as:

Delay in acceptance or refusal of safe vaccines despite availability of vaccination services. The issue is complex and context specific, varying across time, place and vaccines. It is influenced by factors such as misinformation, complacency, convenience and confidence. (WHO, 2015).

It is not a static phenomenon, i.e., a person may have some level of hesitancy for one period and change in another period. It may also happen that a person is reluctant and totally rejects any vaccine presenting a high level of hesitancy, or it may be that they accept some vaccines and reject others throughout their life (Larson *et al.*, 2014).

Hesitancy towards vaccines has been part of history since the beginning of immunization plans. The cases of Great Britain, at the end of the 19th century, stand out, when the government imposed compulsory vaccination, provoking a high level of citizen resistance, which is considered the beginnings of the anti-vaccine movement (Wolfe, 2002). In Brazil, there was a riot against the mandatory smallpox vaccine in Rio de Janeiro in 1904, resulting in dozens of deaths and injuries (Tuells, 2009). At the end of the 1990s, a British scientist claimed that there was a link between the MMR vaccine and autism. Although his study was totally discredited, this fact still feeds the denialist discourse and is considered the propellant of the current anti-vaccine movement (Boyce, 2006). More recently, in Italy in 2012, the Court of Rimini officially recognized a causal relationship between the measles, mumps and rubella vaccine, with autism, and awarded damages to the parents. Such a fact triggered a series of misinformation and news dissemination about this vaccine that was possibly reflected in the reduction of childhood immunization rates in this country since then. In 2015, this judgment was overturned, but the damage had already been done (Carrieri *et al.*, 2019).

We have seen this type of behavior intensify during the COVID-19 pandemic. In a systematic review, Dror *et al.* (2020) identified that the main psychological factors contributing to hesitancy toward COVID-19 vaccines are safety and side effects, as well as level of trust in vaccines, government and health professionals, skepticism about vaccine production, conspiracy beliefs, emotions, and information and knowledge about vaccines.

In this context, many high-income countries have failed to meet their COVID-19 immunization targets. In the case of the United States, for example, the childhood COVID-19 vaccination rate remains low. According to a survey conducted by Panchalingam and Shi (2022) to understand this phenomenon, they found that about 20% of parents refused to vaccinate their children based on sociodemographic issues, political orientation, vaccination status, and previous exposure of parents and children to COVID-19 disease. In this regard, vaccination programs should target specific communities and address the depoliticization of vaccination. Vaccine hesitancy is also present in low-income countries with low

vaccination rates. In the case of Papua New Guinea, survey data showed that less than 20% would get vaccinated, the main reason being fear of side effects and lack of trust in vaccines (Hoy *et al.*, 2022). In a global study of 173 English-, French-, Italian-, and Spanish-speaking countries, Dye *et al.* (2021) identified that people's perception of science is a predicting factor of acceptance of vaccination against COVID-19.

All kinds of content related to vaccines circulates on social media, from reliable sources to pseudoscientific content loaded with misinformation that contributes to vaccine hesitancy (Basch *et al.*, 2021a). In relation to the COVID-19 pandemic, it can be observed how the very dynamics of social media favor that the same hoaxes are published in different countries after adaptating to the local context in order for users to identify with that content (Sánchez-Duarte & Magallón-Rosa, 2020). For Nguyen and Catalan-Matamoros (2020) the fight against disinformation related to health and science in digital media must start from contemporary sociocultural contexts, with the predominance of the decline of experts and the rise of populist politics, beyond focusing more deeply on the different aspects of the psychological nature of its users. There is no doubt that digital social media poses a clear challenge to public health, as well as a being phenomenon that needs to be studied in depth given its importance in public perception of vaccine risk, as indicated by several authors (Wong & Jensen, 2020).

2. Method

2.1. Design

An observational design was followed by means of a nationwide online survey, conducted in June 2022. The recruitment of participants and the execution of the survey were carried out by the population studies company AsuFieldwork. Recruitment occurred through the dissemination of the survey on social media. Respondents received a small incentive for their participation.

2.2 Sample and ethical aspects

The online questionnaire was self-administered by residents of Spain generating a sample composed of 1800 participants with a minimum age of 18 years. To ensure the representativeness of the sample, the following strategies were used: a random selection was performed, a probabilistic method that allowed each individual from the Spanish population to have the same probability of being included in the study (Frost, n.d.). In addition, the

sample was distributed according to quotas established by gender, age, and autonomous community of residence in order to reflect the demographic composition of the Spanish population. Finally, the sampling error was ± 2.34 with a confidence level of 95.5 % and $p = q = 0.5$, which indicates the margin of error in the estimates made from the sample and provides an indication of the precision of the results obtained.

A weighting was applied to adjust the population data by autonomous communities, gender, and age, taking into account that those over 74 years of age obtained a lower participation rate.

The participants gave their authorization to participate in the research, and their data was completely anonymized. To comply with ethical requirements, the PredCov project (Multi-source and multi-method prediction to support Covid-19 policy decision making), in which this study takes place, was approved by the Ethics Committee of the Universidad Carlos III de Madrid through protocol CEI_22. At the end of the survey, participants had access to a text on the benefits of vaccination and the booster dose, as well as links to further information on the subject. The research methodology has been previously published in AsPredicted under code 97920.

2.3 Structure of the questionnaire

The questionnaire was evaluated by four experts and, subsequently, a pilot study was carried out with 110 people in order to verify whether it met the proposed objectives. The questionnaire was structured in 32 questions being most of the questions composed with multiple choice and, in some cases, the person could check more than one option (questions related to vaccination and social media used, for example). We applied filters to some multiple-choice questions so that the next question would only be answered by people who fit the desired profile. For example, if the person answered that he/she would not take the booster dose of the COVID-19 vaccine, the next question that would appear in the questionnaire would be related to the reasons why he/she had made this decision.

The questionnaire was structured in three blocks: sociodemographic questions, personal questions about vaccination against COVID-19, as well as use and behavior towards social media. For the sociodemographic questions, people answered about: **1)** age; **2)** gender; **3)** level of education; and **4)** autonomous community. To ascertain the vaccination status, the following questions were asked: **5)** Have you been vaccinated against COVID-19; **6)** Are you

willing to be vaccinated with a booster or "reminder" dose? Those who answered no were asked: **7)** For what reason(s) would you not consider getting vaccinated with a booster dose? Regarding social media: **8)** Rank the social media media you use in order of importance; **9)** Approximately how much time do you use social media (in hours per day); and **10)** What is your most frequent activity on social media?

2.4 Statistical analysis

Chi-square tests were performed to test whether the variables differed statistically significantly from each other (significance level $p < 0.05$). We started with the main/favorite social media used by the respondent. Secondly, to analyze user behavior towards social media, we relied on three variables describing three related but different dimensions of platform consumption: "users who consume content", "those who share content" and "those who produce content/creators". Third, we analyzed how much time was spent on social media (measured in quartiles). To compare the vaccination behavior of the three groups of social media users, we performed pairwise comparisons (using Wilcoxon rank sum tests) and global comparisons with Kruskal Wallis H-tests.

3. Results

The sample consisted of 51.1 % of males and 48.9 % of females with an average age of 45 years. 10.4 % belonged to the younger age group (18-24 years) and 11.6 % were in the older age group (74 years and older). With regard to educational level, the largest group was high school level (52.11 %), followed by university level (43.6 %) and primary level (3.7 %). 0.59 % of respondents did not provide this information.

To analyze the relationship between the use of social media and behavior towards COVID-19 vaccination, we selected the social media with the highest proportion of users, being WhatsApp ($n=994$; 55.2 %), Facebook (261; 14.5 %), Instagram (182; 10.1 %), YouTube (152; 8.4 %), Twitter (88; 4.9 %) and TikTok (75; 4.2 %).

The use of WhatsApp was frequent in all age groups, but with significant differences in the 65 to 74 age group where we found greater use, as the main network, compared to the other age groups. Facebook was a platform little used by the youngest, with significant differences for the 18 to 24 age group in relation to the others. On the other hand, Instagram presents the extremes, more used among the youngest and less frequent in older people, from 64

years and older. In the case of TikTok, something similar also happened with significant differences between the ages of 18-24 and 65-74 years , as can be seen in Table 1.

Table 1. Most used social media by age group

Social media you use in order of importance	18 a 24	25 a 34	34 a 44	45 a 54	55 a 64	65 a 74	Over 74 years old
WhatsApp	22.8	22.9	25.6	28.0	29.0	*33.8	30.0
Facebook	*7.1	15.0	19.3	21.0	21.9	22.5	22.5
YouTube	15.9	15.0	16.6	16.5	14.6	15.5	16.0
Instagram	*22.6	*21.1	16.8	14.9	13.3	*9.6	*10.6
Twitter	10.1	10.8	10.2	8.1	9.6	9.9	11.1
TikTok	*15.9	11.2	7.1	6.8	5.0	*2.7	5.0
Other	5.6	4.0	4.4	4.7	6.6	6.0	4.8
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Notes: Pearson χ^2 : 95% significance level. * Cells that have a higher contribution to the χ^2 value.

Source: Own elaboration.

Regarding behavior towards vaccination, WhatsApp users were the most vaccinated COVID-19 users, followed by Facebook and Instagram users, as shown in Table 2. However, differences in behavior towards vaccination among different social media users are striking. 56.47 % of TikTok users and 57.62 % of YouTube users, for example, had fairly positive behaviors towards vaccination (full pattern). However, YouTube and TikTok have the highest percentage of non-completers and non-vaccinated respondents compared to the other social media.

Table 2. Relationship between COVID-19 vaccines administered and the most used social media

Have you been administered the COVID-19 vaccine?	Social media you use in order of importance						Total
	Facebook	Instagram	TikTok	Twitter	WhatsApp	YouTube	
Booster dose	88	41	12	34	369	38	582
	36.36	21.47*	14.12*	36.56	37.96*	25.17*	33.56
Complete guideline	127	127	48	45	529	87	963
	52.48	66.49*	56.47	48.39	54.42	57.62	55.54
Partially vaccinated	8	14	16	6	30	5	79
	3.31	7.33*	18.82*	6.45	3.09*	3.31	4.56
Not vaccinated	19	9	9	8	44	21	110
	7.85	4.71	10.59*	8.60	4.53*	13.91 *	6.34
Total	242	191	85	93	972	151	1734**
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Notes: Pearson $\chi^2 = 104.63$ Prob = 0.000. * Cells that have a higher contribution to the χ^2 value. ** Of the 1800 respondents, 49 use other social media and 17 did not answer this question. The first row presents frequencies and the second row, percentages.

Source: Own elaboration.

Regarding receiving a dose of reinforcement, most users would receive it without hesitation, with Facebook users standing out positively. However, YouTube users are the least likely to do so. This social media also stands out in the response "I would only receive it in case of serious infections" in comparison with users of other social media. In addition, their level of rejection of vaccination is also higher when compared to other users, as described in Table 3.

Table 3. Relationship between the intention to be vaccinated with the booster dose and the most used social media

Are you willing to be vaccinated with a booster dose?	<i>The social media you use in order of importance</i>						
	Facebook	Instagram	TikTok	Twitter	WhatsApp	YouTube	Total
Yes, in any case	157	111	48	53	588	61	1018
	70.40*	60.99	63.16	62.35	63.36	46.92*	62.68
If there is a new wave of serious infections	44	45	21	20	238	45	413
	19.73*	24.73	27.63	23.53	25.65	34.62*	25.43
No	22	26	7	12	102	24	193
	9.87	14.29	9.21	14.12	10.99	18.46*	11.88
Total	223	182	76	85	928	130	1624**
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Notes: Pearson $\chi^2 = 22.72$ Prob = 0.0118. * Cells that have a higher contribution to the χ^2 value. ** Of the 1800 respondents, 49 correspond to other social media and 127 did not answer this question. The first row presents frequencies and the second row presents percentages.

Source: Own elaboration.

When exploring the relationship between vaccination status and the use of social media, we observed that the three variables related to social media behavior (consuming content; consuming and sharing; consuming, sharing and producing content) are associated with similar behaviors related to vaccination, as is the case of the complete regimen and the booster dose (Table 4). However, those who consume and share content presented a slightly lower proportion of unvaccinated (4.58%) when compared to the other groups. In addition, there is also a higher proportion of users with this profile who have been partially vaccinated when compared to content consumers and creators.

Table 4. Relationship between vaccination status and type of social media use

Have you been vaccinated against COVID-19?	<i>What is your most frequent use in social media?</i>			
	Read content	Read and share	Read, share and publish	Total
Booster doses with a full schedule	309	188	107	604
	34.88	31.92	34.63	33.86
Complete guideline	472	333	172	977
	53.27	56.54	55.66	54.76
Partially vaccinated	37	41	7	85
	4.18	6.96*	2.27*	4.76
Not vaccinated	68	27	23	118
	7.67	4.58*	7.44	6.61
Total	886	589	309	1784**
	100.00	100.00	100.00	100.00

Notes: Pearson $\chi^2 = 17.88$ Prob = 0.0065. The first row presents frequencies and the second row presents percentages.

* Cells that have a higher contribution to the χ^2 value. ** Of the 1800 respondents, 16 correspond to other social media.

Source: Own elaboration.

To explore the possible association between time spent on social media and vaccination-related behavior, we eliminated extreme results because we considered this information unreliable. Following a previous methodology (Lin *et al.*, 2016), we grouped respondents into quartiles. Results show that 32.6 % of users (quartile 1) spend up to one hour per day on social media, 24.2 % use the platforms from 1.5 to 2 hours (quartile 2), 25.12 %, between 2.5 and 4 hours (quartile 3) and 18.05 % from five to ten hours per day (quartile 4) (Table 5).

Table 5. Time spent on social media by Spanish users

Approximately how much time do you use social media (in hours per day)?	4 quartiles of time spent on social media				Total
	1	2	3	4	
5'	1	0	0	0	1
10'	4	0	0	0	4
15'	2	0	0	0	2
20'	1	0	0	0	1
25'	2	0	0	0	2
30'	9	0	0	0	9
50'	11	0	0	0	11
1	537	0	0	0	537
1.3	0	1	0	0	1
1.5	0	1	0	0	1
2	0	419	0	0	419
2.5	0	0	1	0	1
3	0	0	266	0	266
4	0	0	170	0	170
5	0	0	0	150	150
6	0	0	0	71	71
7	0	0	0	22	22
8	0	0	0	32	32
9	0	0	0	9	9
10	0	0	0	30	30
Total	567	421	437	314	1739*

**Respondents who reported spending 0 hour on social media or more than 10 hours were eliminated.*

Source: Own elaboration.

When associating the time people spend on social media with the decisions they have made regarding vaccination against COVID-19, we found no significant differences between the four quartiles in relation to the complete pattern. However, users who spent more time on social media (quartiles 3 and 4) were less vaccinated with the booster dose when we compared with the other groups. Users who spent more time on social media also presented a higher percentage of partially vaccinated (quartile 4) and unvaccinated (quartile 3), as described in Table 6.

Table 6. Relationship between vaccination status and time spent on social media

Have you been vaccinated against COVID-19?	4 quartiles of time spent on social media				Total
	1	2	3	4	
Booster dose	240	161	117	68	586
	43.09*	38.33*	26.96*	21.79*	34.01
Complete guideline	277	216	259	191	943
	49.73*	51.43	59.68	61.22*	54.73
Partially vaccinated	11	21	21	30	83
	1.97*	5.00	4.84	9.62*	4.82
Not vaccinated	29	22	37	23	111
	5.21	5.24	8.53*	7.37	6.44
Total	557	420	434	312	1723**
	100.0	100.0	100.0	100.0	100.0
	0	0	0	0	0

Notes: Pearson $\chi^2 = 73.45$ Prob = 0.0000. *Cells that have a higher contribution to the χ^2 value. **Of the 1800 respondents, 49 correspond to other social media and 28 did not answer this question. The first row presents frequencies and the second row presents percentages.

Source: Own elaboration.

4. Discussion

This study conducted a national survey with 1800 participants with the aim of analyzing use of and behavior on social media, as well as the decisions taken towards vaccination against COVID-19. Among the results obtained, it is worth highlighting some findings that should be taken into consideration in the planning and management of communication plans during health crises: **(a)** people who use WhatsApp as their main social media show a behavior towards vaccination that is more positive, while those who use YouTube and TikTok are the least vaccinated or the most reluctant; **(b)** intense daily use of social media is associated with less vaccination than reduced daily use; **(c)** the social media preferred by users in Spain during the health crisis were, in this order, WhatsApp, Facebook, Instagram, YouTube, Twitter and TikTok, results similar to those found in other surveys (Digital2022, 2022b; IABSPAIN, 2022). In this sense, the Spanish population presents a particularity according to the consumption of social media when compared to the world ranking, as Spanish users used WhatsApp as their main social media, while, in global terms, Facebook tops the list (Digital2022, 2022a).

Our findings have found associations between the use and behavior of users of social media in Spain and more favorable behaviors towards vaccination against COVID-19, as in the case, for example, of WhatsApp users. Respondents who have highlighted this social media as the most important are, in general, older people, mainly in the 65-74 age group. In this sense, Spain has high booster dose rates in this population compared to the younger population: people aged 60 to 69 years and over 70 years present immunization rates of 94.6 % and 93.7 %, respectively, while the young population aged 20 to 29 years presents immunization rates of 44.90 % (Ministry of Health, 2023). Taking into account that Spain was the country that grew the most in the use of WhatsApp during the COVID-19 health crisis (Elías & Catalan-Matamoros, 2020), it should be considered using this social media or messaging channel in future communication campaigns by public health services during health crises to achieve a larger audience.

However, we have found that using TikTok and YouTube as the main social media is associated with greater vaccine-averse behavior (either not being vaccinated, having a partial vaccination schedule, or not having a booster dose). The effect is even greater in the case of TikTok. This network was created by a Chinese company in which users can produce and share short videos (Fernández, 2022a). Its popularity is growing and its number of users is increasing every year worldwide (Digital2022, 2022a; Fernández, 2022a). In addition, it has conquered more and more users in Spain, becoming the social media to have grown the most in users in 2022 in this country (IABSPAIN, 2022), with approximately 15 million users, and occupying the 20th position in the world ranking (Fernández, 2022b). TikTok also received the highest number of views in 2022 among Spanish users (IABSPAIN, 2022). Its audience is mainly made up of young people: 42% of its users worldwide are between 18 and 24 years old and 31% between 25 and 34 years old (Celi, 2022). This profile coincides with the results among the participants who have used this social media the most in our study.

However, the fact that it is a social media that is mostly used by young people may have implications in relation to the quality of information they have access to related to vaccines against COVID-19. For Basch *et al.* (2021b), young people may be more vulnerable to misinformation about vaccination, considering that their main source of information is social media. There are virtually no studies analyzing content posted on TikTok related to COVID-19 vaccines. Basch *et al.* (2021b), for example, when analyzing the videos posted on

this social media, found content that discouraged vaccination against this disease, receiving a high number of views.

On the other hand, the social network YouTube stood out in our study in several ways. Many people use social media platforms such as YouTube to search for and share health-related information that can influence their decision making about COVID-19 vaccination (Basch *et al.*, 2021a). According to this social media, in our study it has the highest concentration of non-vaccinees (13.91 %) compared to the other groups. Created in 2005, YouTube has 2.56 billion users worldwide (Digital2022, 2022a). In the case of Spain, it ranks second after Google.com in most visited websites (Digital2022, 2022b).

Studies prior to the coronavirus pandemic already noted the frequent presence of antivaccine content in videos posted on YouTube (Basch *et al.*, 2017). In relation to COVID-19 vaccines, Chan *et al.* (2021) and Marwah *et al.* (2021) identified that videos posted on this social network generally lack quality and reliability. Basch *et al.* (2021a) found an increase in the number of videos and views regarding topics such as fear of vaccines, their efficacy, and adverse reactions during the COVID-19 pandemic. In this sense, data originating from these platforms may be an indication related to vaccine hesitancy in population terms. Monitoring misinformation on social media about COVID-19 vaccines should be a central part of health policies in order to create strategies to develop effective information campaigns against negative messages towards vaccination and misinformation during a health crisis (Basch *et al.*, 2021a; Hernández-García *et al.*, 2021).

In relation to the time people spend on social media, we found that using social media more intensively, for longer, from 2.5 to 4 hours and from 5 to 10 hours is associated with being less vaccinated against COVID-19.

Our study has several limitations. The sample is not satisfactorily representative of all age groups, taking into account that we obtained a lower participation rate in those over 74 years of age. The survey was self-administered which cannot guarantee the level of understanding of the respondents towards the questions, as well as the veracity of all the answers received. On the other hand, the answers with more interaction between social media and a rejection towards COVID-19 vaccines come from a limited sample of users (TikTok, YouTube). Moreover, these social media are less used as a main platform in Spain. In this sense, it

would be important to develop future studies that specifically investigate these social media in order to obtain more robust data in relation to the object studied.

We believe that the results presented here should not be generalized. Despite the significant presence and role of social media in our daily lives, it is important to take into account the following aspects: **1)** people have access to various sources (mass media, people close to them, health professionals, scientific institutions, etc.) to obtain information about vaccines (Mosteiro-Miguéns *et al.*, 2021; Park *et al.*, 2021); **2)** starting from this premise, it is complex to specifically assess the influence of social media on behavior towards vaccines; and **3)** vaccine hesitancy is a difficult phenomenon to understand, in which several factors are involved, such as access to health services, perception of disease-related risk, efficacy and safety of vaccines (Arriola *et al.*, 2015; Malecki *et al.*, 2021; Thorpe *et al.*, 2022).

Despite these limitations, our findings are relevant in showing a trend between the use of social media and behaviors towards vaccination, mainly in relation to future booster doses, taking into account that Spain needs to advance in the use of this public health strategy to combat the COVID-19 pandemic. Furthermore, rather than asserting direct causality, we highlight that social media can act as channels for the dissemination of information and misinformation, which can influence people's perceptions and attitudes towards vaccination.

This study provides concrete data that can help in the development of communication strategies such as segmentation and social listening that should be carried out in vaccination campaigns during health crises to improve our understanding of how some factors that may influence vaccination are being propagated through social media. In addition, the importance of communication in health crisis situations is highlighted, as well as the need to integrate the analysis and management of social media in all communication strategies by governments and public health services.

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Conflict of interest

The authors declare that there is no conflict of interest.

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