

Original article

COVID-19 pandemic and mental health in Spain: An analysis of their relationship using Google Trends

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ABSTRACT

Introduction: This study aims to examine the public interest that exists on Internet regarding various mental health topics and its relationship with evolution of COVID-19 pandemic in Spain.

Materials and methods: Google Trends was used to explore relative search volume (RSV) for the following terms related with mental health (TRMH): “anxiety”, “depression”, “stress”, “insomnia” and “suicide”; between January and December 2020. The cross-correlation function was performed to assess association between new COVID-19 cases and RSV levels for TRMH. Finally, Mann–Whitney test was used to examine differences between RSV values for TRMH before and after of state of alarm declarations on March and October 2020.

Results: The “anxiety” term showed the highest RSV indices. A significant correlation was found between new COVID-19 cases and RSV for “anxiety” with a time-lag of +1 week ($r = 0.49$; $p < .05$). Was found an increase of SRV for “anxiety” ($U = 0.00$; $p = .01$) and a decrease of SRV for “depression” ($U = 1.00$; $p = .04$) between 4-week period before and after state of alarm of March 2020. Regarding the state of alarm of October 2020, a higher RSV for “anxiety” ($U = 0.50$; $p = .02$) was found in the four weeks after it compared with a similar previous period.

Conclusions: Anxiety is the mental health topic of greatest public interest on Internet in context of COVID-19 pandemic. Public concern about anxiety rises one week after the increase in COVID-19 cases and is greater after introduction of control measures that entail any type of mobility restriction or activity limitation. There is a greater general need for information on anxiety at specific times in the pandemic evolution.

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Introduction

The health crisis caused by the COVID-19 pandemic and the control measures (such as lockdowns, restricted freedom of movement, etc.) implemented in Spain to contain it have had a negative impact on the psychological well-being and mental health of the population.^{1–3}

Recent studies show that the impact of the pandemic at the psychological level in the population can also be evidenced, on the one hand, by the increase in the volume of Internet searches on topics related to mental health (such as anxiety, worry, panic, or sadness) after the World Health Organisation (WHO) declared the pandemic and when quarantine measures were introduced by different countries.^{4–7} And on the other, the impact can be seen through the positive relationship shown by the number of new cases of COVID-19 with the volumes of web searches on some

of these topics (e.g. anxiety, depression, insomnia, or suicide) in different countries.^{8–10} Several international research studies have conducted initial analyses of the volumes of internet searches on mental health (using the Google Trends application to estimate social interest in these topics) in the context of the COVID-19 pandemic in Spain.^{4,7,8}

These studies show an increase in searches related to anxiety after the state of alarm was decreed on 14 March 2020,⁴ and a positive correlation between the volume of Internet searches for the terms “insomnia” and “anxiety” and the number of cases of COVID-19.⁸ Volumes of web searches for other terms such as suicide or depression have not been associated with the number of COVID-19 cases reported in Spain, although pooled analysis of data from 24 countries indicates a negative relationship between the volume of internet searches for these terms and the number of people infected with coronavirus.⁸ The association found in Spain for the volume of web searches for insomnia and cases of coronavirus infection was not found at the global level.⁸ Regarding the association between COVID-19 cases and web searches on topics of anxiety, pooled data analysis did not show that the relationship found in Spain occurred

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globally.⁸ Similarly, after the implementation of the lockdown measures in March 2020, it was observed that the increase in web searches on anxiety occurred only in Spain, where the levels of web searches for the terms depression and suicide remained stable.⁴

These studies only analyse information on the volume of web searches in Spain up to a few weeks after the WHO (specifically up to 30 March 2020 and 13 April 2020) declared the disease a pandemic,^{4,8} or they integrate the data from Spain with those from other European countries for their joint analysis.⁷ Another aspect to be considered with respect to these studies is that they analyse the relationship between the number of cases of COVID-19 and the volume of Internet searches on mental health issues at the same time (using Spearman or Pearson coefficients),^{8–10} not considering the temporal sequence of these variables and their possible influence at the time of association.

Based on the above, this study investigates over a longer period of time (between January and December 2020) the general interest in various mental health topics (using Google Trends Internet search volumes) as the COVID-19 pandemic evolved in Spain, specifically with the following main objectives: a) to analyse the association, and whether there is a time lag in it, between changes in the number of COVID-19 cases and the volume of internet searches for mental health content; and b) to compare data on the frequency of web searches on different mental health topics during the weeks before and after the states of alarm were declared on 14 March and 25 October 2020.

Materials and method

Information retrieval

Data on COVID-19 cases in Spain were obtained on 14 December 2020 (for the period from 5 January to 5 December 2020), collected from statistics provided by the National Epidemiology Centre of the Ministry of Health.¹¹

Google Trends¹² was used to examine internet search trends for mental health in Spain. This tool calculates a relative search volume index (RSV) for different terms or keywords in a given region and time period. The RBV ranges from 0 to 100, where a score of 100 indicates the highest search volume for a particular term within a specified search category and time period of interest. This online application is very useful because it collects information on the Internet search behaviour of users who use the Google search engine, the most widely used search engine worldwide.^{13,14} It is also a low-cost data source widely used in research and surveillance of various health issues,^{13,15–17} provides aggregate measures of web search activity in specific locations with a high level of geographic accuracy, and captures the expressions and terms used in daily searches.^{7,13,14}

On 9 March 2021, we retrieved weekly RSV index data for the terms related with mental health (TRMH) “*ansiedad*” (anxiety), “*depresión*” (depression), “*estres*” (stress), “*insomnia*”, and “*suicidio*” (suicide) (terms selected because they are keywords repeatedly used in previous studies of mental health web search trends),^{4,6–8,18} for the period 5 January 2020 to 5 December 2020. The search had to have been conducted in Spanish in all web query categories (science, news, health, etc.).

Data analysis

Google Trends search indices for the indicated TRMH and COVID-19 weekly new case data were used to generate integrated line and bar charts for an aggregated representation of weekly data for these variables for the period 5 January to 5 December 2020.

Difference transformations were performed on the data to obtain stationary time series.¹⁹ The aim of these transformations was to calculate the difference between each of the weekly data and the previous datum to eliminate the trend of the time series of each of the measures used in the study. Once obtained, the relationships between the series of new COVID-19 cases and those corresponding to the RSV indices for the five TRMH were analysed using the cross-correlation technique. This technique allows the study of associations between time series that do not occur simultaneously, and can thus analyse the relationship between a series occurring at a given time and another series occurring at a later time.¹⁹ Cross-correlation function coefficients (r coefficients, which report the degree and positive or negative direction of the association between time series and vary in the range from 1 to -1) were calculated using a time lag between -4 and +4 weeks and considering as a precursor variable the time series of new weekly cases of COVID-19 on the series of RSV indices for the different TRMH explored.

The Mann-Whitney U test was used for the comparison of search frequencies for the TRMH of interest between the four-week periods before and after the declaration of the states of alarm on 14 March and 25 October 2020 by the Government of Spain. SPSS version 15 statistical software was used to perform the analyses.

Results

Figure 1 shows the weekly data on new cases of COVID-19 and RSV for the different TRMH in the time period studied. It shows a consistently higher volume of weekly web searches related to the term “anxiety” compared to the terms “depression”, “stress”, “insomnia” and “suicide” in the period examined. The highest peaks of interest for web searches on anxiety were reached in the second week after the state of alarm was decreed on 14 March 2020 (RSV = 100) and in the week when the state of alarm was declared on 25 October 2020 (RBV = 91) (Fig. 1).

Table 1 shows the average RSVs provided by the Google Trends tool for the different TRMH examined in Spain and in the different autonomous communities and cities. In general, as is the case at the national level, it can be observed that in the different regions there is a main interest in anxiety topics followed by search interest in the terms “depression”, “stress”, “suicide”, and “insomnia” (Table 1).

As can be seen in Figure 2, the study of the association between the time series of weekly new COVID-19 cases and RSV indices for the five TRMH found that there was only a significant correlation between the number of COVID-19 cases and the volume of anxiety searches with a one-week lag ($r = .49$; standard error = .14; $p < .05$); (Fig. 2).

Table 2 shows the results of comparisons of average RSVs for the TRMH between the four-week periods before and after the states of alarm of 14 March and 25 October 2020. A higher average volume of anxiety-related internet searches was found in the four weeks after the states of alarm were declared on 14 March and 25 October 2020 compared to the four weeks before these measures came into force (Table 2). Conversely, a lower volume of depression-related internet searches was found in the same four-week period after the state of alarm was declared in March 2020 (Table 2).

Discussion

In this study, Google Trends RSV analysis suggests that anxiety is the mental health topic of greatest public interest in Spain in the context of the COVID-19 pandemic. Peaks of maximum interest in web searches for the term “anxiety” were found after the states of alarm were declared in March and October 2020.

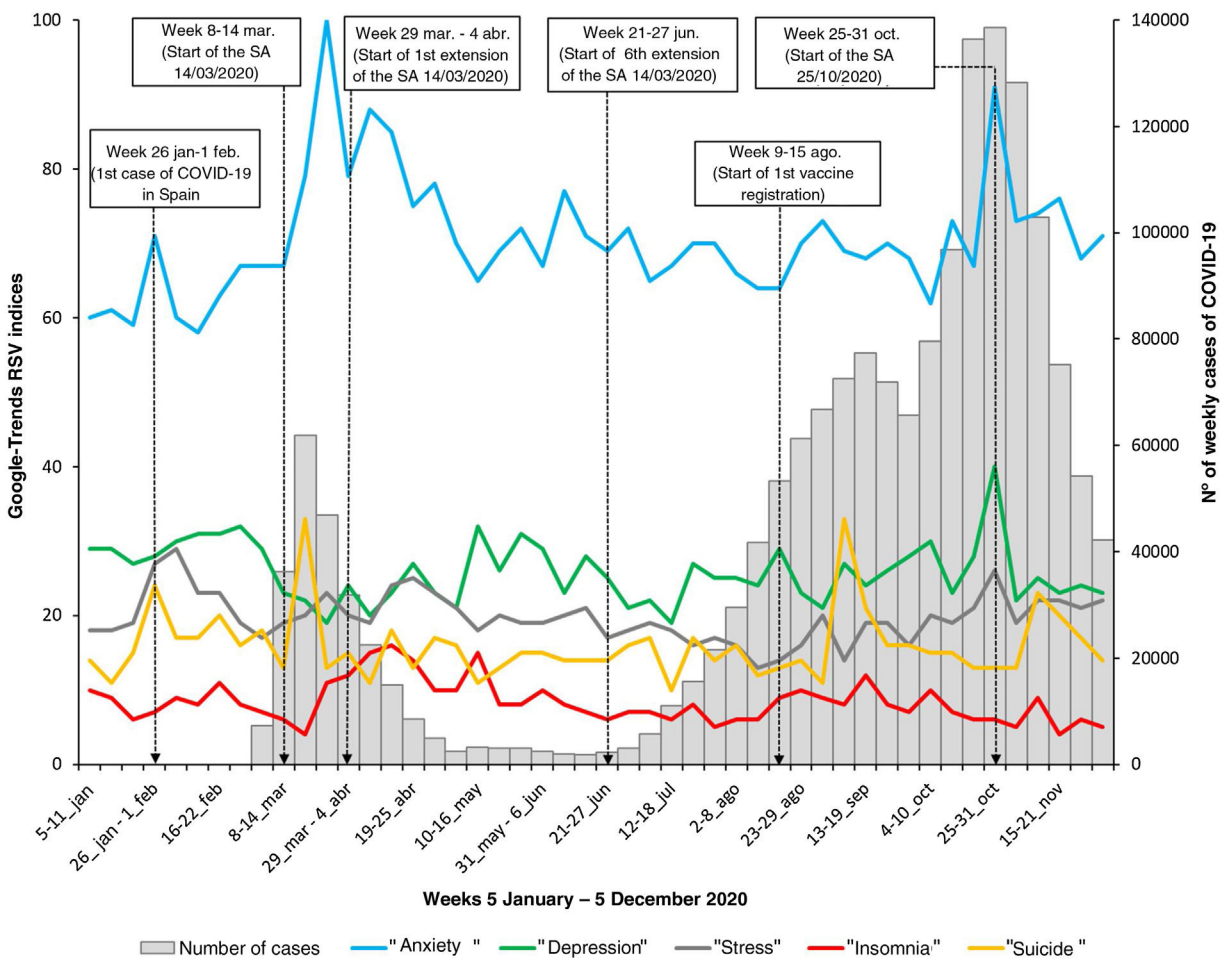


Figure 1. Relative search volume (RSV) indices for the terms “anxiety”, “depression”, “stress”, “insomnia” and “suicide”; together with the number of new weekly cases of COVID-19 in Spain from 5 January-5 December 2020. The dashed arrows and text boxes indicate the week in which different milestones occur that are relevant to the COVID-19 pandemic and the implementation of measures for its control in Spain. SA: state of alarm.

Table 1
Average relative search volumes provided by Google Trends for the terms “anxiety”, “depression”, “stress”, “insomnia”, and “suicide” for the different Spanish regions for the period 5 January to December 2020.

	“anxiety” Average RSV	“depression” Average RSV	“stress” Average RSV	“insomnia” Average RSV	“suicide” Average RSV
Spain	71	26	20	8	16
Andalusia	73	28	22	8	16
Aragon	58	20	16	7	13
Canary Islands	54	21	14	6	14
Cantabria	49	16	14	6	11
Castilla y León	53	19	14	6	13
Castilla-La Mancha	56	17	11	5	10
Catalonia	71	27	21	8	14
Ceuta	15	6	7	0	1
Community of Madrid	66	25	19	8	16
Valencian Community	69	27	18	8	16
Extremadura	48	17	15	6	13
Galicia	54	21	15	6	16
Balearic Islands	52	20	17	7	14
La Rioja	33	10	8	3	6
Melilla	19	4	2	0	0
Navarra	33	11	10	3	7
Basque Country	61	22	19	7	16
Principality of Asturias	54	25	14	5	15
Region of Murcia	56	20	15	6	11

RSV: relative search volume.

Other findings of the present study show, on the one hand, that public interest in anxiety-related topics is higher in the four-week period following the implementation of regulatory measures to contain infections (either more restrictive measures involving lock-

down such as those imposed in the state of alarm of 14 March 2020, or measures involving only restricted activity such as those decreed in the state of alarm of 25 October 2020) compared to a similar period before. And on the other hand, they show that increases or

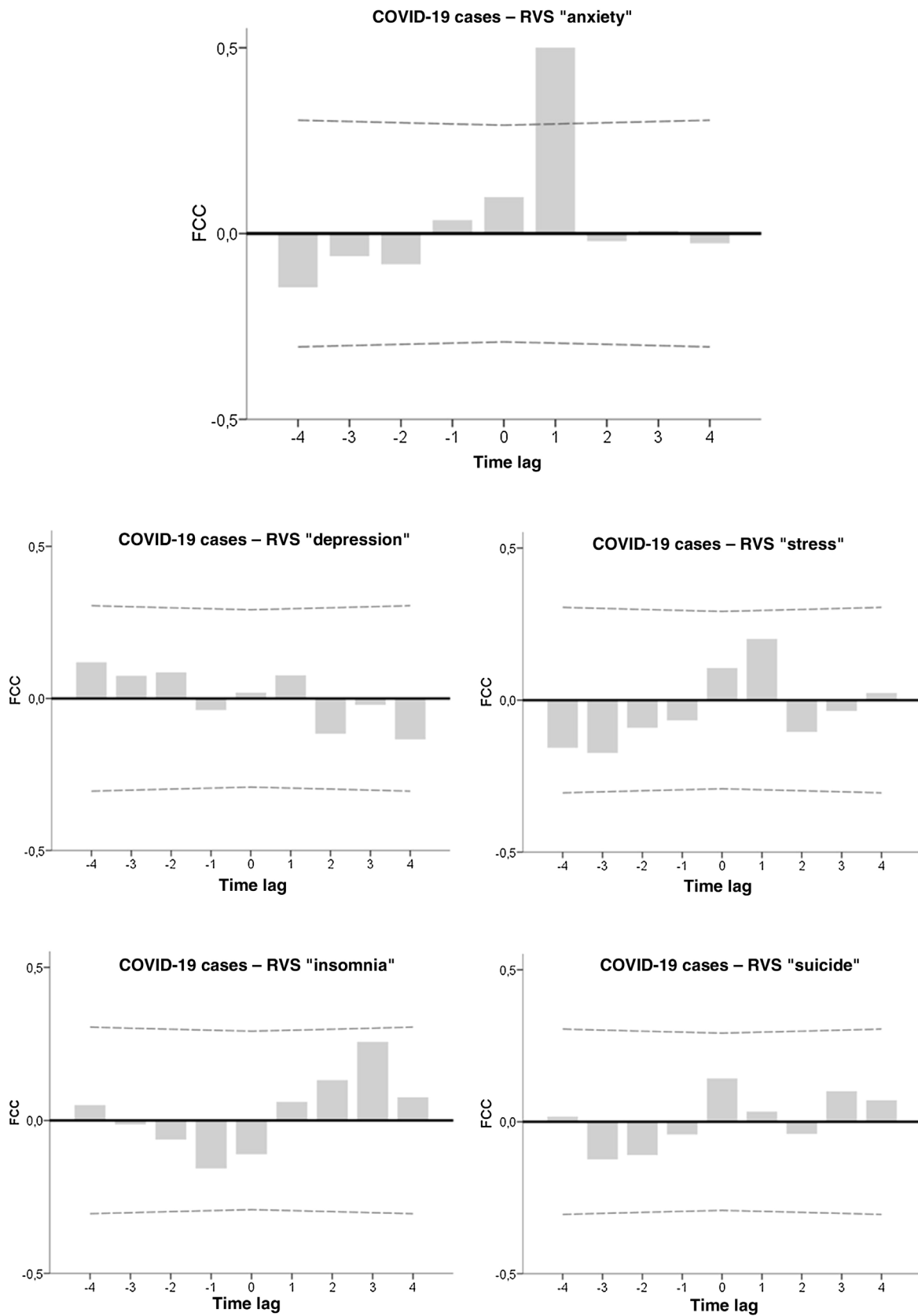


Figure 2. Cross-correlation function (CCF) plots between the time series of new COVID-19 cases and relative search volume (RVS) indices for the terms "anxiety", "depression", "stress", "insomnia", and "suicide". The lag indicated on the x-axis refers to the time lag of the association expressed in weeks. The bars represent the value of the CCF coefficient (r) and the dashed lines indicate the limits for statistical significance at a 95% confidence interval ($p < .05$; if it is satisfied for a given lag (k) that $r(k) > 1.96 \times$ standard error).

Table 2

Comparison of average ranges of relative search volumes performed on Google Trends for the terms “anxiety”, “depression”, “stress”, “insomnia”, and “suicide” in the four-week periods before and after declaration of the states of alarm on 14 March and 25 October 2020.

TRMH	Period before (4 weeks) the SA of 14/03/2020 Average range of RSV	Period after (4 weeks) the SA of 14/03/2020 Average range of RSV	U (p)
“anxiety”	2.50	6.50	.00 (.01)
“depression”	6.25	2.75	1.00 (.04)
“stress”	3.62	5.37	4.50 (.29)
“insomnia”	3.63	5.38	4.50 (.30)
“suicide”	5.13	3.88	5.50 (.46)
TRMH	Period before (4 weeks) the SA of 25/10/2020 Average range of RSV	Period after (4 weeks) the SA of 25/10/2020 Average range of RSV	U (p)
“anxiety”	2.63	6.38	.50 (.02)
“depression”	5.13	3.88	5.50 (.46)
“stress”	3.13	5.88	2.50 (.10)
“insomnia”	5.63	3.38	3.50 (.18)
“suicide”	4.25	4.75	7.00 (.76)

RSV: relative search volume; SA: state of alarm; TRMH: terms related with mental health; U: Mann-Whitney U test.

decreases in the number of COVID-19 cases precede within a week the increases or decreases in public interest in anxiety issues indicated by the RSV indices. In this sense, when the number of cases of people with coronavirus increases, one week later, the volume of internet searches on anxiety-related topics increases.

These results are in line with previous studies conducted in the first 2–4 weeks of the pandemic in Spain, where an increase in searches on anxiety-related topics was observed after the state of alarm declared on 14 March 2020⁴ and a positive correlation between the number of cases of coronavirus and the volume of anxiety-related web searches.⁸ This study analyses RSVs on different mental health topics in the context of the pandemic over a much longer period of time (11 months) than other research conducted in different countries (such as the United States, India, the United Kingdom, Italy, etc.) that have only studied a period of between 14 days and 4 months after the WHO declared the pandemic.^{4,5,8–10} It also considers the time sequence of the variables in the study of the association between the number of cases per COVID-19 and the volume of web searches on mental health issues, an aspect not considered in previous studies.^{4,9,10} Specifically, with respect to these investigations, the present study provides specific information on: a) the directionality and temporality of the association between the evolution of the infection curve in Spain and public interest in mental health issues, and b) the variation that occurs in the RSV in different TRMH before and after the two national states of alarm decreed in order to control the disease.

This higher volume of web searches on “anxiety” could indicate that in the current pandemic context there is an increase in the number of people who are experiencing anxiety,^{6,20} or are more interested in this mental condition than other mental health issues. However, future events potentially being perceived as threatening or out of control (health, economic, social, etc.) due to the evolution of the epidemic and the need to impose strict measures for its control may be responsible for the higher volume of internet searches for anxiety-related topics, reducing, in turn, those of other TRMH (as, for example, occurs with the term “depression” in the weeks following the state of alarm decree of 14 March 2020). In addition, the difficulty in accessing essential health and mental health services due to COVID-19²¹ may impact the higher volume of internet searches for TRMH.⁶ In the case of Spain, this limited access to health services may have led to a higher rate of anxiety-related difficulties and an increase in web searches for guidance that is difficult to obtain by other means.

This study has several limitations that need to be considered. First, Google Trends only provides information from users who use Google as a web search engine and the data on search volumes it collects are relative, not absolute. Second, spelling choices and terms of interest may affect the results and there is no standard procedure for data collection using this tool. Finally, the data provided by Google Trends does not represent a random sample of the Spanish population as there may be population groups with interest or concern for mental health issues who do not have access to the Internet or who do not make web searches using the TRMH used in this study.

In conclusion, the results suggest a potential main need for information on anxiety issues in the Spanish population, which is greater in the week following the increase in COVID-19 cases or when general regulatory control measures are implemented that, to a greater or lesser extent, impose restrictions on mobility and free movement or limitations on personal contacts and social gatherings. This suggests that, during pandemic, it could be relevant to focus mental health information, intervention, and prevention especially on anxiety-related issues, especially after the increase in cases or implementation of infection control measures imposing some kind of limitation of activity or movement.

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Conflict of interests

The authors have no conflict of interests to declare.

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