Predictive factors of non-pharmacological measures to prevent SARS-CoV-2 contagion: A cross-sectional study in a large adult Spanish sample from PSY-COVID study

Corel Mateo-Canedo (1), Juan P. Sanabria-Mazo (1,3), Jose-Blas Navarro (2), Igor Cigarroa (4), María Álvarez (1), Manuel Armayones (7), Luis J. Martínez-Blanquet (6), Rafael Zapata Lamana (5), Neus Crespo (1), Marta Korniyenko (1), and Antoni Sanz (1).

1) Department of Basic, Developmental and Educational Psychology, Autonomous University of Barcelona,08193 Cerdanyola del Vallès, Spain; corel.mateo@uab.cat (C.M.-C.); juanpablo.sanabria@uab.cat (J.P.S.-M.); maria.alvarez@uab.cat (M.A.); neus.crespo@uab.cat (N.C.); marta.korniyenko@autonoma.cat (M-K); antonio.sanz@uab.cat (A.S).

2) Department of Psychobiology and Methodology of Health Sciences. Autonomous University of Barcelona, 08193 Cerdanyola del Vallès, Spain; joseblas.navarro@uab.cat (B.N.).

3) Institut de Recerca Sant Joan de Déu, 08950 Esplugues de Llobregat, Spain

4) Escuela de Kinesiología, Facultad de Salud, Universidad Santo Tomás, Los Ángeles 4440000, Chile; icigarroa@santotomas.cl

5) Escuela de Educación, Universidad de Concepción, Los Ángeles 4440000, Chile; rafaelzapata@udec.cl

6) Facultad de Psicología, Universidad Autónoma de San Luis Potosí, México. luisjmar@gmail.com

7) Behavioural Design Lab, eHealth Center. Universitat Oberta de Catalunya. Rambla del Poblenou 156, 08018 Barcelona. marmayones@uoc.edu

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Conflict of interests

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Correspondence: Antoni Sanz. Departament de Psicología Bàsica, Evolutiva i de l'Educació. Carrer de la Fortuna, s/n. Campus de Bellaterra, Universitat Autònoma de Barcelona, 08193 Cerdanyola del Vallès, Barcelona (Spain). antonio.sanz@uab.cat

ABSTRACT

The objective of the study was to identify the factors that predicted the intention to carry out coronavirus infection prevention behaviors in the Spanish population during the first wave of the pandemic, a time when the vaccines were in the development phase and the containment of the pandemic. depended on non-pharmacological measures. An observational study was carried out based on an online form that contained evaluation instruments for possible predictor variables of 7 prevention behaviors, based on non-probabilistic sampling of the adult Spanish population. Self-efficacy and outcome expectations related to COVID-19 preventive behaviors, as well as the interaction of perceived severity with both personal vulnerability and actual adherence, appeared as the main predictive variables of the intention to carry out preventive behaviors against the SARS-CoV-2 virus. Slight but significant differences were observed in behavioral intentions between Spanish autonomous communities, probably linked to the differences in the impact of the pandemic in each territory. It is necessary to implement consistent communications that allow for the development of appropriate expectations and encourage adherence to preventive behaviors, as well as recognizing regional disparities in preventive behaviors and their causes, to promote compliance.

Keywords: Adherence, behavior, disease prevention, health promotion, self-efficacy, social factors.

INTRODUCTION

Since the first case of the Coronavirus disease (COVID-19) was reported in China in December 2019, the SARS-CoV-2 virus spreaded all over the world. Spain was one of the first and most affected countries, representing a great challenge in the implementation of public policies to stop the virus transmission. In November 2023, more than 771.000.000 people in the world and almost 14.000.000 in Spain had been diagnosed with COVID-19; 6.900.000 had died from this virus worldwide, with 121.000 deaths in Spain. Because of the high number of daily infections, hospitalizations and deaths, the health care system was surpassed throughout the pandemic crisis [1]. In this context, besides the non-existence of pharmacological measures to prevent contagions in the period previous to the development of vaccines, several countries implemented health, behavioral and social measures. In Spain, the measures included home-isolation, use of face masks, social distancing and other hygiene measures to be adopted at individual, group, and public levels. These preventive health measures were adopted worldwide in a somewhat standardized way, following the recommendations of the World Health Organization [2], particularly during the first wave of the pandemic, when up to ⅔ of world inhabitants were simultaneously affected by some type of public measures to contain the spread of the virus. However, the compliance levels between people differ significantly [3,4] making it necessary to understand what drives the heterogeneity of compliance rates of such protective behaviors. Sociodemographic characteristics that predict compliance with preventive measures have been studied to define risk population profiles for non-adherence to measures of public health. Being women [5,6,7,8] and elder [9,10,11] appear to predict the measures compliance. Some studies did not find a direct relationship between compliance and income level [12,8] but the results are not clear [13]. Also, the relation between education level and the willingness to self-isolate needs further studies to clarify [14,15].

Following the prevention and health promotion models [16,17,18,19], several studies have analyzed the predictive factors of this type of behavior. Drury et al. [20] highlighted the importance of understanding the role of group processes in the pandemic, as well as the need to provide reliable information channels to promote compliance with health recommendations. Beca-Martínez [21] found that adherence to preventive measures was associated with severity perception of the virus, trust in specialized information sources and positive attitudes about compliance with the measures. Also, some studies underlined the role of self-efficacy to comply with the measures [21,22,23] and trust in government and health authorities [7,22,24].

Given that the SARS-CoV-2 virus impact on health, health care systems, restrictions and the characteristics of the Spanish population are distinctive, it was necessary to characterize the impact of this pool of factors in compliance with preventive measures in this country.

This study aimed to explore the predictive power of behavioral, cognitive, social, affective, and sociodemographic factors on the past experience and future intention to comply with COVID-19 preventive measures. Also, although the measures were implemented at the national level, our purpose was to analyze the impact of the residence in each territorial unit of the country in the adoption of preventive behaviors, taking in consideration that the differential impact of the pandemic could affect the compliance of the public health measures at individual level. Given the exceptionality of this health alert, the focus was not on a specific set of variables, but rather on identifying the predictive capacity among a broad range of variables from an exploratory perspective. The assessment tool used in the present study aimed to collect a broad spectrum of potential predictors of the intention to behave following the COVID-19 health authorities' recommendations.

METHOD

1. Design and procedure

PSY-COVID is a cross-sectional study that aimed to explore the psychological impact of the COVID-19 pandemic in 30 countries. Particularly, this article reports the findings of the sample resident in Spain during the lockdown measures. An anonymous online survey (Google Forms®) was carried out using a non-probabilistic sampling (snowball method). The approximate time to complete the survey was 15 minutes. The survey was distributed through social networks (Facebook®, Instagram®, Twitter®, WhatsApp®), media (newspapers, television, and radio), and institutional contacts (universities, foundations, and health organizations) from May 15th to June 5th, 2021. The list of variables and instruments selected for this survey were validated by a panel of 30 international health researchers and translated into 16 languages, including Spanish, Catalan, Galician, Basque, and English.

The survey also incorporated a consent to participate in this study. This research was approved by the Animal and Human Experimentation Ethics Committee of the Autonomous University of Barcelona (CEEAH-5197) and followed the Code of Ethics of the World Medical Association (Helsinki Declaration) for experiments involving humans.

2. Participants

In total, 17.725 people answered the online survey in Spain, but 2.594 were excluded from this analysis because they resided in other countries during lockdown measures. Finally, the sample consisted of 15.131 participants. Inclusion criteria were: (1) adults (≥18 years old) and (2) residents in Spain during lockdown measures adopted during the first wave of the COVID-19 pandemic.

3. Measures

The measures described hereinafter are the variables extracted from the PSY-COVID database that are relevant for the purposes of this study [25]

3.1. Sociodemographic characteristics

The sociodemographic information questionnaire was included to collect data about age, gender (female and male), educational level (primary, secondary, and university), income level (low, medium, and high), and region of residence in Spain.

3.2. Personality

A brief, ad-hoc version of the The NEO Five-Factor Inventory [26] was used to measure the five dimensions of personality: neuroticism, extraversion, agreeableness, conscientiousness, and openness to experience. The highest factor saturation item for each dimension was used. The answer to these items was a 5-point Likert type, in which 1 corresponds to "*strongly disagree*" and 5 to "*strongly agree*". Higher values indicate greater traits in each dimension of the personality.

3.3. Prevention behaviors and cognitions

A 35-items ad-hoc inventory was used to measure seven health behaviors in regard to five constructs derived from sociocognitive models in health prevention, i.e. social cognitive theory [27], planned action theory [28] and health belief model [29]: (1) post-confinement prevention behavior intention, (2) experience with prevention behaviors, (3) self-efficacy level for prevention behaviors, (4) outcome expectations of prevention behaviors, and (5) social norm of preventive behaviors. The behaviors measured were selected from those prevention recommendations promoted by WHO and health authorities during the first wave of the pandemic [30]: (1) wearing, carrying, or removing mask; (2) hand washing for at least 40 secs.; (3) avoiding touching the face, mouth or nose; (4) Remembering to wash hands after touching objects, (5) remembering to keep a safe distance from others; (6) resisting the urge to leave home; and (7) asking other people to follow preventive behaviors. The answer to this inventory was a 4-point Likert-type scale, in which 0 corresponds to "*not at all*" and 3 to "*a lot*". Higher values (from 0 to 21 for each dimension) indicate greater prevention behaviors. Internal consistency in this sample for post-confinement prevention behavior intention (Cronbach's a = .81), experience with prevention behaviors (Cronbach's a = .72),

self-efficacy level for prevention behaviors (Cronbach's *a* = .78), outcome expectations of prevention behaviors (Cronbach's *a* = .79), and social norm of preventive behaviors (Cronbach's *a* = .78) was acceptable to excellent. Likewise, an exploratory factor analysis was carried out for the five scales. For all of them, a clear unifactorial structure was evident, with a single factor with an eigenvalue greater than 1 and with an explained variance greater than 40% in all cases.

A 4-items ad-hoc inventory was used to measure adherence to prevention behaviors for avoiding infection and sanction and proxy control [27] on government, health personnel and scientists. The answer to this inventory was a 4-point Likert-type scale, in which 1 corresponds to "*not at all*" and 3 to "*a lot*". Higher values (from 0 to 6 for each dimension) indicate greater preventive behaviors. Internal consistency in this sample for prevention behaviors for avoid infection (Cronbach's *a* = .52), prevention behaviors for avoid sanction (Cronbach's *a* = .72), proxy control of government (Cronbach's *a* = .59), and proxy control of health personnel and scientists (Cronbach's *a* = .71) was questionable to acceptable.

A 5-items ad-hoc inventory was used to measure barriers and facilitators for prevention behaviors. The answer to this inventory was a 5-point Likert-type scale, in which -2 corresponds to "*makes it very difficult*" and +2 to "*makes it very easy*". Higher values (from -10 to 10) indicate greater preventive behaviors. Internal consistency in this sample for barriers and facilitators for prevention behaviors (Cronbach's *a* = .68) was questionable.

A 4-items ad-hoc inventory was used to measure future threats generated by the pandemic. The answer to this inventory was a 4-point Likert-type scale, in which 0 corresponds to "*not at all*" and 3 to "*a lot*". Higher values (from 0 to 12) indicate greater future threats derived from the pandemic. Internal consistency in this sample for future threats (Cronbach's *a* = .63) was questionable.

A 2-items ad-hoc inventory was used to measure perceived vulnerability to coronavirus and perceived vulnerability of others to coronavirus. The answer to this inventory was a 5-point

Likert-type scale, in which 0 corresponds to "*highly unlikely*" and 4 to "*highly likely*". Higher values (from 0 to 4 for each item) indicate greater perceived vulnerability.

A 1-item ad-hoc was used to measure information level (i.e., time consulted for information on the pandemic). The answer to this item was a 3-point Likert-type scale, in which 0 corresponds to "*not at all*", 2 to "*less than 1 hour*", 3 to "*1 hour to 2 hours*", and 3 to "*3 hours or more*". Higher values (from 0 to 12) indicate more information level.

4. Data analyses

Statistical analyses were carried out with Stata 17. The descriptive analysis of the sample's characteristics was carried out using frequencies (*n*) and percentages (%), for categorical variables, and means (*M*) and standard deviations (*SD*), for continuous variables. To keep the real population distribution of the regions, data analysis was weighted by the inverse of the ratio of the real population number of a region divided by the number of subjects in the sample for that region. Comparison of post-confinement prevention behavior intention means between Spanish's regions was done through post-hoc comparisons with the type I error corrected by Šidák's [31] approach. Pearson correlation was used to calculate the raw association between measures.

A predictive linear mixed model for post-confinement prevention behavior intention was developed, including the 14 measures of prevention behaviors as independent terms and perceived severity as moderator. Following the method proposed by Snijders & Bosker [32], a random intercept multilevel model was first estimated using restricted maximum likelihood, with Spanish region as the random factor, and the intra-class correlation (ICC) was calculated. To test the significance of the interactions between predictors and the moderator (perceived severity), Kleinbaum et al. [33] recommended conducting a chunk likelihood ratio test for all interaction terms. If the chunk test is not significant, all interactions will be removed. Otherwise, each interaction will be individually tested through a Wald test. If a

significant interaction is found, the coefficient of the predictor will be estimated for three levels of perceived severity (low = 1000, medium = 9144, and high = 17000).

Given the high number of predictors and to reduce the risk of collinearity, the measures that were necessary for the statistical adjustment were selected following the proposal of Maldonado & Greenland[34]. Two groups of potential confounders were selected, the set of four sociodemographic measures (age, gender, education level, and income) and the set of five personality dimensions (extraversion, conscientiousness, agreeableness,neuroticism, and openness). Models without adjustment, with only the set of sociodemographic terms and with both sets of adjustment terms were estimated and compared. When the mean of change in coefficient estimates between the reduced (i.e., without or with less adjustment terms) and the extended (i.e., with more adjustment terms) models was less than 10%, the reduced model was selected.

RESULTS

1. Characteristics of the sample

Sociodemographic information is displayed in Table 1. In total, the sample consisted of 15.131 residents in Spain during the COVID-19 lockdown measures. Of them, 66.8% were female, 62.5% reported medium income levels, and 75% had a university education. On average they were 38.4 years old and mostly people resided in the region of Catalonia (63.65%).

2. Personality and prevention behaviors

Table 1 also shows descriptives of personality type (extraversion, conscientiousness, amiability, emotionality, and openness traits), prevention behaviors (post-confinement behavior intention, past experience behaviors, adherence behavior, reasons for adherence,

self-efficacy for behavior, outcome expectations of behavior, barriers/facilitators and social norms), level of information, proxy control, perceived vulnerability, and perception of future threats of the sample are presented.

Table 1. Characteristics of the sample (N = 15,131)

Variables (scores ranges)	***M (SD)***	***Min-Max***
Age (18-99)	38.31 (14.86)	16-92
Personality: extraversion (1-5)	3.25 (1.13)	1-5
Personality: conscientiousness (1-5)	3.61 (1.02)	1-5
Personality: agreeableness (1-5)	3.34 (1.08)	1-5
Personality: neuroticism (1-5)	3.01 (1.14)	1-5
Personality: openness (1-5)	3.82 (1.05)	1-5
Post-confinement prevention behavior intention (0-21)	16.28 (3.76)	0-21
Experience with prevention behaviors (0-21)	14.99 (3.60)	0-21
General adherence to prevention behaviors (0-3)	2.55 (0.57)	0-3
Information level (0-3)	1.41 (0.72)	0-3
adherence to prevention behaviors for avoid infection (0-6)	4.96 (1.18)	0-6
adherence to prevention behaviors for avoid sanction (0-6)	2.51 (1.88)	0-6
Self-efficacy level for prevention behaviors (0-21)	15.92 (3.61)	0-21

Outcome expectations of prevention behaviors (0-21)	17.21 (3.41)	0-21
Barriers/facilitators for prevention behaviors (-10-10)	3.39 (3.63)	-10-10
Social Norm of preventive behaviors (0-21)	15.40 (4.25)	0-21
proxy control (Government) (0-6)	2.46 (1.55)	0-6
proxy control (Scientists) (0-6)	5.12 (1.16)	0-6
Perceived vulnerability to coronavirus (0-4)	2.21 (0.98)	0-4
Perceived vulnerability of others to coronavirus (0-4)	2.31 (0.94)	0-4
Future threats (0-12)	5.96 (2.50)	0-12

Variables	***n* (%)**
Gender	10.114 (66.8)
Female	5.017 (33.2)
Male	
Educational level	
Uneducated/ Primary	589 (3.9)
Secondary	3194 (21.1)
University	11.348 (75)

Income level	
Low	4.560 (30.1)
Medium	9.461 (62.5)
High	1.110 (7.4)
Region[1]	
Andalusia	471 (3.1)
Aragon	282 (1.9)
Castilla-La Mancha	175 (1.2)
Castilla-Leon	547 (3.6)
Catalonia	9631 (63.6)
Madrid	871 (5.8)
Valencia	626 (4.1)
Basque Country	192 (1.3)
Galicia	1084 (7.2)
Balearic Islands	156 (1)
Canary Islands	719 (4.7)
Other	377 (2.5)

Note: In brackets minimum and maximum possible values; [1] non-weighted.

3. Comparison of post-confinement prevention behavior intention between regions

Table 2 shows the means of post-confinement prevention behaviors intention separately for each Spanish region. The highest post-confinement prevention behaviors intention was observed in residents of the Canary Islands compared to residents of the other regions. Conversely, the lowest intention of post-confinement prevention behaviors was observed in residents of Aragón and Balearic Islands region compared to residents of the other regions.

Table 2. Post-confinement prevention behavior intention comparison between regions

				Significant differences between means[1]										
Region	***Weighted N***	***M***	***SD***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1. Andalusia	2.720	16.43	3.82											
2. Aragon	427	14.90	3.91	*										
3. Castilla-La Mancha	655	16.44	3.74		*									
4. Castilla-León	767	16.49	3.56		*									
5. Catalonia	2.455	15.89	3.82		*		*							
6. Madrid	2.167	16.46	3.60		*			*						
7. Valencia	1615	16.47	3.78		*			*						
8. Basque Country	702	15.58	4.22											
9. Galicia	865	16.59	3.64		*			*			*			
10. Balearic Islands	390	15.01	3.57	*		*	*		*	*		*		
11. Canary Islands	720	17.26	3.42	*	*		*	*	*	*	*	*	*	
12. Other	1.648	16.23	3.62		*								*	*

Note: [1] Corrected by Sidak

3. Association between the post-confinement prevention behaviors intention and their potential predictive factors

Table 3 shows the association between the post-confinement prevention behaviors intention and the sociodemographic factors in the sample of residents in Spain. Given the sample size, most of the correlation values were significant. Among the highest correlation values, we found that the post-confinement prevention behaviors intention was related to the experience with the prevention behaviors ($r = .64$). Both variables were related to the general adherence (intention $r = .43$; experience $r = .42$), the adherence for avoid infection (intention $r = .51$; experience $r = .52$), self-efficacy level (intention $r = .73$; experience $r = .69$) and outcome expectations of prevention behaviors (intention $r = .72$; experience $r = .54$). Self-efficacy was related to outcome expectations ($r = .41$) and both were related to general adherence(self-efficacy $r = .42$; outcome $r = .38$) and adherence to avoid infection (self-efficacy $r = .48$; outcome expectations $r = .49$). Finally, social norms correlated with outcome expectations ($r = .41$).

Table 3. Bivariate Pearson correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1																				
2	-.02																			
3	-.00	.10																		
4	.13	.32	.08																	
5	-.12	.00	-.05	-.07																
6	.09	.01	.07	.09	.08															
7	.10	.04	.13	.03	.08	.10														
8	.08	.05	.15	-.00	.09	.12	.63													
9	.12	.00	.12	.03	.06	.05	.43	.42												
10	.23	.01	.01	.05	.02	.03	.20	.18	.13											
11	.06	.04	.12	-.03	.07	.05	.5	.52	.38	.11										
12	-.11	.07	.04	-.01	.76	-.03	-.05	-.06	-.06	-.03	.03									
13	.05	.00	.17	.01	.03	.10	.73	.69	.42	.15	.48	-.05								
14	.02	.05	.11	.02	.08	.07	.72	.54	.39	.15	.49	-.00	.62							
15	.04	.12	.09	.12	.02	.06	.35	.25	.22	.12	.29	.09	.30	.40						
16	.07	.08	.09	.07	-.05	.03	.39	.26	.17	.08	.24	.04	.35	.41	.30					
17	.03	.03	-.00	.11	.01	.08	.13	.07	.12	.07	.10	-.02	.10	.16	.24	.05				
18	.02	.08	.07	.13	.01	.08	.29	.21	.20	.10	.24	-.08	.24	.32	.29	.17	.32			
19	.03	.05	-.00	.02	.59	.03	.17	.13	.08	.07	.14	-.07	.12	.17	.08	.04	.01	.10		
20	-.03	.03	-.00	-.00	.07	.05	.15	.12	.09	.05	.12	-.07	.12	.17	.05	.00	.01	.09	.80	
21	.01	-.01	-.01	-.03	.02	-.01	-.01	-.00	-.01	.01	-.02	.01	-.01	-.01	-.01	-.03	-.01	-.02	-.01	-.01

Note: 1.Age; 2.Personality: extraversion; 3.Personality: conscientiousness; 4.Personality: amiability; 5.Personality: emotionality; 6.Personality: openness; 7.Post-confinement prevention behavior intention; 8.Experience with prevention behaviors; 9.General adherence to prevention behaviors; 10.Information level; 11.adherence to prevention behaviors for avoid infection; 12.adherence to prevention behaviors for avoid sanction; 13.Self-efficacy level for prevention behaviors; 14.Outcome expectations of prevention behaviors; 15.Barriers/facilitators for prevention behaviors; 16.Social Norm of preventive behaviors; 17. Proxy Control of Government; 18. proxy Control of Scientists-Health staff; 19.Personal Perceived vulnerability to coronavirus (self); 20.Perceived vulnerability to coronavirus (others) ; 21.Future threats.

4. Predictive model of the post-confinement prevention behavior intention

Table 4 presents results of the linear mixed model to predict the post-confinement prevention behaviors intention. For a random intercept multilevel model with Spanish region as random factor, the ICC was 0.028 (CI 95% 0.012 to 0.061). Although it is a relatively low value, the variance explained by the region (0.049) was statistically significant (p = .005), so the random factor was kept in posterior models. The mean change in coefficient estimates between the model with the two sets of adjustment terms and the model with only the four sociodemographic terms was 6.44%, showing that the set of five personality dimensions could be excluded from the model. However, the mean change in coefficient estimates between the model with the sociodemographic set and the model without any adjustment term was 20.25%, reflecting the need to keep in the model the set of four sociodemographic characteristics.

From the wide pool of variables analyzed, the model composed of the variables that best predicted post-confinement prevention behavior intention was obtained. This model included, ordered by the standardized coefficient B , self-efficacy (B = 0.36; p < .001), outcome expectations (B = 0.36; p < .001) and general adherence to prevention behaviors (B = 0.31; p < .01); information level (B = 0.25; p < .001), experience with prevention behaviors (B = 0.12; p < .001), perceived vulnerability (B = 0.12; p = .008), proxy control (scientists) (B = 0.08 ; p < .01), social norm of preventive behaviors (B = 0.06; p < .001), adherence to prevention behaviors for avoid sanction (B = -0.03; = .10), barriers/facilitators for prevention behaviors (B = 0.02; p = .12), future threats (B = -0.01; p = .23), proxy control (government) (B = 0.00; p = .79). Also the perceived severity level adjusted the adherence to prevention behaviors to avoid infection (for low perceived severity, B = 0.12; p <= .01; for medium perceived severity, B = 0.18; p < .001; for high perceived severity, B = 0.24 ; p < .001) and perceived vulnerability of others to coronavirus level (for low perceived severity,

B = -0.80= ; *p* = .195; for medium perceived severity, *B* = 0.02 ; *p* = .60; for high perceived severity, *B* = 0.12; *p* <= .01).

Table 4. Mixed model for prediction of post-confinement prevention behavior intention

Fixed effects	*B*	*CI 95% (B)*	*p*	β*
Adherence to prevention behaviors to avoid infection				
For low perceived severity = 1000	0.12	0.04 to 0.21	<.01	0.04
For medium perceived severity = 9144	0.18	0.13 to 0.23	<.001	0.06
For high perceived severity = 17000	0.24	0.20 to 0.28	<.001	0.08
Perceived vulnerability of others to coronavirus				
For low perceived severity = 1000	-0.08	-0.20 to 0.04	.20	-0.02
For medium perceived severity =9144	0.02	-0.06 to 0.11	.60	0.01
For high perceived severity = 17000	0.12	0.05 to 0.19	<.01	0.03
Self-efficacy level for prevention behaviors	0.36	0.33 to 0.40	<.001	0.35
Outcome expectations of prevention behaviors	0.36	0.32 to 0.40	<.001	0.33

General adherence to prevention behaviors	0.31	0.11 to 0.52	<.01	0.05
Information level	0.25	0.15 to 0.34	<.001	0.05
Experience with prevention behaviors	0.12	0.11 to 0.14	<.001	0.12
Perceived vulnerability to coronavirus	0.12	0.03 to 0.20	<.01	0.03
Proxy control (Scientists)	0.08	0.03 to 0.14	<.01	0.03
Social Norm of preventive behaviors	0.06	0.05 to 0.072	<.001	0.07
Adherence to prevention behaviors for avoid sanction	-0.03	-0.07 to 0.01	.10	-0.02
Barriers/facilitators for prevention behaviors	0.02	-0.01 to 0.05	.12	0.02
Future threat	-0,01	-0.02 to 0.01	.23	-0.01
proxy control (Government)	0.03	-0.02 to 0.03	.79	0.00
Random effects	*B*	*CI 95% (B)*	*p*	
Spanish region	0.05	0.03 to 0.10	.01	

Note: Adjusted by age, gender, education level and income; B*: standardized regression coefficient

DISCUSSION

The main purpose of this study was to identify the predictor variables on the intention to comply with COVID-19 preventive, non-pharmacological measures. Also, a differential analysis by territory was carried out to identify the differences by autonomous community in these factors. The contribution of this study consists in identifying how a wide pool of variables impacts the level of compliance with preventive measures, in a large sample of Spanish adults. Understanding the psychosocial factors and mechanisms involved in compliance with preventive behaviors recommended by the relevant authorities to address the transmission of COVID-19 is important to design effective health strategies.

The data obtained in this study correspond to the period of the first wave of SARS-CoV-2 spreading, which marked a critical moment in the fight against the COVID-19 pandemic, characterized by the lack of effective pharmacological drug treatments and vaccines, which during this period were still in development. It is important to note that during this period, people lived in a context of great uncertainty, with limited knowledge about the ways of virus transmission, and unclear and inconsistent official recommendations for preventive measures [35]. The first wave of contagion witnessed high rates of virus transmission and a significant number of fatalities, contributing to generating fear and anxiety among the population [36, 37]. This context could explain the high general adherence to reported preventive behaviors, as well as the intention to continue practicing prevention behaviors post-confinement.

The level of proxy control for the government was low, in contrast to the proxy control given to scientists. The absence of a consistent and uniform message from the government regarding prevention and containment measures resulted in confusion and low levels of trust among the population [35]. Surprisingly, during the initial phase of the pandemic, with no previous health precedents for dealing with this type of virus, the high number of infections and deaths, and the lack of treatments and tools to combat the virus, trust in scientists was

significantly high. Roozenbeek et al. [38], found that higher trust in scientists was associated with reduced susceptibility to coronavirus-related misinformation, but more studies will be necessary to clarify the processes of trust in public authorities.

Among the variables analyzed, we observed high levels of correlation. Both Experience and Adherence to preventive behaviors to avoid infection were found to be related to the level of Self-efficacy and Outcome expectations of preventive behaviors. Additionally, the Self-efficacy level and Outcome expectations were positively correlated with each other. These findings align with the Social Cognitive Theory [27], which posits a direct relationship between successful past experiences and increased confidence in self-efficacy and functionality. Both self-efficacy and outcome expectations are shaped by various sources of information, with experience having the most influential impact [17]. The self-efficacy level of individuals is grounded in the information they acquire from their past experiences. Although, during the time of this study, specific experiences with preventive behaviors for COVID-19 were relatively limited, their clear association with both types of expectations is evident.

Among the extensive range of variables analyzed, the model that best predicts the future intention to comply with COVID-19 preventive measures incorporates elements of the health promotion models, such as self-efficacy, outcome expectations, general adherence to preventive behaviors, previous experience, perceived vulnerability, and social norm. Notably, self-efficacy emerged as the most frequently significant predictor of COVID-19-related behavior. This finding is consistent with several studies that have identified self-efficacy as one of the most robust predictors of COVID-19 preventive behaviors [39], and other respiratory syndromes [40]. A systematic review also revealed that self-efficacy was the second most frequent significant predictor (appearing in 87.5% of the studies analyzed) of COVID-19-related behavior and intention [41].

The information level, which represents the time spent searching for information about the virus, was also included in the model, showing a strong relationship with the intention to comply with COVID-19 Shushtari et al. [42] found that investing time in accessing accurate information is crucial for engaging in effective COVID-19 prevention measures. These authors also argue that individuals residing in developed areas may have better access to various internet services, including health information. The internet and social networks are extensively utilized for obtaining health-related information [40,43], and they significantly influence preventive behavior [44]. However, a systematic review conducted by Rocha et al. [45] revealed that different sources of information, such as online social networks, contributed to misinformation and undermined trust in the scientific community, thereby affecting people's preventive behavior. In our study, we did not differentiate between the types of media used to obtain information or the specific content processed. Thus, further research will be necessary to identify the specific effects of various forms of information.

Both the adherence to prevention behaviors to avoid infection and the perceived vulnerability of others to coronavirus depended on the severity level of the pandemic, as determined from the data collected by Mathieu et al. [46] measure as the number of people infected and number of deaths caused by the coronavirus. Adherence to preventive behaviors predicts the future intention of engaging in these behaviors. However, its predictive value increased as the number of COVID-19 cases and deaths rose. This effect could be understood by the fact that as information about the rise in infections and deaths was received, perceived severity heightened, despite this construct being often biased [47,48]. While few studies examine the direct impact of epidemiological reports on behavior, several studies maintain that high levels of perceived severity enhance recommended preventive behaviors [49,50]. While it is expected that at high levels of infections and deaths, perceived vulnerability would predict the intention to engage in preventive behavior [51,52], these findings are striking when considering that one's own perceived vulnerability predicted

vaccination intention at any level of perceived severity. Various studies maintain that perceived vulnerability tends to be higher for others than for oneself. For instance, Wilson et al. [51] found that young individuals tended to perceive lower vulnerability for themselves compared to older individuals. Venema & Pfattheicher [53] argue that the objective vulnerability to contracting an illness plays only a small role in perceived vulnerability. It has been observed that groups of smokers estimated their likelihood of developing lung cancer only slightly more than groups of non-smokers, with risk assessments being underestimated for both groups [54]. Further studies focused on these factors will be needed to comprehend their specific influence.

The Autonomous Community of residence had a minor yet significant influence on the obtained results. Following the declaration of the State of Alarm, national-level decisions regarding healthcare measures to combat the virus were centralized [55].This fact is essential to understand that such diverse regions present relatively similar behaviors. Nonetheless, the distribution of infections and deaths was uneven across the Spanish Autonomous Communities. Gutierrez et al. [56] maintain that this level of inequality was twice as high as observed in relation to income distribution, potentially impacting the healthcare system's capacity during the pandemic. Pre-pandemic records [57] indicated differences in the number of publicly employed healthcare professionals, financed public health expenditures, and hospital beds within the public system, which could explain certain disparities in the pandemic's impact and the preventive behavior of individuals.

This study has both limitations and strengths that should be taken into consideration when interpreting the results. The extensive and heterogeneous sample, along with the wide variety of explored variables, allowed for a comprehensive analysis of the sociodemographic factors influencing individuals' preventive behavior. However, online data collection excluded a significant percentage of the population that lacks internet access for various reasons. This underrepresentation may lead to reduced statistical power for association analyses. Moreover

it is worth highlighting the non-probabilistic nature of the sampling of this study. However, the effects of this limitation have been largely neutralized by the huge sample of participants and the use of weighting in the statistical analyses

Furthermore, given the pandemic's timing and the government's stipulated health measures during the survey period, specific factors pertinent to that juncture (such as the utilization of gloves for virus prevention) were subjected to evaluation, but they later ceased to be the primary focus of analysis. Furthermore, certain phenomena that gained significance as the pandemic progressed and had a cumulative effect were not assessed in this study.

Regarding the reliability of the measurement instrument used in this study, some Cronbach's alphas are low because they represent ad-hoc constructed measures with a limited number of items, aiming to obtain a general and exploratory perspective on the variables that could influence behavioral intention.

It is convenient to take into consideration that the results of this study are probably strictly limited to non-pharmacological measures to prevent SARS-CoV-2. In this sense, a study carried out in an adult Spanish population [58] suggests that the main predictor variables of vaccination intention are related to processes of social influence (attitudes, beliefs about the origin of the virus, trust in authorities) rather than personal beliefs like self-efficacy or outcome expectancies as evidenced in the current study regarding non-pharmacological measures.

It's important also to note that this study was focused on the Spanish population. However, it is essential to examine the interactions between the severity of the pandemic and the extent of mobility restrictions by comparing different countries. In our study, differences in preventive behavior were identified, even though the measures in each autonomous community were consistent during the study period, likely due to varying impacts in each region and structural differences. Given that in other countries all these factors were distinct, along with the country's unique socioeconomic and cultural characteristics, we could

anticipate variations in the analysis of preventive behavior. Such comparative analyses will enable us to understand how various measures have affected the spread and severity of the pandemic in different regions, leading to the identification of effective strategies for mitigating its effects. By comparing data from different countries, common trends and patterns can be identified, providing valuable insights for policy decisions, and predicting potential outcomes of different actions. This type of analysis is crucial for informing effective responses to future pandemics and safeguarding public health.

In summary, this study aimed to identify predictor variables for future compliance with COVID-19 preventive measures among a large sample of Spanish adults during the 'first wave' of the pandemic. The findings emphasized the significance of sociocognitive factors like self-efficacy and outcome expectations as primary predictors of COVID-19-related behavior, while also recognizing the impact of perceiving the pandemic's severity on individuals' intent to adhere to preventive measures. Additionally, the study acknowledged the influence of residents' autonomous communities and highlighted the need to address regional disparities in public health policies. Despite its limitations, this research offers valuable insights for public health authorities, enabling them to formulate strategies and policies to encourage compliance with preventive measures, thus safeguarding public health and community safety. Furthermore, it underscores the importance of cross-country comparisons to gain a better understanding of how diverse factors affect the spread and severity of pandemics in various regions, which can inform effective policy decisions for future public health crises.

Implications for Public Health Authorities and Media:

- Promoting Self-Efficacy: Unlike variables such as personality, which is difficult to influence, self-efficacy is a perception or belief that can vary from various sources of information. Public health authorities should prioritize interventions that enhance individuals' self-efficacy regarding preventive behaviors. Building confidence in one's ability to adopt and maintain these measures is crucial for sustained compliance.
- Communication Consistency: Media outlets play a significant role in disseminating information. Consistent and clear messaging from both government and scientific authorities is essential to reduce confusion and build trust among the population. This can help combat misinformation and encourage adherence to preventive measures.
- Regional Disparities: Acknowledging and addressing regional disparities in preventive behavior and healthcare resources is vital. Tailoring public health strategies to the specific needs and challenges of different autonomous communities can improve overall compliance and mitigate the disease's impact.

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