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Understanding adherence to underused protective measures during the COVID-19 pandemic in France: The role of health beliefs, social norms, and trust in authorities

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Abstract

Introduction: This study explored the determinants of compliance with seven effective but underused COVID-19 protective measures. The investigated measures encompassed both vaccination and nonpharmaceutical interventions, including social and physical distancing, hand washing, and mask-wearing. We tested the factors of the Health Belief Model and an extended model that integrated trust in institutional and medical authorities and social norms.

Methods: In a cross-sectional study, two large samples (Ns = 1,132 & 1,014) were collected at two pandemic stages. Participants responded via an online questionnaire. The hypotheses, materials, analytical strategy, and sample size were preregistered.

Results: We used structural equation modeling to test how the factors of the Health Belief Model and the extended model with trust and social norms were related to self-reported adoption of protective measures. The results showed acceptable fits for the Health Belief Model (CFIs ≥ .938, TLIs ≥ .928, RMSEAs ≤ .068, SRMRs ≤ .070) and for the extended model (CFIs ≥ .927, TLIs ≥ .922, RMSEAs ≤ .066, SRMRs ≤ .059). We identified perceived benefits, self-efficacy, and descriptive norms as pivotal

factors influencing compliance. However, perceived susceptibility, barriers, and trust in authorities showed inconsistent effects.

Discussion: This study underscores the importance of testing integrative models to understand the unique relationships of psychological factors with the adoption of recommended protective behaviors. Indeed, this study shows that not all health beliefs are predictors of compliance and suggests trust has a limited effect beyond health beliefs. The present research contributes to comprehending compliance drivers for many protective behaviors, highlighting practical implications for public health interventions during health crises.

Take-home message: When examining health beliefs, descriptive social norms, and trust in institutional or medical authorities collectively, the primary factors influencing adherence to protective measures against COVID-19 are the perceived benefits of engaging in protective behaviors, the sense of capability to perform these behaviors, and the perception of others' actions.

Keywords: COVID-19; guideline adherence; Health Belief Model; social norms; trust.

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INTRODUCTION

The COVID-19 pandemic emphasized the importance of understanding why people (do not) follow health recommendations from authorities, as noncoercive measures' effectiveness relies on public compliance. The scientific community has sought to identify determinants of compliance, as this knowledge can help design effective communication and behavioral interventions [1,2]. Aligning with health behavior research, studies have focused on risk perception [3], but unlike individual health behavior, pandemic responses demand collective behavior change, making the perception of others' actions and expectations – social norms – a key determinant. Additionally, collective behavioral change is driven by strategies enforced and justified by authorities, making trust in authorities crucial. Studies conducted during the pandemic linked risk perception, social norms, and trust in authorities to compliance [4–8]. However, most studies did not combine these factors [for an exception, see 9], and the results vary on the most influential predictors of adopting protective measures.

The present paper integrates risk perception, social norms, and trust in authorities as predictors of compliance. Two preregistered studies test an integrative model and compare it to the traditional Health Belief Model, shedding light on the primary drivers of protective behavior adoption. Additionally, we focus on specific behaviors recommended by national health authorities but inadequately adopted by the target population, such as physical and social distancing, hygiene, and vaccination [10,11]. This research can offer insights to policymakers on how to encourage the adoption of these critical yet underutilized behaviors during recurring outbreaks.

The "Health Belief" Model

The Health Belief Model (HBM) is a widely used framework for understanding preventive health behaviors and pandemic-related protective and avoidant actions [2]. It outlines four key

determinants of such behaviors [12]. Two factors pertain to beliefs about disease-associated risks: perceived susceptibility, reflecting the perceived likelihood of contamination, and perceived severity, denoting the perceived gravity of the physical, mental, or social consequences of contracting the disease. The other two factors relate to beliefs about preventive behavior: perceived barriers, representing perceived difficulties in adopting the targeted behavior and its negative consequences, and perceived benefits, signifying the perceived protective effectiveness of the preventive behavior. The model incorporates cues to action [13], a stimulus that could trigger the adoption of the targeted behavior, such as mass media campaigns, recommendations from authorities or relatives, or reminder systems. Additionally, self-efficacy was integrated into the model [14], defined as beliefs about one's ability to execute a given action [15]. According to the HBM, individuals adopt protective behaviors when they feel personally threatened by the disease, view consequences as severe, believe that taking action reduces risks at a reasonable cost, feel capable of performing the behavior, or are prompted by internal or external triggers [16].

Recent studies have applied the HBM to COVID-19-related behaviors [17–19]. Notably, the perceived efficacy of protective behaviors and self-efficacy played crucial roles in compliance [9,18,20–22]. Perceived barriers and the perceived severity of COVID-19 also influenced behavior, although less consistently [23,24]. Meta-analyses have previously highlighted inconsistencies in the ability of HBM constructs to predict behavior and the model's overall lack of predictive power [25–27]. This underscores the need for research in specific populations and contexts to assess the relevance of health beliefs as a basis for public health communication. The HBM is criticized for overlooking important social and cultural factors in shaping health behaviors [25,28]. Consequently, scholars have explored the influence of alternative determinants, emphasizing the social dimension of behavioral change.

Social norms

Pandemics necessitate collective change, rendering the behavior and opinions of others particularly pertinent. The perception of what significant others do, known as descriptive norms, and approve, defined as injunctive norms [29], significantly influenced adopting protective behaviors [9,30]. Greater perceived adoption and approval by significant others correlated with increased individual compliance. Recent research further indicates that descriptive norms strongly influenced behavior over injunctive norms [31–33].

Trust in authorities

In a crisis context characterized by authorities' demand for rapid and large-scale behavior change and the implementation of restrictive measures, trust in authorities plays a pivotal role [34]. Trust is a multifaceted construct, and the dimension of interest in this study is confidence in authorities' recommendations and crisis management abilities [34,35]. Trust in both political and scientific authorities is a critical factor in successfully executing public health policies during crises, as it simplifies decision-making when confronted with rapidly evolving information that can make decisions challenging [36]. Additionally, trust helps reduce perceived threats to individual freedom and resistance against policy measures [37].

In the context of the COVID-19 pandemic, longitudinal and meta-analytical research consistently suggests that trust in government predicted compliance with public health recommendations (e.g., 35–37)]. Furthermore, trust in other key stakeholders, such as health authorities and healthcare professionals, was associated with accepting and adopting protective behaviors [e.g., 41]. In this

study, we explored trust in various authorities to account for the diverse sources of recommendations during the pandemic. These authorities encompass political institutions (government and local authorities), health organizations, and healthcare professionals. Our hypothesis is that higher trust in authorities is linked to greater adoption of protective behaviors.

Overview

The present study aims to identify predictors of the adoption of protective behaviors. We first hypothesize that the determinants proposed by the Health Belief Model will predict the adoption of protective measures (Hypothesis 1). Then, we hypothesize that an extended HBM with social norms and trust in authorities will also predict protective behavior adoption (Hypothesis 2) but with more explanatory power (Hypothesis 3).

We collected two samples to investigate the determinants of efficient but under-adopted protective behaviors during data collection [10,11]. The first sample was collected during a phase of progressive lifting of restrictions and targeted physical and social distancing with the intention of vaccination. The second sample was collected during a phase of low restrictions and after a mass vaccination campaign; therefore, we focused on hygiene, social distancing, and intention toward vaccination. By addressing various types of health strategies, the present study offers a general test of the relevance of the proposed models. Importantly, we investigated compliance predictors with nonpharmaceutical (distancing, hygiene) and pharmaceutical (vaccination) measures. For both samples, we preregistered the hypotheses, method, and analytical strategy, and material are available (https://osf.io/dgh24/), as well as the data (sample 1: DOI 10.17605/OSF.IO/AGY6W; sample 2: DOI 10.17605/OSF.IO/2FHWG). These preregistrations are part of a larger project, parts of which are beyond the scope of this paper. Moreover, we report the results of some models that deviated from the preregistration due to space constraints. The test of preregistered models and the rationale for deviation are presented in the supplementary materials (https://osf.io/c5mtw/).

METHODS

Study design and procedure

This study is cross-sectional. Participants completed an online questionnaire created using LimeSurvey (version 3.0). Participants were first informed and provided consent. Then, they were randomly exposed to measures of health beliefs relating to COVID-19 (perceived susceptibility, perceived severity, cues to actions) and trust in authorities. Then, they were asked about four randomly displayed protective behaviors. In sample 1, the behaviors were keeping a physical distance of two meters, avoiding gatherings with more than six people, staying confined, and intending to get vaccinated. In sample 2, the behaviors were wearing a mask covering the nose and the mouth, limiting face-to-face encounters, regular hand washing, and intending to get the vaccine booster (if already vaccinated) or to get the vaccine (if not). Participants first indicated the perceived social norm for each behavior and then presented the perceived benefits, barriers, and self-efficacy in random order. Then, participants reported their frequency of adopting the four protective behaviors (randomly displayed). Finally, they optionally provided socio-demographic information and were thanked for their participation.

Study participants and sampling

Sample 1 was collected between May 10, 2021, and June 12, 2021, following the third wave of the coronavirus pandemic, during a progressive deconfinement period. Based on the context, we investigated four behaviors: keeping a physical distance of two meters, avoiding gatherings of more

than six people, staying confined, and intending to get vaccinated. The first three behaviors are of primary importance in a deconfinement phase when social and physical distancing is no longer enforced by restrictions but by recommendations addressed to the population. At the time of the survey, those measures were among the least applied and/or had a diminishing rate of application [10]. The intention to get vaccinated against COVID-19 was chosen because access to vaccination was still under health and age condition restrictions when the data collection began. Still, the government was planning to relax those restrictions (which indeed occurred during the data collection process on May 31st). Vaccination was a subject of intense debate, with rising protests. Consequently, we investigated the determinants of early intention to receive the vaccine.

Sample 2 was collected later in the pandemic (November 30, 2021 to December 16, 2021), during the anticipation of the omicron variant's coming and the enforcement of a booster campaign. This change in context led us to investigate new behaviors, as our general strategy is to focus on efficient behaviors with suboptimal adoption. Based on the application rate reported by the National Health Agency [11], we targeted wearing a mask correctly (on the nose and the mouth), limiting face-to-face encounters, and regular hand washing. We also reinterrogated the intention to get the vaccine. Regarding vaccination, due to mass immunization in the month preceding the current data collection, we investigated the intention to get the vaccine booster (if already vaccinated) or the vaccine (if not).

We conducted a cross-sectional study by disseminating online surveys on social networks (Instagram and Facebook) via Ads and the researchers' network, and participants were encouraged to share the survey within their networks (snowball sampling method). The invitation to participate targeted our population of interest (i.e., people older than 18 living in Southwest France). Respondents did not receive any compensation for their participation.

As indicated in the preregistration documents, we determined the sample size using a ratio of observation to estimated parameters of 5 to 1 [42] and aimed for 1,075 participants for sample 1 and 820 participants for sample 2. We applied the preregistered exclusion criteria (e.g., removing underaged respondents). Final sample 1 consisted of 1,132 participants and was predominantly feminine (72%), middle-aged (M = 51.17, SD = 12.69, min = 18, max = 82), and educated (78% reported a postsecondary education). Final sample 2 comprised 1,014 respondents who were again predominantly women (74,02%), middle-aged (M = 55.8, SD = 13.47, min = 20, max = 99), and educated (78.41% attained postsecondary education). Sample characteristics are presented in Table S1 and Table S10.

Study instruments

Items were presented in French and are freely translated here. If not specified otherwise, participants answered using a 7-point Likert scale (1 = strongly disagree; 7 = strongly agree).

Health Belief Model

To assess risk perception, we first measured perceived susceptibility with two items [19] evaluating respondents' perceptions of the likelihood of contamination by COVID-19 (e.g., "It is possible that I could be infected by the coronavirus"). Perceived severity was measured by two items [19] regarding the estimated consequences of the infection on their health (e.g., "If I were infected by the coronavirus, it would have important health consequences for me"). In Sample 1, cues to action, which are prompts in the respondent's environment, were measured with media consumption. Participants were asked whether they found information about protective measures on five media types (i.e., social media, TV, press, posters/flyers, and text messages). In Sample 2, cues to action were

estimated using the repetition of a single item for each authority (i.e., "I am encouraged to follow protective measures by [authority]"). It was evaluated using a 5-point Likert scale (1 = never; 5 = always) with the option to indicate that they did not know this authority.

Then, we measured health beliefs specific to the four behaviors investigated in the study: keeping a physical distance of two meters, avoiding the gathering of more than six people, staying confined, and intending to get vaccinated. Perceived barriers were measured using 7 items evaluating various difficulties respondents could face in their application of a behavior (e.g., "[Protective behavior] has a negative impact on my psychological well-being"). Positive consequences that could be expected from the application of protective behavior – perceived benefits – were assessed by 6 items (e.g., "If I [protective behavior], I protect myself from COVID-19"). Self-efficacy was measured with three items (e.g., "[Protective behavior] is easy for me").

Social norms

A single item adapted from Ohtomo and Kimura [33] measured social descriptive norm (i.e., "Most people around me [adopt the protective behavior]").

Trust in authorities

In sample 1, trust was measured with one item for each of the 10 authorities ("To make the right decisions on how to face the coronavirus pandemic, I think that we can trust [authority]". The authorities were either institutional (the government, the health ministry, the prefecture, the regional political authority, the local political authority (municipality), the Regional Health Agency, or the National Health Insurance) or primary care professionals (one's general practitioner, pharmacist), or respondent's close ones. In sample 2, trust was measured with two items [35] that were repeated for each authority (e.g., "To face the pandemic, [authority] generally takes adequate measures"). The institutional authorities were the government, the Regional Health Authority, the local political authority (municipality), and complementary health insurance. Primary care authorities were the participants' general practitioners and pharmacists.

Adoption of protective measures

As the outcome variable, we assessed self-reported adoption of the four protective behaviors with one item rated on a frequency scale for each protective measure (i.e., "In situations where you should apply them, to what extent do you comply with the measures?" from 1 never to 5 always). In Sample 2, collected after vaccination was made available to the entire population, intention was measured using a 6-point scale (e.g., "I intend to receive the vaccine booster shot", with 1 = strongly disagree; 5 = strongly agree; 6 = I already received it, considered as the highest level of intention). The vaccination questions referred to either the first dose or the booster, depending on whether respondents were already immunized. We standardized the answers for each situation (booster vs. first dose) and aggregated the data to obtain intentions toward vaccination.

Socio-demographic profile

We collected participants' gender, age, level of education, socio-professional group, household structure, housing type, and department of residence. In Sample 2, we also asked whether they or any of their close ones were vulnerable or at higher risk.

Data analysis

We applied structural equation modeling (SEM) to the collected data using the lavaan package of R software (40; R version 4.1.2). Structural equation models involve two steps: testing a measurement and structural models. We first performed confirmatory factor analyses (CFA) to test

the measurement models' data fit. This step assesses the assumed factor structure of the scales. It provides important information about structural validity beyond the single index of internal consistency (Cronbach's alpha) usually reported in the literature. Then, the structural models test the predicted relationships between adopting protective behaviors and their determinants. SEM is similar to multiple regressions in that it estimates the "unique" strength of each relationship, that is, the effect of one predictor beyond the effects of the others.

We used robust maximum likelihood estimation with the Yuan-Bentler scaled chi-squared statistic (MLR) and full information maximum likelihood (FIML) to address missing data. We evaluated the (measurement and structural) models' fit according to Hair's recommendations [43], whose cutoffs deviate from those preregistered but are more conservative than originally planned. More precisely, we report the comparative fit index (CFI) and the Tucker–Lewis index (TLI), for which a cutoff of .92 or higher indicates an acceptable fit given our sample size and number of variables. We also consider the root mean square error of approximation (RMSEA), expected to be lower than .07, as well as a standardized root mean square residual (SRMR) below .08. Where applicable, $p < .05$ indicates statistical significance. To compare models, given that they include different variables and are thus based on different data sets, we used the Akaike and Bayesian Information Criterion (AIC et BIC) provided by an analysis of variance (ANOVA). We considered the difference in explained variance (R^2) of our exogenous variables.

Ethical aspects

Ethical review and approval were not required for this study, aligning with national guidelines at the time of data collection. Nevertheless, the survey adhered to local ethical standards and the principles of the American Psychological Association. Informed consent was obtained, and measures were taken to ensure anonymity.

RESULTS

H1 – Health Belief Model factors as predictors of adoption

The first hypothesis was that the determinants of the health belief model – susceptibility, severity, barriers, benefits, cues to action, and self-efficacy – predict the adoption of all protective behaviors. In sample 1, the model reported here deviates from the preregistration on measuring cues to action (see supplementary for further details, https://osf.io/c5mtw/).

Measurement models

The measurement models initially included seven latent variables (2 to 10 observed variables per latent variable) and one variable assessed by a single item (adoption of protective measures). Loadings inferior to .50 led to respecifications of the models. In sample 1, cues to action were divided into two latent variables: exposure to social media and traditional media (i.e., press, TV, posters). The item related to text messages was excluded, as well as an item of barriers ("staying confined makes me feel ridiculous"). In sample 2, one item of self-efficacy regarding hand washing was removed. More notably, we removed the item estimating the cues to action from the government for all investigated behaviors. The fit indicators of the measurement models were acceptable and are reported in Table 1.

Table 1. Robust Fit Indicators of the Measurement Models – Health Belief Model (H1) – sample 1 (upper) & 2 (lower).

Sample 1	***CFI***	***TLI***	***RMSEA***	***90% CI***	***SRMR***
Keeping a distance of 2 meters	.958	.950	.061	.057; .064	.060
Avoiding gatherings of more than 6 people	.954	.945	.061	.058; .065	.066
Staying confined as much as possible	.954	.944	.063	.059; .066	.052
Vaccination Intention	.956	.947	.067	.064; .071	.035
Sample 2					
Wearing a face mask	.943	.934	.066	.063; .070	.072
Limiting face-to-face interactions	.944	.936	.063	.059; .067	.073
Washing hands regularly	.965	.960	.049	.045; .053	.050
Vaccination Intention	.941	.932	.072	.068; .076	.054

Structural models

The descriptive statistics, indices of reliability (alpha and omega), and correlation matrices for the variables included in the structural models are presented in Tables S2-S5 for sample 1 and Tables S11-14 for sample 2. The structural models tested the relationship between the determinants proposed by the Health Belief Model and the adoption of each protective behavior. Level of education and age were entered as control variables. The models showed an acceptable fit, as seen from the indices reported in Table 2.

Table 2. Robust fit indicators of the structural models – Health Belief Model (H1) – sample 1 (upper) & 2 (lower).

Sample 1	***CFI***	***TLI***	***RMSEA***	***90% CI***	***SRMR***	R^2
Keeping a distance of 2 meters	.957	.946	.058	.055; .061	.057	.599
Avoiding gatherings of more than 6 people	.951	.940	.059	.056; .063	.062	.665
Staying confined as much as possible	.951	.939	.061	.057; .064	.049	.589
Vaccination Intention	.953	.942	.065	.062; .069	.034	.826
Sample 2						
Wearing a face mask	.939	.928	.065	.061; .068	.068	.608
Limiting face-to-face interactions	.940	.929	.062	.058; .065	.070	.528
Washing hands regularly	.962	.954	.049	.045; .052	.049	.531
Vaccination Intention	.938	.927	.068	.065; .072	.052	.346

Supporting hypothesis 1, the results showed that perceived susceptibility, vulnerability, benefits, barriers, and self-efficacy explained between 34.6% and 82.5% of the variance in the reported behavior adoption. The full results of the structural models are reported in Table 3.

Table 3. Effect of health beliefs on the reported adoption of protective behaviors in samples 1 (upper) and 2 (lower).

Sample 1	***Keeping a distance of 2 m***		***Avoiding Gathering***		***Staying Confined***		***Vaccination Intention***	
Paths	β	*p*	B	*p*	β	*p*	B	*p*
Barriers	.091	.045	-.063	.129	-.032	.660	-.113	.031
Benefits	.387	<.001	.458	<.001	.525	<.001	.419	<.001
Susceptibility	-.030	.270	.010	.698	.015	.618	.009	.621
Severity	.087	.005	.136	<.001	.122	<.001	.023	.257
Self-Efficacy	.415	<.001	.211	<.001	.125	.147	.406	<.001
Cues to action - social media	-.039	.074	-.030	.142	-.028	.195	-.034	.045
Cues to action - traditional media	.114	.005	.106	.003	.077	.055	-.017	.544
Sample 2	***Wearing a face mask***		***Limiting encounters***		***Washing Hands***		***Vaccination Intention***	
Paths	β	*p*	B	*p*	β	*p*	B	*p*
Barriers	.197	.015	.160	.018	.004	.973	-.066	.610
Benefits	.619	< .001	.433	<.001	.252	<.001	.211	.002
Susceptibility	.042	.139	-.003	.913	.001	.966	-.056	.049
Severity	.072	.018	.117	.001	.018	.572	-.074	.064
Self-Efficacy	.313	< .001	.408	<.001	.567	<.001	.382	.001
Cues to action	-.001	.948	.015	.663	.025	.436	-.040	.244

Note. Standardized coefficients of the structural model testing the Health Belief Model (H1)

As expected, perceived benefits had positive relationships with adopting all protective measures. Self-efficacy was positively related to behavior adoption except for self-confinement. Perceived severity was related to higher adoption of five behaviors involving social and physical distancing and wearing a mask, but it was not related to hygiene or vaccination intention.

Barriers had inconsistent effects, being expectedly associated with lower intentions toward vaccination in sample 1 but also, contrary to expectation, being associated with higher reports for two distancing behaviors (keeping a 2 m distance, limiting encounters) and mask-wearing. The hypothesized positive effect of perceived susceptibility on adoption was never observed, and a hostile link was observed with vaccination intention in sample 2.

The influence of cues to action depended on how they were measured. In sample 1, they referred to information exposure. The more respondents received information through traditional media, the more they reported applying social and physical distancing (keeping a 2 m distance, avoiding gathering). However, receiving information about protective measures through social media had a negative relationship with vaccination intentions but was not significantly linked to

nonpharmaceutical measures. In sample 2, the cues to action questions directly asked whether authorities prompted the respondents to adopt the protective behaviors and were not significantly related to any behavior adoption.

H2 - Health Belief Model extended with descriptive norms and trust in primary care and institutional authorities.

One objective of this research was to integrate health beliefs with other predictors of behavior that seem particularly relevant in situations where collective change is demanded by authorities. The second hypothesis proposed that compliance with preventive measures would be better understood by taking into account health beliefs as well as social norms describing what others do and trust in the authorities making the recommendations. Authorities were divided into two types: institutional authorities (e.g., government, national authorities) and primary care professionals in direct contact with respondents (i.e., general practitioners and pharmacists). The models reported here deviate from the preregistration due to the indication of misspecification when running the preregistered models and the integration of new results observed in the literature. Again, the preregistered analyses are presented in the supplementary materials (https://osf.io/c5mtw/).

Measurement models

The measurement models included 9 latent variables (2 to 14 observed variables per latent variable) and 2 variables assessed by a single item (social norms and adoption of protective measures). Based on loadings in sample 1, the item related to text messages, as well as an item of barriers and the item related to trust in close ones. In sample 2, the measurement models did not fit the data. The preregistered criteria did not allow us to achieve acceptable fit, so we also examined the modification indices. Items of trust in close ones and an item of self-efficacy regarding hand-washing were excluded. We also merged the two items measuring trust for each authority (i.e., compute the mean score). The fit statistics are presented in Table 4.

Table 4. Robust fit indicators of the measurement models of the Health Belief Model extended with social norms and trust.

Sample 1	***CFI***	***TLI***	***RMSEA***	***90% CI***	***SRMR***
Keeping a distance of 2 meters	.945	.936	.059	.056; .061	.055
Avoiding gatherings of more than 6 people	.942	.932	.059	.057; .062	.061
Staying confined as much as possible	.942	.932	.060	.057; .063	.049
Vaccination Intention	.946	.937	.062	.060; .065	.033
Sample 2					
Wearing a face mask	.941	.928	.063	.060; .066	.053
Limiting face-to-face interactions	.943	.931	.060	.057; .063	.057
Washing hands regularly	.959	.950	.050	.046; .053	.040
Vaccination Intention	.938	.925	.069	.066; .072	.035

Structural models

The extended model integrated the HBM and trust and social norms, with age, level of education, and gender as covariates. The structural models showed acceptable fits, as shown in Table 5. Included variables accounted for between 36% and 83% of the variance in self-reported compliance.

Table 5. Robust fit indicators of the structural model of the Health Belief Model extended with social norms and trust.

Sample 1	***CFI***	***TLI***	***RMSEA***	***90% CI***	***SRMR***	***R²***
Keeping a distance of 2 meters	.943	.932	.058	.055;.060	.053	.612
Avoiding gatherings of more than 6 people	.939	.928	.058	.056; .061	.059	.696
Staying confined as much as possible	.939	.927	.059	.057; .062	.047	.600
Vaccination Intention	.943	.932	.061	.059; .064	.033	.830
Sample 2						
Wearing a face mask	.939	.924	.062	.059; .065	.051	.630
Limiting face-to-face interactions	.941	.927	.059	.056; .062	.055	.564
Washing hands regularly	.957	.946	.049	.046; .052	.038	.542
Vaccination Intention	.937	.922	.066	.063; .069	.035	.366

Estimated paths and their respective p-values are reported in Table 6. The results showed that the HBM constructs and adoption relationships were similar to those presented above in the nonextended HBM. Benefits were positively related to the adoption of all behaviors. Higher self-efficacy predicted higher compliance with all but one behavior. Severity was related to the adoption of the four distancing measures and mask-wearing.

All the inconsistent effects of barriers became nonsignificant, suggesting no robust effects of perceived obstacles. Similarly, perceived susceptibility was not related to adoption. Cues to action were not predictive of compliance. In particular, we did not replicate the negative relationship between social media exposure and vaccination intention in sample 1, nor did we observe the positive effect of exposure to traditional media. This suggests that adding trust and norms reduces the explanatory power of exposure to media.

Our results regarding trust showed that it was generally unrelated to adoption. However, the effect of trust varied depending on the type of authorities considered. Trust in institutional authorities exhibited one expected positive effect on self-confinement but two unexpected effects: it suggested that higher trust in institutions was related to lower adherence to hygiene practices (i.e., hand-washing, in sample 2) and lower intention to get vaccinated in sample 1. In contrast, the intention toward vaccination was positively associated with trust in primary care authorities, which also positively predicted physical distancing (i.e., maintaining a distance of two meters in sample 1).

Table 6. Effect of health beliefs, social norms, and trust on the reported adoption of protective behaviors in samples 1 (upper) and 2 (lower).

Sample 1	***Keeping a distance of 2 m***		***Avoiding Gathering***		***Staying Confined***		***Vaccination Intention***	
	β	*p*	B	*p*	β	*p*	β	*p*
Barriers	.085	.061	-.075	.060	-.035	.621	-.082	.126
Benefits	.332	<.001	.377	<.001	.453	<.001	.413	<.001
Susceptibility	-.028	.284	-.000	.986	.015	.610	.001	.965

Sample 1	***Keeping a distance of 2 m***		***Avoiding Gathering***		***Staying Confined***		***Vaccination Intention***	
	β	*p*	B	*p*	β	*p*	β	*p*
Severity	.075	.014	.125	<.001	.116	<.001	.012	.569
Self-Efficacy	.382	<.001	.188	<.001	.110	.190	.419	<.001
Cues to action – social media	-.023	.314	-.010	.630	-.024	.277	-.023	.191
Cues to action – traditional media	.043	.390	.042	.335	.031	.544	-.038	.300
Trust - institutional authorities	.011	.800	.036	.351	.114	.007	-.071	.018
Trust - primary care	.116	.012	.047	.285	-.029	.546	.112	.002
Social Norms	.100	<.001	.192	<.001	.097	<.001	.030	.085

Sample 2	**Wearing a face mask**		**Limiting encounters**		**Washing Hands**		**Vaccination Intention**	
	β	*p*	B	*p*	β	*p*	β	*p*
Barriers	.162	.061	.119	.080	-.023	.823	-.060	.657
Benefits	.554	< .001	.434	<.001	.281	<.001	.295	<.001
Susceptibility	.040	.136	.003	.910	.007	.806	-.047	.105
Severity	.073	.016	.095	.007	.067	.051	-.061	.126
Self-Efficacy	.295	< .001	.353	<.001	.519	<.001	.379	.001
Cues to action - Institutional	-.023	.713	-.117	.080	.008	.893	-.033	.621
Cues to action - Primary care	-.018	.762	.089	.190	.041	.490	.016	.832
Trust - Institutional	-.063	.277	-.015	.789	-.115	.047	-.142	.138
Trust - Primary care	.089	.142	-.020	.749	-.005	.928	-.042	.556
Social Norms	.151	< .001	.194	<.001	.064	.021	.125	<.001

Note. Standardized coefficients of the structural model testing the Health Belief Model extended with trust and social norms (H2).

Model comparison

We tested the hypothesis that the extended Health Belief Model would better account for adopting protective behavior than the original HBM. The Akaike information criterion, Bayesian information criterion, chi-squared, and explained variance of each model are presented in Table 7. The Health Belief Model has lower AIC and BIC values for all behaviors, but the extended version presents slightly higher explained variance.

Table 7. Comparison of the Health Belief Model and the Health Belief Model extended with social norms and trust.

Sample 1	***Health Belief Model***				***Extended HBM***			
	AIC	BIC	χ^2	R^2	AIC	BIC	χ^2	R^2
Keeping distance of 2 m	105386	105990	1398.6	.599	139618	140529	2700	.612
Avoiding Gathering	107586	108190	1459.9	.665	141769	142680	2761.2	.696
Staying Confined	102532	103120	1385.3	.589	136644	137540	2654.6	.600
Vaccination Intention	105752	106356	1693.4	.826	139616	140526	2987	.830
Sample 2								
	AIC	BIC	χ^2	R^2	AIC	BIC	χ^2	R^2
Wearing a face mask	94388	94968	1709.7	.608	111046	111912	2107.	.630
Limiting face-to-face interactions	93320	93911	1578.1	.528	109899	110766	1937.9	.564
Washing hands regularly	81370	81946	1048.8	.531	98210	99061	1411.6	.542
Vaccination Intention	93801	94392	1822.9	.346	109998	110864	2285.5	.366

DISCUSSION

The present study aimed to identify the determinants of the adoption of various protective behaviors. The first sample was collected at the end of the third wave of the pandemic in France. Confinement restrictions were progressively relaxed, and access to vaccination, initially subject to certain conditions, became available to anyone midway through the data collection period. The second sample was collected during a period when there was no enforcement of restrictions, but an implementation of a massive booster campaign and an increase in the number of cases was anticipated. We focused on preventive measures that were relevant in each context but were underutilized by the population, as indicated by the national health agency. Our study, therefore, covers hygiene practices (such as handwashing), mask-wearing, physical distancing (maintaining a distance of two meters), social distancing (avoiding gatherings, face-to-face interactions, and self-confinement), and individuals' intentions to get vaccinated or receive a booster shot.

We first assessed whether the Health Belief Model could serve as an appropriate framework for understanding compliance with recommendations. Three factors consistently emerged as associated with the adoption of protective behaviors. First, perceived benefits emerged as a shared predictor of compliance with all seven preventive measures. Second, the belief in one's capability to perform the behavior (i.e., self-efficacy) was positively related to adopting all behaviors except for self-confinement. Respondents may not perceive staying confined as within their control or capability after periods of confinement imposed by government restrictions. Third, the perception of the severity of the consequences of contracting COVID-19 consistently predicted higher adoption of nonpharmaceutical measures. Interestingly, it was not associated with vaccination intentions. One possible explanation is that since the vaccine is presented to reduce the risk of severe disease, it may diminish the overall perception of risk among those intending to get vaccinated, making them similar to those who do not intend to get vaccinated.

Contrary to the propositions of the Health Belief Model, the perception of susceptibility to

COVID-19 infection did not align with adoption in the expected way. It was largely unrelated to compliance; we even observed a negative association with vaccination intention. This finding suggests that beyond the effect of all health beliefs, an increased perception of the risk of contracting COVID-19 does not appear to be a significant driver of compliance. The last two factors of the HBM, perceived barriers and cues to action, showed predominantly nonsignificant or inconsistent relationships with adoption. The influence of barriers may be overshadowed by the stronger effect of self-efficacy. Indeed, the obstacles and barriers one perceives partly influence the feeling of being capable of adopting a protective behavior. Bivariate correlations support this idea, indicating a strong relationship between barriers and self-efficacy and suggesting that self-efficacy may also capture the influence of barriers.

Regarding cues to action, it is important to acknowledge measurement issues in the first sample that led to the use of a different measure than the one we preregistered. However, in the second sample, prompts reported by authorities were also unrelated to adoption. It appears that when considering other health beliefs, such as perceived benefits, self-efficacy, and severity, authorities' indications do not significantly predict compliance.

In our study, we did not observe all the predicted relationships between health beliefs and self-reported adoption for any behavior. This finding underscores the importance of testing the complete model. Indeed, the factors proposed by the HBM are interconnected. By considering the entire model, rather than only a subset of beliefs, we were able to identify unique relationships between each belief and compliance. This approach also guards against the interpretation of relationships that might be artificially influenced by unmeasured factors. Other research reports results that are consistent with our findings that benefits, severity and self-efficacy are related to compliant behavior, while susceptibility and barriers are not [e.g., 44–46].

The second objective of the present study was to integrate health beliefs with social norms and trust in authorities. Social norms exhibited positive relationships with the adoption of all protective behaviors. In other words, the more respondents reported that most people around them were adopting protective measures, the more likely they were to adopt these measures themselves. This finding underscores the significance of normative processes in adherence to public health recommendations [6,9,47,48]. It also underscores the importance of looking beyond individual health-related beliefs to comprehensively understand individuals' engagement in protective behaviors. Criticisms of the Health Belief Model center around its portrayal of individuals as asocial decision-makers [28]. Our results support that health behaviors are better conceptualized as social behaviors notably influenced by normative factors.

The links between trust and adopting protective behaviors are complex and less clear-cut. Greater trust in health professionals with whom individuals have direct contact is positively associated with compliance with physical distancing and vaccination intentions. This result aligns with previous findings [e.g., 41], although it does not apply uniformly across all behaviors. In contrast, institutional trust showed mostly nonsignificant effects, with one positive effect for self-confinement and two negative effects for hygiene practices and vaccination intentions. This inconsistency is in line with findings in the literature [49]. Other studies have shown that trust can have little to no effect on health behavior when controlling for other factors, such as health importance or health beliefs [e.g., 9,20,48]. The negative effect of institutional trust is consistent with recent findings in France suggesting that a lack of trust in the government can sometimes promote

the adoption of protective measures [51]. This effect may show that defiance toward those in charge increases the perception of threat and worry, which individuals address by taking individual protective actions. Alternatively, it may indicate that individuals who have high confidence in the government's ability to manage the pandemic tend to overly rely on public actions and feel less personally responsible [40,52]. It has also been found that both the level and predictive power of institutional trust diminish over time [5]. In summary, trust, particularly when considered alongside health beliefs, emerges as an inconsistent predictor that requires careful consideration of the cultural context and the specific behaviors under examination.

From an applied research perspective, our findings reveal that the most robust predictors of adoption of protective behaviors are the perceived benefits of engaging in these behaviors, the perception of what others do (descriptive norms), and self-efficacy. This suggests that interventions aimed at promoting compliance may be more effective when they emphasize the advantages gained from adherence, highlight that the behavior is widely adopted by others, and provide support to ensure that individuals feel capable of performing the targeted behavior. Conversely, our results indicate that increasing the perception of the risk of infection (susceptibility) may not be the most effective approach to encourage compliance. Regarding nonpharmaceutical measures specifically, perceived severity emerges as another potential lever to activate to amplify the perception of the negative consequences of the disease. For those focusing specifically on vaccination, the most robust levers to target are the perception of benefits and facilitating easy and accessible vaccination.

The research presented here has several limitations. First, the samples used in this study do not represent the national population. The study was self-administered, and no compensation was offered. The composition of the final samples (mostly women and middle-aged and educated individuals) limits the generalization of our results. Nevertheless, the consistency between our results and those in the literature suggests that our findings are reliable. Second, model fit and specification challenges prevented us from testing more complex preregistered models. This highlights the importance of computing fit indicators to validate the hypothesized data structure obtained from questionnaires with multiple interrelated constructs. This crucial step is often omitted in correlational studies, which can compromise the robustness of the conclusions drawn from the data. However, we faced limitations in examining more intricate relationships between health beliefs and trust. Finally, like all cross-sectional studies that rely on self-reported data, this study is inherently subject to recall bias and social desirability bias, potentially affecting the accuracy of responses. Moreover, cross-sectional studies are valuable for capturing a population's behavior and beliefs. Still, they cannot establish causation and lack temporal context, making it challenging to draw definitive conclusions about the observed relationships.

CONCLUSION

In conclusion, this study delved into the determinants of compliance with seven distinct protective measures implemented at two stages of the COVID-19 pandemic. These measures were selected for their effectiveness and were underutilized by the population. They included physical distancing, social distancing, hygiene practices, mask-wearing, and vaccination intentions. We integrated health beliefs with normative influences and trust in medical and political authorities to comprehensively understand compliance.

Our findings highlight the central role of perceived benefits, descriptive norms, and self-efficacy in shaping compliance with recommended measures. The study also revealed the inconsistent effects of trust in authorities, emphasizing the need for a nuanced understanding of trust's impact on

behavior. Overall, our findings contribute to a better understanding of the factors driving compliance with protective measures and offer practical implications for public health interventions during health crises.

Supplementary Materials: https://osf.io/c5mtw/
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