# Gender differences in COVID-19 attitudes and behavior: Panel evidence from eight countries

Vincenzo Galasso[a,b,c,d,1], Vincent Pons[e,f,g,1], Paola Profeta[a,d,1,2], Michael Becher[h], Sylvain Brouard[i,j], and Martial Foucault[i,j,k]

[a]Department of Social and Political Sciences, Bocconi University, 20136 Milan, Italy; [b]Centre for Economic Policy Research, EC1V 0DX, London, UK [c]Innocenzo Gasparini Institute for Economic Research, 20136 Milan, Italy; [d]Dondena Center, 20136 Milan, Italy; [e]Harvard Business School, Boston, MA 02163; [f]National Bureau of Economic Research, Cambridge, MA 02138; [g]Abdul Latif Jameel Poverty Action Lab, Cambridge, MA 02142; [h]Institute for Advanced Study in Toulouse, University Toulouse 1 Capitole, 31080 Toulouse, France; [i]Department of Political Science, Sciences Po, 75007 Paris, France; [j]Centre de Recherches Politiques de Sciences Po, 75007 Paris, France; and [k]CNRS, 75 016 Paris, France.

Edited by Douglas S. Massey, Princeton University, Princeton, NJ, and approved September 2, 2020 (received for review June 17, 2020)

**The initial public health response to the breakout of COVID-19 required fundamental changes in individual behavior, such as isolation at home or wearing masks. The effectiveness of these policies hinges on generalized public obedience. Yet, people's level of compliance may depend on their beliefs regarding the pandemic. We use original data from two waves of a survey conducted in March and April 2020 in eight Organisation for Economic Co-operation and Development countries ($n$ = 21,649) to study gender differences in COVID-19–related beliefs and behaviors. We show that women are more likely to perceive COVID-19 as a very serious health problem, to agree with restraining public policy measures, and to comply with them. Gender differences in attitudes and behavior are sizable in all countries. They are accounted for neither by sociodemographic and employment characteristics nor by psychological and behavioral factors. They are only partially mitigated for individuals who cohabit or have direct exposure to the virus. We show that our results are not due to differential social desirability bias. This evidence has important implications for public health policies and communication on COVID-19, which may need to be gender based, and it unveils a domain of gender differences: behavioral changes in response to a new risk.**

COVID-19 public health rules | gender differences | compliance with rules

Since the breakout of COVID-19, most countries have advised or required restrictive measures such as isolation at home or wearing face masks, in an attempt to contain the spread of the pandemic, limit pressure on their national health system, and reduce the death counts (1). These rules have been shown to reduce both the individual risk of infection and the likelihood of contaminating others (2, 3). In particular, the main route for the spread of COVID-19—airborne transmission—is largely reduced by wearing face masks: 78,000 fewer infections in Italy in a month and 66,000 fewer in New York City over a 3-wk period (4). Yet, restrictive measures also generate economic and psychological costs (5). Ultimately, the effectiveness of these public health policies hinges on generalized public obedience.

Women have been found to agree (6) and comply more with existing rules in other domains (7, 8). In this study, we ask whether they are also more likely to adopt the rapid behavioral changes required to address the challenge posed by COVID-19, and for what reason. Using original data from two waves of a nationally representative panel survey conducted in eight Organisation for Economic Co-operation and Development countries, we analyze gender differences both in behavior—namely, compliance with the new public health rules—and in attitudes toward the virus—the assessment of how dangerous it is and which policy measures should be adopted to combat it.

A striking feature of the pandemic is that many more men than women are dying of COVID-19 (9–14). An array of factors have been speculated to account for this gender gap, including differences in biology (15–17), preexisting conditions, occupations (18), smoking, and propensity to seek health care (13). Our study investigates the role of a behavioral factor which may be equally important but has received much less attention: compliance with public policy rules.

Our survey data (19) cover Australia ($n$ = 2,010), Austria ($n$ = 2,000), France ($n$ = 4,036), Germany ($n$ = 3,501), Italy ($n$ = 1,997), New Zealand ($n$ = 1,997), the United Kingdom ($n$ = 2,012), and the United States ($n$ = 4,096), for a total of 21,649 respondents. All these countries have high income per capita and advanced health systems, allowing us to pool their data in a common analysis, but they were affected very differently by the pandemic, increasing the external validity of our results. The United States, United Kingdom, and Italy are among the countries with the highest COVID-19 mortality in the world, while Australia and New Zealand each had fewer than 200 deaths (20) attributed to the pandemic by May 31, 2020.

The first wave of the survey was administered between March 16 and March 30, soon after the pandemic reached the countries we study. In this period, most of these countries were beginning to implement lockdowns and stay-at-home orders (*SI Appendix*, Table S1 reports the lockdown date for each country). The second wave was administered between April 15 and April 20.

## Significance

**Public health response to COVID-19 requires behavior changes—isolation at home, wearing masks. Its effectiveness depends on generalized compliance. Original data from two waves of a survey conducted in March–April 2020 in eight Organisation for Economic Co-operation and Development countries ($n$ = 21,649) show large gender differences in COVID-19–related beliefs and behaviors. Women are more likely to perceive the pandemic as a very serious health problem and to agree and comply with restraining measures. These differences are only partially mitigated for individuals cohabiting or directly exposed to COVID-19. This behavioral factor contributes to substantial gender differences in mortality and is consistent with women-led countries responding more effectively to the pandemic. It calls for gender-based public health policies and communication.**

Author contributions: V.G., V.P., and P.P. did the conceptualization of the research question, the data curation, the formal analysis, and the writing of the paper; M.B., S.B., and M.F. provided comments on the final draft and designed the survey questionnaire; V.G. and V.P. provided comments on the final draft of the questionnaire.

The authors declare no competing interest.

This article is a PNAS Direct Submission.



[1]V.G., V.P., and P.P. contributed equally to this work.

[2]To whom correspondence may be addressed. Email: paola.profeta@unibocconi.it.

This article contains supporting information online at https://www.pnas.org/lookup/suppl/doi:10.1073/pnas.2012520117/-/DCSupplemental.

First published October 15, 2020.

SOCIAL SCIENCES

First-wave respondents were contacted again for the second wave. Those who failed to respond were replaced by new people. In each wave, respondents were asked how serious they expected the health consequences of COVID-19 to be in their country and whether they agreed with several public policy measures discussed or already implemented, such as closing schools; closing nonessential businesses, economic activities, and institutions; stopping public transportation; prohibiting meetings of two or more people; imposing quarantine on people entering the country; closing borders; and mandating the use of face masks in public places. Respondents were also asked to report their current level of compliance with several COVID-19–related health and social distancing rules, such as wearing face masks, washing hands, coughing into one's elbow, stopping hugging or greeting, keeping physical distance from others, staying at home, avoiding crowded places, and stopping meeting friends. Finally, the survey collected a wide range of sociodemographic and attitudinal factors.

## Results

We observe large gender differences in the individual perception regarding the seriousness of COVID-19 as a health problem in the respondent's country. The data from the first wave in all eight countries in March ($n$ = 10,594) show that 59.0% of the female respondents considered COVID-19 to be a very serious health problem, against 48.7% of the men (M = 0.590 vs. 0.487, Mdiff = 0.104, 95% CI [0.086; 0.121]). In the pooled data from the second wave, in mid-April ($n$ = 11,025), these proportions had decreased by more than 15 percentage points among both men and women, but a sizable and significant gender difference remained (M = 0.396 vs. 0.330, Mdiff = 0.067, 95% CI [0.048; 0.085]).

In *SI Appendix*, Fig. S1, we report the share of men and women who considered COVID-19 to be a very serious health problem, by country, in the first wave (*SI Appendix*, Fig. S1*A*) and in the second wave (*SI Appendix*, Fig. S1*B*). This fraction largely varies across countries, from Austria, where less than one respondent out of three considered COVID-19 to be a serious health issue in March, to the United Kingdom, where that proportion reaches 72% (first wave). The population's level of concern about the pandemic declined in all countries between March and April. These differences over space and time partly reflect differences in the actual magnitude of the pandemic.[*] For all these differences, one pattern is nearly universal: Except for the second wave in Austria, women were more likely than men to see COVID-19 as a very serious health problem in each wave and in each of the eight countries.

Does this stronger worry about COVID-19 induce women to be more in favor of restraining public policy measures? In both waves of our survey, respondents were asked how much they agree, on a 1 to 5 scale (from completely agree to completely disagree), with each of the following measures: closing schools, closing nonessential shops, postponing elections, prohibiting nonessential travels, stopping public transportation, using cellular phones to trace people's movements, imposing a curfew, imposing quarantine on people entering the country, closing borders, imposing self-quarantine at home, prohibiting meetings of two or more people, imposing quarantine away from home on people infected by COVID-19, and closing nonessential economic activities and institutions.[†] In the second wave, individuals were also asked how much they agree with each of the two following additional measures: conducting systematic tests on the population and mandating the use of face masks in public places. We use respondents' answers to these questions to construct an overall index of their agreement with the restraining measures in each wave. Specifically, we create dummy variables equal to 1 if the respondent completely agrees with a measure, and 0 otherwise, and we average them out over all questions.

Substantial gender differences are also present in individual attitudes toward these restraining measures. Pooling data from all countries in the first wave ($n$ = 10,600), our agreement index was larger among women than among men (M = 0.541 vs. 0.477, Mdiff = 0.063, 95% CI [0.050; 0.077]). In mid-April, pooled data ($n$ = 11,028) show that the overall agreement with restraining measures had decreased among both men and women, but a sizable and significant gender difference remained (M = 0.426 vs. 0.374, Mdiff = 0.052, 95% CI [0.040; 0.064]).

In *SI Appendix*, Fig. S2, we display our agreement index by country, separately for men and women, at the end of March (*SI Appendix*, Fig. S2*A*) and in mid-April (*SI Appendix*, Fig. S2*B*). The range of agreement with restraining measures differs across countries, ranging from below 40% in the United States to nearly 65% in New Zealand in the first wave, and from 28% in Germany to nearly 55% in New Zealand in the second wave. Yet, in each country and each wave, women were more likely to agree with these measures than men. Substantial and statistically significant gender differences exist in each wave for nearly each of the index's components (*SI Appendix*, Table S2). Some of the most important differences concern closing nonessential shops and postponing elections, in both waves, and mandating the use of face masks in public places, in the second wave.

We now turn to the most important outcome regarding public health: people's actual behavior with respect to the pandemic. As women everywhere are more concerned about the health consequences of COVID-19 and more favorable to activity-restraining public policy measures, we may expect them to also be more compliant with such measures. In both waves of our survey, individuals were asked to evaluate how strictly they were following seven recommended rules, on a 0 to 10 scale (from "not at all" to "completely"): washing hands more often, coughing into one's elbow, ending the greeting of people by shaking hands or hugging, avoiding crowed places, keeping physical distance from others, staying at home, and stopping visits to friends. In the second wave, respondents were also surveyed about the three following additional rules: wearing face masks in public places, wearing gloves in public places, and leaving home less than once a day. We construct an overall index of respondents' compliance with public health and social distancing rules in each wave by averaging out their answers to all questions after normalizing each of them on a 0 to 1 range.

Once again, we observe important gender differences, this time in the compliance with rules. Pooling data from all eight countries in the first wave ($n$ = 10,602), compliance was markedly higher among women than among men (M = 0.881 vs. 0. 832, Mdiff = 0.049, 95% CI [0.042; 0.057]). Pooled data ($n$ = 11,029) show that, in mid-April, general compliance had decreased (from 0.857 to 0.747) but remained at a high level. However, a sizable and significant gender difference persisted (M = 0.776 vs. 0.718, Mdiff = 0.058, 95% CI [0.051; 0.065]). Overall, the 4.9 and 5.8 percentage point gender differences in behavior in the first and second waves are smaller than the differences in beliefs about the pandemic (10.4 and 6.7 percentage points, respectively) and of a similar magnitude as the differences in agreement with restraining public measures (6.3 and 5.2 percentage points, respectively).

Fig. 1 displays our compliance index separately for men and women by country in the first wave (Fig. 1*A*) and in the second wave (Fig. 1*B*). Differences across countries are smaller than for

*In SI Appendix, Table S1, we report the number of deaths per million from COVID-19 in the different countries at the start of the first wave and the start of the second wave.

†See *SI Appendix, Supplementary Information Text* for the exact wording of the questions and the full list of questions asked in each wave and in each country.

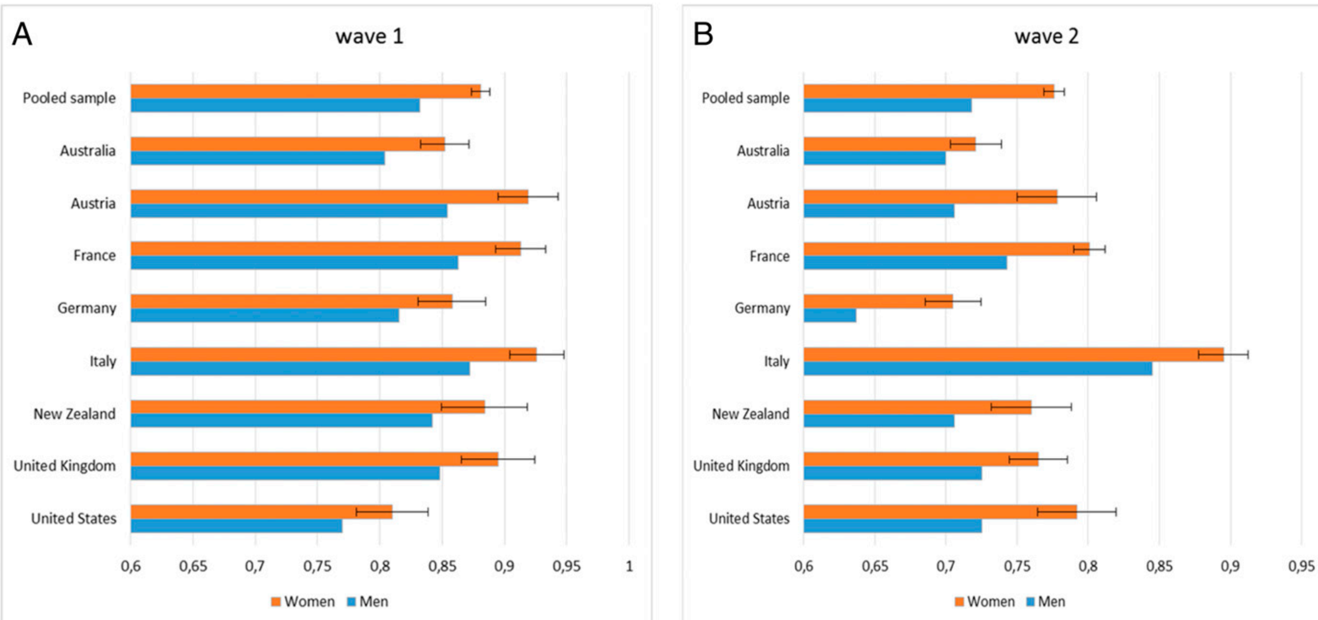


**Fig. 1.** Compliance index. We show the compliance index for men and women, in the pooled sample and by country, in the first wave of the survey (*A*) and in the second wave (*B*). The compliance index is the average of a set of dummy variables equal to 1 if the respondent follows a specific recommended rule (such as washing hands more often and avoiding crowed places) and 0 otherwise (see the *Results* section for the full list of rules included in the index). We also report the 95% CIs from OLS regressions of this compliance index on the female dummy.

our two other outcomes. Yet, gender differences are still apparent, of comparable magnitude, and significant at the 5% level, in each wave and each country. Substantial differences exist in each wave for each of the index's components. Interestingly, the strongest difference between men and women is observed for coughing into one's elbow (*SI Appendix*, Table S3), which only serves the purpose of protecting others, whereas other behaviors can protect both oneself and others.

**Explanatory Factors.** Our data show consistent gender differences in beliefs, attitudes, and behavioral response to the pandemic. What are the determinants of these differences?

Gender differences in sociodemographic characteristics or employment status may create different perceptions and induce different types of behavior. For instance, women may be more concerned about COVID-19 and more compliant with the rules if they are older, poorer, or in worse health conditions on average, or if they perform a type of economic activity for which the risk of contagion is higher (15, 21). Further, housing size may affect the costs associated with complying with measures that require people to stay at home, and people's religions may affect their beliefs on the seriousness of the pandemic and on the policies adopted in response to it. To account for these confounding factors, we regress each of our three variables of interest on the female dummy and a set of control variables: number of people per bedroom, and dummy variables for age groups, level of education, income quartiles, geographical location, employment status (full-time or part-time worker, self-employed, unemployed, or out of the labor force), type of occupation (blue collar, service, white collar, no occupation), population density, religion, and health status.[‡]

Fig. 2 plots estimates of gender differences in our pooled sample for the three main outcomes of interest, separately for the first wave and the second wave, after controlling for these sociodemographic variables. We report the exact point estimates for the pooled sample (*SI Appendix*, Table S4), and separately for each country (*SI Appendix*, Tables S5–S7). The picture that emerges from this empirical evidence is overwhelming. Women remain much more likely than men to believe that the health consequences of the pandemic are very serious, in both waves, after controlling for a large number of sociodemographic characteristics and employment status. Women are also more supportive of the restraining measures and—most importantly—more compliant with the public health and social distancing measures once these variables are controlled for.

We now investigate whether gender differences in psychological and behavioral factors help explain differences in perceptions and behaviors on COVID-19−related issues. We focus on four distinct factors. Two factors may affect people's willingness to adopt costly behavior in order to protect themselves and others: their perceived probability of becoming infected and their level of risk aversion. Two factors may influence their compliance with health rules proposed by the government to serve this objective: the level of trust toward scientists, who recommend the rules, and political ideology, which measures overall support for government intervention and affects the degree of alignment with the particular government in place at the time of the pandemic. We exploit four questions posed in both waves of our survey to measure these factors. Respondents were asked how difficult it is for them to accept health risks (on a 0 to 10 scale), how much they trust scientists (on a 1 to 4 scale, from "not at all" to "completely"), what is their political ideology (on a 0 to 10 scale, from left to right), and how likely they think they are to be infected if they go to work (on a 0 to 10 scale). We convert the responses to the trust in scientists to a dummy variable equal to 1 for the responses "somewhat" and "completely," and 0 otherwise, and we summarize the political ideology into three dummies for liberal (0 to 3), centrist (4 to 6), and conservative (7 to 10).

‡We also control for ethnicity, in the United States, and Aboriginal/non-Aboriginal, in Australia. Available controls vary across countries and waves. See *SI Appendix*, *Supplementary Information Text* for more details.

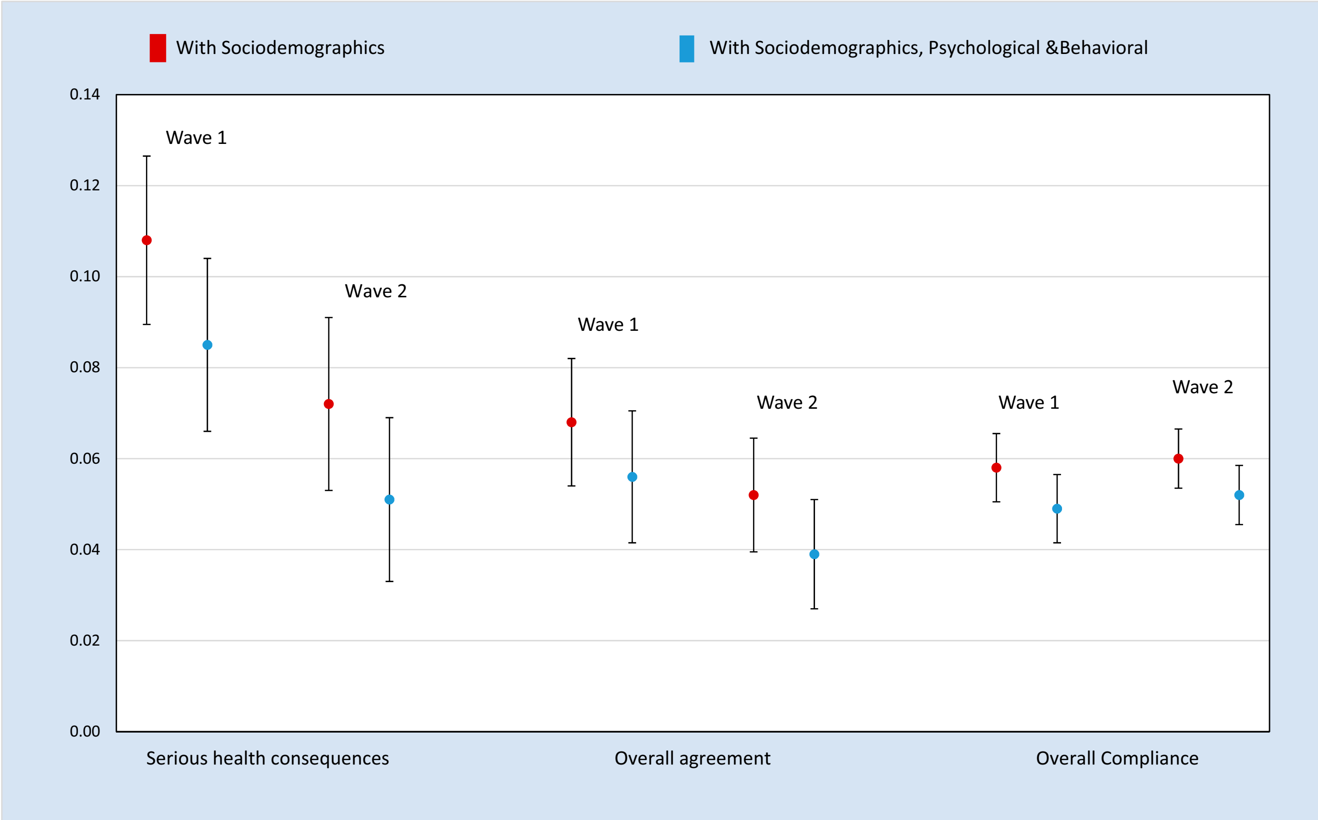


**Fig. 2.** Estimates of gender effects. We show differences between men and women for our main outcomes: serious health consequences, agreement index, and compliance index. The point estimates and corresponding 95% CIs are obtained from OLS specifications regressing the outcome variables on the female dummy. We also control for sociodemographic variables (results in red), as well as psychological and behavioral factors (results in blue). All regressions use pooled data from all countries and from the first and second waves of the survey. Serious health consequences is a dummy variable taking value 1 if the respondent perceives COVID-19 as a very serious health problem and 0 otherwise. The agreement index (compliance index) is the average of a set of dummy variables equal to 1 if the respondent completely agrees with (complies with) a specific restraining public policy measure (such as isolation at home or wearing masks) and 0 otherwise (see the text for the full list of policy measures included in the indices).

The existing literature shows that women are more risk averse than men (22) and that they are more left leaning and more favorable to government intervention (23, 24). Results in *SI Appendix*, Table S8 show that these differences are also present in the survey and that, in addition, women believe they are more likely to be infected. The latter difference may reflect objective gender differences in work environments or preexisting health conditions as well as subjective differences in perception. Finally, the level of trust toward scientists is not significantly different between men and women.

The results of augmented regressions controlling for these four factors are shown in Fig. 2 (and in *SI Appendix*, Table S4). Psychological and behavioral factors explain an important share of the variation in beliefs about the seriousness of the pandemic, and in agreement and compliance with the rules designed to combat it, as reflected by the increase in the R-squared. But the inclusion of these factors only reduces the gender effect modestly. Women remain more likely than men to believe that the consequences of the pandemic are serious and to agree with restraining rules and comply with them by 8.5, 5.6, and 4.9 percentage points, respectively, after controlling for sociodemographic characteristics and for the four psychological and behavioral factors. Point estimates on the female dummy are significant at the 1% level for all three outcomes. In sum, the rich and diverse set of factors that our regressions control for can only explain a small share of the observed differences between men and women.

**Mitigating Factors.** Our results above identify gender-related factors which contribute (to a small extent) to explain the gender gap. We now explore which factors may reduce this gap. Differences in beliefs and behavior between men and women may decrease over time if both groups are exposed to the same flow of information about the pandemic, they may be smaller among married couples who live together and share their views with each other, and they may be smaller among individuals more directly exposed to the pandemic.

To test the first hypothesis, we regress our three outcomes of interest on the female dummy, time (a dummy for the second wave), and the interaction between this variable and the female dummy. The results are shown in Table 1, columns 1 through 3. Consistent with the graphical evidence in Fig. 1 and in *SI Appendix*, Figs. S1 and S2, beliefs on the seriousness of the pandemic, the agreement index, and the compliance index all decrease substantially over time. The gap between men and women is slightly smaller in the second wave for the first two outcomes, but, if anything, the gender gap in compliance increases over time. In other words, the decrease in compliance with health measures is smaller for women. The results are robust to restricting the sample to individuals successfully surveyed in both waves of the panel (ensuring comparability over time) or to individuals who were only surveyed in one wave, so that, by construction, their responses cannot be biased by the desire to show consistency over time (*SI Appendix*, Table S9).

Columns 4 through 6 and 7 through 9 of Table 1 test the two latter hypotheses by interacting the female dummy with a dummy

**Table 1. Heterogeneous effects by time, living situation, and exposure to the pandemic**

| | Gender effect in wave II | | | Gender effect and cohabitation | | | Gender effect and exposure to COVID | | |
|---|---|---|---|---|---|---|---|---|---|
| | Serious health issue | Overall agree | Overall compliance | Serious health issue | Overall agree | Overall compliance | Serious health issue | Overall agree | Overall compliance |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Female | 0.101*** | 0.065*** | 0.054*** | 0.107*** | 0.071*** | 0.070*** | 0.088*** | 0.060*** | 0.061*** |
| | (0.009) | (0.007) | (0.004) | (0.017) | (0.012) | (0.007) | (0.010) | (0.006) | (0.003) |
| Female (times) second wave | −0.027** | −0.012* | 0.008* | | | | | | |
| | (0.011) | (0.007) | (0.004) | | | | | | |
| Second wave | −0.130*** | −0.091*** | −0.107*** | | | | | | |
| | (0.010) | (0.007) | (0.005) | | | | | | |
| Female (times) lives with others | | | | −0.029 | −0.017 | −0.015* | | | |
| | | | | (0.020) | (0.013) | (0.008) | | | |
| Lives with others | | | | 0.051*** | 0.041*** | 0.039*** | | | |
| | | | | (0.017) | (0.009) | (0.006) | | | |
| Female (times) knows COVID patients | | | | | | | −0.025 | −0.004 | −0.014*** |
| | | | | | | | (0.018) | (0.013) | (0.005) |
| Female (times) COVID patient | | | | | | | 0.011 | 0.015 | −0.019** |
| | | | | | | | (0.030) | (0.019) | (0.009) |
| Knows COVID patients | | | | | | | 0.032** | −0.003 | 0.019*** |
| | | | | | | | (0.014) | (0.011) | (0.005) |
| Covid patient | | | | | | | 0.005 | 0.002 | 0.017** |
| | | | | | | | (0.022) | (0.016) | (0.007) |
| Observations | 21,618 | 21,627 | 21,630 | 16,973 | 16,979 | 16,981 | 20,057 | 20,066 | 20,069 |
| R-squared | 0.131 | 0.123 | 0.200 | 0.141 | 0.128 | 0.215 | 0.140 | 0.134 | 0.215 |
| Area FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Wave FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Sociodemographic controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Mean among men | 0.406 | 0.424 | 0.773 | 0.406 | 0.424 | 0.773 | 0.406 | 0.424 | 0.773 |

SEs clustered at the region level are in parentheses (***, **, * indicate significance at 1%, 5%, and 10%, respectively). We pool survey data from the first and second waves together. We control for area fixed effects (FE), wave fixed effects (FE), and sociodemographic characteristics in all regressions. The sociodemographic controls include age dummies (being in one's 30s, 40s, 50s, 60s, and 70s or above); income quartiles and a dummy for people not reporting their income; dummies for high school and college education; dummies for full-time worker, part-time worker, unemployed, and self-employed; dummies for white collar, blue collar, and service worker; a dummy for good overall health; ethnicity dummies (White, Black, Latino, and Asian); a dummy for aboriginal; dummies for religion (Catholic, other Christian, and no religion); the number of people per bedroom or per room; and dummies for low-density area and medium-density area.

indicating whether the individual lives alone or with other people (most individuals in the latter category are married with someone of the opposite gender) and two dummies indicating the level of exposure to the pandemic (having symptoms, or knowing someone with symptoms), respectively. All regressions pool the first and second waves together. Gender differences in our outcomes of interest are smaller for individuals who live in a household than for those who live alone, consistent with the hypothesis that views on the pandemic and on appropriate health measures, as well as behavior, diffuse within households. This echoes evidence of similar transmission patterns for other types of beliefs and behavior, such as voting or using drugs (25, 26). In addition, we find that people with COVID-19 symptoms and those who know others with such symptoms are more likely to comply with health measures, and that gender differences are smaller among them, suggesting that first-hand experience of the pandemic enables men to bridge part of the gap with women.[§]

[§]We do not find a reduction in gender differences in regions with a higher fraction of cases or deaths, as measured at the time of each wave, indicating that the effect of gender is mitigated by first-hand experience of the pandemic, not by its overall prevalence (*SI Appendix*, Table S10).

Finally, we test whether gender differences vary by age, income, and education. We show the results obtained by interacting the female dummy with each of these factors separately (*SI Appendix*, Table S11, columns 1 through 9) and controlling for interactions with all of these factors (*SI Appendix*, Table S11, columns 10 through 12). We find that differences in beliefs and behavior between men and women are smaller among younger individuals and increase as people become older. This pattern may reflect an aging effect, due, for instance, to women being more likely to be socialized to become caregivers, or a cohort effect, if men and women receive a more similar education in younger cohorts. In addition, the gender difference in compliance with health and social distancing measures is smaller among people with a higher income. Finally, we do not find any significant difference across different levels of education. Importantly, although the size of gender differences varies a bit across groups, these differences remain substantial and statistically significant for all of the groups we consider and for all outcomes.

**Social Desirability Bias.** Because our analysis relies on survey data, a possible worry is that gender differences in self-declared compliance with health rules might result from differences in

**Table 2. Test for social desirability bias: List experiment**

| | Number actions reported | |
|---|---|---|
| | No controls (1) | With controls (2) |
| Treatment: Five actions | 0.309 | 0.304 |
| | (0.032)*** | (0.029)*** |
| Treatment (times) female | −0.087 | −0.076 |
| | (0.044)** | (0.043)* |
| Female | −0.076 | −0.091 |
| | (0.030)** | (0.030)*** |
| Observations | 11,019 | 11,019 |
| R-squared | 0.085 | 0.117 |
| Wave | 2 | 2 |
| Area fixed effects | Yes | Yes |
| Sociodemographic controls | No | Yes |
| Treatment (times) sociodemographic controls | No | Yes |

SEs clustered at the region level are in parentheses (***, **, * indicate significance at 1, 5, and 10%, respectively). The treatment is a dummy equal to 1 if the respondent was presented with a list of five actions, including "meeting with two or more friends or relatives who do not live with me" and four nonsensitive actions, and 0 if the respondent was presented with the list of four neutral actions. We control for area fixed effects in all regressions, and for sociodemographic characteristics in column 2. In column 2, we also control for sociodemographic characteristics interacted with the treatment dummy. Sociodemographic controls are as in Table 1.

social desirability bias rather than in actual behavior. To address this concern, we exploit the results of a list experiment (also known as item count technique), which was conducted in the second wave of the survey in all countries.[¶] The experiment focused on one specific behavior: meetings with people outside the household. Many countries required their populations to decrease the frequency of such meetings or to stop them altogether, and the World Health Organization recommended decreasing the number of interpersonal contacts as well (30). A first, randomly selected, half of respondents were presented with a list of five actions: "meeting with two or more friends or relatives who do not live with me" as well as four less sensitive actions. They were asked how many of these actions (from 0 to 5) they performed in the last week. Respondents who met with more than two people outside of their household could include it in the number they provided without revealing whether they had done that particular action or another one.[#] This decreased the risk that their response would be biased by social desirability. The second half of respondents were presented with the list of four neutral actions, which did not include meeting with two or more people outside of their household. We can estimate the fraction of people who engaged in this activity by subtracting the average response in both groups. Formally, we regress the number of actions reported by respondents on a dummy equal to 1 if the list they were presented included meeting with people outside their household. To estimate separately the fraction of men and women who engaged in this behavior, we control for the same dummy interacted with gender as well as the direct effect of gender. We report the results in Table 2 . On average, 30.9% of the male respondents met with people outside their household. This fraction is 8.7 percentage points lower among women, a difference significant at the 5% level (Table 2, column 1). This result is robust to allowing for differences in other sociodemographic factors (Table 2, column 2).

We compare these effects to those obtained when asking respondents, directly, the extent to which they stopped seeing friends, which is one of the components of our overall compliance index. This question is, in principle, more susceptible to social desirability bias, as responding that one did not stop meeting with friends amounts to admitting a behavior which may be frowned upon and, in some countries, forbidden. In Table 3, we find an average level of compliance with this rule of 81.5% on a scale from 0 to 10. More importantly, the difference between men and women is 6.4 percentage points, which is comparable to the difference found in the list experiment. The comparison between respondents' direct responses and the results of the list experiment assuages the concern that the gender differences we observe for this and other outcomes may be driven by differential social desirability bias.

## Discussion

Our evidence convincingly points to strong gender differences in people's belief that COVID-19 represents a very serious health risk, in their agreement with restraining public health rules, and in their compliance with them. These results may help explain the gender differences that have emerged in mortality and vulnerability to COVID-19 (11–14), complementing explanations which point to causes outside of the immediate control of individuals, such as genetic and immunological differences (15–17) and differences in preexisting comorbidities, behavioral risk factors (13), and working conditions (18). Our findings point to the relevance of behavioral factors.

In addition, our evidence is in line with an observation made by several commentators (31): Countries headed by women, such as Germany and New Zealand, have generally responded more effectively to the pandemic. In contrast, some of the countries with the worst record, including the United States and Brazil, are led by men who have projected strong masculinity attitudes and dismissed the need for precautionary practices such as wearing masks.

Finally, our results suggest that, by being more compliant with simple rules such as wearing face masks, women are less likely to spread the disease, conditional on being infected. Because changes in behavior, from reduced mobility to wearing masks, might have to be accepted as the "new normal," at least for some time (32), differential public messages by gender may be required to increase compliance among men (13). More broadly,

**Table 3. Test for social desirability bias: Self-reported behavior**

| | Stopped seeing friends | |
|---|---|---|
| | No controls (1) | With controls (2) |
| Female | 0.064 | 0.065 |
| | (0.005)*** | (0.005)*** |
| Observations | 11,029 | 11,029 |
| R-squared | 0.086 | 0.103 |
| Wave | 2 | 2 |
| Area fixed effects | Yes | Yes |
| Sociodemographic controls | No | Yes |
| Mean among men | 0.815 | 0.815 |

SEs clustered at the region level are in parentheses (***, **, * indicate significance at 1, 5, and 10%, respectively). We control for area fixed effects in all regressions, and for sociodemographic characteristics in column 2. Sociodemographic controls are as in Table 1.

¶List experiments have been shown to elicit truthful answers to sensitive questions for a wide range of behaviors (27–29).

#The answer of truthful respondents would only reveal that they met with more than two people outside of their household if they also performed all other actions. Very few people fall in this category: Only 4% of respondents presented with the list of four neutral actions reported they performed all of them.

our evidence unveils a domain of gender difference: behavioral changes in response to a new risk.

## Materials and Methods

To measure the existence of a gender gap in our three outcomes of interest (belief about the seriousness of the health problem, agreement with restrictive measures, and compliance with health rules), we use ordinary least squares (OLS) estimates of the following linear equation:

$$y_i = \alpha + \beta F_i + X_i^{'}\gamma + C_i^{'}\delta + \sum_a \partial_i^a + w_i + \varepsilon_i, \quad [1]$$

where $y_i$ is one of the outcomes of interest, $F_i$ is a dummy for female, $X_i$ is the vector of sociodemographic characteristics, $C_i$ is the vector of psychological and behavioral factors, $\partial_i^a$ are area fixed effects, and $w_i$ is a fixed effect for the second wave. The coefficient of interest, measuring the difference between men and women (conditional on the controls), is $\beta$. SEs are clustered at the region level. For country regressions, we use survey weights that ensure the representativeness of the survey at the national level. Regressions on the pooled sample are, instead, unweighted to prevent observations from large countries from being overwhelming. These specifications are used in Table 3, and in *SI Appendix*, Tables S2–S8. Area fixed effects are included in all specifications; the second wave fixed effect is included in all specifications pooling observations of both waves; and sociodemographic controls and controls for psychological and behavioral factors are included when specified.

To perform our heterogeneity analysis and identify factors that may mitigate gender differences, we run the following linear equation:

$$y_i = \alpha + \beta F_i + E_i'\mu + F_i \times E_i'\rho + X_i^{'}\gamma + C_i^{'}\delta + \sum_a \partial_i^a + w_i + \varepsilon_i, \quad [2]$$

where $E_i$ is a vector of possible mitigating factors (time, living with others, exposure to the pandemic, age, income, education, and large fraction of COVID cases and deaths in the respondent's region). The coefficient of interest, measuring the differential effect of gender for respondents with characteristics $E_i$, is the vector $\rho$. Results of the estimates from this equation are reported in Table 1 (with time, living with others, and exposure to the pandemic as mitigating factors) and in *SI Appendix* (with time as mitigating factor in *SI Appendix*, Table S9; with large fraction of COVID cases and deaths in the respondent's region as mitigating factors in *SI Appendix*, Table S10; and with age, income, and education as mitigating factors in *SI Appendix*, Table S11).

Finally, we analyze the results of the list experiment using the following equation:

$$y_i = \alpha + \beta F_i + X_i^{'}\gamma + \theta T_i + \tau T_i \times F_i + T_i \times X_i^{'}\varphi + \sum_a \partial_i^a + \varepsilon_i, \quad [3]$$

where $T_i$ is a dummy equal to 1 if the respondent was presented a list of five actions (including "meeting with two or more friends or relatives who do not live with me") and 0 if he or she was presented a list of four actions (excluding "meeting with two or more friends or relatives who do not live with me"). Conditional on the controls, $\theta$ ($\theta + \tau$) estimates the fraction of men (women) who met with two or more friends or relatives not living with them. The results are reported in Table 2. To ensure that the difference between men and women estimated by $\tau$ does not capture the influence of a correlated factor, we control for sociodemographic factors as well as their interaction with the treatment dummy (Table 2, column 2).

This paper was part of "REPEAT: Attitude on Covid related measures" (Protocol SA000085); the Research Ethics Committee of Bocconi University approved this study.

Respondents were informed by the survey companies (IPSOS and CSA) at the beginning of the questionnaire about the general scope of the survey: collecting information on perceptions and attitudes on COVID-19 and related public policies. Each respondent provided explicit consent to the survey companies (IPSOS and CSA) in every country and in each wave of our survey.

**Data Availability.** Anonymized survey dataset and code data have been deposited in Dataverse Harvard (https://dataverse.harvard.edu/dataverse/vincent_pons).

**ACKNOWLEDGMENTS.** Nicola Bariletto, Marco Lo Faso, and Nicolas Longuet Marx provided research assistance. V.G. thanks Roberto Tattà for inspirational discussions. Survey data are from the project Attitudes on COVID-19: A Comparative Study, chaired by S.B. and M.F. (Sciences Po). Financial Support from French Agency for Research (ANR) - REPEAT grant (Special COVID-19), IAST funding from ANR under the Investments for the Future ("Investissements d'Avenir") program, Grant ANR-17-EURE-0010, and Unicredit Foundation are acknowledged.

SOCIAL SCIENCES


1. S. Maharaj, A. Kleczkowski, Controlling epidemic spread by social distancing: Do it well or not at all. *BMC Public Health* **12**, 679 (2012).
2. N. H. L. Leung *et al.*, Respiratory virus shedding in exhaled breath and efficacy of face masks. *Nat. Med.* **26**, 676–680 (2020).
3. M. U. G. Kraemer *et al.*; Open COVID-19 Data Working Group, The effect of human mobility and control measures on the COVID-19 epidemic in China. *Science* **368**, 493–497 (2020).
4. R. Zhang, Y. Li, A. L. Zhang, Y. Wang, M. J. Molina, Identifying airborne transmission as the dominant route for the spread of COVID-19. *Proc. Natl. Acad. Sci. U.S.A.* **117**, 14857–14863 (2020).
5. S. K. Brooks *et al.*, The psychological impact of quarantine and how to reduce it: Rapid review of the evidence. *Lancet* **395**, 912–920 (2020).
6. T. J. Bouchard Jr., J. C. Loehlin, Genes, evolution, and personality. *Behav. Genet.* **31**, 243–273 (2001).
7. C. Tittle, *Sanctions and Social Deviance: The Question of Deterrence*, (Praeger, New York, NY, 1980).
8. B. Torgler, *Tax Compliance and Tax Morale: A Theoretical and Empirical Analysis*, (Edward Elgar, 2007).
9. H. Shattuck-Heidorn, M. W. Reiches, S. S. Richardson, What's really behind the gender gap in Covid-19 deaths? *NY Times*, 24 June 2020. https://www.nytimes.com/2020/06/24/opinion/sex-differences-covid.html. Accessed 25 June 2020.
10. N. Greenfieldboyce, The new coronavirus appears to take A greater toll on men than on women. National Public Radio, 10 April 2020. https://www.npr.org/sections/goatsandsoda/2020/04/10/831883664/the-new-coronavirus-appears-to-take-a-greater-toll-on-men-than-on-women?t=1595847725551. Accessed 7 June 2020.
11. G. Grasselli, A. Pesenti, M. Cecconi, Critical care utilization for the COVID-19 outbreak in Lombardy, Italy: Early experience and forecast during an emergency response. *JAMA* **323**, 1545–1546 (2020).
12. N. Chen *et al.*, Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: A descriptive study. *Lancet* **395**, 507–513 (2020).
13. C. Wenham, J. Smith, R. Morgan; Gender and COVID-19 Working Group, COVID-19: The gendered impacts of the outbreak. *Lancet* **395**, 846–848 (2020).
14. Global Health 50/50, COVID-19 sex-disaggregated data tracker. https://globalhealth5050.org. Accessed 27 May 2020.
15. World Health Organization, *Addressing Sex and Gender in Epidemic-Prone Infectious Diseases*, (World Health Organization, 2007).
16. I. Bianchi, A. Lleo, M. E. Gershwin, P. Invernizzi, The X chromosome and immune associated genes. *J. Autoimmun.* **38**, J187–J192 (2012).
17. S. L. Klein, K. L. Flanagan, Sex differences in immune responses. *Nat. Rev. Immunol.* **16**, 626–638 (2016).
18. G. Bertocchi, COVID susceptibility, women, and work. https://voxeu.org/article/covid-19-susceptibility-women-and-work. Accessed 7 June 2020.
19. S. Brouard, M. Becher, M. Foucault, P. Vasilopoulos, Citizens' attitudes towards COVID-19–A comparative study (2020). http://www.sciencespo.fr/cevipof/attitudesoncovid19. Accessed 25 March 2020.
20. Data from https://www.worldometers.info/coronavirus. Accessed 31 May 2020.
21. M. Boniol *et al.*, *Gender equity in the health workforce: Analysis of 104 countries: Health Workforce Working Paper 1*, (World Health Organization, Geneva, 2019).
22. R. Croson, U. Gneezy, Gender differences in preferences. *J. Econ. Lit.* **47**, 448–474 (2009).
23. L. Edlund, R. Pande, Why have women become left-wing? The political gender gap and the decline in marriage. *Q. J. Econ.* **117**, 917–961 (2002).
24. R. Inglehart, P. Norris, The developmental theory of the gender gap: women's and men's voting behavior in global perspective. *Int. Polit. Sci. Rev.* **21**, 441–463 (2000).
25. D. Nickerson, Is voting contagious? Evidence from two field experiments. *Am. Polit. Sci. Rev.* **102**, 49–57 (2008).
26. M. De Vaan, T. Stuart, Does intra-household contagion cause an increase in prescription opioid use? *Am. Sociol. Rev.* **84**, 577–608 (2019).
27. T. Tsuchiya, Y. Hirai, Y., S. Ono. A study of the properties of the item count technique. *Public Opin. Q.* **71**, 253–272 (2007).
28. A. L. Holbrook, J. A. Krosnick, Social desirability bias in voter turnout reports: Tests using the item count technique. *Public Opin. Q.* **74**, 37–67 (2010).
29. E. Coutts, B. Jann, Sensitive questions in online surveys: Experimental results for the randomized response technique (RRT) and the unmatched count technique (UCT). *Sociol. Methods Res.* **40**, 169–193 (2011).
30. World Health Organization, Coronavirus disease (COVID-19) advice for the public. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public. Accessed 27 May 2020.
31. A. Wittenberg-Cox, What do countries with the best coronavirus responses have in common? Women leaders. *Forbes*, **13** April 2020. https://www.forbes.com/sites/avivahwittenbergcox/2020/04/13/what-do-countries-with-the-best-coronavirus-reponses-have-in-common-women-leaders/. Accessed 27 July 2020.
32. M. S. Cohen, L. Corey, Combination prevention for COVID-19. *Science* **368**, 551 (2020).