

ARTICLE

Iron fists and velvet gloves: Investigating the associations between the stringency of governments' responses to COVID-19, stress, and compliance in the early stages of the pandemic

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Abstract

To tackle the spread of COVID-19, governments worldwide have implemented restrictive public health behavioural measures. Whether and when these measures lead to positive or negative psychological outcomes is still debated. In this study, drawing on a large sample of individuals ($N_{\text{total}} = 89,798$) from 45 nations, we investigated whether the stringency of public health measures implemented at the outset of the COVID-19 pandemic in March–May 2020 was associated with individuals' levels of stress and compliance. Moreover, we addressed the question of how these associations may be moderated by the measures' implementation lag, nations' tolerance for unequal distributions of power (i.e., power distance), and individuals' institutional trust. Linear mixed models suggested that slower implementation of less stringent measures was associated with higher stress and lower compliance. Also, rapid implementation of stricter measures was associated with a mild increase in stress. Such effects were especially pronounced in countries with less tolerance for inequality. Albeit significant, the moderating effect of institutional trust was very small. The results suggest that it may be important to consider the measures' implementation lag when tackling the spread of COVID-19, but findings should be interpreted in relation to the data collection period.

KEYWORDS

compliance, COVID-19, regulations, stress, stringency index

INTRODUCTION

The COVID-19 pandemic is one of the most severe public health crises in living memory. In response to it, governments worldwide have implemented an array of different measures, including lockdowns, social distancing, and quarantines (Fang et al., 2020; Hale et al., 2020; Leung et al., 2020). While these measures help curbing the spread of the virus (e.g., Brauner et al., 2020; Flaxman et al., 2020), they may also have negative psychological and behavioural implications, such as stress and lack of compliance (Brooks et al., 2020; Dubey et al., 2020; Holmes et al., 2020; Kowal et al., 2020).

In the present study, we focused on the relationships between the severity of country-level institutional measures to tackle the pandemic and individual-based psychological responses of stress and compliance. Investigating stress in the context of the COVID-19 pandemic is crucial because it allows us to understand the link between the implementation of restrictions and individuals' well-being (see Hawryluck et al., 2004; Lieberoth et al., 2021). Moreover, because the success of countries' responses to the pandemic often depends on individuals' willingness to comply with official regulations, it is crucial to understand the predictors of people's compliance with such regulations (Travaglini & Moon, 2021).

We assessed these relationships across multiple levels of analysis by drawing for the first time on two novel large-scale datasets, namely the COVIDiSTRESS global survey (Yamada et al., 2021) and the Oxford COVID-19 Government Response Tracker (OxCGRT; Hale et al., 2020). The COVIDiSTRESS dataset includes, inter alia, measures of psychological responses such as stress, compliance, and institutional trust. The OxCGRT dataset includes estimates about the stringency of governments' measures in response to the pandemic over time.

The stringency of the measures implemented to respond to the pandemic differs widely across countries. Recent research examining the socio-psychological outcomes of such variation (e.g., Brooks et al., 2020; Fetzter et al., 2020; Lieberoth et al., 2021; O'Hara et al., 2020; Travaglini & Moon, 2021) has resulted in discordant findings. For instance, Fetzter et al. (2020) investigated citizens' perception of the measures in fifty-eight countries. The authors found that measures perceived as more restrictive were associated with improved psychological well-being. In contrast, O'Hara et al. (2020) reported that more stringent measures were associated with stronger worries and higher depression, especially among those individuals who were more trustful of the government. Differences across findings suggest that the relationship between measure stringency and psychological outcomes may be moderated by other variables. In this research, we focused on two potential moderators, namely (i) the measures' implementation lag and (ii) citizens' views of the authority, either at the individual (citizens' trust in institutions) or at collective (countries' power distance scores) levels.

Implementation lag, stress, and compliance

How rapidly measures are implemented (i.e., the measures' implementation lag) is important from a public health perspective. Flaxman et al. (2020) found the speed of governments' response to COVID-19 to be positively associated with infection mitigation. Countries that delayed the implementation of strict measures to tackle the first wave of the pandemic have experienced larger numbers of fatalities and higher infection rates (see also Pei et al., 2020).

Less clear are the psychological outcomes of the variations in implementation lag. *The slower* implementation of restrictive measures may result in higher rates of infections and more fatalities at the country level, subsequently leading to negative psychological outcomes including fear, stress, confusion, anger, and lower compliance (Brooks et al., 2020). For instance, research indicates that individuals are

more likely to feel stressed when they perceive the situation as too difficult to cope with, or themselves as having insufficient resources (see also Lazarus, 2000; Lazarus & Folkman, 1984). The COVID-19 pandemic meets many of the criteria characterizing stress-inducing events (Bao et al., 2020). Especially early in 2020, at the outset of the pandemic, the virus was perceived as an invisible, potentially deadly, and seemingly invincible (Nicomedes & Avila, 2020) enemy. Several studies reported that individuals were feeling fearful (Fitzpatrick, et al., 2020), helpless (Levkovich & Shinan-Altman, 2021), and hopeless (Hacimusalar, et al., 2020).

However, an alternative plausible prediction is that the *rapid* implementation of severe measures (e.g., lockdown and social distancing) may contribute to higher levels of stress and lower compliance. These outcomes may be due to the sudden changes in individuals' habits and increased isolation (Beam & Kim, 2020; Saltzman et al., 2020). Public communication about the crisis is also likely to be negatively affected by the sudden shift in rules and recommendations, with negative implications for individuals' responses to the crisis (Covello, 2003).

Measure stringency and implementation lag may interact and be potentially associated with different responses to the pandemic. Thus, it is crucial to empirically examine the role of the measures' implementation lag in moderating the relationship between measures' stringency, stress, and compliance. We investigated, for the first time, the role of implementation lag in this research.

Citizens' views of the authority

An additional key factor that might moderate the relationships between severity of the measures and psychological outcomes refers to how individuals view authority (Travaglino & Moon, 2021). In the current study, we examined both individual-level trust in institutions and country-level indices of power distance.

Trust in institutions is especially relevant in risky and uncertain circumstances, where individuals do not possess the necessary knowledge to make decisions (i.e., during a public health crisis). Several studies have reported an association between low levels of institutional trust and mental health problems (Cheung & Tse, 2008; Thoresen et al., 2021). Moreover, as observed by Deurenberg-Yap et al. (2005) and Prati et al. (2011) during previous pandemics (H1N1 and SARS), there exists an association between trust in institutional authorities and citizens' compliance with measures imposed during a pandemic such that higher trust was linked to stronger compliance. Similar results have been obtained in the context of the current pandemic (Lalot et al., 2020; Travaglino & Moon, 2021). Siegrist and Cvetkovich (2000) suggest that trust in authorities managing the crisis has a direct impact on public perceptions of risks. Public perception, in turn, can determine how individuals respond to the crisis and their levels of stress and compliance. For instance, Plohl and Musil (2021) found that perceiving COVID-19 as riskier was related to greater compliance with COVID-19 guidelines. Pagliaro et al. (2021) demonstrated that psychological differences in terms of trust in government, other citizens, and towards science predicted individuals' intentions to comply with official recommendations across 23 countries.

Nations' overall levels of power distance might also moderate the association between stringency of the measures and psychological outcomes. According to Hofstede's model of national culture (Hofstede et al., 2010), the dimension of power distance reflects the extent to which the less powerful members of a society accept and expect that power is distributed unequally in society. Several studies have explored how this element of cultural variation is linked to individuals' responses to the pandemic. For example, Gelfand et al. (2020) observed that countries with tighter cultures and more efficient governments were more effective in limiting COVID-19 growth and mortality. Furthermore, Messner (2020) and Dheer et al. (2020) demonstrated that societies with higher values of power distance also had a flatter virus propagation curve. An explanation for these results is that people from cultural contexts characterized by higher levels of power distance are more willing to comply with the instructions from the authorities, thus improving virus mitigation.

To summarize, individuals' levels of trust in government and nations' overall levels of power distance may play an important role in shaping public responses to governments' actions. In this research, we examined the role of these factors in moderating the relationships between stringency of the measures and psychological outcomes.

Overview of the study and objectives

The overall objective of our study was to provide insights into why previous research has produced discordant findings when assessing the association between stringency and the psychological outcomes of stress and compliance. Greater stringency may be associated with more negative outcomes, such as greater stress (e.g., O'Hara et al., 2020) and lower compliance, because people find it hard to adjust to new and unknown life circumstances. However, more stringent measures may also relieve stress (e.g., Fetzner et al., 2020) and foster compliance, because they promote a greater sense of security when there is high uncertainty (e.g., at the outset of a pandemic). In this research, we investigated whether the direction of these associations could be explained by the measures' implementation lag (SI_{Time}), and individual- (i.e., trust in government) and country-level (i.e., power distance) views of the authority. Because little research has assessed the moderating role of these variables, we explored the direction of the moderating effects in the analyses below.

With regard to the measures' implementation lag, it is conceivable that the rapid implementation of stricter measures may be associated with negative psychological reactions, while gradual implementation may alleviate such effects. Nonetheless, it should also be considered that the slower implementation of weak measures could be perceived as a sign of inactivity and thus predict negative psychological outcomes.

In addition, higher trust in government might mitigate the potential negative psychological implications of stricter measures, resulting in no association between measure stringency, stress, and compliance. Finally, countries' levels of power distance might play a similar role. Because citizens of high-power distance countries may feel more accepting of authorities' actions, the measures' stringency may be less strongly associated with stress or compliance. We examined this set of associations in the present study.

METHODS

Dataset and sample

The COVIDiSTRESS Global Survey (2020) is an international collaborative initiative that assessed people's psychological and behavioural responses to the COVID-19 outbreak across numerous countries between 30 March and 31 May 2020. Participants were recruited online, using a snowballing sampling strategy, both via social and traditional media. Participants took part in the study voluntarily and were not compensated for their participation. The survey was translated into the countries' local languages using forward-back translation. A waiver from the Ethics committee at the university in Denmark was obtained at the beginning of data collection. The Ethics committee approval was granted post hoc on 10 June 2020. For a detailed description of the COVIDiSTRESS Global Survey, see Yamada et al. (2021).

In the present study, we utilized data collected between 30 March (early launch in Denmark, 27 March) and 3 May 2020. We focused on this specific time window because we compared differences among countries using a weighted average of the stringency index in a given timeframe. Thus, we strived to analyse the period when the stringency index was mostly stable within-country across most countries. Doing so increased the likelihood that the weighted average appropriately reflected the severity of imposed measures. By means of visual inspection, we observed that in multiple countries the

stringency index lowered after 3 May 2020 and concluded that this date represented a suitable cut-off point.

We also excluded all the participants who were younger than 18, who had any missing data in relevant predictor and criterion variables, and who did not report their sex. We detected 426 outliers, which we defined as values larger than the third quartile plus 1.5 times the interquartile range, in age, and number of dependents. However, removing those subjects from the subsequent analyses did not change the main conclusions about the moderating effects of the implementation lag, trust in government, and PDI on the relationship between SI, stress, and compliance. Therefore, we retained these data in the final analyses.

Finally, we excluded all countries that had less than 100 participants after matching the aforementioned criteria (see https://osf.io/tupdx/?view_only=a9e6f30fee574aecbad3cc15096e3af7 for the raw data file, and https://osf.io/u34fy/?view_only=061b2627208b4173b5dbb69f1d53e69e for a detailed description of the data-cleaning procedure and reproducible R script).

The final sample consisted of 89,798 respondents from 45 countries, aged between 18 and 110 ($M = 39.37$, $SD = 13.89$), of which 66,018 were women (73.52%).

Measures

Stringency Index (SI)

The OxCGRT uses a standardized set of measures to track governments' policies and interventions through time across more than 160 countries (Hale et al., 2020). It includes four composite indices (an overall government response index, a containment and health index, a stringency index, and an economic support index) that allow for between-country comparison of governments' response to the pandemic. In the present study, we used the Stringency Index (SI) as a tool to compare the severity of the implemented measures across countries. The SI is based on eight indicators of containment (school closure, workplace closure, cancellations of public events, restrictions on gatherings, closure of public transportation, stay-at-home requirements, restrictions on internal movement, international travel controls) and one health measure (public info campaigns). The SI ranges from 1 to 100, and larger values indicate greater severity of the measures. The dataset we used contained information about the country-specific SI for each day starting from 1 January 2020 to 3 May 2020. We used the dataset version from 23 November 2020.

Time of SI change (SI_{Time})

To examine the role of implementation lag in moderating the association between stringency, compliance, and stress, we devised a country-specific index, SI_{Time} , which we defined as the number of days it took a country to reach its maximum SI value from the day that the first restriction was implemented. However, it should be noticed that the first restrictions were commonly implemented before the beginning of the study (e.g., January or February 2020).

Perceived Stress Scale

Stress levels were measured using the Perceived Stress Scale (PSS-10; Cohen et al., 1983; Cohen & Williamson, 1988), which includes 10 items (four reverse-coded) measured on a 5-point Likert scale ranging from 1 (Never) to 5 (Very often). An example item is, 'In the last week, how often have you felt nervous and "stressed"?'. PSS-10 has a two-factor structure (i.e., a positive and a negative factor, with the latter consisting of reversed items; Chaaya et al., 2010; Roberti et al., 2006) and is generally

considered a highly reliable measure of stress (Taylor, 2015). However, in this research we calculated the composite score based on five items which were scalar invariant across countries (see Appendix S1—Estimating the measurement invariance of the Perceived Stress Scale). Only participants with no missing values on the five items were included in the analyses.

Compliance with public health measures

Compliance was measured using the item ‘I have done everything I could possibly do to keep physical distance to others’, constructed specifically for the COVIDiSTRESS Global Survey. (The item in the COVIDiSTRESS Global Survey ‘I have done everything I could possibly do as an individual to reduce the spread of Coronavirus’ also measured compliance in the survey, but we analysed the first one because it was more specific and less susceptible to differences in interpretation; for LMM analyses using the alternative item, see Appendix S1—LMM analyses with the alternative compliance measure.) The item was measured on a 6-point Likert scale, ranging from 1 (strongly disagree) to 6 (strongly agree).

Trust in government

Trust in government was measured using the item ‘How much do you personally trust each of the institutions below: The parliament/government of the country I live in’, in accordance with the OECD guidelines for measuring institutional trust (OECD, 2017). (In the survey, additional items were present measuring trust in other bodies that were not relevant to the aim of the present study). The 11-point Likert scale ranged from 0 (not at all) to 10 (complete trust).

Power distance

The Power Distance Index (PDI) for each country was obtained from Hofstede et al. (2010; see <https://geerthofstede.com/research-and-vsm/dimension-data-matrix/>). The only exception was Bosnia and Herzegovina, for which the index was estimated under the Hofstede Insights (see <https://hi.hofstede-insights.com/faq>). The power distance score ranges from 1 to 100. Lower scores are associated with, for instance, decentralization of power, horizontal communication, and equal rights, while higher scores are associated with, for instance, centralization of power, vertical communication, and hierarchical order without the need for any justification.

Country-level covariates

Country-level measures of gross domestic product per capita (GDP) and daily COVID-19-related deaths were included in our model to adjust for differences among countries. Substandard economic circumstances have been linked to negative psychological outcomes (Godinic et al., 2020; Mucci et al., 2016), while elevated COVID-19-related death rates may increase threat perception. These variables may also potentially be associated with the stringency of implemented measures. We thus controlled for them in regression models to obtain a more unbiased estimation of the association of SI_{wa} , stress, and compliance. To measure GDP, we used the International Monetary Fund nominal estimates in US dollars for 2019 (IMF, 2019). We also modelled the country-level number of daily deaths related to COVID-19 per million citizens. The data were extracted from the ‘Our World in Data’ dataset (Roser et al., 2020), available at <https://ourworldindata.org/coronavirus>.

Individual-level covariates

Kowal et al. (2020) showed that being a woman and younger were characteristics associated with higher stress during the COVID-19 pandemic. In addition, job insecurity has also been linked to negative psychological outcomes (Kuhnert et al., 1989). Finally, the number of dependents one has, and being at higher risk for COVID complications might worsen stress reactions. On these bases, in the present study, we included the following individual-level covariates to account for the between-country differences in samples: participants' sex (coded as 0 for male and 1 for female), age, employment status (coded as 0 for unemployed and 1 for other statuses, i.e., students, self-employed, part-time employed, full-time employed, retired), number of dependents, and whether they or any of their close relations (family or close friends) belonged to a high-risk group for coronavirus (e.g., pregnant women, elderly, or people with pre-existing medical conditions; coded as 0 for no-risk group and 1 for possible or certain risk).

Data preparation

Prior to the analyses, we calculated the weighted average SI (SI_{wa}) for each country in the period between 30 March (early launch in Denmark, 27 March) and 3 May 2020. The average was weighted by the number of participants who filled out the survey on a certain date to attenuate the effect of SI change that was exhibited in some countries like South Korea, Czech Republic, and Indonesia. Analogously, we also computed the weighted average of the number of daily deaths per million citizens within a specific country. Finally, all continuous variables used as predictors were z-standardized at the between-country level (GDP, SI_{wa} , SI_{Time} , age, number of dependents, trust in government, PDI, and the number of daily deaths per million citizens). Figure 1 shows psychological stress and the stringency index (solid blue line) across time and countries.

Data analysis

Detailed descriptive statistics can be accessed via the .Rmd file at https://osf.io/u34fy/?view_only=061b2627208b4173b5dbb69f1d53e69e. Before analysing differences in stress across the 45 countries, we examined the measurement invariance of the PSS-10. We obtained partial scalar invariance, with intercepts of items 1, 2, 3, 8 and 10 estimated freely for the model postulating a general factor and an orthogonal nested method factor saturating four positively phrased items (items 4, 5, 7 and 8). For subsequent cross-country comparisons, we calculated the average composite PSS score based on the invariant items only (4, 5, 6, 7, and 9). Only participants who had no missing data in these items were used in further analyses. The correlation of the reduced scalar invariant and original version of PSS average scores was 0.932. It should be noted, however, that the significance of linear mixed model effects does not replicate when using the original 10-item scale (although the pattern of results is similar). This could be due to the lack of invariance in the 10-item scale. For details about the measurement invariance testing, see Appendix S1—Estimating the measurement invariance of the Perceived Stress Scale.

Linear mixed model analyses

In this research, our main objective was to examine whether SI_{Time} , PDI, and Trust moderated the association between SI_{wa} and perceived stress and compliance during the early stages of the COVID-19 pandemic. We adjusted for the effects of the number of daily deaths per million citizens, GDP, sex, age, employment status, and belonging (or having close relations that belong) to a risk group for COVID-19. We also investigated how PDI and trust in government further moderate these relationships by exploring

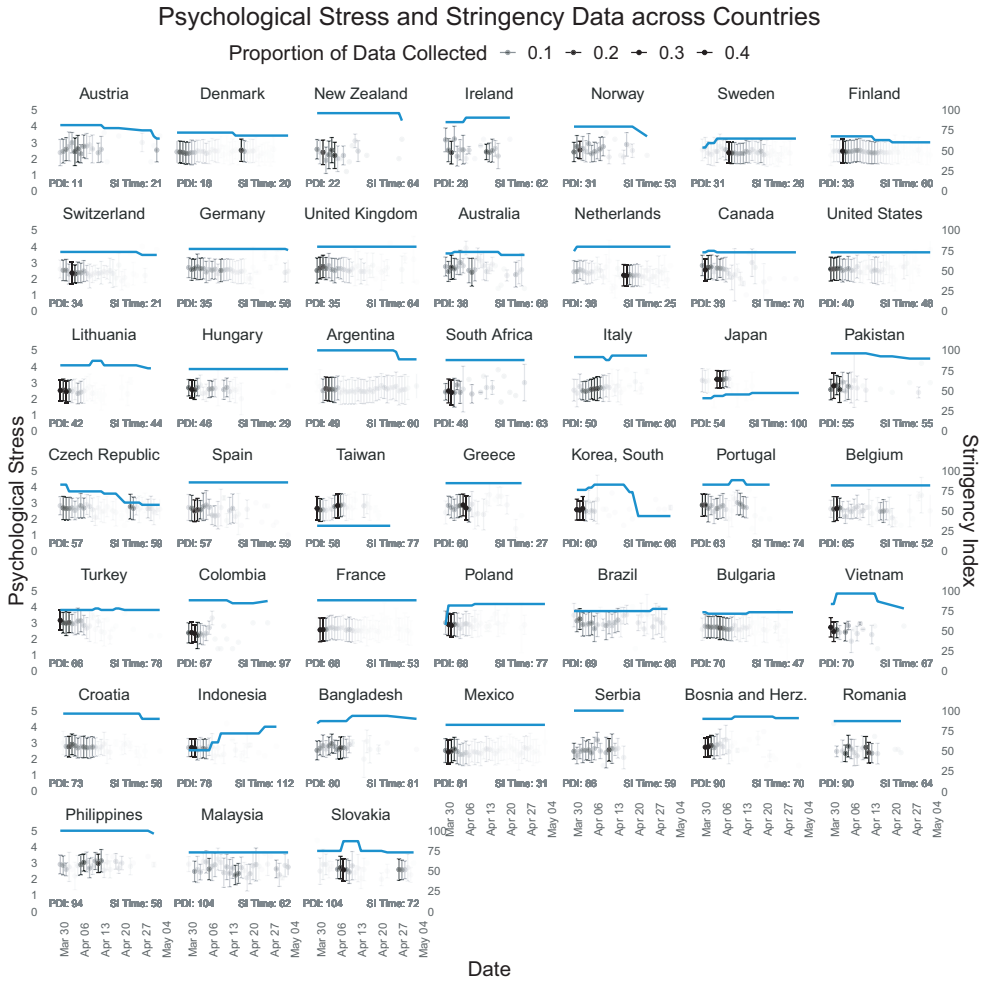


FIGURE 1 Psychological stress (mean and standard deviation) across countries and time, with transparency indicating the proportion of data collected relative to each country. The blue line gives the Stringency Index, ranging from the first data point to the last for each country

two- and three-way interactions between SI_{wa} , SI_{time} , PDI, and trust in government. To analyse the data, we fitted two linear mixed-effects models using perceived stress and compliance as outcome variables. In both cases, the fixed effects were estimated for the within- and between-country predictors, whereas the random effects (RE) were estimated only for within-country predictors. For a description of how the RE structure was modelled, see Appendix S1—Modelling the random effects structure.

Software

For data manipulation and data cleaning, we used R 3.6.2 (R Core Team, 2019) and the following packages: tidyverse (Wickham et al., 2019), lubridate (Grolemund & Wickham, 2011), multicon (Sherman, 2015), and glue (Hester, 2019). For estimating metric invariance, we used lavaan (Rosseel, 2012), semTools (Jorgensen et al., 2019), and cpsyc (Karl, 2020). For LMMs, we used the software Julia 1.4.2 (Bezanson et al., 2017) and the package MixedModels (Bates et al., 2020). We used the JuliaCall (Li, 2019) package to integrate Julia with R.

RESULTS

Perceived stress

After fitting the LMM for perceived stress, we reduced the RE structure by the number of dependents and affiliation to the risk group for COVID-19 (for details, see Appendix S1—modelling the random effects structure). Tables 1 and 2 report results from the final model.

As shown in Table 1, there was no significant relationship between SI_{wa} and stress across countries ($b = -0.035, p = .230$), but people seemed to experience more stress in countries where it took more time for SI_{wa} to reach its maximum ($b = 0.045, p = .021$). Moreover, there was a significant interaction between SI_{wa} and SI_{Time} ($b = -0.092, p < .001$). Figure 2 shows all countries grouped into tertiles depending on how quickly they reached their respective maximum stringency. The regression lines depict the association between perceived stress and SI_{wa} for a SI_{Time} value corresponding to the median of the three tertiles, keeping all other predictors at the country averages. The fact that SI_{Time} varies with the other predictors explains why, when we fix all predictors at the country average and only allow SI_{Time} to vary, the regression lines are not well aligned with the data points representing estimated perceived stress means for different countries. Results indicate that as the SI_{Time} increases, the relationship between SI_{wa} and perceived stress shifts from marginally positive to negative.

The effect of SI_{wa} and SI_{Time} on perceived stress was further moderated by PDI ($b = 0.054, p = .016$), as illustrated in Figure 3. The left panel shows the association of perceived stress with SI_{wa} and SI_{Time} for countries with low acceptance of power distance (i.e., belonging to the first tertile). For countries with lower PDI and lower SI_{Time} , the relationship between SI_{wa} and perceived stress is again weakly positive, but very close to zero. On the other hand, for countries lower in PDI

TABLE 1 The fixed effects of the final LMM using perceived stress as dependent variable

Terms—fixed effects	<i>b</i>	95% CI	<i>z</i>	Pr ($> z $)
Intercept	2.478	2.431, 2.525	103.552	<.001
SI (wa)	-0.035	-0.092, 0.022	-1.200	.230
SI_{Time}	0.045	0.006, 0.084	2.301	.021
PDI	-0.022	-0.075, 0.031	-0.790	.430
Trust in government	-0.120	-0.132, -0.108	-19.282	<.001
Daily deaths per million (wa)	-0.008	-0.037, 0.021	-0.534	.593
GDP per capita	0.008	-0.039, 0.055	0.336	.737
Sex	0.176	0.151, 0.201	13.349	<.001
Age	-0.178	-0.198, -0.158	-17.837	<.001
Employment	-0.104	-0.129, -0.079	-7.902	<.001
No. of dependents	0.012	0.008, 0.016	5.116	<.001
Riskgroup	0.092	0.082, 0.102	17.228	<.001
$SI(wa) \times SI_{Time}$	-0.092	-0.137, -0.047	-3.991	<.001
$SI(wa) \times PDI$	0.046	-0.005, 0.097	1.761	.078
$SI_{Time} \times PDI$	-0.009	-0.042, 0.024	-0.511	.609
$SI(wa) \times Trust$ in government	0.023	0.007, 0.039	2.988	.003
$SI_{Time} \times Trust$ in government	0.014	0.002, 0.026	2.449	.014
$SI(wa) \times SI_{Time} \times PDI$	0.054	0.011, 0.097	2.419	.016
$SI(wa) \times SI_{Time} \times Trust$ in government	-0.002	-0.014, 0.010	-0.283	.778

Note: All variables except for Sex, Employment, and Riskgroup were \bar{x} -standardized.

Abbreviation: wa, weighted average.

TABLE 2 The random effects of the final LMM using perceived stress as dependent variable

Terms	1.	2.	3.	4.	5.
1. Intercept	.010				
2. Trust in government	-.063	.001			
3. Sex	.144	-.569	.005		
4. Age	.062	.250	-.139	.003	
5. Employment	-.172	-.023	-.206	.453	.003

Note: The diagonal shows variable variances, and the non-diagonal values display correlations.

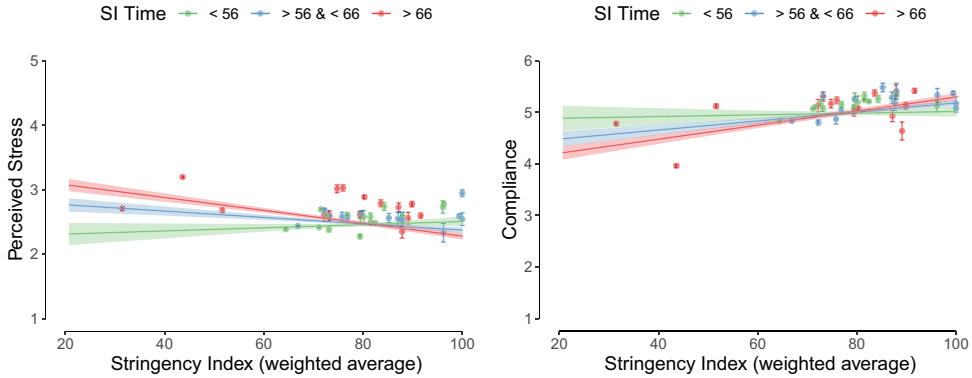


FIGURE 2 Relationship between Stringency Index and Psychological Stress (left) and Compliance (right) across Countries. Colours reflect tertiles in the time it took the countries to reach their maximum Stringency Index

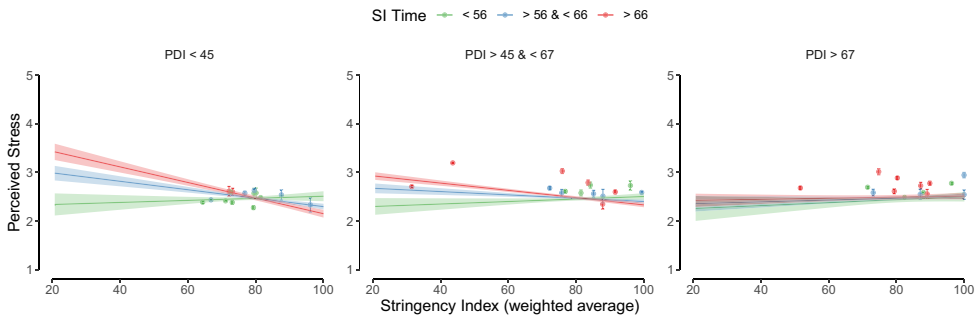


FIGURE 3 Relationships between Stringency Index and Perceived Stress across time it took the countries to reach their maximum Stringency Index and PDI. Colours and panels reflect tertiles in the variables. PDI, Power Distance Index

and with higher SI_{Time} , the relationship between SI_{wa} and stress was negative—people experienced higher stress when SI_{wa} was lower. This interaction was weaker for countries with medium PDI (middle panel). For countries higher in PDI, the time to reach the SI maximum did not modify the relationship of SI_{wa} and stress, which was generally around zero. Note the discrepancy between the raw data and the visualization of the conditional effects, which shows that the model interpolates to areas where little data exist.

Finally, although the two-way interactions of SI_{wa} and SI_{Time} with trust in government were significant ($b = 0.023, p = .003$ and $b = 0.014, p = .014$, respectively), Figure 4 illustrates that the effects were very small (the lines for different levels of trust in government were nearly parallel).

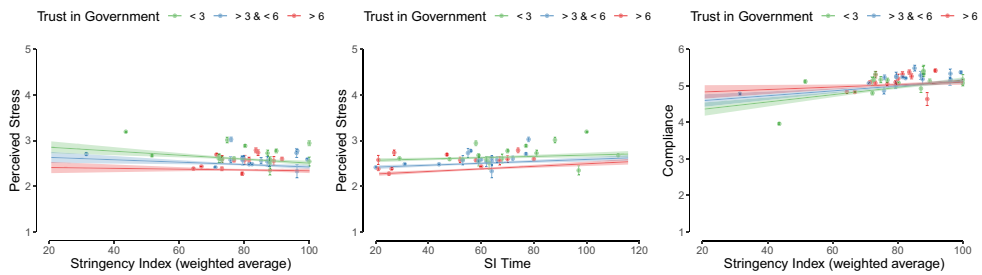


FIGURE 4 Left: Shows relation between Stringency Index and Perceived Stress across Trust in Government. Middle: Shows relation between SI Time and Perceived Stress across Trust in Government. Right: Shows relation between Stringency Index and Compliance across Trust in Government. Colours reflect tertiles in the variables

TABLE 3 The fixed effects of the final LMM using compliance as dependent variable

Terms—fixed effects	<i>b</i>	95% CI	<i>z</i>	Pr (> <i>z</i>)
Intercept	4.966	4.892, 5.040	130.392	<.001
SI (wa)	0.090	0.012, 0.168	2.223	.026
SI _{Time}	-0.012	-0.067, 0.043	-0.418	.676
PDI	0.060	-0.016, 0.136	1.551	.121
Trust in government	0.052	0.030, 0.074	4.778	<.001
Daily deaths per million (wa)	0.033	-0.010, 0.076	1.477	.140
GDP per capita	-0.028	-0.097, 0.041	-0.797	.425
Sex	0.207	0.183, 0.231	16.550	<.001
Age	0.093	0.073, 0.113	9.202	<.001
Employment	-0.083	-0.112, -0.054	-5.597	<.001
No. of dependents	0.009	-0.003, 0.021	1.563	.118
Riskgroup	0.103	0.087, 0.119	13.609	<.001
SI (wa) × SI _{Time}	0.089	0.026, 0.152	2.798	.005
SI (wa) × PDI	-0.103	-0.177, -0.029	-2.715	.007
SI _{Time} × PDI	-0.012	-0.059, 0.035	-0.516	.606
SI (wa) × Trust in government	-0.044	-0.071, -0.017	-3.098	.002
SI _{Time} × Trust in government	-0.008	-0.028, 0.012	-0.763	.445
SI (wa) × SI _{Time} × PDI	-0.020	-0.083, 0.043	-0.625	.532
SI (wa) × SI _{Time} × Trust in government	0.017	-0.005, 0.039	1.519	.129

Note: All variables except for Sex, Employment, and Riskgroup were z-standardized.

Abbreviation: wa, weighted average.

Looking at the other fixed effects, we observed that PDI, weighted average of the number of daily deaths per million, and GDPpC were not significantly associated with perceived stress. On the other hand, the results suggested that women ($b = 0.176, p < .001$), younger people ($b = -0.178, p < .001$), the unemployed ($b = -0.104, p < .001$), those affiliated with a risk group for COVID-19 ($b = 0.092, p < .001$), those who have more dependents ($b = 0.012, p < .001$), and people who have less trust in government ($b = -0.120, p < .001$) generally experienced higher levels of stress during the COVID-19 pandemic. Interestingly, the RE structure indicated that there was little between-country variance in these predictors.

TABLE 4 The random effects of the final LMM using compliance as dependent variable

Terms	1.	2.	3.	4.	5.	6.
1. Intercept	.033					
2. Trust in government	-.062	.003				
3. Sex	-.732	.144	.003			
4. Age	-.030	-.258	-.076	.003		
5. Employment	.233	.347	-.220	-.629	.002	
6. No. of dependents	.261	-.170	-.020	.504	.125	.001

Note: The diagonal shows variable variances, and the non-diagonal values display correlations.

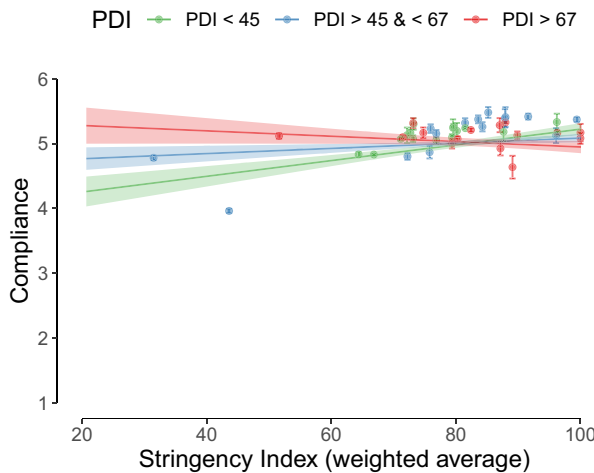


FIGURE 5 Relation between Stringency Index and Compliance moderated by Power Distance Index (PDI). Colours reflect tertiles in PDI

Compliance

The initial LMM RE structure for compliance was reduced by the affiliation to the risk group for COVID-19 RE component (for details, see Appendix S1—Modelling the random effects structure). The final model is presented in Tables 3 and 4.

The analysis suggests that SI_{wa} is positively related to compliance ($b = 0.090, p = .026$), that is, people in countries with higher SI_{wa} comply more. Moreover, this relationship is moderated by SI_{Time} , PDI, and trust in government.

The interaction of SI_{wa} and SI_{Time} ($b = 0.089, p = .005$) indicates that as SI_{Time} increases, the relationship between SI_{wa} and compliance becomes more strongly positive (see Figure 2, right panel). In countries where the SI maximum was reached slowly, SI_{wa} was more strongly positively associated with compliance than in countries where SI maximum was reached quickly.

The relationship between SI_{wa} and compliance was moderated by PDI ($b = -0.103, p = .007$). As Figure 5 shows, in countries with low PDI (operationalized here as being in the first tertile), there is a positive relationship between SI_{wa} and compliance; as PDI increases, the association comes closer to zero in high-PDI countries (operationalized here as being in the third tertile). The visualization of the conditional effect again illustrates how the model interpolates to areas where little data were observed.

Finally, although the interaction of SI_{wa} and trust in government ($b = -0.044, p = .002$) suggests that the relationship between SI_{wa} and compliance becomes less positive as the trust in government rises, the effect was small (see Figure 4, right panel).

The fixed effects of individual-level predictors suggested that women ($b = 0.207, p < .001$), older people ($b = 0.093, p < .001$), the unemployed ($b = -0.083, p < .001$), people affiliated with a risk group for COVID-19 ($b = 0.103, p < .001$), and people who have greater trust in government ($b = 0.052, p < .001$) tended to comply more. Similarly to the model for perceived stress, the RE variances indicated little between-country variation in the mentioned fixed effects. On the other hand, the country-level predictors, PDI, weighted average of daily deaths per million, and GDP were not associated with compliance.

DISCUSSION

Research examining relationships between stringency of public health measures, stress, and compliance has so far yielded contrasting results. Some authors suggest that higher stringency may have positive implications for individuals' psychological well-being (Fetzer et al., 2020), whereas others emphasize the negative consequences of strict governments' responses (O'Hara et al., 2020). In this article, we addressed this discordance and extended previous research by examining the moderating roles of SI_{Time} , and people's relationship with the authority at the individual (trust in government) and country level (power distance).

Stringency and stress

The findings indicate that SI_{Time} moderates the relationship between SI_{wa} and stress. When the implementation of restrictive measures was slower, weaker stringency measures were associated with greater stress. Conversely, when the implementation was quicker and the stringency higher, there was a small but positive increase in stress. In all other circumstances (slow implementation and high stringency, fast implementation and low stringency), stress levels appeared to be generally unchanged. Because we adjusted for the influence of the number of recorded deaths due to COVID-19, we were able to rule out the explanation that it is the severity of the situation that is linked to increased stress, rather than the stringency and implementation lag of public health measures.

What is a plausible explanation for this finding (Figure 2)? Previous research suggests that factors such as the need to adapt to the situation, the amplified perception of threat or harm, situational demands that exceed individuals' resources or interruptions to one's goals may make changes in life circumstances more stressful (Cohen et al., 2019). All such factors should be intensified by an increase in the stringency and speed of governments' responses to the pandemic, even when there is an objective need for governments to step in and protect their citizens against a public health menace. This may explain the slight increase in stress when more stringent measures are implemented quickly.

Nonetheless, the results more robustly suggest that it is the lack of change/action in such situations that may be associated with higher levels of stress (note, however, that this refers exclusively to circumstances at the beginning of pandemic when there were lots of unknowns about the virus). For instance, citizens who see their government fail to act against the pandemic may wonder whether their government has done enough to protect them compared to other governments and thus feel less safe. According to neuroscientific and evolutionary research and theorizing, and in line with the Generalized Unsafety Theory of Stress, perceived unsafety is one of the crucial triggers for (chronic) stress response (Brosschot et al., 2016, 2018). Future research should seek to clarify the potential mediating role of perceived unsafety between stringency and implementation lag of measures, and stress.

Interestingly, the interaction between stringency index and implementation lag was stronger in countries with lower (vs higher) PDI. Citizens from low-PDI countries tend to question the authorities more and live in more egalitarian contexts (Hofstede et al., 2010). Conversely, in high-PDI countries, people are more accepting of hierarchical structures and unequal social relationships among people and groups. Thus, a possible explanation for the moderating role of PDI is that in

low-PDI countries individuals are more sensitive to extreme governmental measures (e.g., inaction with slow implementation of weak measures or severe action with rapid implementation of stricter measures), whereas individuals in higher PDI countries are less responsive to governmental action. For instance, research measuring power distance orientation at the individual level suggests that high-power distance individuals are less prone to negative reactions when experiencing injustice from their supervisors (Lee et al., 2000; Lian et al., 2012).

Alternatively, it may be that citizens in low-PDI countries were expecting more draconian responses from their governments to tackle the pandemic, paradoxically reporting higher levels of stress when SI_{Time} was slower and SI_{wa} weaker. This dynamic would be consistent with findings showing that authoritarianism (measured at the individual level) is associated with stronger support for harsher pandemic mitigation policies (Manson, 2020), and that threats attributable to the pandemic magnify the expression of authoritarianism in society (Hartman et al., 2021). Instead, in higher PDI countries, individuals may have lower expectations about and be less attuned to how authorities and governments respond to the pandemic. Future research should further examine the role of power distance in shaping people's responses of stress at various levels of analysis and across different contexts.

Stringency and compliance

Results indicated that SI's relationship with compliance becomes more positive as the time taken to reach the maximum SI level increases. Thus, the lowest levels of compliance are predicted in situations when weaker measures are implemented more slowly. Such implementation may signal a lack of government action and imply that officials are attaching lower importance to the disease, thus making people less prone to keeping physical distance. Interestingly, signalling that the situation was serious either in terms of higher SI or lower measure implementation lag was associated with greater compliance.

Similar to stress, our model predicted that citizens in lower-PDI cultures are also more responsive to their country's instructions and are more likely to comply when the SI_{wa} is higher. Conversely, the model predicts that high-PDI cultures maintain a nearly constant level of compliance irrespective of the SI_{Time} and SI_{wa} . This suggests that while people in low-PDI countries adjust their behaviours in accordance with government's instructions, citizens in high-PDI countries are less tuned to changes in government measures while still complying with the official recommendations.

Trust and the relationship of stringency, stress and compliance

Notably, although trust in government significantly moderated the association between SI and stress/compliance, the effects were very small. Because there are countries where the measures were proposed by civil protection bodies and not by the government, it is possible that the trust towards such institutions might be a stronger moderator of the association. Also, how trust in government influences individual compliance depends on other factors such as current and/or past state regimes (Schmelz, 2021), age and estimated health conditions (Groeniger et al., 2021), and the importance of believing that taking health precautions will be effective for avoiding COVID-19 (Clark et al., 2020).

Limitations

There are a number of limitations to our study that need to be considered when interpreting the results. First, our research was exploratory and descriptive in nature. As other large COVID-19-related datasets focused on stress and compliance become available, they may be used to try to replicate our results in

more diverse samples or across different contexts. Moreover, we analysed observational data, and, thus, no causal inferences can be drawn from the present study. Although in our analyses we adjusted for a set of relevant variables, including GDP per capita and proportion of deaths due to COVID-19, countries also differ on a myriad of variables that we have not measured. Furthermore, while our dataset comprises a large number of individuals, the number of countries is limited; this means that we have less power to detect associations regarding country-level predictors. In addition, the lower number of country-units enable more extreme cases to have a disproportionate influence on the regression results. This is especially relevant with regard to the interactions. For instance, notice that our statistical model linearly extrapolated to areas where little data were observed. Moreover, some of the measures we used comprised only a single item, which may have resulted in lower reliability, while others (e.g., PSS) were used in a shorter form to achieve measurement invariance across countries. It should be noted that SI_{Time} is a country-specific measure, and so we could not quantify the lag of the implementation of stringent measures in an objective manner.

In addition, we used countries' SI averages. However, because SI changes across time, examining the relationship of SI, stress, and compliance within countries could yield important insights on how such factors operate over time. To examine such association, data covering a substantially longer period of time would be needed.

Finally, this research has enabled us to explore the role of variables that have not yet been examined in relation to people's reactions of stress and compliance during the pandemic. Especially relevant are SI_{Time} and PDI in predicting individuals' stress and compliance across contexts. Nonetheless, due to the exploratory nature of the research, we warn against drawing specific direct practical implications or policy decisions. The data used in this study were collected at the onset of the pandemic (March–May 2020) when there was much less available information about the virus, and when people had yet to acquire immunity. Today, the context has changed dramatically, and this study's conclusions cannot be translated to the current circumstances without further research.

Conclusion

Taken together, our findings show that, at the onset of the COVID-crisis, failing to take institutional action for a longer period of time was associated with stronger negative psychological outcomes—such that individuals reported lower compliance and higher levels of stress. Also, rapid implementation of strict measures mildly increased citizens' stress response. These findings provide insights into why previous research yielded contrasting results. They also enabled us to generate a set of novel research questions that can be tested in other datasets and future studies.

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AUTHOR CONTRIBUTION

Dominik-Borna Čepulić: Conceptualization (equal); Data curation (equal); Formal analysis (equal); Investigation (equal); Methodology (equal); Supervision (equal); Visualization (equal); Writing – original draft (equal); Writing – review & editing (equal). **Giovanni A. Travaglino:** Conceptualization (equal); Formal analysis (equal); Methodology (equal); Writing – original draft (equal); Writing – review & editing (equal). **Stavroula Chrona:** Conceptualization (equal); Investigation (equal); Writing – original draft (equal); Writing – review & editing (equal). **Ena Uzelac:** Conceptualization (equal); Investigation (equal); Writing – original draft (equal); Writing – review & editing (equal). **Alma Jeftić:** Conceptualization (equal); Investigation (equal); Writing – original draft (equal); Writing – review & editing (equal). **Cecilia Reyna:** Conceptualization (equal); Investigation (equal); Writing

– review & editing (equal). **Marta Kowal**: Conceptualization (equal); Writing – review & editing (equal).

DATA AVAILABILITY STATEMENT

The raw data from the COVIDiSTRESS global survey can be accessed via https://osf.io/tupdx/?view_only=a9e6f30fee574aecbad3cc15096e3af7. Other datasets used in the analyses are available at https://osf.io/u34fy/?view_only=061b2627208b4173b5dbb69f1d53e69e

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