Beliefs in COVID-19 conspiracy theories predict lower level of compliance with the preventive measures both directly and indirectly by lowering trust in government medical officials

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Abstract

The COVID-19 pandemic represents a global health crisis, making compliance with governmental policies and public health advice crucial in decreasing transmission rates. At the same time, we are faced with the rapid spread of COVID-19 conspiracy theories. Therefore, we aimed to investigate the predictive power of COVID-19 conspiracy theories in explaining the level of compliance with official COVID-19 guidelines, by including mediating roles of pseudoscientific information beliefs and trust in government officials. A total of 1882 participants provided sociodemographic information and completed all measures in the study. Multiple mediation analysis revealed a direct negative effect of COVID-19 conspiracy beliefs on the compliance with the preventive measures. In addition, conspiracy beliefs were indirectly associated with compliance via trust in government officials. The present study builds upon emerging research showing that conspiracy beliefs have potentially significant social consequences. Practical implications of these findings are further discussed.

Keywords: COVID-19, pandemic, conspiracy theory, preventive measures

Introduction

The COVID-19 pandemic caused by coronavirus represents a global health crisis, and up until the beginning of July 2020 has caused or is related to more than half a million deaths worldwide (World Health Organisation, 2020). In Croatia, where the present study was conducted, 3.722 people had tested positive for coronavirus and 119 have died as of July 12th, 2020 (Croatian Institute of Public Health, 2020). In response to the pandemic, Croatian government reacted quickly by issuing evidence-based prevention guidelines and numerous restrictions, such as enforcing social distancing measures, shutting down public transport, closing schools, restaurants, shopping centres and other public places like cinemas and libraries. Confirmed coronavirus cases and people suspected to be infected (those who were in a close physical contact with the infected people) were ordered 14-day quarantine, which has left more than a 30.000 people in self-isolation.

Although compliance with governmental policies and public health advice are crucial in decreasing transmission rates during COVID-19 pandemic, it has been reported that a minority of people do not comply with the governmental guidelines. Ministry of Interior of the Republic of Croatia reported that, by the middle of May, almost two thousand possibly infected people deliberately disregarded instructions to self-isolate, and thus increased a possibility to spread the virus by infecting others. Considering a possible exponential growth of the number of infected people, few thousand people who disobey government instructions present a serious public health risk. When considering reasons why some people do not comply with self-isolation instructions, it is worth noting that different socio-demographic factors have been shown to play a significant role. For example, Atchison et al. (2020) reported that adoption of social-distancing measures was higher among people older than 70 years in comparison to the younger adults, possibly because they are the most vulnerable group. Furthermore, people with the low household income, and minority ethnic groups were less able to self-isolate. In addition,

Zhang et al. (2019) found that married people were more willing to obey self-isolation measures. This study has also shown that education level was positively associated with the willingness to self-isolate, although others did not find this effect (Plohl & Musil, 2020).

Apart from socio-demographic factors that are related to compliance with the health guidelines, previous studies have shown that different psychological variables predict pandemic-related behaviour. For example, Plohl and Musil (2020) found that COVID-19 risk perception and trust in science predict compliance with COVID-19 prevention measures. When it comes to the trust in science, it is important to take into an account a wide and rapid spread of various conspiracy theories and misinformation related to the current pandemic. Director-General of the World Health Organization noted that experts are now fighting an infodemic together with the epidemic, as it was clear that belief in COVID-19-related conspiracy theories could potentially affect people's behaviour and increase distrust in governmental preventive measures.

In modern society, conspiracy theories are a widespread phenomenon, which can be defined as a belief that a group of people secretly work to attain some malevolent goal (Bale, 2007). van Prooijen and van Vugt (2018) elaborate this definition further by describing five main characteristics of conspiracy theory. First, conspiracy theory includes a pattern and explains how people or events are connected. Second, main actors or conspirators are working intentionally, so their plans are deliberate. Third, conspirators always represent a group of people, or a coalition, and not just an individual. Forth, conspiracy theories always include threat, meaning that conspirator's plans are harmful. Finally, plans within a conspiracy theory are characterized by secrecy making it difficult to judge the validity of conspiracy theory. Another important aspect of the conspiracy theories is that they are more likely to occur during societal crisis situations (van Prooijen & Douglas, 2017), and COVID-19 pandemic, with global health, political, and economical consequences, represents such a situation.

The importance of investigating how belief in conspiracy theories is related to the people's behaviour during COVID-19 pandemic is highlighted in the studies conducted prior COVID-19 pandemic, which have shown that agreement with conspiracy theories is associated with disregarding public health advice in various health domains. For example, Jolley and Douglas (2014a) found a negative relationship between anti-vaccine conspiracy beliefs and vaccination intentions. Another evidence of how conspiracy belief can affect behaviour comes from a study which showed that participants who were exposed to conspiracy theories about the climate change reported decreased intention to reduce their carbon footprint (Jolley & Douglas, 2014b). When it comes to epidemic-related conspiracy theories, there are many theories about the origin of HIV virus or Zika virus (e.g. HIV is a bioweapon used for racial genocide, Zika virus vaccine will ultimately be used for global depopulation, etc.; Wood, 2018). There is evidence that these and similar conspiracy theories are related to believer's health behaviour. It has been found that the odds of having unsafe sex are higher amongst AIDS conspiracy believers (Grebe & Nattrass, 2012). Likewise, stronger AIDS-related conspiracy beliefs are associated with inconsistent condom use (Bogart & Thorburn, 2005).

These findings imply that belief in conspiracy theories might pose a public health threat and highlight the importance of investigating them further. The content and the characteristics of conspiracy theories about COVID-19 are not much different than the ones related to previous epidemics (e.g. Zika virus). Most of the theories include belief that the coronavirus is human-made virus, created to control population, possibly via 5G technology or via global vaccination. Theories also include beliefs that COVID-19 is not more dangerous than the regular flu because the mortality rates are lower than those reported by government officials and health care providers. By investigating how those beliefs relate to the behaviour during the pandemic, Allington and Dhavan (2020) found a negative relationship between belief in COVID-19 conspiracy theories and compliance with public health guidance. In the same study, 37%

participants who reported agreement that 5G technology is connected to COVID-19 also believed that there is no good reason for the lockdown. In addition, it has been shown that people high in conspiracy mentality are less willing to comply with preventive behaviours recommended by the government (Constantinou et al., 2020; Marinthe et al., 2020). Furthermore, Erceg et al. (2020) showed that endorsement of COVID-19 unfounded beliefs led to less responsible COVID-19 behaviour which included avoiding physical contact, washing hands, avoiding going out and coughing and sneezing into an elbow. Similar results were reported by Swami and Barron (2020). Likewise, it has been found that belief that COVID-19 was a hoax negatively predicted containment-related behaviours, such as handwashing and keeping physical distance (Imhoff & Lamberty, 2020). However, some studies have produced inconsistent results. For instance, Čavojová et al. (2020) did not find correlation between coronavirus specific conspiracy beliefs and recommended behaviour against COVID-19, calling for further more nuanced exploration of this subject..

Apart from the widespread of conspiracy thinking regarding the origin of the coronavirus and the mortality rates, people are exposed to many pseudoscientific medical recommendations on how to prevent and cure the infection. Some of these recommendations can be dangerous and even lethal, like ingesting disinfectant or irradiating body with UV light. Less dangerous, but equally ineffective ways to prevent or cure the infection found circulating online include consumption of garlic, colloidal silver, large doses of vitamin C, drinking water every 15 minutes, and drinking hot beverages. The fact that people actually turn to unscientific remedies during pandemic is supported by several extreme cases. For example, the South China Morning Post reported that a woman from Tiantai county ate as much as 1.5 kg of garlic, hoping to prevent the coronavirus infection (Yan, 2020). She then suffered consequences like throat inflammation and inability to speak. More extreme case comes from Iran where more than 700 people have died of methanol poisoning after they tried to prevent the infection by ingesting

toxic alcohol (Al-Arshani, 2020). Relatedly, Belgium Poison Control Center reported 15 % increase in the number of calls for poisoning by hazardous substances during pandemic (Belgium Poison Control Center, 2020). In addition, according to the report from the American Centers for Disease Control and Prevention, 39 percent of participants engaged in dangerous practices to prevent coronavirus transmission, which included washing food with bleach, applying disinfectant products to skin and even drinking diluted bleach solutions (Gharpure et al., 2020). Previous studies have highlighted a link between belief in conspiracy and endorsement of pseudoscientific medical treatments. For example, Lamberty & Imhoff (2018) reported that conspiracy mentality predicted a preference for alternative over biomedical therapies. In the context of the current pandemic, belief in conspiracy theories about COVID-19 might be positively related to endorsement of pseudoscientific medical information. This endorsement might in turn lead to more risky health behaviours and ignoring of the government pronouncements.

When it comes to the government pronouncements, they can be seriously undermined by the conspiracy theories. As Connolly et al. (2019) stated, conspiracy theories can be seen as a marker of institutional distrust. In another words, people who endorse conspiracy beliefs are more likely to doubt government communication, even during the crisis situations. Therefore, it can be assumed that COVID-19-related conspiracy beliefs negatively predict the level of trust in government officials and their decisions made during pandemic in order to prevent spread of the coronavirus infection. Consequently, lower levels of trust might also lead to a risky health behaviour and lower compliance with governmental orders.

The present study

Based on the previous studies, the spread of conspiracy theories can potentially lead to disobeying official medical recommendations and governmental restrictions. In this study, we suggest that this relationship is mediated by two additional factors. First, since conspiracy

thinking predicts the endorsements of medical misinformation (Lamberty & Imhoff, 2018), we suggest that the pseudoscientific information beliefs could be an important mediator between conspiracy beliefs and compliance with COVID-19 guidelines. Second, taking into an account that conspiracy theories can undermine authoritative information and governmental orders, beliefs in conspiracy theories could lower trust in government officials and hence lead to lower compliance with governmental restrictions.

Therefore, in the present study, we aimed to investigate the predictive power of conspiracy theories related to COVID-19 in explaining level of compliance with official COVID-19 guidelines, by including mediating roles of pseudoscientific information beliefs and trust in government officials. In this way, this study further explores the mechanisms by which conspiracy beliefs can lead to undesirable social and medical outcomes. In general, the present study builds upon emerging research showing that conspiracy beliefs may represent a substantial public health risk.

Method

Participants

Minimum sample size required was determined using Monte Carlo power analysis designed for multiple mediation models (Schoemann et al., 2017). Following previous studies (eg. Erceg et al., 2020; Marinthe et al., in press; Swami & Barron, 2020) we assumed small to moderate correlations between variables in model. We assessed minimum sample size needed to achieve power of 0.80, with confidence level of 99% by using 10,000 Monte Carlo replications with 20,000 draws. A power analysis revealed that sample size for these research settings should be at least 650.

Croatian citizens aged 18+ years were invited to participate in the online study. Participants were recruited through advertisements on social media websites, especially Facebook. Invitation to participate in the study was also published by Index.hr, the most popular news website in Croatia according to the SimilarWeb (2020). A total of 1976 participants completed all measures of the study. We oversampled for two reasons. First, all measures used in this study were novel and developed for the purpose of this study. Therefore, a large sample size was needed in order to conduct factor analyses. Second, we took into an account possible exclusion of some participants who do not meet study requirements. Relatedly, we excluded 94 participants who failed the three attention check questions which explicitly asked to mark the highest rating (“*This is a control question. Please, mark the highest value on the right*”). The resulting sample consisted of 1882 participants (1268 women, 596 men, 18 responded as “Do not wish to answer”; $M_{age} = 36.57$, $SD_{age} = 11.18$).

Measures

Participants were asked to provide sociodemographic information and to complete several scales related to COVID-19 conspiracy beliefs, pseudoscientific information beliefs, trust in government officials, and compliance with official COVID-19 guidelines. All scales were developed for the purpose of this study. Therefore, factor structures of responses to novel measures were reported in the section *Results*, while all items and their factor loadings are presented in online Supplementary materials.

Sociodemographic information

Participants were asked to provide information about their gender (man, woman, *prefer not to say*), age, and the highest education level (from *primary education* to *doctoral degree*).

COVID-19 conspiracy beliefs

To assess conspiracy beliefs related to COVID-19, we created a list of nine items, with each describing one of the popular conspiracy theories regarding the coronavirus origin (e.g. *“Coronavirus was intentionally made in a laboratory”*, *“Coronavirus was created as a bioweapon in the war between the powerful countries (like China, USA, Russia)”*), its spread (*“Spread of the coronavirus is related to the 5G technology”*, *“Bill Gates is using the pandemic for population control”*), threat level (e.g. *“Coronavirus is equally or less dangerous than the regular flu”*, *“Videos and photographs of empty hospitals are a proof that the pandemic is a hoax”*), and infection and mortality rates (*“Official infection and mortality rates provided by the WHO are false”*). Participants reported the agreement with each statement on a scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The average rating on a 5-point scale on these nine items was used as the endorsement of COVID-19 conspiracy beliefs.

Pseudoscientific information beliefs

To assess pseudoscientific information beliefs we asked participant to report their agreement that the following products can prevent/cure the coronavirus infection: alcohol, garlic, high vitamin C dosage, colloidal silver, and hot beverages. Each product was rated on a 5-point scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

Trust in government officials

Government officials who were communicating information and guidelines to the public during pandemic in Croatia were represented by the National Civil Protection Headquarters. In order to assess trust in government officials, we asked participants to report their agreement with the five statements about the work of the National Civil Protection Headquarters (e.g. *“I trust the*

National Civil Protection Headquarters and I think they are doing a good job”, “Members of the National Civil Protection Headquarters are experts in their field”, “National Civil Protection Headquarters works in the best interest of the Croatian people”). Participants reported their agreement with each statement on a scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Compliance with official COVID-19 guidelines

Participants were asked to indicate their compliance to eight behaviours which represented main guidelines issued by the government officials during pandemic. Behaviours included physical-distancing measures (e.g. *“I keep physical distance of at least two meters in enclosed spaces and at least one meter in the open”, “I avoid crowded places”, “I avoid meeting with my friends”*), and increased hygiene measures (e.g. *“I wash/disinfect my hands regularly”, “I sneeze into my elbow”*). Participants reported how often they act in accordance with the COVID-19 prevention guidelines, by using a 5-point scale from 1 (never) to 5 (always).

Procedure

Ethical approval was granted by the Ethics Committee of the Department of Psychology at the University of Zadar. The study was set online by using Google Form. Data were collected between May 15th – 26th. Before the beginning of the survey, participants were guaranteed the anonymity of their responses and presented with a general instruction stating that the aim of the study was to investigate attitudes towards the COVID-19 pandemic, and some aspects of pandemic-related behaviour. Instruction also included estimated study duration of 15 minutes. After the instructions, participants were asked to provide digital informed consent before being directed to the scales described above.

Upon completion of the study, participants had the chance to leave their personal contact and participate in a raffle to win 200 Croatian kunas. To ensure the anonymity of their responses, participants were instructed to follow a link which directed them to a separate Google form in which they could leave their contact. In this way, their response could not be connected to their personal information.

Results

Factor analyses

The analyses were conducted using *R* ver. 4.0.1. (R Core Team, 2020), using packages *psych* v. 1.9.12 (Revelle, 2019), *paran* (Dinno, 2018) and *lavaan* v. 0.6-6 (Rosseel, 2012). To explore underlying structure of novel measures, *COVID-19 conspiracy beliefs*, *Pseudoscientific information beliefs*, *Trust in government officials*, and *Compliance with official COVID-19 guidelines*, we employed exploratory and confirmatory factor analyses. First, we randomly split the dataset in two partitions, with each consisting of $n = 941$ participants. First partition served for conducting an exploratory factor analysis (EFA), and the other served to validate obtained factor structure using confirmatory factor analysis (CFA). Factorability of the EFA data partition was assessed by using Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) and Bartlett's sphericity test. Values of KMO greater than 0.80, and statistically significant Bartlett's sphericity test indicated that the data was appropriate for application of factor analysis. Furthermore, we decided on number of factors to retain based on the results of parallel analysis (Horn, 1965) of 10.000 randomly drawn samples, using *R* package *paran* v. 1.5.2 (Dinno, 2018). *param* produces eigen values adjusted for sample size error-induced inflation, and it is advised to retain those factors with adjusted eigenvalues greater than 0 (Dinno, 2014). Each parallel analysis was conducted using 10.000 random samples and by comparing

eigenvalues of factors from the actual data to the eigenvalue value of 95th percentile of random data. If parallel analysis indicated more than one factor should be retained, we applied Promax rotation after EFA. Furthermore, items with loadings greater than 0.32 were considered as valid measures of a factor (Tabachnick & Fidell, 2012). EFA was followed by the CFA in which a factor structure was specified according to exploratory analysis. CFA models were estimated using maximum likelihood procedure, and fit indices root mean square error of approximation (RMSEA, Steiger, 1990), Tucker-Lewis index (TLI, Tucker & Lewis, 1973), standardized root mean square residual and comparative fit index (SRMR and CFI, Bentler, 1990) were used to evaluate model fit. A good model fit is characterised by low levels of RMSEA and SRMR (both < 0.06), and high values of TLI and CFI (both > 0.95). All factor loadings for the items on novel measures can be found in online Supplementary materials.

COVID-19 conspiracy beliefs

Both measures of factorability, KMO and Bartlett's sphericity test, indicated that the correlation matrix of nine COVID-19 conspiracy beliefs items is suitable for the analysis (KMO = 0.92, Bartlett's test: $\chi^2(36) = 5845.99$, $p < 0.001$), and parallel analysis indicated that three factors should be retained. All items loaded highly on their respective factors, and three-factor solution accounted for 70% of variance. However, due to high correlations between the factors after Promax rotation (ranging from 0.65 to 0.74) we tested two alternative models in CFA: one with three orthogonal factors, and one with the second order factor measured by the three first order factors. Model with the second order factor showed significantly better fit ($\Delta\chi^2(3) = 1479.6$, $p < 0.001$), compared to a model with orthogonal factors. Furthermore, the model with second order factors had acceptable fit indices ($\chi^2(24) = 142.68$, $p < 0.001$, RMSEA = 0.072, 95% CI [0.061, 0.084], SRMR = 0.028, CFI = 0.979, TLI = 0.968), whereas an orthogonal solution provided poor model fit ($\chi^2(27) = 1622.28$, $p < 0.001$, RMSEA = 0.251, 95% CI [0.240, 0.261],

SRMR = 0.411, CFI = 0.712, TLI = 0.616). We followed these results by computing a mean of all nine items, which showed high reliability ($\alpha = 0.92$).

Pseudoscientific information beliefs

Both KMO (0.85) and Bartlett's sphericity test ($\chi^2(10) = 5845.99, p < 0.001$) indicated that five items are suitable for factor analysis. However, after the first iteration of analysis, one item ("alcohol") was excluded from analysis due to the low factor loading. We suggest that this specific item provided confusion among participants because alcohol actually is an effective disinfectant, and should not be included in the list of pseudoscientific cures of infection. Next, parallel analysis suggested that one factor should be retained. All items loaded highly on one extracted factor, that accounted for 62% of variance. One-factor solution was further showed to be appropriate by CFA ($\chi^2(2) = 28.03, p < 0.001$, RMSEA = 0.118, 95% CI [0.081, 0.158], SRMR = 0.023, CFI = 0.984, TLI = 0.953). It should be noted that RMSEA, together with its 95% CI, was high and did not indicate good fit of a model. However, simulation studies showed that RMSEA over-penalizes models with a few degrees of freedom (Breivik and Olsson, 2001), and that it shows lower values for models with greater number of items. Following this finding and taking into consideration acceptable values of other used indexes, we argue that low RMSEA value was due to the small number of items included. Therefore, we find one-factor solution suitable for items of pseudoscientific beliefs scale. We formed a mean score of four items, which had high internal reliability ($\alpha = 0.86$).

Trust in government officials

Both KMO (0.88) and Bartlett's sphericity test ($\chi^2(10) = 3642.05, p < 0.001$) indicated that five items are suitable for factor analysis. Parallel analysis indicated that only one factor should be retained. All items loaded on one extracted factor, which accounted for 63% of variance.

Unidimensional structure was further confirmed by CFA that indicated good model fit ($\chi^2(5) = 29.744, p < 0.001$, RMSEA = 0.073, 95% CI [0.049, 0.099], SRMR = 0.018, CFI = 0.993, TLI = 0.989). The mean of five items was computed and showed high internal consistency ($\alpha = 0.90$).

Compliance with official COVID-19 guidelines

Both KMO (0.92) and Bartlett's sphericity test ($\chi^2(28) = 3952.52, p < 0.001$) indicated that eight items are suitable for factor analysis. Parallel analysis indicated that only one factor should be retained. First extracted factor explained 54% of variance in compliance with official COVID-19 guidelines, and all items had fair loadings. Unidimensional structure was further confirmed by CFA with a good model fit ($\chi^2(20) = 111.69, p < 0.001$, RMSEA = 0.070, 95% CI [0.057, 0.083], SRMR = 0.027, CFI = 0.978, TLI = 0.969). We proceeded by computing a mean score of eight items, which show high internal reliability ($\alpha = 0.90$).

Mediation analysis

Descriptive statistics and correlations between scales are presented in Table 1. After inspecting correlations between pairs of variables, we conducted a multiple mediation analysis to examine mediating role of pseudoscientific information beliefs and trust in government officials on the relation between the COVID-19 conspiracy beliefs and compliance with official COVID-19 guidelines as an outcome variable. Multiple mediation analysis was conducted using R package *lavaan* v. 0.6-6 (Rosseel, 2012), with maximum likelihood estimator and standard errors were calculated using 1,000 bootstrap samples. Significance of effects was evaluated by inspecting p-values and parameter's 95% confidence interval (CI). Lastly, we estimated power of indirect effects using Monte Carlo-based post-hoc power analysis (Schoemann et al., 2017).

Table 1- Descriptive statistics and correlations between all variables included in the study

	M	SD	SE	SI	KI	r		
						2	3	4
(1) COVID-19 conspiracy beliefs	2.06	0.969	0.02	0.96	-0.01	.56	-.44	-.46
(2) Pseudoscientific information beliefs	2.09	1.024	0.02	0.54	-0.86		-.17	-.25
(3) Trust in government officials	3.28	0.995	0.02	-0.51	-0.28			.47
(4) Compliance with official COVID-19 guidelines	3.32	0.679	0.02	-1.21	0.84			

M- mean, SD- standard deviation; SE- standard error of the mean; SI- skewness index; KI-

kurtosis index; r- Pearson correlation coefficient. Note: p-values for all correlations are $p < 0.001$

Results of mediation analysis are presented in Figure 1. It has been shown that the direct effect of COVID-19 conspiracy beliefs on the compliance was significant ($\beta = -0.31$, $B = -0.21$, $SE = 0.02$, $p < 0.001$, 95% CI [-0.25, -0.17]). Apart from this direct association, results also showed that conspiracy beliefs were indirectly associated with compliance via trust in government officials ($\beta = -0.15$, $B = -0.10$, $SE = 0.01$, $p < 0.001$, 95% CI [-0.12, -0.09]), with power estimated at 100%. However, an indirect effect via pseudoscientific information belief was insignificant ($\beta = -0.02$, $B = -0.01$, $SE = 0.01$, $p > 0.05$, 95% CI [-0.03, 0.01]), with power estimated at 20%. Thus, the relation between the conspiracy beliefs and compliance with official guidelines is partially mediated by the trust in government officials. The direct effect of COVID-19 conspiracy beliefs on the trust in government officials was significant ($\beta = -0.44$, $B = -0.46$, $SE = 0.02$, $p < 0.001$, 95% CI [-0.50, -0.41]), so as the direct effect of trust in government officials on compliance with official COVID-19 guidelines ($\beta = 0.33$, $B = 0.23$, $SE = 0.02$, $p < 0.001$, 95% CI [0.19, 0.26]). On the other hand, COVID-19 conspiracy beliefs showed significant direct effect on pseudoscientific information beliefs ($\beta = 0.56$, $B = 0.59$, $SE = 0.02$, $p < 0.001$, 95% CI [0.55, 0.63]), but pseudoscientific information beliefs did not have significant direct effect on the compliance with official COVID-19 guidelines ($\beta = -0.02$, $B = -0.02$, $SE = 0.02$, $p > 0.05$, 95% CI [-0.05, 0.01]).

Figure 1. Unstandardized regression coefficients of the multiple mediation analysis

Robustness analysis

We further conducted robustness analysis for the relationship between COVID-19 conspiracy beliefs and compliance with the official guidelines by including gender, age and education level as covariates in the next analysis. This analysis was conducted on a smaller sample size ($n = 1864$), since 18 participants did not reveal the information about their gender. Education level was included in the model as an ordered factor, and we used diagonally weighted least squares estimator to account for the ordinal nature of that variable. After inclusion of the three control variables, significance of all effects remained the same as in the main analysis. Analysis also revealed that gender had a significant direct effect on the compliance with official COVID-19 guidelines ($\beta = 0.26, B = 0.38, SE = 0.03, p < 0.001, 95\% CI [0.32, 0.43]$), indicating that women were more compliant with the guidelines. Likewise, age had a significant direct effect on the compliance with guidelines ($\beta = 0.07, B = 0.003, SE = 0.001, p < 0.001, 95\% CI [0.0003,$

0.006]), suggesting that older participants report higher levels of compliance. On the other hand, education level did not have a significant effect on compliance ($\beta = 0.01$, $B = 0.008$, $SE = 0.012$, $p > 0.05$, 95% CI [-0.01, 0.01]). In short, after robustness analyses, results remain substantially similar to the patterns displayed in Figures 1.

Discussion

In the present study, we sought to replicate previous findings regarding the negative relationship between the beliefs in conspiracy theories about COVID-19 and compliance with the official governmental recommendations and restrictions during pandemic, and to test whether the endorsements of medical misinformation and the trust in governmental medical officials would mediate this relationship. The results of the multiple mediation analysis support our assumption regarding the direct negative effect of conspiracy belief on compliance with official guidelines. Likewise, hypothesis related to the mediating role of the trust in government officials is supported. Specifically, COVID-19-related conspiracy beliefs lower the levels of compliance with official preventive measures directly and indirectly via lowering the levels of trust in governmental information. Robustness of these findings were further supported in the analysis with several sociodemographic variables included as covariates.

The present results are consistent with previous studies showing that conspiracy beliefs are associated with disregarding public health advice in other health domains (Bogart & Thorburn, 2005; Grebe & Nattrass, 2012), and during the present COVID-19 pandemic (Allington & Dhavan, 2020; Constantinou et al., 2020; Erceg et al., 2020; Marinthe et al., 2020). When it comes to the mediating role of the trust in government officials in the present study, conspiracy beliefs lowered the levels of trust, and consequently decreased the levels of compliance with governmental protective measures. As Marietta & Barker (2018) noted, people who endorse

conspiracy theories generally doubt government and scientific information. This makes them prone to disobeying governmental restrictions and adherence to public safety guidelines. Of course, it might be the case that people with generally lower level of trust in government would actively search for the opposing and alternative information on how to deal with the crisis, and thus show greater tendency to believing in conspiracy theories.

This result highlights the importance of governmental communication of information about COVID-19 in order to fight, not only the spread of coronavirus, but the spread of misinformation as well. Current pandemic represents a situation in which it is crucial to follow recommendations from trustful scientific sources. At the same time, conspiracy theories are on the rise during the social crisis situations like the current pandemic. Not only they are on the rise, but they are very easily spread via social media platforms. In fact, studies have shown positive relationship between COVID-19 conspiracy beliefs and use of social media as a source of information about the pandemic (Allington et al., 2020). Therefore, social networking services, such as Facebook, Twitter, and TikTok joined to help spreading of scientific information, by encouraging people to search for trustful sources (Wiederhold, 2020).

Still, government has a difficult task to develop strategies to fight the infodemic which has a risk to public health. Some authors argue that these strategies should include transparency by using e-government tools in order to share information with the public in real time and more often (van Prooijen, 2018). Relatedly, Croatian government has been criticized for not providing machine-readable data on coronavirus infection. In response to these criticisms, government has published all the data, but it was two months after the first infected case was detected. Of course, we can only speculate that this and similar examples of governmental decisions led to or increased the spread of conspiracy theories, so this is an empirically open question. Another strategy for fighting infodemic includes government campaign about fake

news related to COVID-19, in which government officials address conspiracy theories as false before they start to spread to fast.

Furthermore, in line with previous studies (e.g. Lamberty & Imhoff, 2018), we found positive correlation between beliefs in COVID-19 conspiracy theories and pseudoscientific information beliefs regarding the products that can prevent or cure the infection. The importance of including this latter measure in the present study is highlighted in several extreme cases in which people consumed unscientific remedies and suffered serious consequences. Despite being correlated with both, conspiracy beliefs and compliance with the preventive measures, pseudoscientific information beliefs did not significantly predict our main outcome variable in the mediation model. We propose an explanation taking into an account our primary assumption that people will report lower levels of compliance with safety measures if they act in order to prevent the infection by using alternative products (e.g. garlic). However, we did not ask participants directly about the exact acts and usage of the said products, but about their belief regarding the product effectiveness in preventing/curing the COVID-19 disease. Therefore, participants only expressed their opinion and not their actual behaviour. We propose a possibility that the results would have shown different pattern if actual behaviour and frequency of consuming alternative remedies have been assessed. Therefore, we suggest the inclusion of this variable in future studies.

One additional finding of the present study is worth discussing. Mediation analysis showed that women and older participants reported higher levels of compliance with official pandemic guidelines. These results are consistent with previous research which showed that women and slightly older participants were more likely to engage in health-protective behaviours (Allington et al., 2020). As for the age effect, one possibility is that older people worry more about possible infection and perceive greater risk because difficulty of symptoms and mortality rates increase with age. Greater perception of personal risk and serious threat can make older people more

likely to follow the recommended public health guidelines (Marinthe et al., 2020; Plohl & Musil, 2020). However, Allington et al. (2020) propose another plausible explanation and note that older people may be more likely to comply with preventive measures because they use social media less than younger people. Regarding the gender effect, previous studies have also shown that women are more likely to adopt health-protective behaviours, especially those that can be characterized as non-pharmaceutical, such as handwashing or face mask use (Moran & Del Valle, 2016). In a similar vein, a recent study revealed that women report greater compliance with safety measures, like washing hands and keeping physical distance in public places (de la Vega et al., 2020). We can speculate about the reasons behind these findings and even propose that lower compliance with health-protective measures is one of the factors that might play a role in greater COVID-19 prevalence and mortality rates among men (Sharma et al., in press).

These findings also suggest some practical implications for the policy makers and government communication aimed at decreasing the infection spread. Direct communication to these population groups (young people and man) might be beneficial for infection control.

Limitations and conclusions

There are several limitations and implications of this study design worth discussing. First, at the time of data collection (second half of May 2020), the spread of coronavirus in Croatia was under control with just a few cases pointing to the local transmission. Future research should examine the association between variables presented in this study during other phases of coronavirus pandemic. Second, despite fairly large sample size in the present study, it is clear that the representative sample would be more adequate. However, since most of the conspiracy theories emerge online, we tried to focus on people who are exposed to social medial platforms. Third, future studies would benefit from including additional variables (apart from age and

gender in the present study) in order to identify individual characteristics of people prone to the conspiracy theories. In this way, policy makers can work with more information about targeted groups when creating certain interventions aimed at fighting the pandemic and infodemic. Despite described limitations, this study managed to replicate previous findings and highlight the association between conspiracy beliefs and compliance with protective measures issued by government. Furthermore it showed that the conspiracy beliefs lowers the trust in government information and measures which are based on scientific epidemiological findings, which emphasize the importance of government role in creating strategies to fight the infodemic. Taken all together, the current findings imply that beliefs in conspiracy theories can have potentially significant consequences and highlight the need for further research on the role of conspiracy beliefs during social crisis caused by COVID-19 pandemic.

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