Journal of Affective Disorders Reports 8 (2022) 100317

Contents lists available at ScienceDirect

Journal of Affective Disorders Reports

journal homepage: www.sciencedirect.com/journal/journal-of-affective-disorders-reports

Research Paper

Relationship between sense of control, psychological burden, sources of information and adherence to anti-COVID-19 rules

J. Brailovskaia *, J. Margraf

Mental Health Research and Treatment Center, Department of Clinical Psychology and Psychotherapy, Ruhr-Universität Bochum, Bochum, Germany

ARTICLE INFO

Keywords:
Sense of control
Psychological burden by COVID-19
Adherence to anti-COVID-19 rules
Source of COVID-19 information

ABSTRACT

Background: Adherence to anti-COVID-19 rules is important to slow down the pandemic spread. The present study investigated potential predictors of the adherence.
Methods: Data of 1.247 participants from Germany (age: *M* (*SD*) = 22.99 (6.18)) were assessed via online surveys in autumn and winter 2020. The focus of the data collection was on adherence to anti-COVID-19 rules, sense of control, psychological burden, and sources of COVID-19 information.
Results: In moderated mediation analyses, the positive relationship between sense of control and adherence to anti-COVID-19 rules was significantly mediated by the level of psychological burden experienced by the COVID-19 situation. The source of COVID-19 information significantly moderated the negative association between burden and adherence. Specifically, the higher the use of social media (e.g., Facebook, Twitter) and the lower the use of official governmental sites and of television reports, the closer the link between high burden and low adherence.
Limitations: Due to the cross-sectional study design, the present findings allow only hypothetical assumptions of causality.
Conclusions: The present results disclose potential mechanisms that could contribute to the adherence to anti-COVID-19 rules. They emphasize the role of the COVID-19 information source for the adherence level. Potential ways of how the level of adherence could be enhanced are discussed.

1. Introduction

The outbreak of the coronavirus disease (COVID-19; severe acute respiratory syndrome coronavirus 2, SARS-CoV-2) in China in December 2019 and its rapid spread since the beginning of the year 2020 resulted in changes of everyday life around the globe (World Health Organization, 2020). In many countries, governments and authorities introduced restrictive anti-COVID-19 rules to slow down the pandemic spread (Garfin et al., 2020; Sohrabi et al., 2020). The rules mainly included closing of non-essential businesses, public institutions, leisure places and shops, bans on traveling and non-family gatherings. In some regions, overnight or fulltime curfews were introduced. Behavioral measures such as the wearing of face masks, hand disinfection and maintaining distance to other people in public transport and public places became mandatory (Gandhi and Rutherford, 2020; Tso and Cowling, 2020) and remain this in the course of the year 2021 (Su et al., 2021).

The anti-COVID-19 rules caused wide-ranging reactions in the population. Some people adhere to the introduced rules, while other individuals doubt their usefulness and refuse adherence (Ditekemena et al., 2021; Margraf et al., 2020; Nivette et al., 2021). Recent findings from different countries emphasize that adherence to the introduced governmental rules is important to fight the pandemic and its negative consequences for the individual and the society (Howard et al., 2021; Liang et al., 2020; Tanaka and Okamoto, 2021). For example, the wearing of face masks in public places has been shown to significantly reduce the COVID-19 cases in Germany and in France (Hoertel et al., 2021; Mitze et al., 2020). Moreover, in a cross-national study that investigated representative samples from eight countries (Germany, France, Spain, Poland, Russia, Sweden, the U.K., the U.S.) during the summer 2020, the level of overall adherence to the anti-COVID-19 rules was significantly negatively linked to the COVID-19 mortality rate up to three months later (Margraf et al., 2021).

The continuation of the COVID-19 situation remains unclear in the year 2021. The adherence to anti-COVID-19 rules can reduce the pandemic spread and its negative consequences, and thus it can speed up

* Corresponding author.
E-mail address: Julia.Brailovskaia@rub.de (J. Brailovskaia).

https://doi.org/10.1016/j.jadr.2022.100317
Received 14 May 2021; Received in revised form 2 January 2022; Accepted 5 February 2022
Available online 9 February 2022

the global return to "normal" life (a life without pandemic caused restrictions and infection fear) (e.g., Howard et al., 2021). Therefore, it is urgent to investigate potential predictors of adherence to anti-COVID-19 rules and their interaction to find the most effective way for its enhancement. Recent research reported younger age, male gender, and a low education level to be negatively linked to adherence to anti-COVID-19 rules (Berg-Beckhoff et al., 2021; de Moura Villela et al., 2021; Ditekemena et al., 2021; Hearne and Niño, 2021; Júnior et al., 2021; Margraf et al., 2020; Nivette et al., 2021). In addition to the demographic factors, it has been described that individuals who experience a reduced level of sense of control and a high level of psychological burden by the COVID-19 situation (i.e., emotional state that is characterized by feelings of being overwhelmed, frustration, uncertainly and anxiety; see Brailovskaia et al., 2021b) could tend to lower levels of adherence (Brailovskaia and Margraf, 2021; Coroiu et al., 2020). Furthermore, intensive use of social media (SM) as a COVID-19 information source was negatively linked to adherence (Cuello-Garcia et al., 2020; Júnior et al., 2021).

Focusing the non-demographic factors, following considerations might at least partly explain the available findings on adherence. Human beings want to control the course of events in the own life and to decide on their own where to go, what to do and whom to meet (Seligman, 1972; Vollmayr and Gass, 2013). The lack of control over important life events can contribute to the experience of psychological burden and negatively impact mental health by the development of depression symptoms (Miller and Seligman, 1975). Survivors of terroristic attacks and natural disasters, but also people who experience individual tragedies and losses that contribute to unexpected and extraordinary changes of their daily routine often report a reduced sense of control, and therefore are prone to the experience of psychological burden (Goldmann and Galea, 2014; Parrish et al., 2011; Southwick and Southwick, 2018; Thompson et al., 2017).

The outbreak of COVID-19 and the introduced rules that are important to fight the pandemic have resulted in unexpected and extraordinary changes of everyday life for many people (Galea et al., 2020). Some individuals who quickly adopted to the required changes and kept a high level of sense of control experience the COVID-19 situation as less burdensome. They express less negative emotions, show more understanding for the necessity of the anti-COVID-19 rules and try to maintain their daily routine under the new life conditions (Margraf et al., 2020; Ornell et al., 2020; Usher et al., 2020). Other people experience the need to stay at home, to cancel trips and travels, and to forgo in person work and leisure meetings as a significant loss of control of their lifestyle (Settersten et al., 2020; Taylor et al., 2020). This can contribute to the experience of high psychological burden that is enhanced by the uncertainty about the duration of the COVID-19 situation and its unpredictability (Brailovskaia and Margraf, 2020; Usher et al., 2020). Recent studies reported that individuals who experience loss of control and psychological burden are prone to dysfunctional coping strategies that could negatively impact their mental and physical health and that could have negative societal consequences (Bäuerle et al., 2020; Brailovskaia and Margraf, 2021; Coroiu et al., 2020). This corresponds to earlier research that described that a longer-term loss of control over important areas of life can result in self-destructive behavior and problematic substance use that can also harm other people (Southwick and Southwick, 2018; Volpicelli, 1987). Against this framework, it can be hypothesized that low sense of control and high psychological burden by COVID-19 might be potential predictors of low adherence to anti-COVID-19 rules. Moreover, low sense of control could contribute to the experience of high burden, and high burden might – as a mediator – reduce the willingness to adhere to the introduced rules.

Considering available research, a further predictor of adherence to anti-COVID-19 rules could be the use of SM as source of COVID-19 information (González-Padilla and Tortolero-Blanco, 2020; Ren et al., 2020). Due to the need for "social distance", the use of SM such as Twitter, Instagram and Facebook has increased since the pandemic outbreak (Depoux et al., 2020; Zhong et al., 2021). Many people engage in intensive SM use (SMU) to gain information about the COVID-19 situation (Banerjee and Meena, 2021; Cinelli et al., 2020). In contrast to other sources of COVID-19 information such as television reports, newspaper articles and official governmental online sites, users of SM can actively contribute to the creation, modification and sharing of the presented content. Each user can add own thoughts and emotional expressions to the shared content (Allington et al., 2020; Banerjee and Meena, 2021). As a consequence, SM provide access to a lot of information in a very short period of time (Garfin et al., 2020). However, this information is unfiltered and prone to fake news, conspiracy theories, and exaggerations amplified by emotions (Allington et al., 2020; Apuke and Omar, 2021; Budhwani and Sun, 2020; Gao et al., 2020). Through online re-sharing that often works as a snowball system the misinformation can rapidly spread (Pennycook et al., 2020). Portable devices such as laptops, smartphones and tablets with mobile Internet access allow SMU at any time and at any place. Therefore, users could be permanently at risk for the consume of the unfiltered information (Zhong et al., 2021). Research on earlier extraordinary situations (e.g., epidemics, terrorist attacks) reported that enhanced exposure to such unfiltered information can overwhelm the user and foster stress, anxiety symptoms and dysfunctional coping-strategies (Garfin et al., 2015; Holman et al., 2014; Thompson et al., 2017; Wang et al., 2019). In line with these findings, recent studies reported a positive association between SMU as COVID-19 information source and the experience of psychological burden as well as a reduced adherence to the introduced rules (Brailovskaia et al., 2021a; Júnior et al., 2021; Ren et al., 2020).

We do not know for how long COVID-19 will spread around the globe. To contribute to its reduction, the adherence to governmental rules is important because it can foster the behavior that may limit the transmission of the virus. Therefore, the main aim of the present study was to investigate potential predictors of the adherence to anti-COVID-19 rules. Against the presented findings, we focused on sense of control, psychological burden and SMU as COVID-19 information source, and formulated following hypotheses: Sense of control is expected to be negatively linked to psychological burden by COVID-19 (Hypothesis 1a). Its relationship with adherence to anti-COVID-19 rules is expected to be positive (Hypothesis 1b). Burden by COVID-19 is expected to be negatively related to adherence (Hypothesis 1c). Moreover, burden by COVID-19 is assumed to mediate the association between sense of control and adherence (Hypothesis 2). SMU as COVID-19 information source is expected to be positively associated with burden by COVID-19 (Hypothesis 3a) and to be negatively associated with adherence to anti-Civid-19 rules (Hypothesis 3b). Furthermore, we hypothesized that SMU as COVID-19 information source moderates the association between burden and adherence (Hypothesis 4). Specifically, the higher the SMU, the closer the link between high burden and low adherence. Fig. 1 illustrates the hypothesized relationships as a moderated mediation model (cf., Hayes, 2013; p. 450).

Even though the main focus of the present study was on SM, it is important to consider that they are a popular but not the only source of COVID-19 information. Therefore, we included further information sources in the investigation (that are newspaper reports (print media), television reports, and official online sites of the federal government and authorities). To avoid speculations, we formulated three research questions to investigate their role for the adherence to anti-COVID-19 rules:

Research Question 1: Does the use of official governmental sites as COVID-19 information source moderate the relationship between burden by COVID-19 and adherence to anti-COVID-19 rules?

Research Question 2: Does the use of television reports as COVID-19 information source moderate the relationship between burden by COVID-19 and adherence to anti-COVID-19 rules?

Research Question 3: Does the use of newspaper reports as COVID-19 information source moderate the relationship between burden by COVID-19 and adherence to anti-COVID-19 rules?

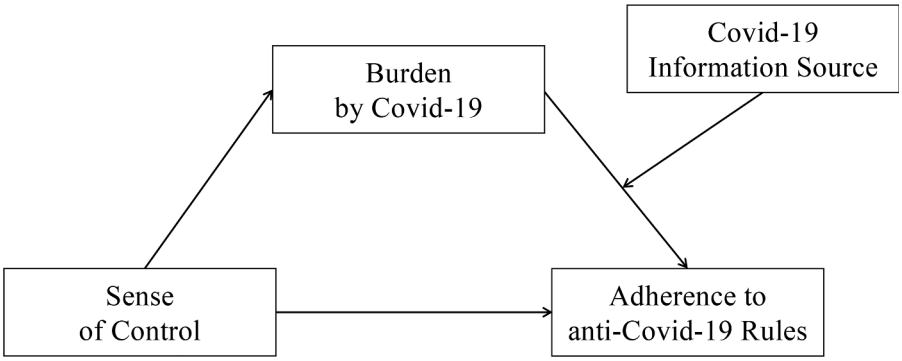

Fig. 1. Moderated mediation model with sense of control (predictor), burden by COVID-19 (mediator), COVID-19 information source (moderator) and adherence to anti-COVID-19 rules (outcome).

2. Methods

2.1. Procedure and participants

The sample comprised of 1,247 participants from Germany (73.1% women; $M_{age}(SD_{age}) = 22.99$ (6.18), range: 18–70; occupation: 86.5% students, 13.2% employed, 0.3% unemployed; marital status: 52.3% single, 38.3% in a romantic relationship, 9.5% married). Of them 15.7% reported to belong to a COVID-19 risk group (i.e., age-related, pre-existing condition, weakened immune system), and eight persons had been tested positive for the virus. Data were collected between November and December 2020. A participation invitation including a link leading to the online survey was emailed to all freshmen who enrolled at a large university in the Ruhr region in October 2020. Additionally, the invitation was emailed to 838 persons who were current or former students at the university and had previously agreed to be contacted for research investigations. There were no specific requirements for participation that was voluntary and compensated by course credits for students. All participants were provided instruction and gave informed consent to participate via an online form. The responsible Ethical Committee approved the study implementation. There were no missing data. No data were excluded. Power analyses using the G*Power program, version 3.1 indicated that the sample size is sufficient for valid results (power > 0.80, $\alpha = 0.05$, effect size: $f^2 = 0.15$; cf., Mayr et al., 2007).

2.2. Measures

2.2.1. Sense of control

Following Niemeyer et al. (2019) sense of control was assessed with the two items "Do you experience important areas of your life (i.e., work, free-time, family, etc.) to be uncontrollable, meaning that you cannot, or barely can, influence them?" and "Do you experience these important areas of your life as unpredictable or inscrutable?". Both items are rated on a 5-point Likert-type scale (0 = *not at all*, 4 = *very strong*; current scale reliability: $\alpha = 0.798$). The higher the sum score, the lower the sense of control.

2.2.2. Psychological burden caused by COVID-19

The experience of psychological burden caused by COVID-19 was measured with six items (e.g., "I am burdened by the current social situation", "I feel restricted in my everyday life"). Items are rated on a 7-point Likert-type scale (1 = *I do not agree*, 7 = *I totally agree*; current scale reliability: Cronbach's $\alpha = 0.763$). Higher sum scores indicate higher burden.

2.2.3. COVID-19 specific media use

Participants rated the frequency of their use of 1) newspaper articles (print media), 2) news reports on television, 3) official governmental sites, and 4) SM (e.g., Facebook, Twitter) to inform themselves about the COVID-19 situation on a 7-point Likert-type scale (1 = *not at all*, 7 = *intensively*). The higher the score, the higher the use frequency.

2.2.4. Adherence to anti-COVID-19 rules

Participants were asked to rate how much they adhere to the rules introduced to combat COVID-19 (e.g., wearing of face masks, keeping distance to other people, adherence to bans on gatherings) on a 5-point Likert-type scale (0 = *not at all*, 4 = *very strong*). Higher scores indicate higher adherence to the rules.

2.3. Statistical analyses

Statistical analyses were conducted using SPSS 26 and the macro Process version 3.5 (www.processmacro.org/index.html). After descriptive analyses, the extent of SMU was compared with the extent of use of the other three sources of COVID-19 information by calculating dependent t-tests. Cohen's d was included as effect size measure. Next, the association between the investigated variables was assessed by zero-order bivariate correlations. Then, four moderated moderation analyses that included a conditional indirect effect (see Fig. 1) were run (Process: model 14). This allowed to examine the multiple effects simultaneously (integration of the hypothesized mediation and moderation models) (Edwards and Lambert, 2007; Hayes, 2018). The moderated mediation effect was assessed by the bootstrapping procedure (10,000 samples) that provides percentile bootstrap confidence intervals (*CI* 95%). The analyses included sense of control as predictor, burden by COVID-19 as mediator, the four sources of COVID-19 information, respectively, as moderator and adherence to anti-COVID-19 rules as outcome; due to the mostly young and female composition of our sample and considering previous findings that reported age and gender to be significantly linked to adherence (Hearne and Niño, 2021; Nivette et al., 2021), we controlled for age and gender by including both as covariates. Path *a* denoted the relationship between sense of control and burden; path *b* denoted the association between burden and adherence to rules; path *c'* (the direct effect) denoted the link between sense of control and adherence to rules after the inclusion of burden and information source in the model.

3. Results

Table 1 shows the descriptive statistics of the investigated variables and their correlations. Considering the mean usage frequency of the four COVID-19 information sources, t-tests revealed that participants tended to use SM more frequently than newspaper articles, $t(1246) = -22.194$, $p < .001$, Cohen's $d = 0.92$, and less frequently than official governmental sites, $t(1246) = -2.436$, $p = .015$, $d = 0.10$. No significant difference was found between the use of SM and of television reports, $t(1246) = 1.412$, $p = .158$.

Table 1
Descriptive statistics and correlations of sense of control, burden by COVID-19, adherence to anti-COVID-19 rules and sources of COVID-19 information.

	M(SD)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Sense of Control	3.19 (2.01)	0.278**	−0.073**	−0.099**	−0.097*	−0.011	0.130**
(2) Burden by COVID-19	23.78 (7.12)		−0.130**	−0.028	−0.013	−0.043	0.228**
(3) Adherence to rules	4.20 (0.78)			0.107**	0.209**	0.193**	−0.117**
(4) Newspaper	2.05 (1.62)				0.306**	0.127**	−0.071*
(5) Television	3.66 (2.12)					0.114**	−0.072*
(6) Official Sites	3.98 (1.95)						0.033
(7) Social Media	3.79 (2.13)						

Notes. $N = 1{,}247$; M = Mean, SD = Standard Deviation; $^{**}p < .001$, $^{*}p < .05$.

The correlation analyses revealed that sense of control was significantly positively correlated with burden and SMU (all: $p < .001$). Furthermore, it was significantly negatively correlated with adherence to anti-COVID-19 rules and with use of newspaper articles (both: $p < .001$) as well as with use of television reports ($p < .05$). Burden was significantly negatively correlated with adherence to rules, and significantly positively with SMU (both: $p < .001$). Moreover, adherence to rules was significantly positively correlated with the use of newspaper articles, television reports and official sites (all: $p < .001$). However, it was significantly negatively correlated with SMU ($p < .001$) (see Table 1).

The moderated mediation analyses revealed significant findings for the models that included SMU, use of official governmental sites, and use of television reports as moderators. The analysis that included use of newspaper reports as moderator was not significant. Table 2 shows the results of the three significant moderated mediation analyses. The analysis that included SMU as moderator had a significant overall model, $F(6,1240) = 5.744$, $p < .001$. The explained variance of the overall model was $R^2 = 0.045$. The direct effect (path *c'*) of sense of control on adherence to rules was not significant ($p = .428$) after controlling for burden, SMU, and their interaction. The conditional indirect effect of sense of control on adherence to rules through burden was not significant in participants with low levels of SMU. In contrast, it was significant in participants with medium and high levels of SMU. As shown in Table 2, this effect was stronger for participants with a high level of SMU than for participants with a medium level of SMU.

The moderated mediation analysis that included use of official governmental sites as moderator was significant, $R^2 = 0.074$, $F(6,1240) = 10.516$, $p < .001$ (see Table 2). The direct effect (path *c'*) of sense of control on adherence was not significant ($p = .284$) after controlling for burden, use of official sites, and their interaction. The conditional indirect effect of sense of control on adherence to rules through burden was not significant in participants with high levels of use of official sites. In contrast, it was significant in participants with medium and low levels of use of official sites (low use > medium use; see Table 2).

The moderated mediation analysis that included the use of television reports as moderator was significant. It showed a similar result pattern as the analysis that included the use of official sites as moderator, $R^2 = 0.085$, $F(6,1240) = 13.130$, $p < .001$ (see Table 2). The direct effect (path *c'*) of sense of control on adherence was not significant ($p = .638$) after controlling for burden, use of television reports, and their interaction. The conditional indirect effect of sense of control on adherence to rules through burden was not significant in participants with high levels of use of television reports. In contrast, it was significant in participants with medium and low levels of use of television reports (low use > medium use; see Table 2).

As indicated by the index of moderated mediation, the test of moderated mediation was significant revealing a significant moderated mediation effect in all three analyses (see Table 2). Fig. 2 visualizes the moderation effects of the three analyses.

4. Discussion

The adherence to anti-COVID-19 rules is important for the fight with the pandemic spread. The current study investigated potential predictors of the adherence and their interaction in a large-scale sample from Germany. Our results reveal that sense of control, psychological burden and the COVID-19 information source are significantly linked to the level of individual adherence to the introduced rules.

As expected, sense of control was negatively associated with psychological burden by COVID-19 (confirmation of Hypothesis 1a). Its relationship with adherence to anti-COVID-19 rules was positive (confirmation of Hypothesis 1b). Burden by COVID-19 was negatively associated with adherence (confirmation of Hypothesis 1c). These results correspond to available findings that described low sense of control and high burden by the COVID-19 situation to reduce the adherence to anti-COVID-19 rules (Brailovskaia and Margraf, 2021; Coroiu et al., 2020). Moreover, the present findings compliment available knowledge of the relationship between the three variables. They show that psychological burden could serve as a mediator between sense of control and adherence (confirmation of Hypothesis 2). Notably, the cross-sectional design of our study does not allow true conclusions on causality. Nevertheless, the significant mediation effect contributes to the hypothetical assumption that, on the one hand, individuals with low sense of control might be at enhanced risk to experience the COVID-19 situation as burdensome, which might reduce their adherence to anti-COVID-19 rules. On the other hand, people with a high sense of control could better adapt to the COVID-19 situation, and thus experience less psychological burden. As a consequence, they could show more adherence to the introduced rules. This assumption corresponds to earlier research that described the significance of sense of control for individual mental health and behavior (Seligman, 1972). Typically, people with high sense of control have low level of anxiety, while their resilience level is high (Southwick et al., 2014). They experience unexpected situations as less stressful and consider them as challenges that they can master (Collishaw et al., 2007). To master the extraordinary situations, individuals with high sense of control actively search for references that could support them in achieving this aim (Johnson et al., 2018; Lachman and Weaver, 1998). The anti-COVID-19 rules serve as such references. They provide ways how the pandemic spread can be reduced (Ditekemena et al., 2021). Thus, it can be assumed that people with high sense of control who experience the COVID-19 situation as a challenge rather than as a burden consider the introduced rules as a supportive way to fight the pandemic, and therefore adhere to them. In contrast, individuals with low sense of control typically have a low level of resilience and tend to a high level of anxiety (Barzilay et al., 2020). They feel overwhelmed by unexpected and unknown situations, and often tend to dysfunctional coping strategies (Keeton et al., 2008; Vollmayr and Gass, 2013). These strategies can include lack of any action in situations that require specific action, self-harm (e.g., problematic substance use) and harm of other people (e.g., aggressive behavior) (MacKinnon and Colman, 2016; Southwick and Southwick, 2018; Volpicelli, 1987; Wortman and Brehm, 1975). Against this background, it can be assumed that people with low sense of control could experience high burden by COVID-19 (see also Barzilay et al., 2020). As a consequence, they could tend to low adherence to anti-COVID-19 rules as a dysfunctional coping strategy.

Furthermore, our findings show that the source of COVID-19

Table 2
Moderated Mediation Models (outcome: adherence to anti-COVID-19 rules).

	ß	SE	t	*p*	95% *CI*
Moderator: *Social Media Use*					
Path *a*: Control → Burden	0.982	0.104	9.441	<0.001	[0.778, 1.187]
Path *b*: Burden → Adherence to rules	−0.012	0.004	−3.501	0.001	[−0.019, −0.005]
Interaction: Burden*Social Media → Adherence to rules	−0.005	0.002	−3.082	0.002	[−0.008, −0.007]
Path *c'* (direct effect): Control → Adherence to rules	−0.010	0.012	−0.793	0.428	[−0.033, 0.014]
Conditional Indirect Effects: Control → Adherence to rules					
Control → Burden → Adherence to rules					
Social Media:					
Low (one SD below mean = −2.127)	−0.002	0.004			[−0.010, 0.006]
Medium (mean = 0)	−0.012	0.004			[−0.020, −0.005]
High (one SD above mean = 2.127)	−0.022	0.006			[−0.034, −0.011]
Index of Moderated Mediation	−0.005	0.002			[−0.008, −0.002]
Moderator: *Use of Official Governmental Sites*					
Path *a*: Control → Burden	0.982	0.104	9.441	<0.001	[0.778, 1.187]
Path *b*: Burden → Adherence to rules	−0.015	0.003	−4.456	<0.001	[−0.021, −0.008]
Interaction: Burden*Official Governmental Sites → Adherence to rules	0.005	0.002	3.164	0.002	[0.002, 0.008]
Path *c'* (direct effect): Control → Adherence to rules	−0.013	0.012	−1.071	0.428	[−0.036, 0.011]
Conditional Indirect Effects: Control → Adherence to rules					
Control → Burden → Adherence to rules					
Official Governmental Sites:					
Low (one SD below mean = −1.947)	−0.024	0.006			[−0.037, −0.013]
Medium (mean = 0)	−0.015	0.004			[−0.023, −0.008]
High (one SD above mean = 1.947)	−0.005	0.004			[−0.013, 0.003]
Index of Moderated Mediation	0.005	0.002			[0.002, 0.009]
Moderator: *Use of Television Reports*					
Path *a*: Control → Burden	0.982	0.104	9.441	<0.001	[0.778, 1.187]
Path *b*: Burden → Adherence to rules	−0.014	0.003	−4.232	<0.001	[−0.021, −0.008]
Interaction: Burden*Television Reports → Adherence to rules	0.007	0.002	4.540	<0.001	[0.004, 0.010]
Path *c'* (direct effect): Control → Adherence to rules	−0.006	0.012	−0.471	0.638	[−0.028, 0.017]
Conditional Indirect Effects: Control → Adherence to rules					
Control → Burden → Adherence to rules					
Television Reports:					
Low (one SD below mean = −2.118)	−0.028	0.006			[−0.041, −0.017]
Medium (mean = 0)	−0.014	0.004			[−0.022, −0.007]
High (one SD above mean=2.118)	0.001	0.004			[−0.008, 0.008]
Index of Moderated Mediation	0.007	0.002			[0.004, 0.010]

Notes. $N = 1{,}247$; covariates: age and gender; Control = Sense of Control; Burden = Burden by COVID-19; β = Standardized Beta, SE = Standard Error, t = *t*-test, p = significance, *CI* = Confidence Interval.

information might impact the relationship between the experienced COVID-19 burden and the adherence to anti-COVID-19 rules. COVID-19 and its consequences are a global topic that is omnipresent in different information sources (Cinelli et al., 2020), such as newspaper articles, television reports, official governmental sites, and SM (e.g., Twitter, Facebook). In the present sample from Germany, SM were used more frequently than newspaper articles, similar frequently as television reports, and less frequently than official sites as a COVID-19 information source. In contrast to the other forms of mass media, SM provide user generated content that is typically unfiltered and rather prone to misinformation (Srivastava et al., 2020).

Recent research showed that intensive SMU as COVID-19 information source might trigger burdensome feelings (Ren et al., 2020). Furthermore, a negative relationship between SMU as information source and adherence to anti-COVID-19 rules has been described (Júnior et al., 2021). Our results confirm and extend these findings. They show how the experience of psychological burden, SMU as COVID-19 information source and adherence to the rules might interact. As assumed, we found a positive association between SMU as COVID-19 information source and psychological burden by COVID-19 (confirmation of Hypothesis 3a). Its relationship with adherence to anti-Civid-19 rules was negative (confirmation of Hypothesis 3b). Moreover, SMU served as a moderator between burden and adherence: The higher the SMU, the closer the link between high burden and low adherence (confirmation of Hypothesis 4). Our findings allow a hypothetical assumption – due to the cross-sectional study design no causal conclusion can be drawn – that especially individuals who experience the COVID-19 situation as a psychological burden could be at risk for less adherence to anti-COVID-19 rules. Intensive SMU that allows the access to a huge amount of unfiltered COVID-19 information might contribute to their reduced adherence. In the current study, we did not assess beliefs in general conspiracy theories or in different types of conspiracy theories about COVID-19. However, recent research showed that enhanced experience of psychological burden can reduce the ability to rationally evaluate available information and to differ between true and fake news (Apuke and Omar, 2021; Ren et al., 2020). Moreover, it can increase the vulnerability to belief in conspiracy theories that at the first glace might seem to provide sense of extraordinary situations such as the pandemic outbreak (Douglas et al., 2017; Van Prooijen and Douglas, 2017). The fast information flow on SM that can include fake news and conspiracy theories often disseminated on SM could overwhelm people with high level of psychological burden and reduce their adherence to anti-COVID-19 rules (Erku et al., 2021). Against this background, future studies that investigate mechanisms that might influence adherence to anti-COVID-19 rules should also focus on beliefs in general conspiracy theories as well as in different types of conspiracy theories about COVID-19.

SMU as COVID-19 information source was the main focus of the present study, but we also investigated other information sources. In contrast to SMU, the use of newspaper reports, television reports and official governmental sites as COVID-19 information source was positively linked to adherence to anti-COVID-19 rules. Furthermore, SMU

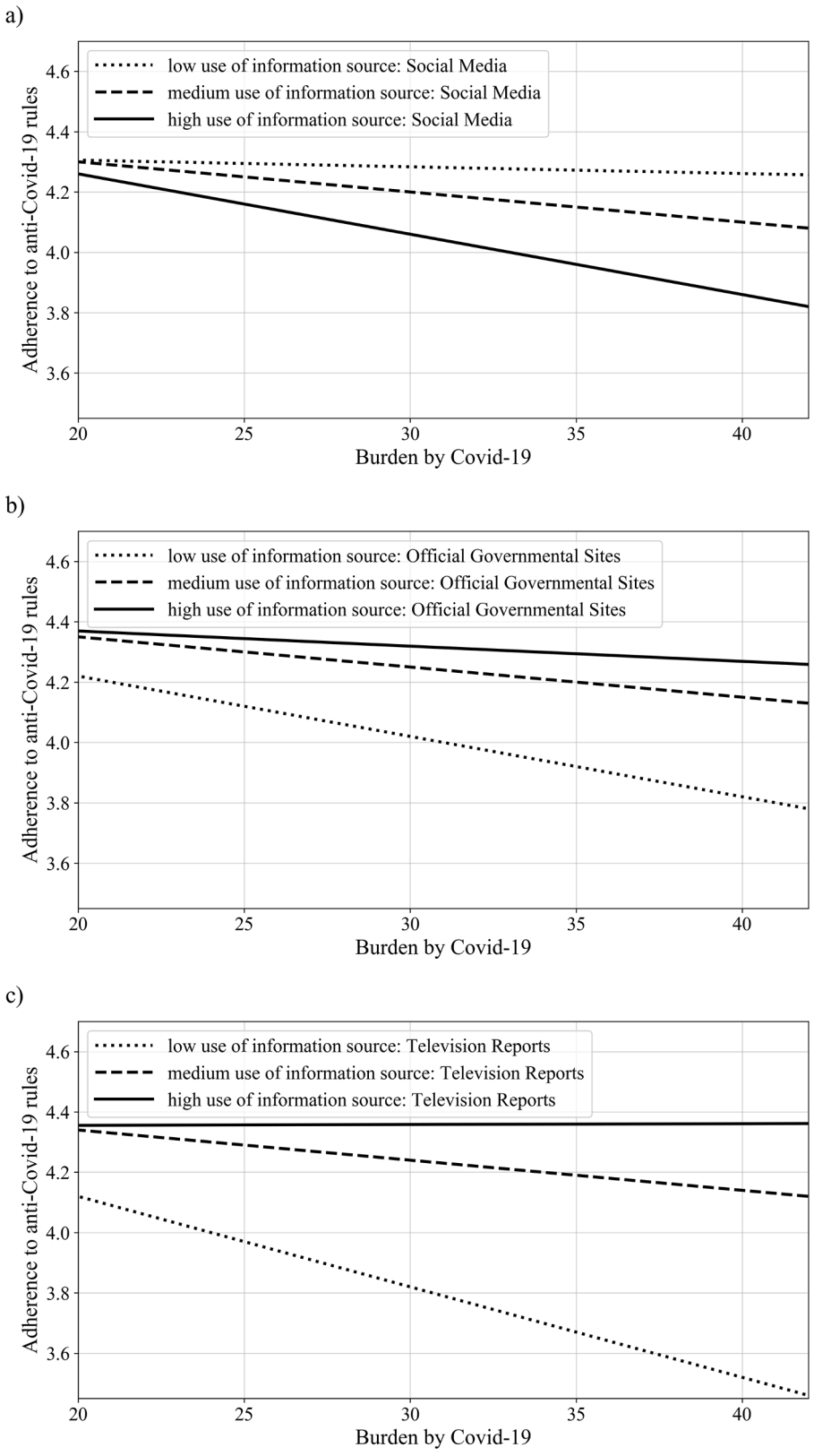

Fig. 2. Moderating effect of the source of COVID-19 information on the connection between burden by COVID-19 and adherence to anti-COVID-19 rules: a) moderator: social media use; b) moderator: use of official governmental sites; c) moderator: use of television reports.

was the only information source that was significantly positively associated with psychological burden by COVID-19. While there was no moderation effect of the use of newspaper reports on the association between burden and adherence (see Research Question 3), the use of official governmental sites (see Research Question 1) and of television reports (see Research Question 2) served as significant moderators of this relationship. For both sources, we found a similar result pattern that was opposite to the pattern of SMU: The lower the use of official sites or

of television reports, the closer the association between high burden and low adherence. These findings allow the hypothetical assumption that individuals with a high level of burden who tend to search for COVID-19 information on official sites and by watching television reports are less prone to decreased adherence to anti-COVID-19 rules. These information sources might support them to understand the global situation and the need for adherence without overwhelming the people with fake news and misinformation (Mohamad et al., 2020).

The present results reveal that individuals with a low level of sense of control who are at risk to experience high burden by COVID-19 might be prone to potential negative impact of SMU as information source that might result in low adherence to anti-COVID-19 rules. In contrast, the use of official sites and television reports as COVID-19 information source might have a less negative impact on their adherence or even contribute to its enhancement.

Against these findings, it seems possible to foster adherence to anti-COVID-19 rules. Therefore, it is urgent to enhance the individual sense of control and to reduce the experience of burden. This could be done by providing the people with alternatives how to experience positive emotions and control despite the COVID-19 restrictions. Following available research (e.g., Rebar et al., 2015), engagement in regular physical activity might be such an alternative. Physical activity such as jogging, gymnastics and yoga does not require expensive equipment and can be performed during lockdown and by keeping social distance. Regular exercises not only improve physical health, they also contribute to the experience of positive emotions (joy, happiness, satisfaction) and to a mental relaxation (Richards et al., 2015; Wang et al., 2012). In a recent cross-national study, physical activity reduced the psychological burden experienced by the COVID-19 situation in samples from Germany, Spain, Italy and Russia (Brailovskaia et al., 2021b). Moreover, physical activity and the experience of a steady improvement of own performance can foster the sense of control (McAuley et al., 2000; McKercher et al., 2009). This can enhance the individual resilience to master the requirements of the COVID-19 situation. Furthermore, engagement in physical activity reduces the time spent on SMU, and thus indirectly protects the people against the consume of misinformation (Brailovskaia et al., 2020).

Following available literature (Williams et al., 2021), training in mindfulness – that is enhanced attention to and nonjudgment awareness of the current moment (Bishop et al., 2004) – and in Tai Chi Qigong mediation (Chan et al., 2017) might be further protective strategies in the COVID-19 situation. A person can engage in both on one's own by the use of videos provided online, or in groups via videotelephony to maintain social distance. In addition, it is important to keep the daily routine and to satisfy basic psychological needs (Ryan and Deci, 2017) such as autonomy (e.g., feeling of freedom in things undertaken), competence (e.g., feeling to be able to achieve own goals), and relatedness (e.g., feeling to be connected to other people). A conscious remembering and writing down of situations when the individual was able to feel sense of autonomy, of competence, and/or of relatedness despite the restrictions caused by the pandemic outbreak could decrease the burden experience and increase positive emotions and sense of control (Cantarero et al., 2021).

Previous research on emergency risk communication emphasized that it is important – especially in extraordinary situations – to engender the public's trust (World Health Organization, 2017). Therefore, the public communication has to be honest, transparent, and credible. It should be guided by competence and expertise. In an emphatic and caring way, the population should be explained the reasons of the necessity of adherence to introduced measures (Reynolds and Quinn, 2008). Hereby, clear messages that promote specific actions should be provided (Reynolds and Seeger, 2005; Seeger et al., 2018). Against this background and our present findings, in addition to the explanation of the specific anti-COVID-19 rules, public governmental communication should for example promote physical activity to foster sense of control. It should provide clear examples of how physical activity could be practiced without violation of anti-COVID-19 rules. Moreover, the governmental communication should raise awareness of the potential negative consequences of intensive use of SM as COVID-19 information source. By the presentation of recent research results in an easily comprehensive way, it should emphasize that the source where the information comes from matters. Intensive users of platforms such as Facebook and Twitter should be informed about the potential negative impact of their online activity. They should be warned against the consume and (re-)sharing of misleading information and its influence on individual mental state and behavior. The necessity to verify the provided news by the use of alternative COVID-19 information sources such as official governmental sites and television reports could be recommended. Furthermore, people who are responsible for the content of such information sources should be encouraged to attach specific attention to stress the significance of adherence to anti-COVID-19 rules, a detailed explanation of the rules and the fostering of the individual awareness for misinformation and fake news. Notably, recent research emphasized that it is important not only to debunking misinformation, but also to proactively prebunking it – that is a combination of a forewarning and a pre-emptive refutation (van der Linden et al., 2021). Short browser games such as "Go Viral!" and "Bad News" were developed for this form of preventive inoculation (Basol et al., 2021; Roozenbeek and van der Linden, 2019). They can strengthen one's ability to spot misinformation and to perceive its manipulativeness. The recognition of manipulative content and the awareness of own vulnerability can increase one's psychological resistance against misinformation and fake news. Furthermore, the willingness to share misinformation decreases (Basol et al., 2021; van der Linden et al., 2020, 2021). These strategies could be included in governmental public COVID-19 communication.

Following limitations of our study should be considered. First, due to the cross-sectional online survey design only hypothetical assumptions on causality are possible. To draw true causal conclusions, longitudinal experimental investigations are required. For example, it could be investigated whether an experimental increase of participants' daily physical activity could enhance their sense of control and whether this could result in a decrease of burden experience and in an increase of adherence to COVID-19-rules in the longer-term. Furthermore, longitudinal investigates on the adherence to COVID-19-rules are important because the pandemic situation and the rules change over times. Therefore, future studies are suggested to replicate our findings with a longitudinal study design to ensure whether our moderated mediation model can keep up with the time. Second, the COVID-19 situation is a global issue that impacts people's daily life worldwide. Therefore, it should be investigated whether the present moderated mediation model that focused on potential predictors of adherence to anti-Codvid-19-rules in the Ruhr region of Germany can be replicated in other parts of Germany and in other countries. Third, earlier research described younger age and male gender to be negatively related to adherence (Hearne and Niño, 2021; Nivette et al., 2021). The composition of the present sample was mostly female and relatively young. This might bias the findings and limit their generalizability to other samples. To partly tackle this limitation, age and gender were controlled for in the analyses. Nevertheless, future research should replicate our investigation in a more age and gender balanced sample. Furthermore, it could compare whether our moderated mediation model works similarly well in different age groups. Fourth, we assessed the general adherence to anti-COVID-19-rules that refer to individual behavior with one item only which is an obvious simplification. The governmental rules focus on different forms of individual behavior (e.g., wearing of face masks in public places, frequent hand washing, staying at home, avoiding in-person meetings). Adherence to the specific rules might be experienced as more or less challenging. Moreover, the rules change over times and concern some individuals more than others (e.g., working from home). Therefore, to better understand the relationship between the potential predictors and adherence, future studies are suggested to

include more detailed assessments that focus on adherence to specific rules. Also, it should be assessed how much specific rules influence participants' everyday life. Fifth, we assessed only the general use frequency of SM as COVID-19 information source. Thus, we cannot draw conclusions about SMU that is motivated by other reasons than information search (such as the search for social interaction, the wish to experience positive emotions, or to escape negative ones) (Masur et al., 2014). Also, we did not assess which form of SM the participants used. It might be that different age groups prefer different SM as COVID-19 information source. And the content on different SM could be differently strong affected by fake news and conspiracy theories (Hopp et al., 2020). In addition, we have no information about how our participants evaluate the COVID-19 information provided by the different sources (e.g., as clear, understandable, credible, supportive, frustrating, stressful) and whether they belief in fake news and conspiracy theories about COVID-19. The form of used SM, usage motives and the evaluation of the received information should be focused by future research that investigates potential predictors of adherence to anti-COVID-19 rules.

In conclusion, the current study shows that low sense of control might reduce the adherence to anti-COVID-19 rules. Enhanced psychological burden combined with intensive use of social media as COVID-19 information source could foster this relationship. In contrast, it could be weakened by the use of other COVID-19 information sources such as official governmental sites and television reports. Following previous research on emergency risk communication (e.g., Reynolds et al., 2002), to increase the adherence to anti-COVID-19 rules, public governmental communication should present concrete ways how to foster the individual sense of control during the pandemic. One of such ways could be the engagement in daily physical activity and/or mindfulness training. In an open and emphatic style, the governmental communication should recommend to increase awareness to the potential consequences of the use of the different COVID-19 information sources.

Declaration of Competing Interest

None.

Funding

This work was financially supported by the Volkswagen Foundation. The funding source had no role in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication.

Author statement

Contributors: Julia Brailovskaia and Jürgen Margraf conducted the study design. Julia Brailovskaia wrote the first draft of the manuscript and conducted statistical analysis. Julia Brailovskaia conducted literature searches. Julia Brailovskaia conducted data collection and data preparation. Jürgen Margraf reviewed and edited the first draft. All authors contributed to and have approved the final manuscript. All authors state their compliance with the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Role of the funding sources

This work was financially supported by the Volkswagen Foundation. The funding source had no role in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication.

Acknowledgements

None.

References

Allington, D., Duffy, B., Wessely, S., Dhavan, N., Rubin, J., 2020. Health-protective behaviour, social media usage and conspiracy belief during the COVID-19 public health emergency. Psychol. Med. 1–7.

Apuke, O.D., Omar, B., 2021. Fake news and COVID-19: modelling the predictors of fake news sharing among social media users. Telematics Inform. 56, 101475.

Banerjee, D., Meena, K.S., 2021. COVID-19 as an "Infodemic" in public health: critical role of the social media. Front. Public Health 9, 231.

Barzilay, R., Moore, T.M., Greenberg, D.M., DiDomenico, G.E., Brown, L.A., White, L.K., Gur, R.C., Gur, R.E., 2020. Resilience, COVID-19-related stress, anxiety and depression during the pandemic in a large population enriched for healthcare providers. Transl. Psychiatry 10, 1–8.

Basol, M., Roozenbeek, J., Berriche, M., Uenal, F., McClanahan, W.P., Linden, S.v.d., 2021. Towards psychological herd immunity: cross-cultural evidence for two prebunking interventions against COVID-19 misinformation. Big Data Soc. 8, 1–18.

Bäuerle, A., Steinbach, J., Schweda, A., Beckord, J., Hetkamp, M., Weismüller, B., Kohler, H., Musche, V., Dörrie, N., Teufel, M., 2020. Mental health burden of the COVID-19 outbreak in germany: predictors of mental health impairment. J. Prim. Care Commun. Health 11, 1–8.

Berg-Beckhoff, G., Dalgaard Guldager, J., Tanggaard Andersen, P., Stock, C., Smith Jervelund, S., 2021. What predicts adherence to governmental COVID-19 measures among Danish students? Int. J. Environ. Res. Public Health 18, 1822.

Bishop, S.R., Lau, M., Shapiro, S., Carlson, L., Anderson, N.D., Carmody, J., Segal, Z.V., Abbey, S., Speca, M., Velting, D., 2004. Mindfulness: a proposed operational definition. Clin. Psychol. 11, 230–241.

Brailovskaia, J., Cosci, F., Mansueto, G., Margraf, J., 2021a. The relationship between social media use, stress symptoms and burden caused by Coronavirus (COVID-19) in Germany and Italy: a cross-sectional and longitudinal investigation. J. Affect. Disorders Reports 3, 100067.

Brailovskaia, J., Cosci, F., Mansueto, G., Miragall, M., Herrero, R., Baños, R.M., Krasavtseva, Y., Kochetkov, Y., Margraf, J., 2021b. The association between depression symptoms, psychological burden caused by COVID-19 and physical activity: an investigation in Germany, Italy, Russia, and Spain. Psychiatry Res. 295, 113596.

Brailovskaia, J., Margraf, J., 2020. Predicting adaptive and maladaptive responses to the Coronavirus (COVID-19) outbreak: a prospective longitudinal study. Int. J. Clin. Health Psychol. 20, 181–191.

Brailovskaia, J., Margraf, J., 2021. The relationship between burden caused by coronavirus (COVID-19), addictive social media use, sense of control and anxiety. Comput. Human. Behav. 119, 106720.

Brailovskaia, J., Ströse, F., Schillack, H., Margraf, J., 2020. Less Facebook use–More well-being and a healthier lifestyle? An experimental intervention study. Comput. Human Behav. 108, 106332.

Budhwani, H., Sun, R., 2020. Creating COVID-19 stigma by referencing the novel coronavirus as the "chinese virus" on twitter: quantitative analysis of social media data. J. Med. Internet Res. 22, e19301.

Cantarero, K., van Tilburg, W.A.P., Smoktunowicz, E., 2021. Affirming basic psychological needs promotes mental well-being during the COVID-19 outbreak. Soc. Psychol. Personal Sci. 12, 821–828.

Chan, A.W.K., Yu, D.S.F., Choi, K.C., 2017. Effects of tai chi qigong on psychosocial well-being among hidden elderly, using elderly neighborhood volunteer approach: a pilot randomized controlled trial. Clin. Interv. Aging 12, 85–96.

Cinelli, M., Quattrociocchi, W., Galeazzi, A., Valensise, C.M., Brugnoli, E., Schmidt, A.L., Zola, P., Zollo, F., Scala, A., 2020. The COVID-19 social media infodemic. Sci. Rep. 10, 1–10.

Collishaw, S., Pickles, A., Messer, J., Rutter, M., Shearer, C., Maughan, B., 2007. Resilience to adult psychopathology following childhood maltreatment: evidence from a community sample. Child Abuse Negl. 31, 211–229.

Coroiu, A., Moran, C., Campbell, T., Geller, A.C., 2020. Barriers and facilitators of adherence to social distancing recommendations during COVID-19 among a large international sample of adults. PLoS ONE 15, e0239795.

Cuello-Garcia, C., Pérez-Gaxiola, G., van Amelsvoort, L., 2020. Social media can have an impact on how we manage and investigate the COVID-19 pandemic. J. Clin. Epidemiol. 127, 198–201.

de Moura Villela, E.F., López, R.V.M., Sato, A.P.S., de Oliveira, F.M., Waldman, E.A., Van den Bergh, R., Fodjo, J.N.S., Colebunders, R., 2021. COVID-19 outbreak in Brazil: adherence to national preventive measures and impact on people's lives, an online survey. BMC Public Health 21, 1–10.

Depoux, A., Martin, S., Karafillakis, E., Bsd, R.P., Wilder-Smith, A., Larson, H., 2020. The pandemic of social media panic travels faster than the COVID-19 outbreak. J. Travel Med. 27, 1–2.

Ditekemena, J.D., Nkamba, D.M., Muhindo, H.M., Siewe, J.N.F., Luhata, C., Van den Bergh, R., Kitoto, A.T., Van Damme, W., Muyembe, J.J., Colebunders, R., 2021. Factors associated with adherence to COVID-19 prevention measures in the Democratic Republic of the Congo (DRC): results of an online survey. BMJ Open 11, e043356.

Douglas, K.M., Sutton, R.M., Cichocka, A., 2017. The psychology of conspiracy theories. Curr. Direct. Psychol. Dcience 26, 538–542.

Edwards, J.R., Lambert, L.S., 2007. Methods for integrating moderation and mediation: a general analytical framework using moderated path analysis. Psychol. Methods 12, 1–22.

Erku, D.A., Belachew, S.A., Abrha, S., Sinnollareddy, M., Thomas, J., Steadman, K.J., Tesfaye, W.H., 2021. When fear and misinformation go viral: pharmacists' role in deterring medication misinformation during the'infodemic'surrounding COVID-19. Res. Soc. Admin. Pharm. 17, 1954–1963.

Galea, S., Merchant, R.M., Lurie, N., 2020. The mental health consequences of COVID-19 and physical distancing: the need for prevention and early intervention. JAMA Intern. Med. 180, 817–818.
Gandhi, M., Rutherford, G.W., 2020. Facial Masking for COVID-19—Potential for "Variolation" as We Await a Vaccine. New England J. Med. 383, e101.
Gao, J., Zheng, P., Jia, Y., Chen, H., Mao, Y., Chen, S., Wang, Y., Fu, H., Dai, J., 2020. Mental health problems and social media exposure during COVID-19 outbreak. PLoS ONE 15, e0231924.
Garfin, D.R., Holman, E.A., Silver, R.C., 2015. Cumulative exposure to prior collective trauma and acute stress responses to the Boston Marathon bombings. Psychol Sci 26, 675–683.
Garfin, D.R., Silver, R.C., Holman, E.A., 2020. The novel coronavirus (COVID-2019) outbreak: amplification of public health consequences by media exposure. Health Psychol. 39, 355–357.
Goldmann, E., Galea, S., 2014. Mental health consequences of disasters. Annu. Rev. Public Health 35, 169–183.
González-Padilla, D.A., Tortolero-Blanco, L., 2020. Social media influence in the COVID-19 Pandemic. Int. Brazilian J. Urol. 46, 120–124.
Hayes, A.F., 2013. Introduction to Mediation, Moderation, and Conditional Process Analysis. Guilford Press, London.
Hayes, A.F., 2018. Partial, conditional, and moderated moderated mediation: quantification, inference, and interpretation. Commun. Monogr. 85, 4–40.
Hearne, B.N., Niño, M.D., 2021. Understanding how race, ethnicity, and gender shape mask-wearing adherence during the COVID-19 pandemic: evidence from the COVID impact survey. J. Racial Ethn. Health Disparities 1–8.
Hoertel, N., Blachier, M., Sánchez-Rico, M., Limosin, F., Leleu, H., 2021. Impact of the timing and adherence to face mask use on the course of the COVID-19 epidemic in France. J Travel Med 28, taab016.
Holman, E.A., Garfin, D.R., Silver, R.C., 2014. Media's role in broadcasting acute stress following the Boston Marathon bombings. Proc. Natl. Acad. Sci. 111, 93–98.
Hopp, T., Ferrucci, P., Vargo, C.J., 2020. Why do people share ideologically extreme, false, and misleading content on social media? A self-report and trace data–based analysis of countermedia content dissemination on Facebook and Twitter. Hum. Commun. Res. 46, 357–384.
Howard, J., Huang, A., Li, Z., Tufekci, Z., Zdimal, V., van der Westhuizen, H.-.M., von Delft, A., Price, A., Fridman, L., Tang, .L..-H., 2021. An evidence review of face masks against COVID-19. Proc. Natl. Acad. Sci. 118, e2014564118.
Johnson, S.J., Willis, S.M., Evans, J., 2018. An examination of stressors, strain, and resilience in academic and non-academic UK university job roles. Int. J. Stress Manag. 26, 162–172.
Júnior, A., Dula, J., Mahumane, S., Koole, O., Enosse, S., Fodjo, J.N.S., Colebunders, R., 2021. Adherence to COVID-19 preventive measures in Mozambique: two consecutive online surveys. Int. J. Environ. Res. Public Health 18, 1091.
Keeton, C.P., Perry-Jenkins, M., Sayer, A.G., 2008. Sense of control predicts depressive and anxious symptoms across the transition to parenthood. J. Family Psychol. 22, 212–221.
Lachman, M.E., Weaver, S.L., 1998. The sense of control as a moderator of social class differences in health and well-being. J. Pers. Soc. Psychol. 74, 763.
Liang, L.-.L., Tseng, C.-.H., Ho, H.J., Wu, .C..-Y., 2020. COVID-19 mortality is negatively associated with test number and government effectiveness. Sci. Rep. 10, 1–7.
MacKinnon, N., Colman, I., 2016. Factors associated with suicidal thought and help-seeking behaviour in transition-aged youth versus adults. Canadian J. Psychiatry 61, 789–796.
Margraf, J., Brailovskaia, J., Schneider, S., 2020. Behavioral measures to fight COVID-19: an 8-country study of perceived usefulness, adherence and their predictors. PLoS ONE 15, e0243523.
Margraf, J., Brailovskaia, J., Schneider, S., 2021. Adherence to behavioral COVID-19 mitigation measures strongly predicts mortality. PLoS ONE 16, e0249392.
Masur, P.K., Reinecke, L., Ziegele, M., Quiring, O., 2014. The interplay of intrinsic need satisfaction and Facebook specific motives in explaining addictive behavior on Facebook. Comput. Human Behav. 39, 376–386.
Mayr, S., Erdfelder, E., Buchner, A., Faul, F., 2007. A short tutorial of GPower. Tutor Quant. Methods Psychol. 3, 51–59.
McAuley, E., Blissmer, B., Katula, J., Duncan, T.E., Mihalko, S.L., 2000. Physical activity, self-esteem, and self-efficacy relationships in older adults: a randomized controlled trial. Ann. Behav. Med. 22, 131.
McKercher, C.M., Schmidt, M.D., Sanderson, K.A., Patton, G.C., Dwyer, T., Venn, A.J., 2009. Physical activity and depression in young adults. Am. J. Prev. Med. 36, 161–164.
Miller, W.R., Seligman, M.E., 1975. Depression and learned helplessness in man. J Abnorm Psychol 84, 228.
Mitze, T., Kosfeld, R., Rode, J., Wälde, K., 2020. Face masks considerably reduce COVID-19 cases in Germany. Proc. Natl. Acad. Sci. 117, 32293–32301.
Mohamad, E., Tham, J.S., Ayub, S.H., Hamzah, M.R., Hashim, H., Azlan, A.A., 2020. Relationship between COVID-19 information sources and attitudes in battling the pandemic among the malaysian public: cross-sectional survey study. J. Med. Internet Res. 22, e23922.
Niemeyer, H., Bieda, A., Michalak, J., Schneider, S., Margraf, J., 2019. Education and mental health: do psychosocial resources matter? SSM-Popul. Health 7, 100392.
Nivette, A., Ribeaud, D., Murray, A., Steinhoff, A., Bechtiger, L., Hepp, U., Shanahan, L., Eisner, M., 2021. Non-compliance with COVID-19-related public health measures among young adults in Switzerland: insights from a longitudinal cohort study. Soc. Sci. Med. 268, 113370.
Ornell, F., Schuch, J.B., Sordi, A.O., Kessler, F.H.P., 2020. Pandemic fear" and COVID-19: mental health burden and strategies. Brazilian J. Psychiatry 42, 232–235.
Parrish, B.P., Cohen, L.H., Laurenceau, .J..-P., 2011. Prospective relationship between negative affective reactivity to daily stress and depressive symptoms. J. Soc. Clin. Psychol. 30, 270–296.
Pennycook, G., McPhetres, J., Zhang, Y., Lu, J.G., Rand, D.G., 2020. Fighting COVID-19 misinformation on social media: experimental evidence for a scalable accuracy-nudge intervention. Psychol. Sci. 31, 770–780.
Rebar, A.L., Stanton, R., Geard, D., Short, C., Duncan, M.J., Vandelanotte, C., 2015. A meta-meta-analysis of the effect of physical activity on depression and anxiety in non-clinical adult populations. Health Psychol. Rev. 9, 366–378.
Ren, Z., Zhou, Y., Liu, Y., 2020. The psychological burden experienced by Chinese citizens during the COVID-19 outbreak: prevalence and determinants. BMC Public Health 20, 1–10.
Reynolds, B., Galdo, J.H., Sokler, L., 2002. Crisis and Emergency Risk Communication. Centers for Disease Control and Prevention, Atlanta, U.S.
Reynolds, B., Quinn, S.C., 2008. Effective communication during an influenza pandemic: the value of using a crisis and emergency risk communication framework. Health Promot. Pract. 9, 13–17.
Reynolds, B., Seeger, M.W., 2005. Crisis and emergency risk communication as an integrative model. J. Health Commun. 10, 43–55.
Richards, J., Jiang, X., Kelly, P., Chau, J., Bauman, A., Ding, D., 2015. Don't worry, be happy: cross-sectional associations between physical activity and happiness in 15 European countries. BMC Public Health 15, 53.
Roozenbeek, J., van der Linden, S., 2019. Fake news game confers psychological resistance against online misinformation. Palgrave Commun. 5, 1–10.
Ryan, R.M., Deci, E.L., 2017. Self-Determination Theory: Basic psychological Needs in Motivation, Development, and Wellness. Guilford Publications, New York.
Seeger, M.W., Pechta, L.E., Price, S.M., Lubell, K.M., Rose, D.A., Sapru, S., Chansky, M.C., Smith, B.J., 2018. A conceptual model for evaluating emergency risk communication in public health. Health Secur. 16, 193–203.
Seligman, M.E.P., 1972. Learned helplessness. Annu. Rev. Med. 23, 407–412.
Settersten Jr, R.A., Bernardi, L., Härkönen, J., Antonucci, T.C., Dykstra, P.A., Heckhausen, J., Kuh, D., Mayer, K.U., Moen, P., Mortimer, J.T., 2020. Understanding the effects of COVID-19 through a life course lens. Adv. Life Course Res. 45, 100360.
Sohrabi, C., Alsafi, Z., O'Neill, N., Khan, M., Kerwan, A., Al-Jabir, A., Iosifidis, C., Agha, R., 2020. World Health Organization declares global emergency: a review of the 2019 novel coronavirus (COVID-19). Int. J. Surg. 76, 71–76.
Southwick, F.S., Southwick, S.M., 2018. The loss of a sense of control as a major contributor to physician burnout: a neuropsychiatric pathway to prevention and recovery. JAMA Psychiatry 75, 665–666.
Southwick, S.M., Bonanno, G.A., Masten, A.S., Panter-Brick, C., Yehuda, R., 2014. Resilience definitions, theory, and challenges: interdisciplinary perspectives. Eur. J. Psycho. 5, 25338.
Srivastava, K.C., Shrivastava, D., Chhabra, K.G., Naqvi, W., Sahu, A., 2020. Facade of media and social media during COVID-19: a review. International Journal of Research in Pharmaceutical Sciences 11, 142–149.
Su, Z., Wen, J., McDonnell, D., Goh, E., Li, X., Šegalo, S., Ahmad, J., Cheshmehzangi, A., Xiang, .Y..-T., 2021. Vaccines are not yet a silver bullet: the imperative of continued communication about the importance of COVID-19 safety measures. Brain, Behav. Immun. Health 12, 100204.
Tanaka, T., Okamoto, S., 2021. Increase in suicide following an initial decline during the COVID-19 pandemic in Japan. Nat. Hum. Behav. 5, 229–238.
Taylor, S., Landry, C.A., Paluszek, M.M., Fergus, T.A., McKay, D., Asmundson, G.J.G., 2020. COVID stress syndrome: concept, structure, and correlates. Depress Anxiety 37, 706–714.
Thompson, R.R., Garfin, D.R., Holman, E.A., Silver, R.C., 2017. Distress, worry, and functioning following a global health crisis: a national study of Americans' responses to Ebola. Clin. Psychol. Sci. 5, 513–521.
Tso, R.V., Cowling, B.J., 2020. Importance of face masks for COVID-19–a call for effective public education. Clin. Infect. Dis. 71, 2195–2198.
Usher, K., Durkin, J., Bhullar, N., 2020. The COVID-19 pandemic and mental health impacts. Int. J. Ment. Health Nurs. 29, 315–318.
van der Linden, S., Roozenbeek, J., Compton, J., 2020. Inoculating against fake news about COVID-19. Front. Psychol. 11, 2928.
van der Linden, S., Roozenbeek, J., Maertens, R., Basol, M., Kácha, O., Rathje, S., Traberg, C.S., 2021. How can psychological science help counter the spread of fake news? Span J. Psychol. 24, 1–9.
Van Prooijen, J.-.W., Douglas, K.M., 2017. Conspiracy theories as part of history: the role of societal crisis situations. Memory Studies 10, 323–333.
Vollmayr, B., Gass, P., 2013. Learned helplessness: unique features and translational value of a cognitive depression model. Cell Tissue Res. 354, 171–178.
Volpicelli, J.R., 1987. Uncontrollable events and alcohol drinking. Br. J. Addict. 82, 381–392.
Wang, F., Orpana, H.M., Morrison, H., De Groh, M., Dai, S., Luo, W., 2012. Long-term association between leisure-time physical activity and changes in happiness: analysis of the prospective national population health survey. Am. J. Epidemiol. 176, 1095–1100.
Wang, Y., McKee, M., Torbica, A., Stuckler, D., 2019. Systematic literature review on the spread of health-related misinformation on social media. Soc. Sci. Med. 240, 112552.
Williams, C.Y.K., Townson, A.T., Kapur, M., Ferreira, A.F., Nunn, R., Galante, J., Phillips, V., Gentry, S., Usher-Smith, J.A., 2021. Interventions to reduce social isolation and loneliness during COVID-19 physical distancing measures: a rapid systematic review. PLoS ONE 16, e0247139.
World Health Organization, 2017. Communicating Risk in Public Health emergencies: a WHO Guideline For Emergency Risk Communication (ERC) Policy and Practice. World Health Organization, Switzerland. https://www.who.int/publications/i/item/9789241550208 (accessed 02 January 2022).

World Health Organization, 2020. Coronavirus Disease 2019 (COVID-19): Situation Report, 51. World Health Organization. https://apps.who.int/iris/bitstream/handle/10665/331475/nCoVsitrep11Mar2020-eng.pdf (accessed 14 May 2021).
Wortman, C.B., Brehm, J.W., 1975. Responses to uncontrollable outcomes: an integration of reactance theory and the learned helplessness model. In: Berkowitz, L. (Ed.), Advances in Experimental Pocial Psychology. Elsevier, New York, pp. 277–336.
Zhong, B., Huang, Y., Liu, Q., 2021. Mental health toll from the coronavirus: social media usage reveals Wuhan residents' depression and secondary trauma in the COVID-19 outbreak. Comput. Hum. Behav. 114, 106524.