Original Article

Perceptions of Macro- and Microlevel Factors Predict Covid-19 Health and Self-Reported Adherence to Safety Guidelines

A Study Across Eight Countries

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Abstract: *Introduction*: Adherence to Covid-19 safety measures reduces the spread of the pathogen and lowers mortality rates. The present study examines microlevel (including sociodemographics, health risk factors, and mental health) and perceived macrolevel variables (including freedom, justice, and wealth) concerning self-perceived and self-reported Covid-19 safety measure adherence across eight countries. *Methods*: Self-reported adherence to Covid-19 safety measures and its potential predictors were assessed in representative samples from eight countries (total $N = 7,437$; Germany, France, Spain, Poland, Russia, Sweden, UK, US) by online surveys (end of May 2020 to the beginning of June 2020). *Results*: Self-reported adherence was positively predicted by female sex, higher age, higher social status, belonging to a Covid-19 risk group, being personally affected (physically, economically, and mentally), and positive mental health. Adherence was negatively predicted by depression and anxiety. Perceptions of governmental communication as credible and honest, government communication being guided by political interests, the feeling of being well informed, and perceived country-level freedom positively predicted self-reported adherence. Perceived country-level justice negatively predicted adherence, and perceived country-wide wealth was unrelated to it. *Conclusions*: Self-reported adherence to COVID-19 safety protocols is negatively predicted by depression, anxiety, and perceived justice, is positively predicted by perceived freedom, and not predicted by perceived country-level wealth.

Keywords: adherence to Covid-19 safety measures, predictors, cross-national, freedom, justice

The Coronavirus disease of 2019 (Covid-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is a global pandemic. It was identified by the World Health Organization (WHO) in mid-March 2020 (World Health Organization, 2020) and is now present in nearly every country on the globe. As of this writing (August 2021), over 200 million people worldwide have been affected, resulting in over four million deaths (World Health Organization, 2021). However, the number of cases relative to the population as well as the mortality rate varies dramatically by country. While the US has been especially hard hit, with over 600,000 deaths, other countries have experienced lower cases per capita, lower mortality rates, and lower excess all-cause death rates compared to the year prior (Appel et al., 2021; Bilinski & Emanuel, 2020).

An important individual factor that contributes to country-level differences is behavior. Behavioral safety measures are critical to slowing the spread of Covid-19; they include wearing face masks and practicing social distancing. Adherence to Covid-19 health and safety guidelines is strongly related to lower mortality across countries. Between June 2020 and August 2020, country-level mortality increased in low-adherence countries (US, Sweden, Poland, Russia), surpassing mortality rates in high-adherence countries (Germany, France, Spain, UK) by a factor of ten (Margraf et al., 2021). In a large-scale Covid-19-specific study spanning the same countries, most respondents across these countries rated safety measures as useful (77.4%) and reported adhering to them (91.7%) (Margraf et al., 2020). However, there was some consequential variation. Areas of Asia with more restrictive safety measures (Taiwan) also saw lower disease incidence than nearby countries with less aggressive governmental safety campaigns (Korea and Japan) (Lai et al., 2020). A multitude of

interacting factors may impact adherence to behavioral safety measures. The present study explores the association between both perceived micro- and macrolevel factors with these differences.

Microfactors

Numerous factors have been identified that are related to increased adherence to behavioral safety measures on a microlevel: Females, older people, people in high-risk groups, those more informed, those with higher positive mental health (PMH), and individuals personally more affected were more likely to adhere to safety protocols. Reporting greater adverse economic impact was related to lower adherence (Margraf et al., 2020). In another international study of safety compliance, female sex was slightly related to greater compliance, as was the perception of the measures as useful in preventing Covid-19, even after controlling for demographic and personality variables (Clark et al., 2020). After accounting for the control variables, other variables that were not found to be significant included the following beliefs and views: seeing oneself as vulnerable to catching the virus, perceived severity of the virus, and trust in the government (Clark et al., 2020). In a study of over 19,000 people in Germany, age was a significant predictor of adherence, with older individuals more likely to adhere to safety protocols, especially in the absence of state mandates. Those with higher perceived risk and greater trust in institutions were also more likely to follow protocols (Korn et al., 2021). A study in Ethiopia found an adherence rate of 44% to Covid-19 safety measures, predicted by self-efficacy, perceived benefits, perceived barriers, and perceived susceptibility to Covid-19 (Shewasinad Yehualashet et al., 2021).

Adherence was low in Russia and Poland compared to six other countries (Germany, France, Spain, the UK, Sweden, the US), accompanied by feelings of being alone, being adversely impacted economically, and not well supported (Margraf et al., 2020). In Jordan, individual income insecurity, social withdrawal, and health consequences were identified as barriers to compliance with quarantine (Al-Sabbagh et al., 2021). A study from Israel identified male sex, not having children, high attention-deficit/hyperactivity disorder (ADHD), smoking, past risk-taking behavior, psychological distress, low perceived risk of Covid-19, and low perceived efficacy of the instructions as associated with nonadherence to safety measures (Pollak et al., 2020). In the Democratic Republic of Congo, 36.6% of the population was found to be noncompliant with public health instructions, with individual lower educational attainment, unemployment, female head-of-household, and being poorly informed about Covid-19, significant contributors to nonadherence (Kabamba Nzaji et al., 2020). In Poland,

while relatively rare, conspiracy beliefs, when held, were related to lower safety measures adherence. Such beliefs had their roots in boredom and tendencies toward paranoid thinking. Trust in the media and coronavirus-related anxiety moderated the relationship between conspiracy beliefs and adherence (Kowalski et al., 2020). In line with the results from Poland implicating paranoid thinking, a review across studies spanning countries from around the globe, conspiracy beliefs were widely associated with lower adherence to safety measures and lower professed likelihood of accepting vaccination against the virus (Pavleva Banai & Mikloušić, 2021). Finally, two recent research reviews illuminate the role personality can play in Covid-19 safety protocol adherence: Across several studies examining compliance concerning the personality factors across personality models, extraversion was related to a reluctance to socially isolate, while conscientiousness was related to increased compliance with safety guidelines (Bacon et al., 2021). In a separate review of 24 studies involving nearly 20,000 participants, people with aversive personality traits (such as high Machiavellianism, narcissism, psychopathy, sadism, and low honesty-humility and social-value orientation) were less likely to view guidelines as protective and less likely to engage in health safety behavior (Ścigała et al., 2021).

In sum, adherence to safety measures is positively related to high threat (countries with increased mortality, being in a high-risk group, perceived severity of the virus, older age), female sex, being better informed, perception of the measures as useful, PMH, and conscientious personality. It was negatively related to loneliness, adverse economic impact (including unemployment), lack of support, male sex, past risk-taking, psychological distress, low perceived threat, smoking, low education, conspiracy beliefs, extraversion, and aversive personality traits. These results are in line with hypotheses based on the protection motivation theory (PMT), which indicates that an individual's motivation to take safety precautions to protect themselves depends on the individual's threat appraisal (perception of the severity of the threat, personal vulnerability, and emotional response to the threat) and coping appraisal (perceptions of the safety behavior as effective, self-efficacy regarding the safety behavior, and costs of the safety behavior) (Margraf et al., 2020; Rogers, 1983). Negative mental health factors concerning safety measure adherence have not been thoroughly explored in the context of Covid-19 but might have an impact on individual threat appraisal, as PMH is linked to adherence (Margraf et al., 2020).

Macrofactors

While there is little research on the impact of macrolevel factors on Covid-19 response, specifically research from

prior pandemics points to several potentially influencing factors. An examination of the influenza pandemic from 1918 as a natural experiment indicates that some cities overcame the pandemic with fewer deaths than others (Morse, 2007). Rapid implementation of multiple nonpharmaceutical interventions such as social distancing or wearing surgical masks significantly reduced influenza transmission (Bootsma & Ferguson, 2007; Hatchett et al., 2007). The timing of *when* such interventions were recommended was an important factor in reducing spread. In a recent cross-sectional study with 5,057 Jordanian participants, governmental instructions were also a predictor for self-reported adherence (Al-Sabbagh et al., 2021). Whether or not population-based health behaviors such as handwashing or physical distancing were successfully applied was highly related to the extent to which the government was able to gain the public's trust (Gostin, 2020). Thus, public trust in the government and health agencies was critical to the practical implementation of these measures (Bangerter, 2013; Liao & Fielding, 2014; Siegrist & Zingg, 2013). These findings highlight the importance of taking the population's perspective on macrolevel factors into account. Scholten, Velten, Neher et al. (2017) proposed assessing the perception of macrofactors on the individual level to complement research on objective indicators for macrofactors. Their study compared objective indicators and individual perceptions of macrofactors as predictors of mental health, with the result that only perceived macrofactors significantly predicted mental health. For that reason, the subjective evaluation of macrofactors is the focus of the present study as well.

Regarding the Covid-19 pandemic, adherence to safety protocols has been high in countries with the highest mortality rate (UK, Spain, France) and perceived positive governmental communication (Germany) (Margraf et al., 2020). In contrast, adherence was low in the US and Sweden, where both populations were subject to governmental ambivalence about the measures (Margraf et al., 2020). However, creating trust has been pointed out as a major challenge in effective risk and outbreak communication (Abraham, 2011). To create trust, communication and strategies are needed that are perceived as competent, fair, efficient, and caring, taking into account the economic, political, and social environment (Abraham, 2011).

Perceived justice, freedom, and wealth are macrolevel factors that may also account for public adherence to safety measures for several reasons. Clearly, pandemic outbreaks may worsen existing vulnerabilities and inequities. For example, care supply may be allocated according to the ability to pay (Kelley et al., 2020), immigration policies are affected (Miller et al., 2020), and minority groups are disproportionately impacted by the pandemic's health and economic fallout (Lee & Miller, 2020), in that people with

lower socioeconomic status (SES) are at higher risk of being infected (e.g., because of denser living environments and more exposed jobs) *and* have higher risks of harm because of Covid-19 adherence measures (e.g., job termination, domestic violence because of quarantine) (Silva & Smith, 2020). Women had an increased exposure risk of contracting SARS-CoV-2, a unique exacerbation of multifactorial stress, and an increase in intimate partner violence (Roesch et al., 2020). It is to be expected that solutions grounded in principles of social justice will be more effective and equitable (Kelley et al., 2020); otherwise, the sense of "always . . . getting skipped over" on the part of vulnerable populations might be exacerbated (Schmidt, 2020). This sense might add to a noncompliant attitude toward Covid-19 safety measures, while the perception that one's own country is guided by principles of justice might enhance adherence.

Another value that needs to be considered is freedom, especially freedom of expression and access to information, freedom of movement and freedom of choice (Joseph, 2020). In particular, in democratic governments, a higher number of Covid-19 infections might be accepted for individuals to have more freedom (Tisdell, 2020). Yet, in a dataset comprising 72 countries, political freedom as well as mobile connectivity were found to contribute to Covid-19-related fake news tendencies, whereas economic freedom and media freedom prevent it (Shirish et al., 2021). Fake news might in turn reduce adherence to Covid-19 safety measures (Kowalski et al., 2020; Pavleva Banai & Mikloušić, 2021). However, it has yet to be answered how perceived freedom in a country might contribute to the adherence to Covid-19 safety measures.

In general, pandemics adversely impact the economy of all affected countries, including the gradual erosion of state capacities and an increase in poverty (Tandon, 2020). Across one wide-reaching sample of 42 countries, a significant driver of GDP growth over the first half of 2020 was stringent mandatory and government-enforced distancing (Konig & Winkler, 2021). However, it is important to note that Covid-19 safety measures can offer potential benefits to some groups, while imposing costs on other groups, and that they are more likely to be popular when the benefits and costs are distributed more evenly across the population via redistribution (Glover et al., 2020). Rescue packages were announced varying from $260 billion in India alone up to $1.9 trillion in the US alone (Jena et al., 2021). There might be more adherence to Covid-19 safety measures by those who perceive their country's wealth as higher, as better compensation for personal losses may be expected.

In sum, positive governmental communication, trust in government and health institutions were found to be positively related to the adherence to Covid-19 safety measures. Regarding perceived justice, freedom, and wealth, we expect that perceived wealth and justice contribute to

adherence, whereas it is uncertain how freedom affects adherence.

Present Study

The present study is a large-scale, cross-cultural, multinational investigation of the relationship between self-perceived and self-reported safety measure adherence (e.g., mask-wearing and social distancing) and perceived micro- and macrofactors. Though research on Covid-19 protocol adherence is new, past research supports the validity of self-reported medical protocol adherence for other protocols. For example, past self-reported adherence to medication protocols shows both concurrent and predictive validity for hypertension (Morisky et al., 1986, 2008). The current dataset is part of a larger study of mental health across eight countries (Margraf et al., 2020; Scholten et al., 2018; Scholten, Velten, Neher et al., 2017). The present study examines the potential impact of micro- and perceived macrofactors. Perceived macrovariables (hereinafter referred to simply as macrovariables for this study), specifically wealth, justice, and freedom, because they are perceived by the individual, have not yet been examined concerning self-reported safety protocol adherence, but they may be useful in understanding both within- and between-country variation in safety, spread, and ultimately mortality.

The hypotheses for this study were developed based on the existing literature. First, controlling for sex, age, and SES, we examined risk group, the impact of the virus, and status as covariates on the microlevel. Female sex, older age, higher SES, greater health-risk group, and greater impact of the virus were expected to predict greater self-reported adherence to safety protocols. All presentations and the discussion of results in this paper that refer to adherence use self-reported data. We expected that, on a microlevel, individual measures of mental health are related to protocol adherence. While this has only been touched upon in prior research, indicating mental distress and burden are related to lower protocol adherence and PMH to greater adherence (Margraf et al., 2020). We explore the relationships more in-depth in the present study. We expect that more severe symptoms of depression and anxiety are related to lower self-reported adherence, while controlling for previously examined PMH. Second, on the macrolevel, we controlled for perceptions regarding macrolevel government communication (credibility, motives, etc.) and feelings of being well-informed about the virus and safety measures because these variables were related to adherence in our prior work (Margraf et al., 2020). We expected that greater perceived country-level justice and wealth result in greater self-reported safety protocol adherence, while greater perceived freedom may be related to lower

adherence. We limited the number of predictors in both prior studies and the present study for methodological reasons (Peduzzi et al., 1996).

Method

Participants and Procedure

The present study utilizes a subset of data from the Eight Countries Study: Covid-19 and Well-Being. The Ethics Committee of the Faculty of Psychology of the Ruhr-Universität Bochum approved the Eight Countries Study: Covid-19 and Well-Being (approval number: 118, approved 12 May 2020). It was preregistered with AsPredicted.org on 25 May 2020 (https://aspredicted.org/e7a9 g.pdf).

The overall sample investigated in the present study consisted of 7,437 participants from eight countries: Germany (GE): $N = 904$, France (FR): $N = 891$, Spain (ES): $N = 945$, Poland (PL): $N = 930$, Russia (RU): $N = 954$, Sweden (SV): $N = 889$, the United Kingdom (UK): $N = 1,046$, and the United States (US): $N = 878$. The demographics of all samples are presented in Table 1. Data collection was conducted by the independent social marketing and research institute YouGov (www.yougov.de). YouGov obtained all required permits and approvals for the data collection in the eight countries. Data were collected within 10 days (from the end of May 2020 to the beginning of June 2020) via population-based online panel surveys in the national language of the countries. YouGov implemented age, sex, and regional stratification to achieve representativeness of the samples. All participants were recruited from residential populations aged 18 years and above. They were compensated by panel-specific tokens that can be converted into monetary payments or vouchers. In all countries, participants were properly instructed and provided their informed consent to participate online. There were no missing data. No datasets were excluded. A priori power analyses (G*Power program, version 3.1) revealed that a total sample size of $N = 178$ was required for valid results (linear multiple regression analysis; power > .80, $\alpha = .05$, effect size: $f^2 = .15$; cf. Mayr et al., 2007).

Measures

Demographic Form: Personal Information
The participants' age range (assessed as ordinal scaled groups: 1 = *18 to 24 years*, 2 = *25 to 34 years*, 3 = *35 to 44 years*, 4 = *45 to 54 years*, 5 = *55 years and older*), sex (0 = *female*, 1 = *male*), marital status (1 = *single*, 2 = *in a relationship, but not married*, 3 = *married*, 4 = *widowed, divorced*), social class (on a scale ranging from 1 = *lower class* to 6 = *upper class*), and

Table 1. Descriptive statistics of demographic variables (overall and all samples separately)

	All	GE	FR	ES	PL	RU	SV	UK	US
Sex (female, %)	52.1	49.8	57.6	50.7	54.1	54.7	50.2	52.2	50.1
Age groups (%)									
18 to 24 years	8.0	6.9	7.9	6.1	9.1	8.1	6.4	9.8	9.2
25 to 34 years	16.4	12.5	14.4	13.7	17.0	21.6	19.9	18.0	13.4
35 to 44 years	16.4	15.0	14.5	21.6	19.0	19.3	8.9	16.7	15.1
45 to 54 years	18.4	19.1	18.9	20.3	15.3	17.4	19.6	18.1	18.7
55 years and older	40.9	47.0	43.9	38.3	39.6	33.6	45.2	37.5	43.5
Marital status (%)									
Single	23.0	24.3	21.0	23.1	19.5	16.5	32.4	25.6	22.1
Romantic relationship, not married	16.4	13.8	23.3	18.5	18.1	11.5	22.4	16.3	7.7
Married	48.1	45.8	43.8	48.4	50.3	57.2	36.3	46.4	55.9
Widowed, divorced	12.5	16.0	11.9	10.1	12.2	14.8	8.9	11.8	14.2
Social status (%)									
Lower class	4.8	7.3	6.4	4.3	3.4	2.6	4.9	2.6	7.7
Working class	22.1	17.9	19.4	31.3	15.5	19.2	20.9	33.7	16.4
Lower middle class	25.8	25.7	26.7	20.6	32.9	37.4	13.4	29.6	18.7
Middle middle class	37.0	39.0	33.2	37.0	36.7	36.4	46.8	29.2	39.1
Upper middle class	9.2	9.4	12.5	6.6	8.8	3.8	12.7	5.0	16.6
Upper class	1.0	0.7	1.8	0.1	2.7	0.6	1.2	–	1.5
Living environment (%)									
Large city	42.5	35.6	28.7	38.5	48.8	77.6	46.8	25.8	38.8
Small city	35.0	36.2	40.3	41.5	36.5	19.5	33.1	35.0	38.5
Rural community	22.5	28.2	31.0	20.0	14.7	2.9	20.1	39.2	22.7

Note. All: $N = 7,437$; Germany (GE): $N = 904$, France (FR): $N = 891$, Spain (ES): $N = 945$, Poland (PL): $N = 930$, Russia (RU): $N = 954$, Sweden (SV): $N = 889$, the UK (UK): $N = 1,046$, the US (US): $N = 878$; because of rounding, the sum of the percentages is not always 100%.

living environment (1 = *large city*, 2 = *small city*, 3 = *rural community*) were assessed. Note that marital status and living environment are categorial variables that can only be used in the sample description but were not included in further analysis.

Covid-19-Specific Content

Following Margraf et al. (2020, 2021), participants were asked to rate (1) whether they belong to the Covid-19 risk group (i.e., pre-existing condition, age-related, weakened immune system) (0 = *no*, 1 = *yes*); (2) to what extent they are affected by the Covid-19 situation in terms of (2a) physical health, (2b) economically, and (2c) mentally, respectively, on 5-point Likert-type scales (0 = *not at all*, 4 = *very strong*); (3) to what extent they consider the communication of the national government and authorities regarding the Covid-19 situation to be (3a) clear and understandable, (3b) credible and honest, (3c) guided by the interests of the people, and (3d) guided by political interests, respectively (these four dimensions of governmental communication are examined separately), on a 5-point Likert-type scale (0 = *not at all true*, 4 = *very true*); (4) to what extent they feel themselves well informed about the Covid-19 situation by the national government and authorities on a 5-point Lik-

ert-type scale (0 = *not at all true*, 4 = *very true*). Furthermore, participants rated (5) how much they adhere to the introduced Covid-19 safety measures on a 5-point Likert-type scale (0 = *not at all*, 4 = *very strong*). Notably, adherence is the main outcome of the present study.

Positive Mental Health

PMH was assessed using the unidimensional Positive Mental Health Scale (PMH Scale; Lukat et al., 2016), an internationally well-established instrument for the measurement of psychological, emotional, and social well-being. The original German-language version of the PMH Scale was used to assess PMH in the German sample (Lukat et al., 2016). The English- and Russian-language versions of the PMH Scale – used in the Russian, UK, and US samples – were validated by previous research (e.g., Bieda et al., 2017). Because no validated national French, Spanish, Swedish, and Polish language versions of the PMH Scale were available, the measures were translated from the English language version by the customary translation-backtranslation-modification procedure by the authors (Berry, 1989) and discussed with cultural experts. Strong measurement invariance of the PMH-Scale was reported in available research, supporting its use in cross-cultural

studies (Bieda et al., 2017). This instrument includes 9 items that are rated on a 4-point Likert-type scale (e.g., "I enjoy my life"; 0 = *do not agree*, 3 = *agree*). Current scale reliability ranges from Cronbach's α = .869 (FR) to .933 (SV). Higher sum scores indicate higher levels of PMH.

Depression and Anxiety Symptoms

Symptoms of depression and anxiety were measured by the depression and anxiety subscales of the Depression Anxiety Stress Scales 21 (DASS-21; Lovibond & Lovibond, 1995). The DASS-21 is an internationally well-established instrument. The original English language version of this instrument (Lovibond & Lovibond, 1995) was used to assess the negative symptoms in the UK and the US samples. The included French, German, Polish, Russian, Spanish, and Swedish versions were validated by previous research (e.g., Scholten et al., 2018). Because of its strong measurement invariance across cultures, this instrument has been recommended to be used in cross-cultural studies (Scholten, Velten, Bieda et al., 2017). The 7 items of each subscale (depression subscale, e.g., "I couldn't seem to experience any positive feeling at all"; anxiety subscale, e.g., "I felt scared without any good reason") are rated on a 4-point Likert-type scale (0 = *did not apply to me at all*; 3 = *applied to me very much or most of the time*). Current scale reliability for the depression subscale ranges from α = .900 (RU) to α = .936 (US). Reliability for the anxiety subscale ranges from α = .845 (UK) to α = .923 (US). Higher sum scores indicate higher levels of depression and anxiety symptoms.

Perceived Justice, Freedom, and Wealth of the Living Country

Following Scholten et al. (2018; Scholten, Velten, Neher et al., 2017), participants were asked to rate the perceived justice, freedom, and wealth of the country where they live in comparison to other countries on a scale ranging from 0 (*not fair/free/wealthy at all*) to 100 (*very fair/free/wealthy*). The single items were formulated as follows: (a) justice: "When you compare [specific country name, e.g., Germany] to other countries, how *fair* do you find [specific country name, e.g., Germany]?"; (b) freedom: "When you compare [specific country name, e.g., Germany] to other countries, how *free* do you find [specific country name, e.g., Germany]?"; (c) wealth: "When you compare [specific country name, e.g., Germany] to other countries, how *wealthy* do you find [specific country name, e.g., Germany]?."

When available, earlier validated versions of the used scales in the, respectively, national language were taken (e.g., PMH-Scale: Lukat et al., 2016; DASS-21: Scholten, Velten, Bieda et al., 2017). If no validated national language version was available, the measures were translated from the English language version by the customary transla-

tion-backtranslation-modification procedure (Berry, 1989), and discussed with cultural experts.

Statistical Analyses

All statistical analyses were conducted with SPSS 26. After descriptive analyses, we investigated the relationship between the adherence to Covid-19 safety measures and the other assessed variables by calculating zero-order bivariate correlation analyses. We first ran the calculations with the overall sample (N = 7,437) and subsequently with the eight country-specific samples, respectively. Next, we ran a five-step hierarchical regression analysis with the overall sample. There was no violation of the multi-collinearity assumption (all values of tolerance > .25, all variance inflation factor values < 5; Urban & Mayerl, 2006); the data met the assumption of independent residuals (Durbin-Watson: $1 < x < 3$), the assumption of nonzero variance, and the assumptions of homogeneity and linearity (as indicated by the scatterplot). Furthermore, the data contained approximately normally distributed errors (indicated by the P-P plot). The regression model included self-reported adherence to Covid-19 safety measures as the outcome. Step 1 included the eight country variables dummy-coded (0 = *no*, 1 = *yes*) to consider the two-level structure of the data and to control for country differences. SPSS automatically sets the constant term. Step 2 included sex (0 = *female*, 1 = *male*), age group, and SES to control for sociodemographic variables. In Step 3, we included other microlevel variables that have been shown to predict adherence to Covid-19-safety measures before (Margraf et al., 2020), namely, belonging to the Covid-19 risk group, being affected by the Covid-19 situation in terms of physical, economic, and mental health, PMH, depression and anxiety symptoms. Step 4 included perceived macrolevel variables that predicted adherence in previous research (Margraf et al., 2020) including the perception of the governmental communication as clear and understandable, credible and honest, guided by interests of people, guided by political interests, and the feeling of being well informed. In Step 5, we added the perceived macrolevel variables that were newly added to the model to uncover the unique contribution of these variables to previous research findings. These variables included the perception of justice, freedom, and wealth of the country where the participants live in.

Results

Table 2 presents the descriptive statistics of the assessed variables. The correlations among self-reported adherence to Covid-19 safety measures and the other investigated

Table 2. Descriptive statistics of the assessed variables (overall and all samples separately)

	All	GE	FR	ES	PL	RU	SV	UK	US
Risk group (yes, %)	38.7	46.6	30.0	31.9	44.6	42.0	37.9	30.2	47.6
M (SD)									
Adherence to Covid-19 safety measures	2.97 (.99)	3.03 (.91)	3.08 (.92)	3.29 (.83)	2.81 (1.07)	2.49 (1.03)	2.84 (.94)	3.34 (.82)	2.88 (1.14)
Affected: health	1.03 (1.16)	.62 (.95)	1.10 (1.13)	1.21 (1.19)	1.28 (1.13)	1.53 (1.25)	.97 (1.14)	.63 (.97)	.95 (1.19)
Affected: economically	1.50 (1.29)	1.02 (1.12)	1.43 (1.21)	1.57 (1.26)	1.97 (1.15)	2.36 (1.22)	.97 (1.16)	1.13 (1.23)	1.49 (1.31)
Affected: mentally	1.52 (1.17)	1.23 (1.06)	1.35 (1.13)	1.61 (1.10)	1.77 (1.16)	1.58 (1.26)	1.54 (1.15)	1.46 (1.13)	1.62 (1.24)
Positive mental health	17.42 (5.75)	17.97 (5.20)	16.96 (4.85)	17.56 (5.35)	17.51 (6.42)	15.74 (5.64)	17.42 (6.69)	17.37 (5.68)	18.96 (5.48)
Depression symptoms	5.19 (5.27)	4.15 (4.69)	4.13 (4.91)	5.47 (5.34)	6.59 (5.48)	6.26 (4.96)	4.29 (5.12)	5.57 (5.39)	4.88 (5.57)
Anxiety symptoms	3.56 (4.44)	2.55 (3.62)	2.96 (4.01)	4.04 (4.60)	5.22 (4.98)	4.64 (4.62)	2.64 (3.88)	2.76 (3.69)	3.66 (5.11)
Gov Com: clear & understandable	1.76 (1.29)	2.20 (1.15)	1.45 (1.22)	1.60 (1.28)	1.72 (1.30)	1.79 (1.36)	2.15 (1.34)	1.55 (1.24)	1.64 (1.31)
Gov Com: credible & honest	1.64 (1.30)	2.15 (1.17)	1.36 (1.19)	1.59 (1.31)	1.46 (1.29)	1.55 (1.31)	2.10 (1.38)	1.42 (1.27)	1.54 (1.27)
Gov Com: guided by interests of people	1.58 (1.26)	1.85 (1.14)	1.57 (1.23)	1.61 (1.27)	1.46 (1.27)	1.50 (1.35)	1.52 (1.19)	1.60 (1.24)	1.51 (1.34)
Guided by political interests	2.64 (1.27)	2.42 (1.20)	2.67 (1.27)	2.57 (1.32)	2.78 (1.35)	2.59 (1.26)	2.27 (1.23)	2.79 (1.21)	3.03 (1.20)
Feeling of being well informed	1.94 (1.29)	2.42 (1.14)	1.63 (1.20)	1.75 (1.33)	1.66 (1.26)	2.04 (1.33)	2.34 (1.30)	1.92 (1.21)	1.79 (1.33)
Country justice	51.06 (27.42)	56.57 (24.79)	43.71 (23.16)	50.12 (24.69)	41.20 (27.18)	48.82 (31.89)	56.70 (26.70)	54.65 (26.08)	56.75 (29.06)
Country freedom	63.11 (27.54)	71.08 (24.39)	63.44 (24.99)	61.33 (26.34)	48.83 (29.03)	51.57 (31.49)	70.37 (25.70)	69.46 (22.70)	69.22 (24.80)
Country wealth	58.83 (26.03)	68.39 (23.86)	58.24 (21.05)	61.05 (21.82)	40.21 (23.16)	42.09 (28.37)	64.86 (24.92)	65.06 (21.49)	71.64 (23.59)

Note. All: *N* = 7,437; Germany (GE): *N* = 904, France (FR): *N* = 891, Spain (ES): *N* = 945, Poland (PL): *N* = 930, Russia (RU): *N* = 954, Sweden (SV): *N* = 889, the UK (UK): *N* = 1,046, the US (US): *N* = 878; *M* = Mean; *SD* = standard deviation; Gov Com = governmental communication.

variables are shown in Table 3. The overall bivariate correlations indicated adherence was significantly negatively related to sex, indicating that women tend to be more adherent than men. In contrast, adherence was significantly positively related to age group, belonging to the Covid-19 risk group, being affected by the Covid-19 situation in terms of physical, economic, and mental health, consideration of the governmental communication regarding the Covid-19 situation as clear and understandable, credible and honest, guided by interests of people and guided by political interests, as well as the feeling of being well informed about the Covid-19 situation by the government and authorities. Moreover, adherence was significantly positively linked to perceived freedom and wealth of the country where the people live in. In contrast, it was significantly negatively correlated with anxiety symptoms. Most zero-order correlations were small (*r* > .10); exceptions were relations between adherence and sex, belonging to a risk group, being affected physically and mentally, evaluating government communication as guided by the interests of people and feeling of being well-informed, and perceiving one's own country as free and wealthy (see Table 3).

The correlation analyses in the country-specific samples revealed some commonalities as well as some differences in the resulting pattern. Adherence was significantly related to the female sex in all country-specific samples. Its link to age

group was significant and positive in GE, FR, PL, SV, UK, and US. There were no significant associations between adherence and SES in any country-specific sample (see Table 3).

Regarding microlevel variables, adherence was significantly positively associated with belonging to the risk group in all country-specific samples except ES. Furthermore, in all samples, it was significantly positively linked to being affected in the domains of physical and mental health. The relationship between adherence and being affected economically was significantly positive in FR, ES, PL, RU, and US. The relationship between adherence and PMH was only significant (positive direction) in SV. The relationship between adherence and depression symptoms was significantly negative in GE and ES. The link between adherence and anxiety symptoms was only significant (negative direction) in GE.

On a perceived macrolevel, adherence was significantly positively related to the consideration of the governmental communication as clear and understandable as well as credible and honest in all samples, except for UK. The association between adherence and the consideration of governmental communication as guided by the interests of people was also significantly positive, except for SV and UK. The link between adherence and the consideration of governmental communication as guided by political

Table 3. Bivariate correlations among adherence to Covid-19 safety measures and the other investigated variables (overall and all samples separately)

	All	GE	FR	ES	PL	RU	SV	UK	US
Adherence to Covid-19 safety measures correlated with									
Sex	−.103**	−.085*	−.094**	−.111**	−.170**	−.084**	−.162**	−.104**	−.093**
Age group	.088**	.218**	.077*	.063	.107**	.008	.080*	.072*	.066*
Social status	.001	−.020	.064	−.017	.056	.062	.018	−.039	.046
Risk group	.100**	.233**	.105**	.058	.176**	.171**	.116**	.064*	.100**
Affected: health	.137**	.099**	.117**	.108**	.258**	.347**	.215**	.112**	.213**
Affected: economically	.037**	−.012	.108**	.069*	.227**	.192**	.046	.018	.153**
Affected: mentally	.192**	.105**	.182**	.150**	.349**	.232**	.243**	.083**	.294**
Positive mental health	.022	−.021	−.035	.056	−.014	.034	.081*	−.012	−.038
Depression symptoms	−.018	−.087**	.061	−.096**	.033	.021	.014	−.035	.020
Anxiety symptoms	−.030**	−.102**	.033	−.065	.026	.063	.012	−.015	−.012
Gov Com: clear & understandable	.072**	.269**	.092**	.125**	.106**	.222**	.119**	.013	−.131**
Gov Com: credible & honest	.094**	.318**	.104**	.148**	.113**	.202**	.121**	.025	−.114**
Gov Com: guided by interests of people	.101**	.228**	.079*	.139**	.106**	.230**	.060	.037	−.093**
Guided by political interests	.051**	.007	.031	−.002	.044	.124**	−.041	.040	.155**
Feeling of being well informed	.103**	.324**	.137**	.163**	.118**	.193**	.181**	.035	−.110**
Country justice	.018	.125**	.056	.007	.002	.148**	.102**	−.039	−.286**
Country freedom	.150**	.270**	.160**	.131**	.070*	.134**	.171**	.090**	.050
Country wealth	.116**	.121**	.079*	.050	−.050	.141**	.170**	−.039	−.079*

Note. All: N = 7,437; Germany (GE): N = 904, France (FR): N = 891, Spain (ES): N = 945, Poland (PL): N = 930, Russia (RU): N = 954, Sweden (SV): N = 889, the UK (UK): N = 1,046, the US (US): N = 878; Gov Com = governmental communication; **p < .01, *p < .05.

interests was only significantly positive in RU and US. Adherence was significantly positively linked to the feeling of being well informed in all samples, except for UK. While the association between adherence and the perception of justice was significant in a positive direction for GE, RU, and SV, it was significantly negative for US. Furthermore, adherence was significantly positively related to the perception of freedom in all samples, except for US. Its relationship with the perception of wealth was significantly positive for GE, FR, RU, and SV, but significantly negative for US.

Table 4 shows the findings of the hierarchical regression analysis. In Step 1, all included countries except for ES significantly negatively predicted self-reported adherence to Covid-19 safety measures compared to adherence for UK, meaning that all countries had lower adherence in comparison with UK. In Step 2, male sex significantly negatively predicted reported adherence (meaning females reported more adherence, and males generally reported less adherence), while age group and SES significantly positively predicted reported adherence, indicating the older and the higher the SES the more reported adherence. In Step 3, belonging to the Covid-19 risk group, being affected by Covid-19 in terms of physical, economic, and mental health, and PMH significantly positively predicted reported adherence. In contrast, depression and anxiety symptoms significantly negatively predicted reported adherence. Consideration of governmental communication as credible and honest, guided by political interests, and the feeling of

being well informed significantly positively predicted reported adherence in Step 4. In contrast, consideration of the governmental communication as clear and understandable and guided by the interests of people was not significantly related to reported adherence. In Step 5, perceived justice of the country significantly negatively predicted reported adherence, while perceived freedom of the country significantly positively predicted reported adherence while the perceived wealth of the country was not significantly linked to reported adherence (see Table 4).

Because of bivariate correlations indicating opposite sign relationships for some variables (e.g., communication, justice, and wealth) and adherence for US (negative relationships for US as opposed to null or positive relationships in the other countries), replications of the regression analysis for the complete country sample without US and for US only were conducted. These analyses were beyond the scope of this paper and are available in an online repository at https://osf.io/bnqjf/ (Lavallee et al., 2021).

Discussion

The current findings illuminate the potential importance of macrolevel predictors of self-reported adherence to Covid-19 safety measures. Notably, nearly all countries included (except Spain) were significantly negatively associated with

Table 4. Hierarchical regression analysis for the overall sample (outcome: adherence to Covid-19 safety measures)

	β	95% CI	T	Adjusted R^2	Changes in R^2
Step 1, F (7, 7,429) = 81.365, p < .001				.070	0.71
United Kingdom (constant term)		[3.286, 3.402]	112.795		
Germany	−.104**	[−.403, −.232]	−7.294		
France	−.086**	[−.348, −.177]	−5.999		
Spain	−.020	[−.143, .026]	−1.358		
Poland	−.177**	[−.618, −.449]	−12.343		
Russia	−.288**	[−.942, −.774]	−19.982		
Sweden	−.165**	[−.593, −.422]	−11.597		
United States	−.150**	[−.548, −.375]	−10.515		
Step 2, F (10, 7,426) = 73.866, p < .001				.089	.019
Sex	−.111**	[−.263, −.177]	−9.970		
Age group	.083**	[.045, .077]	7.436		
Social status	.028*	[.005, .045]	2.459		
Step 3, F (17, 7,419) = 84.982, p < .001				.161	.073
Risk group	.081**	[.117, .214]	6.724		
Affected: health	.110**	[.073, .115]	8.758		
Affected: economically	.037**	[.009, .048]	2.834		
Affected: mentally	.215**	[.161, .207]	15.877		
Positive mental health	.047**	[.004, .013]	3.517		
Depression symptoms	−.043*	[−.015, −.001]	−2.317		
Anxiety symptoms	−.079**	[−.025, −.010]	−4.552		
Step 4, F (22, 7,414) = 75.873, p < .001				.181	.021
Gov Com: clear & understandable	.001	[−.029, .030]	.029		
Gov Com: credible & honest	.060**	[.014, .077]	2.811		
Gov Com: guided by interests of people	.019	[−.011, .041]	1.142		
Gov Com: guided by political interests	.070**	[.037, .072]	6.182		
Feeling of being well informed	.091**	[.046, .095]	5.580		
Step 5, F (25, 7,411) = 73.269, p < .001				.195	.014
Country justice	−.154**	[−.007, −.004]	−9.663		
Country freedom	.155**	[.004, .007]	9.409		
Country wealth	.020	[.000, .002]	1.323		

Note. N = 7,437; sex: 0 = *female*, 1 = *male*; Gov Com = governmental communication; β = standardized coefficient beta; CI = confidence interval; only new included variables are presented in each step; **p < .01, *p < .05.

reported adherence compared to the UK which served as the baseline, meaning that these other countries had less adherence than the UK On the microlevel, and consistent with past research, female sex, higher age, higher SES, belonging to the Covid-19 risk group, being affected in terms of physical, economic, and mental health, and the level of positive mental health significantly positively predicted reported adherence. Depression and anxiety symptoms were significant negative predictors of reported adherence. This was consistent with our expectations and prior research, indicating that mental distress and burden have a negative relationship and positive mental health a positive relationship with adherence (Margraf et al., 2020). The impact of some macrolevel variables on adherence may flow through mental health, as past research indicates macrolevel variables are related to depression and

anxiety (Scholten et al., 2018; Scholten, Velten, Neher et al., 2017). This potential mediational relationship should be explored further in future research.

On the macrolevel, previously reported variables (Margraf et al., 2020) used as covariates in this study (consideration of governmental communication as credible and honest, guided by political interests, the feeling of being well informed) all significantly positively predicted reported adherence. New to this study was the examination of perceived wealth, justice, and freedom as perceived macrofactors. We expected that greater perceived justice and wealth of the country would result in greater safety protocol adherence, while greater perceived freedom may be related to lower adherence. Regarding the correlation between perceived wealth and adherence, the zero-order correlations differed from the regression effects.

The zero-order aggregate correlation across countries was significantly positive on the whole.

In regression analysis, we controlled for country-level effects in Step 1. Hence, objective indicators of macrofactors are represented in this country-level control variable, and the results discussed subsequently focus on the perception of macrofactors. A puzzling finding was that perceived justice of the country significantly negatively predicted reported adherence in the regression. This means that the higher the perceived justice of a country, the lower the reported Covid-19 adherence. It may be that this was an artifact of being in a regression with many other variables. The relationship in the zero-order correlations was null when viewed across all countries combined. Further, the zero-order correlation was positive in Germany, Russia, and Sweden, and negative in the US, so it may also be that it is not possible to examine this construct across an aggregate of countries, but rather must be looked at within a specific country, and the correlation itself compared across countries in future studies. However, country-level differences should be controlled for in the regression analysis, indicating that the results might not be an artifact, but a reveal because of a relationship that might otherwise be covered by other variables. Nevertheless, the finding is puzzling, and a straightforward interpretation of these results is difficult.

Another finding that contradicted our hypothesis was that perceived freedom of the country positively predicted reported adherence. In the case of perceived freedom, both the aggregate zero-order correlation and the effect in the regression were in the same positive direction. In most countries, correlations were positive on the country level. Freedom was measured very broadly in the present study (i.e., how "free" the individual rates their country), but freedom may be assumed to refer to various aspects of freedom, including freedom of expression and access to information, freedom of movement, and freedom of choice (Joseph, 2020). Across countries, political freedom (along with mobile connectivity) has contributed to Covid-19-related fake news tendencies, whereas economic freedom and media freedom prevent it (Shirish et al., 2021). Fake news might in turn reduce adherence to Covid-19 safety measures (Kowalski et al., 2020; Pavleva Banai & Mikloušić, 2021; van Mulukom et al., 2020). Given prior research, we hypothesized that greater freedom might predict lower adherence, possibly because of greater fake news and a lower perceived ability of an individual to *not* adhere to government guidance. However, perhaps it was the case that perceptions of freedom are more important than actual freedom in predicting safety protocol adherence, and that people who were most likely to comply were least likely to see guidelines as an imposition. Conversely, people who are most opposed to the safety protocols were perhaps the ones most likely to see their country as restrictive and imposing, thus rating it less free. It would be interesting to explore this topic in more depth, perhaps with objective measures of freedom or with more nuanced measures of individuals' perceptions of freedom.

Inconsistent with our hypothesis that it would positively predict adherence, perceived wealth was not related to self-reported adherence. This hypothesis assumed that, with higher perceived wealth, greater compensation for personal losses would be expected, meaning that people would be more likely to risk losing work to social distancing (Glover et al., 2020). The results indicate that, in general, this conclusion cannot be drawn, and instead perceived wealth of the country is not associated with adherence when controlling for other relevant variables such as country-level effects or economic affectedness. The relationship between country-level perceptions of wealth and adherence is likely complicated and nuanced and depends on many factors, including the country (and its social support system), the economy, and individual job compatibility with adherence measures (i.e., public-facing and in-person jobs such as service work, warehouse work, or healthcare versus white-collar digital jobs that can be performed from home). Indeed, the zero-order correlations again indicated a possible between-country difference, as the relationship was negative in the US, but nonsignificant or significantly positive in other countries. This should be explored further in future research; it was previously explored in part by the present authors, with results available in the online repository at https://osf.io/bnqjf/ (Lavallee et al., 2021). Analog to the Easterlin paradox, which describes that average levels of happiness do not increase beyond a certain level of wealth as countries grow wealthier (Easterlin, 1974), there might also be a ceiling effect in the countries included in the sample because they can all be considered comparably wealthy. In that sense, a potential association between perceived wealth and adherence might disappear in wealthier countries. To shed light on this issue, it would be interesting to repeat this survey in a more heterogeneous country sample and to look at moderators of the effect, such as individual job type and the types of jobs making up the majority of a country's economy.

Notably, the US appeared to be an outlier among countries in several areas. Across several countries, freedom, justice, and wealth were related to more adherence, whereas in the US – and unique to the US – these results appeared in the negative direction in the zero-order correlations: Perceptions of justice and wealth were related to lower adherence. These findings may be related to the highly politicized pandemic in the US. During the pandemic, the US went through a period of an unprecedented political divide. Therefore, perceived freedom and justice might be more relevant for adherence than more personal

variables. Another interpretation may be that Europeans' views of wealth, justice, and freedom have a different tone than in the US, as European countries tend to have a more socialized economic support system than the US does. Another explanation for potentially differing results in the US as compared with the other countries may be the wording of the question. While wealth, justice, and freedom are generally very broad terms that comprise highly complex and philosophical meanings (Scholten et al., 2018; Scholten, Velten, Neher et al., 2017), the translations might additionally have led to slightly varying interpretations (Byrne, 2016).

The present study has several strengths. It is a large-scale study that spans eight countries and examines multiple potential factors in explaining variance in an important behavior during the current pandemic: adherence to safety protocol guidance. However, the present study also has some limitations. First, it was based on self-report data; it would be interesting to assess macrolevel variables objectively and separately from adherence to safety protocols in addition. Further, adherence itself was self-perceived and self-reported. There may be important individual and country-level differences in knowledge of the country-level guidelines, differences by state or district within countries, self-perceptions of adherence, as well as the adherence guidelines themselves (i.e., some countries may have required more masking and social distancing than others at various times surrounding the time of the study). Indeed, the self-reported adherence may depend on being well-informed and on the clarity of the government's communication about the guidelines. Furthermore, the available literature reveals that self-reports may overestimate adherence behavior (Stirratt et al., 2015). Despite these potential limitations, past research does support the validity of self-reported medical protocol adherence (Morisky et al., 1986, 2008). Second, the country-level sample was too small to represent a random sample from the population of countries (Diez-Roux, 2000). However, a multilevel approach might be better suited for statistical analysis. Therefore, a replication of the study in a larger country sample using multilevel analysis would be important to shed light on the robustness of the results. Especially since the findings were in part contradictory or contrary to our assumptions, replication is needed. Third, some of our variables were measured with single items (i.e., Covid-19 specific content, perceived justice, freedom, and wealth of the living country). Therefore, they lack internal reliability data. Moreover, single-item scales have the shortcoming of simplifying multidimensional topics and are often criticized as being unable to assess fine-grained differences between individuals (e.g., Nunnally & Bernstein, 1994). We do wish to note, however, that using single items is not without precedent, and single-item scales can be efficient and reli-

able measures (Brailovskaia & Margraf, 2020; Brailovskaia et al., 2018). Finally, the education level of the participants, which could potentially influence the level of adherence as well as the other assessed variables (Júnior et al., 2021), was not measured in the present study.

In conclusion, the present study illuminated the relationships between perceptions of macrolevel variables and individual reported safety protocol adherence during the Covid-19 pandemic. Depression and anxiety negatively predicted reported adherence. Contrary to expectations, perceived freedom positively predicted reported adherence, while perceived justice negatively predicted reported adherence (possibly skewed by effects in the US), and perceived country-level wealth was not significantly related to reported adherence. Future studies should examine these macrofactors using objective and independent measures to determine whether country-level wealth, justice, and freedom affect individual behavior beyond people's individual perceptions of those variables, too. Further, the US is a potential outlier across the macrolevel variables' relationships with adherence. It would be prudent for future studies to examine how relationships between variables differ between countries.

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