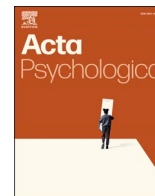




Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



# Improving vaccination intent among skeptics through confidence in governments' handling of the COVID-19 pandemic

Chee Meng Tan<sup>a</sup>, Chuma Kevin Owuamalam<sup>b</sup>, Vengadeshvaran Sarma<sup>a,\*</sup>

<sup>a</sup> Nottingham University Business School, University of Nottingham Malaysia, Selangor, Malaysia

<sup>b</sup> Division of Organisational and Applied Psychology, University of Nottingham Malaysia, Selangor, Malaysia

## ARTICLE INFO

### Keywords:

COVID-19  
Vaccine hesitancy  
Vaccination intent  
Boosters  
Child vaccination  
Confidence in government

## ABSTRACT

Scientific evidence suggests that individuals vaccinated with COVID-19 vaccines are less likely to require hospitalization, possibly lowering the burden on the healthcare system. Despite such benefits, substantial segments of the world's population remain skeptical of COVID-19 vaccines and are hesitant to take them. Even if such individuals have been inoculated with COVID-19 vaccines out of economic, social, or legal necessity, they may be less inclined to receive booster shots or vaccinate their offspring when such options become available. What might help reduce this hesitancy? We examined this question using nationally representative survey data across 15 developed countries (max  $N = 122,516$ ). Our findings suggest that inspiring confidence in the government's handling of the pandemic is pivotal in enhancing vaccination intent among vaccine skeptics. Specifically, results from a hierarchical linear analysis showed that among vaccine skeptics, confidence in the government's management of the pandemic was associated with greater intent to (a) take COVID-19 vaccines (b) take booster shots and (c) vaccinate one's children.

## 1. Introduction

The deadly COVID-19 virus has infected more than 285 million people worldwide and has claimed over 5.4 million lives by the end of 2021. However, skepticism and hesitancy towards Coronavirus vaccines remain prevalent in many segments worldwide.<sup>1</sup> For developed countries in the West (e.g., the US and the UK in particular), vaccine hesitancy has made mass vaccination difficult, even when the relevant governments have secured sufficient supply of vaccines for their entire populations (Karni, 2021). Similar trends have been reported elsewhere in developing regions of the world, such as Africa (Anjorin et al., 2021), Asia (Bhopal & Nielsen, 2021), and the Middle East (Sallam et al., 2021).

With scientific evidence indicating waning immunity against the novel coronavirus amidst rapid mutations (e.g., Delta and Omicron variants), governments have ramped up efforts to promote vaccines and booster shots to restore immunity against the virus and help enhance herd protection (Burki, 2021). Although many adults have taken Coronavirus vaccines and first booster shots, emerging scientific evidence suggests that additional boosters may be required to protect the old and vulnerable (Heller & Lubell, 2022). Furthermore, inoculation of children

has slowed,<sup>2</sup> and a major reason for this stems from parental reluctance to vaccinate their children over safety concerns, primarily attributed to the misinformation in society (Suran, 2021). Infection among children and adolescents is on the rise (Morgan et al., 2021), and governments are ramming up inoculation efforts in hopes that the same protection accorded to adults will also be extended to the younger generation (Aschwanden, 2021). Still, as many countries require parental consent before vaccinating children below the age of 18, understanding how to enhance parental willingness to vaccinate their offspring is vital (Alfieri et al., 2021).

Several factors appear to drive vaccine hesitancy, which includes a general deficit of vaccine confidence (Vergara et al., 2021), misinformation about vaccines (Ersing et al., 2021; Lockyer et al., 2021), a lack of support from government or national leaders (Kosc, 2020), and religious fundamentalism (Lowicki et al., 2022). Another serious determinant that undermines vaccine acceptance is conspiracy theories. In the US, individuals who reportedly hold conspiracy beliefs about the COVID-19 virus (e.g., the virus was developed by the government as a bioweapon, or the government could cure the virus but chose not to for financial gains) were four times less likely to take coronavirus vaccines

\* Corresponding author.

E-mail address: [vengadeshvaran.sarma@nottingham.edu.my](mailto:vengadeshvaran.sarma@nottingham.edu.my) (V. Sarma).

<sup>1</sup> Based on statistics provided by the World Health Organization (WHO) on its Coronavirus (COVID-19) Dashboard, here: <https://covid19.who.int/info/>.

<sup>2</sup> Based on statistics provided by the American Academy of Pediatrics (AAP), here: <https://www.aap.org/en/pages/2019-novel-coronavirus-covid-19-infections/>.

than individuals without such beliefs (Earnshaw et al., 2020). In Poland, vaccine uptake has generally been lower than the EU average (Vaccines Today, 2021): a trend that has been attributed to national narcissism (a form of national defensive identity that aims to solidify some national ideal and desires special treatment for the nation). Vaccines are often portrayed in the country as tools used by foreign agents to undermine the nation, thereby heightening vaccine hesitancy (Cichočka et al., 2021; Cislak et al., 2021; Sternisko et al., 2021).

Researchers have proposed several solutions to promote vaccination intent amid rising hesitancy. One such method is to employ trusted messengers who are members of the social in-group (e.g., conspiracy forums) that would speak in favor of vaccination (Sharfstein et al., 2021), and another is to “inoculate” people with factual information to counter the influence of conspiracy theories (Douglas, 2021). Another plausible solution that is central to our paper is to increase citizen’s trust/confidence in their governments (the very source/advocate of these vaccines), given that people tend to be more persuaded by communications or recommendations coming from credible (or trusted) authorities, as has been shown by classic psychological science evidence (Bochner & Insko, 1966).

In the current pandemic, numerous studies have documented the persuasive influence of faith in one’s government in encouraging health and safety-compliant behaviors. For example, citizens who trust authorities in their country can even endure personal hardships to comply with government-recommended movement restrictions (Bargain & Aminjonov, 2020). Beyond the fact that citizens heed their government’s recommended mitigation policies when these entities are trusted, there are other palliative benefits too: the reassurance that things will eventually return to normal can help soothe mental distress (Tan et al., 2021).

However, when taking novel vaccines with little (if any) information about longer-term side effects, some realities may put the persuasive influence of confidence in government in doubt. One reality is that there may be dispositional skeptics who may hold reservations about the efficacy of vaccines themselves and the primary advocate for them (i.e., their government). This dispositional skeptic thesis predicts that vaccine-hesitant individuals are unlikely to vaccinate themselves. The degree of confidence in their governments should not matter because they are also likely to distrust authorities. Hence, only a direct effect of vaccine skepticism is expected under this framework.

A second possibility, however, concerns not only the barrage of misinformation and conspiracy theories with a strong presence on the internet that people rely so heavily upon in the current pandemic (e.g., Bok et al., 2021; Trujillo & Motta, 2021) but also real concerns over the safety and efficacy of COVID-19 vaccines (Karlsson et al., 2021). This is further compounded by historical examples of failed medical trials, especially in some disadvantaged communities (e.g., the Tuskegee experiment in Alabama, 1932–1972, discussed in Gray, 1998). This alternative fact thesis also predicts a negative main effect of vaccine mistrust on vaccination intent. In addition, it anticipates that vaccine skeptics who are already unlikely to vaccinate themselves will have an even lower inclination of doing so precisely because the alternative facts they possess contradict those advocated by their governments. Nevertheless, one might expect the foregoing proposition to be visible only when individuals have little or no trust in their government’s handling of the pandemic, to permit the apparent “instructional vacuum” to be filled with alternative facts that promote vaccine hesitancy. This instructional vacuum (i.e., ambiguity over what to do or which information to rely on) is absent when people have confidence in their governments (especially in mitigating the pandemic).

Hence, the alternative facts thesis predicts not only a main effect of skepticism on vaccination intent (as the dispositional skeptic thesis does), but also that confidence in government should moderate this relationship. Specifically, the alternative facts thesis assumes that the intention to vaccinate should increase even among vaccine skeptics when the trust in government (especially their handling of the

pandemic) is high. Under this condition, such citizens should prioritize recommendations from this trusted entity. No other study has tested these propositions let alone do so with nationally representative data from several developed and developing countries.

## 2. Method

### 2.1. Dataset

Our analysis uses nationally representative data collected by the Imperial College London YouGov COVID-19 Behavior Tracker (Jones, 2020), restricted to  $N = 122,516$  participants spread across 15-countries from February 10, 2021, until October 11, 2021 (18 waves).<sup>3</sup> The investigative period spans eight months because this was the period during which all the variables that were relevant to our investigation were simultaneously present. Although the correlational nature of our current research does not permit causal inference from our multi-level analysis, the comparative longitudinal dataset across a large geographical spread of countries and the relevance on raising vaccination intent through booster shots and for one’s children (at a time when many adults in developed countries have been vaccinated), should nonetheless be instructive.

### 2.2. Measures

#### 2.2.1. Outcome variables (vaccination intent)

Individual-level vaccination intent was measured with three indicators. The first one concerned with generalized vaccination intent: “To what extent do you agree or disagree that if a Covid-19 vaccine were made available to me this week, I would definitely get it?”

The second one concerned the respondent’s intention to take COVID-19 vaccine booster shots: “In the next 12 months, a booster may become available to make Covid-19 vaccination more effective. To what extent do you agree or disagree with the statement ‘if a Covid-19 vaccine booster becomes available to me, I intend to get it definitely.’”

The third one concerned the parents’ intention to vaccinate their children: “To what extent do you agree or disagree that ‘if a Covid-19 vaccine were made available to my child of between 3 and 18 years, they would definitely get it?’”

Responses to all three queries were measured on a 5-point scale (“1 = strongly agree” to “5 = strongly disagree”) but were reverse coded so that higher scores indicated a greater intention to get vaccinated.

#### 2.2.2. Predictors (vaccine skepticism)

We measured vaccine skepticism using two indicators which evaluated individuals’ agreement vs. disagreement (i.e., skepticism) over the efficacy of vaccines for themselves (“To what extent do you agree or disagree that getting a vaccine will protect me against coronavirus (COVID-19)?”) and others (“To what extent do you agree or disagree that getting a vaccine will protect others against coronavirus (COVID-19)?”) (“1 = disagree”, ..., “7 = agree”). Both indicators were reverse coded so that higher values denoted greater vaccine skepticism and were

<sup>3</sup> These 15 countries are Australia, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Norway, Singapore, South Korea, Spain, Sweden, the UK, and the USA.

subsequently summed then averaged to create a single index ranging from 1 to 7. Note that the Pearson correlation coefficient for both indicators (of  $r=0.85$ ) suggests a strong association between them (Akoglu, 2018; Dancey & Reidy, 2020, p. 183). Therefore, we created a single index of vaccine skepticism by averaging the scores on both items.

### 2.2.3. Moderator (confidence in the government's handling of the COVID-19 pandemic)<sup>4</sup>

Participants were asked, "How well or badly do you think the government is handling the issue of the coronavirus (COVID-19)?" ("1 = very well", "2 = somewhat well", "3 = somewhat badly", and "4 = very badly"). This variable was reverse coded so that higher scores reflected greater confidence in how participants thought their government was handling the pandemic.

### 2.2.4. Covariates

We included the following controls that have been shown to affect vaccination hesitancy: Age, since older individuals in developed countries are more predisposed towards COVID-19 vaccines and may be more likely to accept vaccines for self-preservation (Lazarus et al., 2020). Gender, since women appear to be less likely to accept vaccines than men, especially breastfeeding women who may worry about their offsprings' safety (Paul et al., 2021). Whether respondents live alone, since people who live alone have been shown to be more willing to take vaccines (Paul et al., 2021). Employment status, since fully employed people are supposed to be more likely to become inoculated with COVID-19 vaccines, presumably due to demands at work, though this produces mixed results (El-Elimat et al., 2021). We also included a binary variable that accounts for whether survey participants have any children given the tendency for parents to hesitate in vaccinating their children and themselves (Druckman, 2021).

We could not account for individual-level education and income because both demographic questions were not asked during data collection, even though people with lower self-reported income and education tend to be more vaccine-hesitant (Kricorian et al., 2021). As such, we attempted to remedy this potential shortcoming by including the following contextual-level variables in our analysis to measure the average country-level effect that education and income may have on vaccination intent: (i) the country's 2019 average years of schooling and (ii) real GDP per capita (log-transformed). Data for both contextual-level variables were retrieved from the Human Development Data Center (2020a, 2020b).

## 2.3. Descriptive statistics

Descriptive statistics from Table 1 indicates that just over half of the respondents (52%) were women, the average individual was about 48 years old, and on average, 19% of the respondents lived alone, 43% had a full-time job, and 38% had children between ages 3 and 18. Table 1 also indicates that the average individual was more likely to get the vaccine and booster shot and expressed less skepticism towards COVID-19 vaccines. However, confidence in the government's handling of the pandemic was neutral—with the mean response for the question being somewhere between "somewhat well" and "somewhat badly." Table 2 presents the pairwise Pearson Correlation coefficients between

<sup>4</sup> While the variable does not explicitly state confidence per se, its phrasing suggests the same. One rationale here is that confidence is usually used to describe the perception that some individual or organization has competence in performing certain tasks (Lyons & Mehta, 1997). This concept also applies to systems (e.g., governments) tasked to "protect against anxiety, uncertainty, and the contingencies of every day" (Smith, 2005). Hence, how competent individuals think governmental performance is handling the COVID-19 pandemic could be an expression of how confident they are in the government's ability to handle the pandemic.

**Table 1**

Descriptive statistics of variables used in analysis.

Variable	<i>n</i>	<i>M</i>	<i>SD</i>	Min	Max
Vaccination intent (generalized)	111,489	3.29	1.61	1	5
Vaccination intent (booster)	135,071	3.80	1.45	1	5
Vaccination intent (one's children)	16,067	3.38	1.49	1	5
Vaccine skepticism index	225,314	2.83	1.83	1	7
Vaccine skepticism (for self)	225,314	2.81	1.89	1	7
Vaccine skepticism (for others)	225,314	2.84	1.90	1	7
Confidence in how gov. is handling COVID-19	212,926	2.48	0.97	1	4
Age	226,280	48	16.66	18	99
Female	226,280	0.52	0.50	0	1
Lives alone	220,440	0.20	0.40	0	1
Fully employed	224,119	0.43	0.50	0	1
Has children	209,005	0.38	0.48	0	1
Mean years of schooling (2019)	226,280	12.38	1.13	10.3	14.2
GDP per capita (2019)	226,280	5.39	1.42	4.09	9.73

variables.

## 3. Results

We adopted a three-level random intercept, and random slope model (Fairbrother, 2014) since individuals (level-1) were nested in country-waves (level-2) that were in turn nested within countries (level-3). We included the level-1 predictor (vaccination skepticism) and moderator (confidence in the government's ability in handling the COVID-19 pandemic) as random slopes. Furthermore, we group mean centered all non-dichotomous level-1 variables (vaccine skepticism and confidence in the government's ability to handle the pandemic) by country-wave, while all contextual or country-level variables (mean years of schooling and real GDP per capita) were grand-mean centered (Brincks et al., 2017).<sup>5</sup> We estimated our multi-level models using the STATA 17 SE statistical software.

Models 1 to 3 contain no interaction terms and demonstrated that stronger vaccine skepticism is associated with a lower generalized intent to get vaccinated ( $b = -0.453, p < .001$ ), lower likelihood to get boosters ( $b = -0.409, p < .001$ ), and a lower likelihood of vaccinating one's children ( $b = -0.350, p < .001$ ). Hence, vaccine skeptics are generally less likely to vaccinate themselves and are less inclined to vaccinate their children. While this result is intuitive, it is unable to resolve the tension between the dispositional skeptic and alternate facts theses because their predictions converge when it comes to the main effect of vaccine skepticism. Diagnostic support for either thesis rests on the outcome of the interaction between vaccine skepticism and confidence in how governments have handled the pandemic. Specifically, if the dispositional skeptic thesis better describes the data, then the 2-way interaction (vaccine skepticism  $\times$  confidence in government) should not be significant. This implies that the average effect of vaccine skepticism on vaccination intent would be uniform across respondents regardless of their confidence in the government's pandemic management.

On the other hand, if the alternative fact hypothesis better explains the data, then the interaction term would be positive and significant so that even skeptics who are highly confident in the government's handling of the pandemic report a boost in vaccination intent. In contrast, their counterparts with low confidence in government would convey lower vaccination intent.

Consistent with the alternative fact thesis, the vaccine skepticism  $\times$  confidence interaction was positive and significant when it

<sup>5</sup> In addition to these main analyses (using an index as the outcome variable), as a robustness check, we measured the vaccination intent outcomes for adults, children, and booster shots as single items constructs. The Appendices report the findings from these additional analyses, which are similar to those from our main analyses reported below.

**Table 2**  
Pearson correlation coefficients between variables.

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Vaccination int. (general)	3.29	1.61	-													
2. Vaccination int. (booster)	3.80	1.45	0.80*	-												
3. Vaccination int. (children)	3.38	1.49	0.70*	0.68*	-											
4. Vaccine skep. index	2.83	1.83	-0.60*	-0.55*	-0.48*	-										
5. Vaccine skep. (for self)	2.81	1.89	-0.61*	-0.55*	-0.46*	0.96*	-									
6. Vaccine skep. (for others)	2.84	1.90	-0.56*	-0.51*	-0.46*	0.96*	0.86*	-								
7. Confidence in gov.	2.48	0.97	0.26*	0.27*	0.28*	-0.29*	-0.28*	-0.27*	-							
8. Age	48.07	16.66	0.08*	0.21*	0.18*	-0.15*	-0.15*	-0.13*	0.07*	-						
9. Female	0.52	0.50	-0.06*	-0.03*	-0.08*	0.02*	0.03*	0.01*	0.04*	-0.03*	-					
10. Lives alone	0.20	0.40	-0.01*	0.01*	-0.02*	0.02*	0.01*	0.02*	0.01	0.15*	0.01*	-				
11. Fully employed	0.43	0.50	0.02*	-0.02*	0.08*	0.02*	0.02*	0.01*	0.004	-0.23*	-0.14*	-0.07*	-			
12. children	0.38	0.48	-0.04*	-0.07*	0.004	0.06*	0.06*	-0.04*	-0.04*	-0.22*	0.0001	-0.20*	0.15*	-		
13. Mean years school (2019)	12.38	1.13	-0.01*	0.004	-0.05*	0.08*	0.07*	0.03*	0.03*	0.03*	0.003	0.13*	-0.06*	-0.08*	-	
14. GDP per capita (2019)	53,944	14,188	0.003	-0.004	0.01	0.02*	0.01*	0.02*	0.22*	-0.06*	-0.01*	-0.03*	0.09*	-0.03*	0.12*	-

Note: "Vaccination int." denotes vaccination intent; "vaccine skep." denotes vaccine skepticism; "confidence in gov." denotes confidence in the way the government has handled the COVID-19 pandemic; "mean years school" denotes mean years of schooling.  
\*  $p < .01$ .

comes to generalized vaccination intent (Model 4,  $b = 0.045, p < .001$ ), intent to get boosters (Model 5,  $b = 0.084, p < .001$ ), and intention to vaccinate one's children (Model 6,  $b = 0.051, p < .001$ ). To further unpack the moderating effect of governmental confidence, we examined simple slopes (see Fig. 1a to c). Here, vaccine skepticism predicted lower generalized vaccination intent,  $b = -0.455, p < .001$ , when confidence in the government was low ( $M - 1SD$ ). When confidence towards governmental performance was high ( $M + 1SD$ ), the negative association between skepticism and vaccination intent was visible,  $b = -0.374, p < .001$ : though nonetheless reliably weaker in strength compared to when confidence in government was high ( $\Delta b = 0.081, p < .001$ ). When the outcome of focus is the intent to take booster shots and the parental intent of vaccinating one's children, the simple slope probe again yielded patterns supportive of the alternate fact hypothesis. In Model 5, a negative association exists between vaccine skepticism and intent to get booster shots, when governmental confidence was low,  $b = -0.426, p < .001$ , and when governmental confidence was high,  $b = -0.275, p < .001$  (note that  $\Delta b = 0.151, p < .001$ ). Similarly for Model 6, the influence of vaccine skepticism on the intent to vaccinate one's children was  $b = -0.339, p < .001$ , when confidence in the government's performance was low, this negative effect was weaker  $b = -0.248, p < .001$  when confidence in government was high (note that  $\Delta b = 0.091, p < .001$ ).

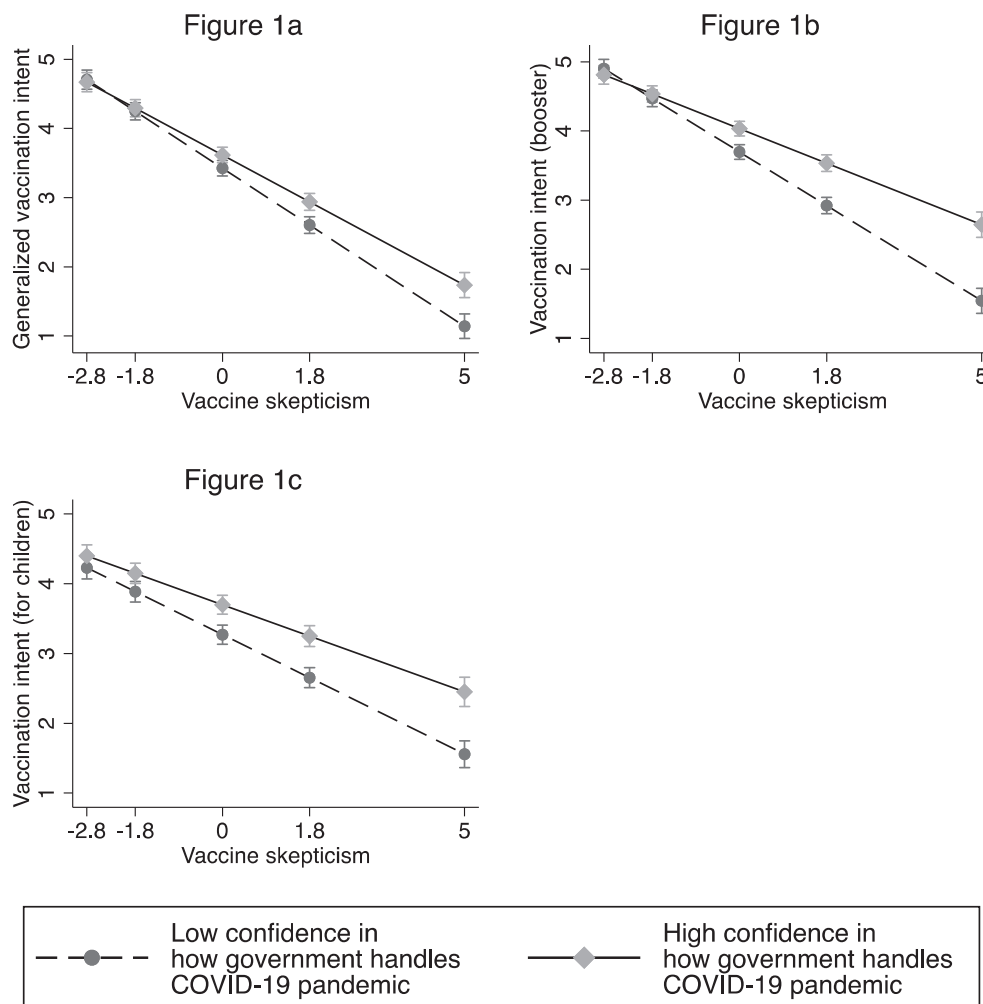
We discern an important phenomenon from Fig. 1a to c: the overall vaccination intent of individuals who are confident in the government's management of the pandemic is generally higher than the vaccination intent of individuals with low confidence in the government. This observation is crucial in validating the alternate fact hypothesis. In accordance to the hypothesis, we found that among individuals who were highly skeptical of COVID-19 vaccines ( $M + 1SD$ ), an increase in confidence in the government's management of the pandemic (from  $-1SD$  to  $+1SD$ ) was associated with greater generalized vaccination intent (Fig. 2a,  $b = 0.351, p < .001$ ), higher intent on getting booster shots (Fig. 2b,  $b = 0.611, p < .001$ ), and a greater willingness to vaccinate one's offspring (Fig. 2c,  $b = 0.590, p < .001$ ). In contrast, improvements to vaccination intent induced by governmental confidence appear less pronounced among individuals with low vaccine skepticism ( $M - 1SD$ ). That is, a rise in governmental confidence among participants with low vaccine skepticism did not produce any measurable change in generalized vaccination intent (Fig. 2a,  $b = 0.060, p = .141$ ) and intent to get a booster shot (Fig. 2b,  $b = 0.067, p = .139$ ). The situation differs somewhat in Fig. 2c, where an increase in confidence towards the government's handling of the pandemic was associated with improved parental intentions to vaccinate their offspring ( $b = 0.262, p < .001$ ). This finding reveals that irrespective of the degree of skepticism that individuals hold towards COVID-19 vaccines, governmental confidence appears to play a pivotal role in determining parental decisions when vaccinating their children.

It is possible to argue that our measure of confidence in the government's handling of the pandemic potentially taps into the same psychological reality as our measure of vaccine skepticism. This would raise the issue of multicollinearity, given that both these variables were predictors in Model 2. When we investigated for potential multicollinearity, we noted that the overall variance inflation factor (VIF) was low for Model 4 (VIF = 1.13), Model 5 (VIF = 1.11), and Model 6 (VIF = 1.12). This outcome affirms a low likelihood of multicollinearity in the current analyses.

#### 4. Discussion

Trust or confidence in government has historically played a crucial role in determining citizens' compliance with public health measures (Tan et al., 2021; Taylor-Clark et al., 2005). For example, hesitancy in taking the measles-mumps-rubella (MMR) vaccines was attributed to "historic levels of distrust" towards the British government, while hesitancy towards similar vaccines in Orange County, California, after a





**Fig. 1.** The effect of vaccine skepticism on vaccination intent (general, booster and child vaccination) given confidence in the government's handling of the COVID-19 pandemic.

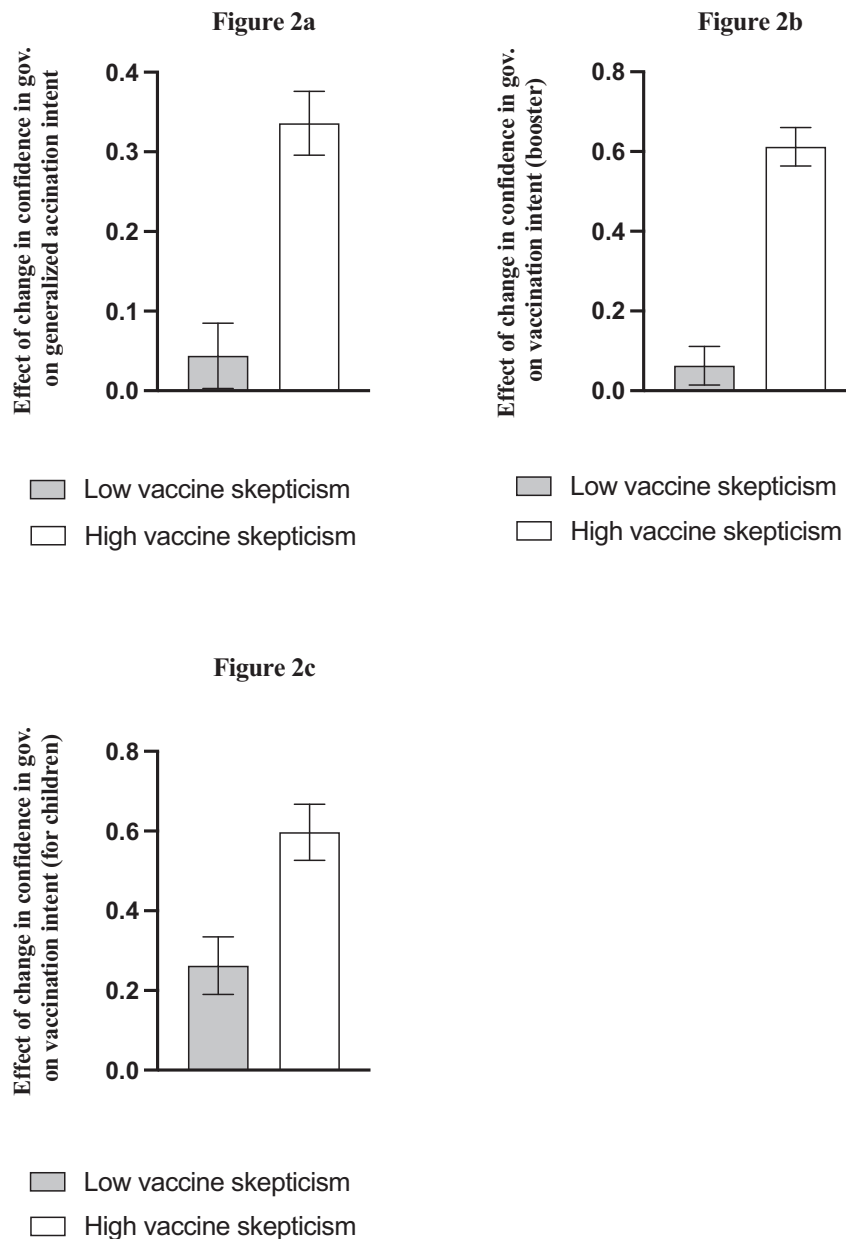
2015 measles outbreak, was predominantly linked to parental distrust of health authorities (Blair et al., 2017). Public trust in institutions also plays an indispensable role in ensuring that citizens adhere to public health measures during the pandemic (Bedford et al., 2020; Saechang et al., 2021).

However, misinformation and conspiracy theories have become relatively widespread, and such rhetoric has reduced adherence to public health measures (Kowalski et al., 2020), including vaccination drives. Narratives supporting conspiracy beliefs that impede such drives include suspicions (a) concerning governmental motives to vaccinate their citizens (Jamieson, 2021), and (b) that external forces are seeking to undermine the nation (i.e., national narcissism) (Cichocka et al., 2021; Cislak et al., 2021; Sternisko et al., 2021). Influential government figures publicly questioning the need for vaccines to counter the Coronavirus have also further fueled conspiracy beliefs (Germani & Biller-Andorno, 2021). As such, vaccine hesitancy remains a national hurdle for many countries across the globe, with much strain on national health care systems, which potentially jeopardizes the much-coveted herd immunity (Cornwall, 2020).

Considering this hesitancy to get vaccinated against COVID-19 (Sallam, 2021), we tested two competing explanations in how the confidence in the way the government handled the COVID-19 pandemic might affect citizens' intention to get vaccinated. The first proposition (i.e., alternative facts thesis) assumes that among vaccine skeptics, confidence in how the government dealt with the pandemic would elevate people's vaccination intent and the intent of parents to vaccinate their

children. The second proposition (i.e., the dispositional skeptics), on the other hand, assumes that such confidence should matter little (if at all) in the vaccination intentions of skeptics since such individuals are likely to distrust their governments anyway. Hence, the dispositional skeptic thesis proposes a gloomy/bleak outcome for governments' vaccination drive regarding vaccine skeptics. In contrast, the alternative facts thesis proposes the opposite (more positive) output if governments can do more to earn their citizens' trust. Our results more strongly support the optimism implied by the alternative facts thesis than the pessimism implicit in the dispositional skeptic thesis (see also Elgar et al., 2020).

Several measures could be implemented to improve people's confidence in their governments vis-à-vis the pandemic. Firstly, governments could avoid sending mixed and confusing messages and acknowledge that uncertainties in the information presented by authorities may evolve alongside the pandemic (Carlsen & Glenton, 2016; Enria et al., 2021). Secondly, governments could also invest in some "qualitative feedback mechanism," where ordinary people's opinions could be collected and acted upon (to reassure people that their views matter and to help shore up the public trust) (Leonard & Philippe, 2021). Thirdly, authorities could train health professionals to engage with vaccine skeptics with conspiracy beliefs in an open and non-judgmental manner (Leonard & Philippe, 2021). Fourthly, authorities should ensure that information about Coronavirus vaccines is transparently communicated using strong supportive evidence for vaccination to counter the not-so-rsory data that skeptics are likely to see in alternative platforms (Hyland-Wood et al., 2021). Hyland-Wood et al. (2021) also argue that it



**Fig. 2.** The effect of confidence in the government's handling of the COVID-19 pandemic on vaccination intent (general, booster and child vaccination) given vaccine skepticism.

is crucial to tailor the communication to diverse audiences during a pandemic appropriately. Such transparent (even targeted) communication potentially takes the "oxygen out" of "alternative facts" and may help to instill greater confidence in the government's handling of the pandemic, which has potent positive downstream effects on intentions to (a) get booster shots and (b) vaccinate one's children.

## 5. Conclusion

Vaccine skeptics are less likely to (a) become inoculated with COVID-19 vaccines, (b) get booster shots and (c) vaccinate their offspring. Using nationally representative data from 15 countries, we demonstrate that a boost in public trust in their governments can help to thwart vaccine hesitancy among vaccine skeptics. This benefit extends not only to themselves, but it also enhances the chances that children with vaccine sceptic parents are inoculated.

## Pre-registration

This is not a pre-registered study.

## Availability of data and materials

The dataset used and analysed in the current study is publicly available from here: <https://www.imperial.ac.uk/centre-for-health-policy/our-work/our-response-to-covid-19/covid-19-behaviour-tracker/>.

## Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**Declaration of competing interest**

The authors declare that they have no competing interests.

**Appendix A**

In addition to the analysis in the main text where we measured the outcome (vaccination intent) controlling for additional covariates, we produced two additional tables as a robustness check. Here, we removed these additional covariates to identify if the main effect still holds. Note that the predictor was included as a simple slope in Models A1 to A3, while both the predictor and moderator are included as simple slopes in Models B1 to B3.

Models A1 to A3 in Table A report effects like those in Table 3, where we see that the effect of vaccine skepticism on the intent on getting vaccinated in general and the booster shot is negative and significant,  $b = -0.447, p < .001$ , and  $b = -0.425, p < .001$ , respectively. When the outcome is switched to vaccination intent for one's children, we see similar results,  $b = -0.360, p < .001$ . Models B1 to B3 in Table B reports effects similar to those in Table 4, where we see that the interaction effect of vaccine skepticism and confidence in government improves general intention to vaccinate,  $b = 0.037, p < .001$ , improves intention to get the booster shot,  $b = 0.070, p < .001$ , and improves intention to vaccinate one's children,  $b = 0.042, p < .001$ .

**Table A**

The effect of vaccine skepticism on generalized vaccination intent, intent on getting the booster shot, and vaccinating one's children without controls.

	Model A1 (vaccination intent, general)	Model A2 (vaccination intent, booster)	Model A3 (vaccination intent, children)
Vaccine skepticism	-0.447*** (0.012)	-0.425*** (0.016)	-0.360*** (0.017)
Intercept	3.402*** (0.048)	3.783*** (0.049)	3.455*** (0.062)
Level-1 N	111,489	135,071	15,399
Level-2 N	246	148	75
Level-3 N	15	15	15

Note: standard errors in parentheses.

\*\*\*  $p < .001$ .

**Table 3**

The effect of vaccine skepticism on vaccination intent.

Effect	Model 1 (vaccination intent, general)	Model 2 (vaccination intent, booster)	Model 3 (vaccination intent, children)
<b>Individual-level variables</b>			
Vaccine skepticism	-0.453*** (0.012)	-0.409*** (0.016)	-0.350*** (0.016)
Age	0.006*** (0.0003)	0.011*** (0.0002)	0.016*** (0.001)
Female	-0.089*** (0.008)	-0.060*** (0.007)	-0.134*** (0.022)
Alone	-0.023* (0.011)	-0.023** (0.009)	-0.207 (0.111)
Fully employed	0.016 (0.008)	0.025*** (0.007)	0.030 (0.023)
Children	-0.026** (0.009)	-0.003 (0.008)	
<b>Contextual variables</b>			
Average years of schooling	0.015 (0.048)	0.010 (0.049)	-0.030 (0.055)
2019 GDP per capita (per thousand)	-0.016 (0.037)	-0.009 (0.037)	-0.005 (0.042)
Intercept	3.594*** (0.203)	3.874*** (0.205)	3.638*** (0.231)
Level-1 N	97,884	122,516	15,017
Level-2 N	230	139	74
Level-3 N	15	15	15

Note: standard errors in parentheses.

\*\*\*  $p < .001$ .

\*\*  $p < .01$ .

\*  $p < .05$ .

**Table 4**

The effect of vaccine skepticism on vaccination intent (booster and child vaccination).

Effect	Model 4 (vaccination intent, general)	Model 5 (vaccination intent, booster)	Model 6 (vaccination intent, children)
<b>Individual-level variables</b>			
Vaccine skepticism	-0.414*** (0.014)	-0.351*** (0.014)	-0.294*** (0.014)
Conf. gov.	0.114*** (0.022)	0.189*** (0.025)	0.237*** (0.035)
Vaccine skepticism × conf. gov.	0.045*** (0.002)	0.084*** (0.002)	0.051*** (0.006)
Age	0.006*** (0.0003)	0.011*** (0.0002)	0.018*** (0.001)
Female	-0.109*** (0.008)	-0.082*** (0.007)	-0.146*** (0.022)
Alone	-0.028* (0.011)	-0.025** (0.009)	-0.242* (0.113)
Fully employed	0.017* (0.009)	0.021** (0.007)	0.015 (0.023)
Children	-0.039*** (0.010)	-0.021* (0.008)	
<b>Contextual variables</b>			
Average years of schooling	0.017 (0.048)	0.017 (0.045)	-0.030 (0.053)
2019 GDP per capita (per thousand)	-0.015 (0.037)	-0.007 (0.035)	-0.008 (0.040)
Intercept	3.633*** (0.203)	3.940*** (0.191)	3.698*** (0.223)
Level-1 N	91,930	115,829	14,181
Level-2 N	230	139	74
Level-3 N	15	15	15

Note: standard errors in parentheses.

\*\*\*  $p < .001$ .

\*\*  $p < .01$ .

\*  $p < .05$ .



Table B

The effect of vaccine skepticism on generalized vaccination intent, intent on getting the booster shot, and vaccinating one's children.

	Model B4 (vaccination intent, general)	Model B5 (vaccination intent, booster)	Model B6 (vaccination intent, children)
Individual-level variables			
Vaccine skepticism	-0.417*** (0.014)	-0.371*** (0.015)	-0.309*** (0.015)
Conf. gov.	0.112*** (0.022)	0.193*** (0.026)	0.226*** (0.039)
Vaccine skepticism × conf. gov	0.037*** (0.002)	0.070*** (0.002)	0.042*** (0.006)
Intercept	3.431*** (0.047)	3.840*** (0.046)	3.477*** (0.061)
Level-1 N	104,003	126,812	14,485
Level-2 N	246	148	75
Level-3 N	15	15	15

Note: standard errors in parentheses.

\*\*\*  $p < .001$ 

## References

- Akdoglu, H. (2018). User's guide to correlation coefficients. *Turkish Journal of Emergency Medicine*, 18(3), 91–93. <https://doi.org/10.1016/j.tjem.2018.08.001>
- Alfieri, N. L., Kusma, J. D., Heard-Garris, N., Davis, M. M., Golbeck, E., Barrera, L., & Macy, M. L. (2021). Parental COVID-19 vaccine hesitancy for children: Vulnerability in an urban hotspot. *BMC Public Health*, 21(1), 1–9. <https://doi.org/10.1186/s12889-021-11725-5>
- Anjorin, A. A., Odetokun, I. A., Abioye, A. I., Elnadi, H., Umoren, M. V., Damaris, B. F., & Fasina, F. O. (2021). Will Africans take COVID-19 vaccination?. <https://doi.org/10.2139/ssrn.3813174>
- Aschewand, C. (2021). Five reasons why COVID herd immunity is probably impossible. *Nature*, 520–522. <https://doi.org/10.1038/d41586-021-00728-2>
- Bargain, O., & Aminjonov, U. (2020). Trust and compliance to public health policies in times of COVID-19. *Journal of Public Economics*, 192, Article 104316. <https://doi.org/10.1016/j.jpubeco.2020.104316>
- Bedford, J., Enria, D., Giesecke, J., Heymann, D. L., Ihekweazu, C., Kobinger, G., Wieler, L. H., ... (2020). COVID-19: Towards controlling of a pandemic. *The Lancet*, 395(10229), 1015–1018.
- Blair, R. A., Morse, B. S., & Tsai, L. L. (2017). Public health and public trust: Survey evidence from the Ebola virus disease epidemic in Liberia. *Social Science & Medicine*, 172, 89–97. <https://doi.org/10.1016/j.socscimed.2016.11.016>
- Bhopal, S., & Nielsen, M. (2021). Vaccine hesitancy in low- and middle-income countries: Potential implications for the COVID-19 response. *Archives of Disease in Childhood*, 106(1), 113–114. <https://doi.org/10.1136/archdischild-2020-318988>
- Bochner, S., & Insko, C. A. (1966). Communicator discrepancy, source credibility, and opinion change. *Journal of Personality and Social Psychology*, 4(6), 614.
- Bok, S., Martin, D. E., & Lee, M. (2021). Validation of the COVID-19 disbelief scale: Conditional indirect effects of religiosity and COVID-19 fear on intent to vaccinate. *Acta Psychologica*, 219, Article 103382. <https://doi.org/10.1016/j.actpsy.2021.10.3382>
- Brincks, A. M., Enders, C. K., Llabre, M. M., Bulotsky-Shearer, R. J., Prado, G., & Feaster, D. J. (2017). Centering predictor variables in three-level contextual models. *Multivariate Behavioral Research*, 52(2), 149–163. <https://doi.org/10.1080/00273171.2016.1256753>
- Burki, T. (2021). Booster shots for COVID-19—The debate continues. *The Lancet Infectious Diseases*, 21(10), 1359–1360. [https://doi.org/10.1016/S1473-3099\(21\)00574-0](https://doi.org/10.1016/S1473-3099(21)00574-0)
- Carlsen, B., & Glenton, C. (2016). The swine flu vaccine, public attitudes, and researcher interpretations: A systematic review of qualitative research. *BMC Health Services Research*, 16(1), 1–15. <https://doi.org/10.1186/s12913-016-1466-7>
- Cichočka, A., Cislak, A., Gronfeldt, B., & Wojcik, A. D. (2021). Can ingroup love harm the ingroup? Collective narcissism and objectification of ingroup members. *Group Processes & Intergroup Relations*. <https://doi.org/10.1177/1368430220959451>
- Cislak, A., Marchlewska, M., Wojcik, A. D., Śliwiński, K., Molenda, Z., Szczepańska, D., & Cichočka, A. (2021). National narcissism and support for anti-vaccination policy: The mediating role of vaccination conspiracy beliefs. *Group Processes and Intergroup Relations*. <https://doi.org/10.1177/1368430220959451>
- Cornwall, W. (2020). Officials gird for a war on vaccine misinformation. <https://doi.org/10.1126/science.369.6499.14>
- Dancey, C. P., & Reidy, J. (2020). *Statistics without maths for psychology*. Pearson Education.
- Douglas, K. M. (2021). COVID-19 conspiracy theories. *Group Processes & Intergroup Relations*, 24(2), 270–275. <https://doi.org/10.1177/1368430220982068>
- Druckman, J. (2021). Survey Shows Parents Are More Hesitant to Get Vaccines for Their Kids. Institute for Policy Research. <https://www.ipr.northwestern.edu/news/2021/survey-parents-more-hesitant-to-vaccinate-their-kids.html>. (Accessed 2 January 2022).
- Elgar, F. J., Stefaniak, A., & Wohl, M. J. A. (2020). The trouble with trust: Time-series analysis of social capital, income inequality, and COVID-19 deaths in 84 countries. *Social Science & Medicine*, 263(Oct), Article 113365. <https://doi.org/10.1016/j.socscimed.2020.113365>
- Earnshaw, V. A., Eaton, L. A., Kalichman, S. C., Brousseau, N. M., Hill, E. C., & Fox, A. B. (2020). COVID-19 conspiracy beliefs, health behaviors, and policy support. *Translational Behavioral Medicine*, 10(4), 850–856. <https://doi.org/10.1186/s12913-016-1466-7>
- El-Elimat, T., Abu Al Samen, M. M., Almomani, B. A., Al-Sawalha, N. A., & Alali, F. Q. (2021). Acceptance and attitudes toward COVID-19 vaccines: a cross-sectional study from Jordan. *PLoS One*, 16(4), Article e0250555. <https://doi.org/10.1371/journal.pone.0250555>
- Enria, L., Waterlow, N., Rogers, N. T., Brindle, H., Lal, S., Eggo, R. M., Roberts, C. H., ... (2021). Trust and transparency in times of crisis: Results from an online survey during the first wave (April 2020) of the COVID-19 epidemic in the UK. *PLoS One*, 16(2), Article e0239247.
- Ersing, R. L., Neely, S., & Remington, C. (2021). To Overcome Vaccine Hesitancy, Public Officials Need to Get Creative. Government Executive. <https://www.govexec.com/management/2021/07/overcome-vaccine-hesitancy-public-officials-need-get-creative/183935/>.
- Fairbrother, M. (2014). Two multilevel modeling techniques for analyzing comparative longitudinal survey datasets. *Political Science Research and Methods*, 2(1), 119. <https://doi.org/10.1017/psrm.2013.24>
- Germani, F., & Biller-Andorno, N. (2021). The anti-vaccination infodemic on social media: A behavioral analysis. *PLoS one*, 16(3), Article e0247642. <https://doi.org/10.1371/journal.pone.0247642>
- Gray, F. D. (1998). *The Tuskegee syphilis study: The real story and beyond*. New South Books.
- Heller, J., & Lubell, M. (2022). Fourth COVID-19 vaccine dose boosts antibodies five-fold in Israeli study, PM says. <https://www.reuters.com/world/middle-east/israeli-study-finds-fourth-dose-covid-19-vaccine-boosts-antibodies-five-fold-pm-2022-01-04/>.
- Hyland-Wood, B., Gardner, J., Leask, J., & Ecker, U. K. H. (2021). Toward effective government communication strategies in the era of COVID-19. *Humanities and Social Sciences Communications*, 8, 30. <https://doi.org/10.1057/s41599-020-00701-w>
- Center, H. D. D. (2020a). GDP per capita (2017 PPP \$). <http://hdr.undp.org/en/indicators/194906>.
- Center, H. D. D. (2020b). Mean years of schooling (years). <http://hdr.undp.org/en/indicators/103006>.
- Jamieson, K. H. (2021). How conspiracists exploited COVID-19 science. *Nature Human Behaviour*, 5(11), 1464–1465. <https://doi.org/10.1038/s41562-021-01217-2>
- Jones, S. P. (2020). Imperial College London Big Data Analytical Unit and YouGov Plc. 2020. Imperial College London YouGov Covid Data Hub, v1. 0, YouGov Plc. <https://github.com/YouGov-Data/covid-19-tracker>.
- Karlsson, L. C., Soveri, S., Lewandowsky, S., Karlsson, L., Karlsson, H., Nolvli, S., Karukivi, M., Lindfelt, M., & Antfolk, J. (2021). Fearing the disease or the vaccine: The case of COVID-19. *Personality and Individual Differences*, 172(Apr), Article 110590. <https://doi.org/10.1016/j.paid.2020.110590>
- Karni, A. (2021). Biden administration announces ad campaign to combat vaccine hesitancy. <https://www.nytimes.com/2021/04/01/us/politics/coronavirus-vaccine-hesitancy.html>.
- Kosc, W. (2020). Duda taps into anti-vax sentiment ahead of Poland's presidential election. Politico. <https://www.politico.eu/article/andrzej-duda-anti-vax-sentiment-polish-election/>.
- Kowalski, J., Marchlewska, M., Molenda, Z., Górska, P., & Gawęda, Ł. (2020). Adherence to safety and self-isolation guidelines, conspiracy and paranoia-like beliefs during COVID-19 pandemic in Poland—associations and moderators. *Psychiatry Research*, 294, Article 113540. <https://doi.org/10.1016/j.psychres.2020.113540>
- Kricorian, K., Given, R., & Equils, O. (2021). COVID-19 vaccine hesitancy: Misinformation and perceptions of vaccine safety. *Human Vaccines & Immunotherapeutics*, 1–8. <https://doi.org/10.1080/21645515.2021.1950504>
- Lazarus, J. V., Wyka, K., Rauh, L., Rabin, K., Ratzan, S., Gostin, L. O., El-Mohandes, A., ... (2020). Hesitant or Not? The Association of age, gender, and education with potential acceptance of a COVID-19 vaccine: A country-level analysis. *Journal of Health Communication*, 25(10), 799–807. <https://doi.org/10.1080/10810730.2020.1868630>
- Leonard, M. J., & Philippe, F. L. (2021). Conspiracy theories: A public health concern and how to address it. *Frontiers in Psychology*, 3007.

- Lockyer, B., Islam, S., Rahman, A., Dickerson, J., Pickett, K., Sheldon, T., & Bradford Institute for Health Research Covid-19 Scientific Advisory Group. (2021). Understanding COVID-19 misinformation and vaccine hesitancy in context: Findings from a qualitative study involving citizens in Bradford, UK. *Health Expect.*, 24(4), 1158–1167. <https://doi.org/10.1111/hex.13240>
- Łowicki, P., Marchlewska, M., Molenda, Z., Karakula, A., & Szczepańska, D. (2022). Does religion predict coronavirus conspiracy beliefs? Centrality of religiosity, religious fundamentalism, and COVID-19 conspiracy beliefs. *Personality and Individual Differences*, 111413. <https://doi.org/10.1016/j.paid.2021.111413>
- Lyons, B., & Mehta, J. (1997). Contracts, opportunism and trust: Self-interest and social orientation. *Cambridge Journal of Economics*, 21(2), 239–257. <https://doi.org/10.1093/oxfordjournals.cje.a013668>
- Morgan, L., Schwartz, J. L., & Sisti, D. A. (2021). COVID-19 vaccination of minors without parental consent: Respecting emerging autonomy and advancing public health. *JAMA Pediatrics*, 175(10), 995–996. <https://doi.org/10.1001/jamapediatrics.2021.185>
- Paul, E., Steptoe, A., & Fancourt, D. (2021). Attitudes towards vaccines and intention to vaccinate against COVID-19: Implications for public health communications. *The Lancet Regional Health-Europe*, 1, Article 100012. <https://doi.org/10.1016/j.lanepe.2020.100012>
- Saechang, O., Yu, J., & Li, Y. (2021). Public trust and policy compliance during the COVID-19 pandemic: The role of professional trust. In , 9. *Healthcare* (p. 151). Multidisciplinary Digital Publishing Institute. <https://doi.org/10.3390/healthcare9020151>. No. 2.
- Sallam, M. (2021). COVID-19 vaccine hesitancy worldwide: A concise systematic review of vaccine acceptance rates. *Vaccines*, 9(2), 160. <https://doi.org/10.3390/vaccines9020160>
- Sallam, M., Dababseh, D., Eid, H., Al-Mahzoum, K., Al-Haidar, A., Taim, D., Yaseen, A., Ababneh, N. A., Bakri, F. G., & Mahafzah, A. (2021). High rates of COVID-19 vaccine hesitancy and its association with conspiracy beliefs: A study in Jordan and Kuwait among other Arab countries. *Vaccines*, 9(1), 42. <https://doi.org/10.3390/vaccines9010042>
- Sharfstein, J. M., Callaghan, T., Carpiano, R. M., Sgaier, S. K., Brewer, N. T., Galvani, A. P., Hotez, P. J., ... (2021). Uncoupling vaccination from politics: A call to action. *The Lancet*, 398(10307), 1211–1212. [https://doi.org/10.1016/S0140-6736\(21\)02099-7](https://doi.org/10.1016/S0140-6736(21)02099-7)
- Smith, C. (2005). Understanding trust and confidence: Two paradigms and their significance for health and social care. *Journal of Applied Philosophy*, 22(3), 299–316. <https://doi.org/10.1111/j.1468-5930.2005.00312.x>
- Sternisko, A., Cichočka, A., Cislak, A., & Van Bavel, J. J. (2021). National Narcissism predicts the belief in and the dissemination of conspiracy theories during the COVID-19 pandemic: Evidence from 56 countries. *Personality and Social Psychology Bulletin*. <https://doi.org/10.1177/01461672211054947>
- Suran, M. (2021). Why parents still hesitate to vaccinate their children against COVID-19. *JAMA*. <https://jamanetwork.com/journals/jama/fullarticle/2787289>. (Accessed 1 January 2022).
- Tan, C. M., Owuamalam, C. K., & Ng, P. K. (2021). Stay at home, protect the NHS and save lives! Confidence in government moderates the negative effects of staying at home on mental health. *Personality and Individual Differences*, 179(September), Article 110948. <https://doi.org/10.1016/j.paid.2021.110948>
- Taylor-Clark, K., Blendon, R. J., Zaslavsky, A., & Benson, J. (2005). Confidence in crisis? Understanding trust in government and public attitudes toward mandatory state health powers. *Biosecurity and Biodefense: Biodefense Strategy, Practice, and Science*, 3(2), 138–147.
- Trujillo, K. L., & Motta, M. (2021). How internet access drives global vaccine skepticism. *International Journal of Public Opinion Research*, 33(3), 551–570. <https://doi.org/10.1093/ijpor/edab012>
- Vaccines Today. (2021). Polands Vaccine Skepticism Problem – a European Problem. <https://www.vaccinestoday.eu/stories/polands-vaccine-scepticism-a-european-problem/>.
- Vergara, R. J. D., Sarmiento, P. J. D., & Lagman, J. D. N. (2021). Building public trust: A response to COVID-19 vaccine hesitancy predicament. *Journal of Public Health*, 43(2), e291–e292. <https://doi.org/10.1093/pubmed/fdaa282>