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# COVID-19 information exposure and vaccine hesitancy: The influence of trust in government and vaccine confidence

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## ABSTRACT

As the novel coronavirus (COVID-19) continues to spread, vaccine hesitancy increasingly threatens public health worldwide. Health information from traditional, online and social media may influence vaccine hesitancy. The purpose of this study was to explore the influence of exposure to COVID-19 information from various media on vaccine hesitancy, as well as the mediating roles of public trust in government and vaccine confidence. With a sample of 438 online participants (mean age = 30.69 years) responding to an anonymous questionnaire, the study tested a mediation model using bias-corrected bootstrap. The results indicated that exposure to COVID-19 information from online news media and traditional media can reduce vaccine hesitancy indirectly. Whereas a positive and indirect relationship between COVID-19 information exposure on social media and vaccine hesitancy was revealed. Trust in government and vaccine confidence were found to be salient mediators between exposure to COVID-19 information from various media and vaccine hesitancy. Findings from this study offer implications for strategies to address vaccine hesitancy.

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COVID-19 information exposure; vaccine hesitancy; trust in government; vaccine confidence; mediation analysis

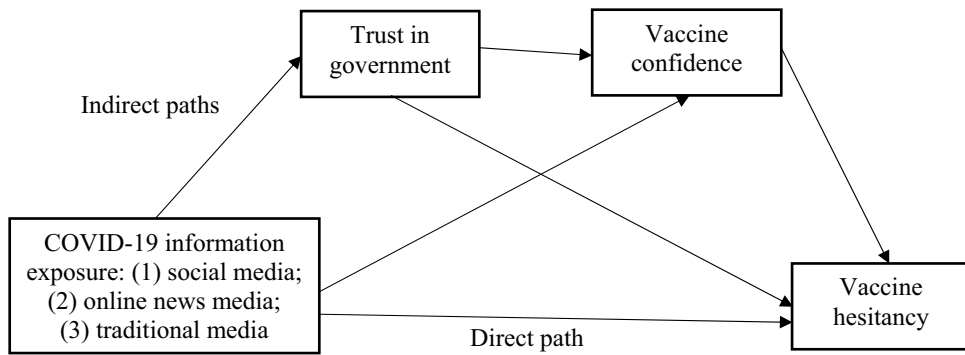
## Introduction

The novel coronavirus disease (COVID-19) continues to spread worldwide, posing a dangerous threat to public health. By November 2021, there were about 250 million confirmed cases worldwide and well over 5 million deaths. In the past year, nonpharmaceutical interventions (e.g. cancelling mass gathering activities, travel restrictions, and mandating social distancing) were implemented by countries to reduce the transmission of COVID-19 (Dinleyici et al., 2020; Liu, 2021, 2020). In the meanwhile, health experts recognize COVID-19 vaccination as one of the most important measures for combating COVID-19 infection (Dinleyici et al., 2020). Recently, the distribution of COVID-19 vaccines has begun in many countries, such as the United States, Russia, and China (Smith et al., 2020). However, an alarming number of people are highly suspicious of the safety and efficacy of COVID-19 vaccines and refuse immunization, a behavior defined as vaccine hesitancy (Featherstone et al., 2019; Getman et al., 2018). Statistics showed that around one in six British people refused COVID-19 vaccination, and a similar

proportion was hesitant to make up their minds (Burki, 2020). Similar findings were reported in other research suggesting that vaccine hesitancy was prevalent around the world: the United States (25%) (Taylor et al., 2020), Italy (14%) (Barello et al., 2020), Canada (20%) (Taylor et al., 2020), and Australia (14%) (Rhodes et al., 2020).

Vaccine hesitancy is a growing threat that needs to be overcome because effective control of COVID-19 requires indefinite maintenance of high rates of timely vaccination. A broad range of factors contributing to vaccine hesitancy have been identified, including unfamiliarity with the disease, deficient knowledge of vaccines, and lack of trust in government and public health authorities (Salmon et al., 2015). In addition to these, mass media might be another salient factor that potentially influences vaccine hesitancy. During the time of pandemic outbreaks, people rely on mass media to stay updated on the news, obtain disease prevention and treatment knowledge, and understand the government's containment strategies and policies (Liu, 2020). However, research suggested that news exposure might somehow cause increased vaccine hesitancy (Featherstone et al., 2019; Vrdelja et al., 2018) because people are exposed to a large amount of information that varied dramatically in quality. For instance, new information technologies (e.g. social media), with high accessibility, allow both information and disinformation to reach a wider audience without regulation or quality checks (Liu & Huang, 2020). A recent survey, which polled 1663 people, found that individuals who frequently used social media for COVID-19 related information were more hesitant to get vaccinated (Burki, 2020). However, extant research mainly focused on news exposure on the internet and vaccine hesitancy (Puri et al., 2020; Wilson & Wiysonge, 2020), and we know little about whether news exposure on different media can influence vaccine hesitancy differently. Given that traditional media (e.g. television and radio) and online news media remain important sources for risk information during a pandemic outbreak (Chipidza et al., 2020; Liu, 2020), scholars suggested that there is a need for more rigorous investigation of different media (Liu, 2020).

Of particular interest to this study is the role of trust in government and vaccine confidence may play in mediating the relationship between COVID-19 information exposure and vaccine hesitancy. It suggests that media exposure to risk and health information was significantly associated with trust in government and health systems, and public confidence in the safety and efficacy of vaccines and immunization (Cook et al., 2010; Quinn et al., 2013; Wilson et al., 2014). For instance, Quinn et al. (2013) found that closely following H1N1 news was associated with higher trust in the government's actions in responses to the H1N1 pandemic. Furthermore, trust in the government and vaccine confidence can reduce vaccine hesitancy and increase vaccine intentions in sequence. Du et al. (2020) investigated the Changchun Changsheng vaccine incident and found that public trust in the vaccine delivery system and the government would enhance vaccine confidence and reduce vaccine hesitancy. However, contradictory findings have been reported in some other research. In a study conducted by Wilson et al. (2014), scholars found an adverse impact of news media in fueling anti-vaccine sentiment, destroying public confidence in vaccines, and increasing vaccine hesitancy. The inconsistent findings highlighted the need to examine information exposure on different media and, possibly, different effects on public trust in government, vaccine confidence, and vaccine hesitancy.



**Figure 1.** Conceptual framework.

To fill the research gap, the current study proposed and tested mediation pathways linking COVID-19 information exposure on different media, namely social media, traditional news media, and online news media, to vaccine hesitancy, with additional assessment of the mediating roles of public trust in government and vaccine confidence (see Figure 1). Specifically, three types of associations can be hypothesized about COVID-19 information exposure on media and vaccine hesitancy. First, COVID-19 information exposure on media would be directly related to vaccine hesitancy. Second, the relationship between COVID-19 information exposure and vaccine hesitancy would vary across different media (e.g. social media, traditional news media, and online news media). Third, public trust in government and vaccine confidence would mediate the distal association between COVID-19 information exposure on different media and vaccine hesitancy.

## Method

### Procedure

This study was approved by the research ethics committee of the author's institution. To test the above formulated relationships, an online questionnaire was launched in December 2020. To be eligible, participants needed to be 18 years or older and Chinese residents. To ensure high validity and reliability, we borrowed the measurement scales from previous research that have been widely verified with good validity and reliability. Moreover, before we collected the data formally, a pilot test has been conducted with 46 respondents to further ensure the validity and reliability of the measurement instruments. In the pilot test, the reliability coefficients (Cronbach alpha) of the focal variables were all above 0.7, which indicated good reliability. Subsequently, a total of 438 respondents were recruited through convenience sampling, using a widely accepted online questionnaire survey platform Wenjuanxing ('问卷星' in Chinese). The sample respondents were composed of 42.2% male and 57.8% female. The participants were between 18 and 58 years old ( $M = 30.69$ ,  $SD = 9.68$ ). Overall, the respondents were highly educated with 84.3% of the sampling having a college degree or higher education. With regard to the income,

35.4% of respondents had a monthly disposable income above 12,000 Chinese Yuan (CNY), 26.2% reported a monthly income of 6,000 to 12,000 CNY, and 38.4% of the respondents indicated that they received a monthly income below 6,000 CNY.

## **Measurement**

COVID-19 information exposure was measured by three items, drawn from Liu and Jiang (2019). Participants answered questions about their exposure to three major information sources for COVID-19 related information. Three information sources include social media (e.g. WeChat and Weibo), online news media, and traditional news media (e.g. television and newspaper). Respondents were required to answer the questions regarding each information source. A five-point Likert scale was used ranging from never (= 1) to always (= 5) (social media:  $M = 4.10$ ,  $SD = .81$ ; online news media:  $M = 3.83$ ,  $SD = .98$ ; traditional news media:  $M = 3.44$ ,  $SD = 1.23$ ).

Trust in government was measured using three items adapted from previous research (Betsch et al., 2018; Marlow et al., 2007; Quinn et al., 2013). Respondents were asked to rate the extent to which they trust in Chinese government for public health: 'Chinese government would stop vaccinations if there was evidence of a serious risk', 'The Chinese government does a good job of protecting us from risks to health', and 'regarding vaccines, I am confident that Chinese public authorities decide in the best interest of the community'. A five-point scale was used (1 = strongly disagree, 5 = strongly agree), and the answers were averaged to create a scale ( $M = 3.84$ ,  $SD = .68$ , Cronbach's  $\alpha = .84$ ).

Vaccine confidence was measured using two items adapted from Moran et al. (2017). Respondents were asked to indicate on a five-point scale to what extent they agree with two statements on a five-point scale where 1 meant 'strongly disagree' and 5 meant 'strongly agree'. Sample items include: 'COVID-19 vaccines are safe', and 'I am completely confident that COVID-19 vaccines developed in China are safe'. Responses of the two items were averaged to create the measure of vaccine confidence ( $M = 3.40$ ,  $SD = .83$ , Cronbach's  $\alpha = .83$ ).

Vaccine hesitancy was measured using the Vaccine Hesitancy Scale developed by Shapiro et al. (2018). Respondents were asked to indicate to what extent they agree with six statements regarding COVID-19 vaccination: 'COVID-19 vaccines are important for my health', 'getting vaccines is a good way to protect my health from COVID-19', 'having COVID-19 vaccines is important for the health of others in my community', 'COVID-19 vaccines offered by the government are beneficial', 'new vaccines carry more risks than old vaccines', and 'I am concerned about serious adverse effects of COVID-19 vaccines'. Responses of positively phrased items were reversely coded and all responses were averaged to create an index of vaccine hesitancy ( $M = 2.53$ ,  $SD = .60$ , Cronbach's  $\alpha = .68$ ).

Demographics, including age, gender (0 = female, 1 = male), education (1 = primary school or below, 6 = postgraduate degree), average monthly income (1 = 3,000 CNY or less, 6 = 18,001 CNY or more), were queried.

## Data analysis

SPSS version 22 was used for the data analysis. Before data analysis, we tested for homoscedasticity and normality of residuals. Kernel density and Q-Q plots of the standardized residuals in addition to the Shapiro–Wilk test suggested that in our model using vaccine hesitancy as the dependent variable, the residuals are normally distributed and have met the assumption of homoscedasticity of variance. To test the assumption of multicollinearity, the variance inflation factors (VIF) and tolerance values were calculated. The results indicated that VIF values ranged from 1.47 to 2.29, and tolerance values were dispersed between 0.36 and 0.68, which suggested that multicollinearity might not exist. Subsequently, a bivariate Pearson correlation was conducted to illustrate bivariate relationships between COVID-19 information exposure on social media, online news media, traditional media, trust in government, vaccine confidence, and vaccine hesitancy. To test the mediation models, SPSS PROCESS (Zhao, et al., 2013) was used to generate the bootstrapped confidence interval (CI). SPSS PROCESS utilizes the ordinary least squares path analysis and allows a more accurate estimation of the results by bootstrapping with 5,000 samples. Specifically, after controlling for participants' age, gender, education, and income, Model 6 in SPSS PROCESS was used to examine three serial mediation models. In these mediation models, trust in government and vaccine confidence were two serial mediators, vaccine hesitancy was the outcome variable, and three indicators of information exposure (e.g. social media, online news media, and traditional media) were the predictive variables, respectively. In each model, the other two indicators of information sources were added as the covariates.

## Results

Bivariate correlations among focal variables are reported in Table 1, indicating significant correlations among COVID-19 information exposure on social media, traditional news media, online news media, trust in government, vaccine confidence, and vaccine hesitancy ( $r$  ranging from .09 to .82,  $p < .05$  and below).

The results in Table 2 suggests that there was no significant direct association between COVID-19 information exposure and vaccine hesitancy, irrespective of the media used for COVID-19 information.

Nevertheless, the results supported the indirect relationship between COVID-19 information exposure and vaccine hesitancy via trust in government and vaccine confidence. The bootstrap results indicated that COVID-19 information exposure on social media would increase vaccine hesitancy indirectly ( $\beta = .11$ , CI: [.071, .154]).

**Table 1.** Zero order correlation of key variables.

	Alpha	Mean	2	3	4	5	6
1 Social media		4.10	.68***	.55***	.29***	.18***	.09*
2 Online news media		3.83		.65***	.34***	.37***	.20***
3 Traditional media		3.44			.39***	.37***	.20***
4 Trust in government	.84	3.84				.82***	-.67***
5 Vaccine confidence	.83	3.40					-.73***
6 Vaccine hesitancy	.68	2.53					

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

**Table 2.** Regressions testing the relationships between COVID-19 information exposure, vaccine confidence, trust in government and vaccine hesitancy.

Hierarchical regression models	$\beta$	SE	95%CI	Cohen's $f^2$
<i>Predicting Trust</i>				
Social media	.09	.05	[-.015, .186]	.005
Online news media	.06	.05	[-.031, .155]	.003
Traditional news media	.17***	.03	[.102, .232]	.062
<i>Predicting vaccine confidence</i>				
Social media	-.27***	.04	[-.345, -.204]	.042
Online news media	.23***	.03	[.164, .294]	.031
Traditional news media	.03	.02	[-.014, .080]	.001
Trust	.87***	.03	[.652, .914]	.821
<i>Predicting vaccine hesitancy</i>				
Social media	.03	.04	[-.036, .101]	.001
Online news media	.01	.03	[-.056, .070]	.001
Traditional news media	.03	.02	[-.015, .071]	.002
Trust	-.26***	.05	[-.363, -.157]	.031
Vaccine confidence	-.39***	.04	[-.477, -.303]	.087
Mediation models	$\beta$	SE	BootLLCI	BootULCI
<i>Indirect effect</i>				
SM→Trust→Vaccine hesitancy	-.02	.02	-.072	.005
SM→Vaccine confidence→Vaccine hesitancy	.11	.02	.071	.154
SM→Trust→Vaccine confidence→Vaccine hesitancy	-.03	.02	-.083	.008
ONM→Trust→Vaccine hesitancy	-.02	.01	-.045	.007
ONM→Vaccine confidence→Vaccine hesitancy	-.09	.02	-.127	-.059
ONM→Trust→Vaccine confidence→Vaccine hesitancy	-.02	.02	-.067	.010
TNM→Trust→Vaccine hesitancy	-.05	.01	-.072	-.023
TNM→Vaccine confidence→Vaccine hesitancy	-.01	.01	-.037	.006
TNM→Trust→Vaccine confidence→Vaccine hesitancy	-.06	.02	-.101	-.039

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

CI: Confidence interval; Covariates: Demographic variables: gender, age, education and income; SM: Social media; ONM: Online news media; TNM: Traditional news media.

In each mediation model, the other two indicators of information sources were added as the covariates.

Specifically, COVID-19 information exposure on social media was negatively associated with vaccine confidence ( $\beta = -.27$ ,  $p < .001$ , Cohen's  $f^2 = .042$ ), and reduced vaccine confidence would result in vaccine hesitancy ( $\beta = -.39$ ,  $p < .001$ , Cohen's  $f^2 = .087$ ). Whereas COVID-19 information exposure on online news media would decrease vaccine hesitancy indirectly via vaccine confidence ( $\beta = -.09$ , CI: [-.127, -.059]). Moreover, the results in Table 2 shows that COVID-19 information exposure on traditional media would increase trust in government ( $\beta = .17$ ,  $p < .001$ , Cohen's  $f^2 = .062$ ). Trust in government was positively related to vaccine confidence ( $\beta = .87$ ,  $p < .001$ , Cohen's  $f^2 = .821$ ) and negatively associated with vaccine hesitancy ( $\beta = -.26$ ,  $p < .001$ , Cohen's  $f^2 = .031$ ). These findings supported the indirect relationship between COVID-19 information exposure on traditional media and vaccine hesitancy via: (1) trust in government ( $\beta = -.05$ , CI: [-.072, -.010]), and (2) trust in government and vaccine confidence in sequence ( $\beta = -.06$ , CI: [-.101, -.039]).



## Discussion

The purpose of this study was to explore the influence of COVID-19 information exposure on different media on vaccine hesitancy, as well as the mediating roles of trust in government and vaccine confidence. Through a survey of 438 respondents in China, this study found that COVID-19 information exposure can influence vaccine hesitancy indirectly, and the impact varied across different media. Detailed results are discussed below.

This study provided empirical evidence suggesting that trust in government and vaccine confidence would mediate the association between COVID-19 information exposure and vaccine hesitancy. COVID-19 information exposure on traditional news media and online news media can reduce vaccine hesitancy via increased trust in government and improved vaccine confidence. These findings can be explained by the governmental hegemonic practices regarding the COVID-19 containment in the Chinese mass media. In China, mass media (e.g. newspaper, radio, and online news media) are under strict control of the party-state (Yang, 2013). As China has managed to control COVID-19 rapidly and effectively (Liu, 2020), COVID-19 information on news media was likely to be framed in the favor of the government, such as the Chinese government's extraordinary efforts in containing the pandemic and developing vaccines. Individuals who are more trusting of the government in handling the crisis show more confidence in Chinese-made COVID-19 vaccines, therefore less likely to refuse COVID-19 vaccination.

However, COVID-19 information exposure on social media was found to be positively associated with vaccine hesitancy indirectly. Exposure to COVID-19 information on social media was negatively related to vaccine confidence, and the lower vaccine confidence would increase vaccine hesitancy. The statistically acknowledged ( $p < .05$ ) indirect path and unacknowledged (aka non-significant) direct path form indirect-only mediation (Zhao et al., 2010; Jiang et al., 2021). One plausible reason is that social media contain a fair amount of misinformation that was closely related to public health (Bode & Vraga, 2018; Chou et al., 2018). Given that COVID-19 vaccine development was compressed in time, and news about temporary side effects of the vaccines has been reported and raised global concerns, it is worrying that misinformation and unsubstantiated rumors about COVID-19 and vaccines against the disease were spread widely on the internet (Duffy, 2020; Liu & Huang, 2020). Individuals who relied on social media for COVID-19 related information were more likely to be misinformed by disinformation about COVID-19 vaccines (Burki, 2020; Wilson & Wiysonge, 2020). The spread of disinformation and misinformation about COVID-19 vaccines on social media can weaken people's confidence in vaccine safety and increase vaccine hesitancy.

The findings of this study hold valuable practical implications. First, during the outbreak of a pandemic, media environments are of particular importance that determines one's vaccination decisions. Social media, while providing an unprecedented capacity for the public to stay informed on COVID-19 updates, has been a major channel that fuels unsubstantiated rumors regarding COVID-19 and vaccinations that jeopardize public health. Thus, reconciling principles of online information with the policing of social media for malicious falsehoods remains a conundrum. It is imperative for policymakers to invest in digital and media literacy as a solution to disinformation. Second, given the different influence of COVID-19 information exposure, trust in government

and vaccine confidence on vaccine hesitancy. Practitioners should use cross-media strategies to communicate tailored information to enhance public trust and confidence toward the government and vaccines. For instance, through traditional news media, online news media, and social media, we should continue to provide vaccine-hesitant individuals with evidence-based information about the ongoing government activities for a safe and effective COVID-19 vaccine.

Several limitations of this study should be noted. First, single-item measures were used to investigate participants' COVID-19 information exposure on traditional news media, online news media, and social media, and this might incur measurement errors. Future research should use multiple items to ensure adequate reliability (e.g. internal consistency). Second, the cross-sectional study design might preclude an assessment of causality between COVID-19 information exposure, trust in government, vaccine confidence, and vaccine hesitancy. Scholars can use longitudinal research designs or experimental methods to better understand the relationships. Third, the data of this study was collected through an online survey which might be influenced by sampling bias, and the results cannot be generalized. For instance, the survey was available to respondents who are active online, and the sample of this study is skewed toward a highly educated population. Scholars should use probability sampling methods to research a diverse population and obtain higher-quality findings.

## Conclusion

During the crisis of COVID-19 pandemic, mass media play a salient role that potentially influences people's decision-making processes regarding the COVID-19 vaccination. The current study examined the influence of COVID-19 information exposure on different media on vaccine hesitancy, as well as the mediating roles of public trust in government and vaccine confidence. The findings suggested that COVID-19 information exposure on different media did not impact vaccine hesitancy directly. Whereas the results provide empirical evidence indicating that trust in government and vaccine confidence mediated the relationships between COVID-19 information exposure on different media and vaccine hesitancy. This study sheds some light on the previous findings that decision-making on vaccination is proportional to the exposure to COVID-19 information on different media. It is also meaningful to continue the investigation of mechanisms underlying the impacts of COVID-19 information exposure on vaccination hesitancy.

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## Disclosure statement

No potential conflict of interest was reported by the author(s).

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