

## **Anti-Vaccine Beliefs and COVID-19 Information Seeking on Social Media: Examining Processes Influencing COVID-19 Beliefs and Preventative Actions**

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This study explored how anti-vaccine beliefs and social media use operate as interrelated factors contributing to COVID-19-specific beliefs and actions. Results show that those harboring greater anti-vaccine sentiments rely strongly on social media sources for COVID-19 information. Tests of indirect effects show that COVID-19 information seeking on social media mediates the relationship between anti-vaccine beliefs and COVID-19 conspiracy beliefs. Furthermore, results support a three-step model linking anti-vaccine beliefs to reduced COVID-19 preventative actions through social media use and conspiracy beliefs. Although anti-vaccine beliefs and information seeking contribute to reduced prevention action, the results also indicate these factors have differing relationships with anti-vaccine intentions. Whereas anti-vaccine beliefs predict more vaccine resistance, COVID-19 information seeking on social media contributes to higher levels of vaccine efficacy and intentions.

*Keywords: anti-vaccine beliefs, COVID-19 information seeking, social media, conspiracy beliefs*

The COVID-19 pandemic highlights the importance of mitigating barriers to preventative health actions. As individuals seek information sources that provide guidance and support, an increasing number of American citizens use social media platforms to acquire immediate and personalized health information. Unfortunately, these platforms frequently contain inaccurate, misleading information that perpetuates false beliefs and promotes unhealthy behaviors. The current investigation explores how anti-vaccine judgments and social media use can be influential in current attitudes and behaviors surrounding COVID-19. A recent analysis by the U.K. organization The Center for Countering Digital Hate ([CCDH], 2020) determined that large social media platforms were failing to flag coronavirus-related anti-vaccine posts that overtly contained harmful information. This investigation uncovered over 900 examples of anti-vaccine messaging, many of which focused on conspiracy theories. Results also showed that even after receiving notification of these

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anti-vaccine messages, major social media platforms failed to take action. Although certain social media platforms have recently taken more aggressive steps to combat this problem (Heilweil, 2020), the prevalence of COVID-19 misinformation via social media may continue to thwart prevention efforts.

This study examines underlying processes linking anti-vaccine beliefs and social media use to COVID-19-specific health outcomes. We explore how these factors operate together to promote COVID-19 conspiracy beliefs and resistance to preventative actions. The findings from this investigation offer broader insight on how these factors contribute to broader resistant actions and challenges to public health initiatives.

### **Anti-Vaccine Beliefs and Social Media**

Individuals holding anti-vaccine perceptions express a reluctance or outright refusal to be vaccinated (Smith, 2017). Those who are vaccine hesitant may engage in various cognitive strategies (Dubé, Vivion, & MacDonald, 2015), including omission bias (Healy & Pickering, 2011). This occurs when individuals perceive the risk tied to getting a vaccine as greater than that of avoiding inoculation. The rise of the anti-vaccine movement correlates with declining immunization rates and subsequent vaccine-preventable outbreaks (Gangarosa et al., 1998; Phadke, Bednarczyk, Salmon, & Omer, 2016). In 2019, the United States reported its greatest number of measles cases since 1992 (Patel et al., 2019).

The anti-vaccine movement proliferates in the digital sphere, pre-dating the social media age (Zimmerman et al., 2005). Digital media offers an inexpensive platform to share information to many people. Over time, with the introduction of social media, thought influencers on sites such as Facebook (Buchanan & Beckett, 2014; Smith, 2017) have amassed numerous followers. The CCDH (2020) noted that between 2019 and 2020, social media accounts held by those embracing anti-vaccine ideology increased by nearly 8 million. Furthermore, those findings show that roughly 31 million people follow anti-vaccine groups on Facebook with another 17 million subscribing to anti-vaccine accounts on YouTube. This implies that those likely to hold more negative or skeptical beliefs toward vaccines are likely to use social media platforms to engage in anti-vaccine messaging. This connection can result in resistance to large-scale vaccine initiatives. In particular, research indicates that increased consumption of misinformation related to vaccines impacts both attitudes and intentions (Chou, Oh, & Klein, 2018). For example, a recent study of HPV vaccine-related tweets showed that vaccine rates were lower in states where greater numbers of tweets contained false information about HPV vaccine safety as well as the promotion of conspiracy theories (Dunn et al., 2017).

Lazer and his colleagues (2018) posit that the ability of individuals and groups to share false information via social media facilitates greater spread of misinformation than through other information sources. More broadly, researchers have found that social media advice from the "crowd" is viewed as equally, if not more credible than, advice from the medical establishment (Bäckström et al., 2017). This supports earlier trends documenting preferences to seek health information from user-generated platforms as opposed to traditional vaccine information websites (Wittman & Zikmund-Fisher, 2012). Investigators of social media platforms such as YouTube and Facebook suggest that negative messaging is particularly powerful in generating interest and engagement (Ache & Wallace, 2008; Bradshaw, Shelton, Wollney, Treise, & Auguste, 2021; Briones, Nan, Madden, & Waks, 2012). Furthermore, an investigation of Twitter shows that greater prior exposure to anti-vaccine tweets drives subsequent negative vaccine posts (Dunn, Leask, Zhou, Mandl, & Coiera, 2015). In

support of these arguments, researchers examining pro- versus anti-vaccine blogs indicate that negative blogs lead to negative attitudes and reduced intentions to get vaccines, whereas positive blogs have no effect on either attitudes or intentions (Nan & Madden, 2012). Overall, those embracing anti-vaccine sentiments should be motivated to use social media platforms that help perpetuate these perspectives. In this investigation, we explore how this relationship translates into COVID-19-specific beliefs and actions.

### **COVID-19 Information Seeking**

Information seeking and conspiracy thinking perspectives—highlighting uncertainty as a motivating factor—help explain the link between anti-vaccine attitudes and COVID-19-related social media use. The health information acquisition model argues that uncertainty is the initial driver for information seeking action (Freimuth, Stein, & Kean, 1989). Information seeking, in turn, serves as a functional way to manage and cope with gaps in knowledge (Brashers, Goldsmith, & Hsieh, 2002). Media systems dependency theory further states that people will rely on mediated resources when faced with ambiguity or threat (Ball-Rokeach, 1985). Ultimately, information seeking action is a method to reduce the cognitive and emotional discomfort induced through this ambiguity. The COVID-19 pandemic has triggered various perspectives pertaining to the infectiousness and deadliness of the virus (Atkeson, 2020; Fauci, Lane, & Redfield, 2020), testing availability, effectiveness of various preventative measures (Anderson, Heesterbeek, Klinkenberg, & Hollingsworth, 2020; Berger, Herkenhoff, Huang, & Mongey, forthcoming), and the potential economic costs (Alfaro, Chari, Greenland, & Schott, 2020; Baker, Bloom, Davis, & Terry, 2020). The high level of information, some of which may be contradictory, can generate uncertainty. Amid the COVID-19 pandemic, information resources that assist in managing the emotional and cognitive discomfort generated by this ambiguity should be particularly appealing.

Prior investigations also indicate that contexts that produce greater uncertainty give rise to conspiracy beliefs (Miller, 2020; van Prooijen & Acker, 2015). A unitary conspiracist worldview reflects a perception that clandestine networks of individuals have hidden or have bad intentions to engage in behaviors that negatively impact the public (Hornsey, Harris, & Fielding, 2018). Those embracing this perspective are more likely to accept conspiracy theories tied to science; in turn, this may reduce vaccine motivations. Recent international analysis examining the psychological roots of anti-vaccine attitudes showed that anti-vaccine attitudes correlated most strongly with general conspiracy beliefs (Hornsey et al., 2018). Additional research stresses that anti-vaccine beliefs are a result of a broader psychological tendency embracing conspiracies (Goldberg & Richey, 2020).

The comprehensive model of information seeking (CMIS) argues that perceptions of information sources are a key determinant of actual media selection (Johnson & Meischke, 1993). Ultimately, media platforms that present greater conspiracy messaging during a time of pandemic-specific uncertainty should be particularly appealing to those who embrace broader anti-vaccine sentiments. Content analysis of YouTube HPV videos indicates that conspiracy theory messaging is a common theme in anti-vaccine videos (Briones et al., 2012). Analysis of Facebook shows that the bulk of those that enjoy or comment on conspiracy information are those who typically interact with conspiracy stories (Bessi et al., 2015). In addition, those in Facebook communities are inclined to spread conspiracy content. Recent Twitter research shows that pseudoscientific claims proliferate Zika virus posts (Dredze, Broniatowski, & Hilyard, 2016).

Overall, social media offers a platform to promote and reinforce anti-vaccine conspiracy beliefs. These perspectives gain greater traction during times of heightened uncertainty. The uncertainty created by this pandemic should drive those with anti-vaccine beliefs to social media sources known to facilitate conspiracy beliefs. In particular, the uncertainty driving information seeking, coupled with the attraction to conspiracy messaging, should motivate those with anti-vaccine perspectives to seek out COVID-19 information via social media. This leads to the following prediction:

*H1: Anti-vaccine beliefs will predict greater COVID-19 information seeking on social media.*

### **COVID-19 Conspiracy Beliefs**

The broader connection among anti-vaccine beliefs, social media use, and underlying conspiracy thinking should extend to COVID-19-specific conspiracy beliefs. Examples of prevalent conspiracy arguments revolve around perceptions that the virus is a biological weapon used by China, the media exaggerates the seriousness of the virus to make former President Trump look bad, and that Bill Gates injected a tracking device in the coronavirus vaccine (see Miller, 2020, for review). Recent data indicates a strong relationship between dispositional conspiracy thinking and COVID-19 conspiracy beliefs (Miller, 2020). Consequently, those holding anti-vaccine perspectives who generally embrace conspiracy theories are inclined to respond positively to conspiracies specifically tied to COVID-19:

*H2: Anti-vaccine beliefs will predict COVID-19 conspiracy beliefs.*

In addition, recent data indicates that COVID-19 anti-vaccine information has become increasingly more common on social media sites (CCDH, 2020), with COVID-19 conspiracy theories permeating these platforms. Allington, Duffy, Wessely, Dhavan, and Rubin (2020) found a positive relationship between U.K. residents' social media use for COVID-19 information and COVID-19 conspiracy beliefs. Ultimately, the greater prevalence of conspiracy messaging via social media as opposed to traditional news sources offers increased opportunity to develop COVID-19 conspiracy beliefs. Among digital resources, social media is increasingly becoming a popular source for addressing health concerns (Zhao & Zhang, 2017). As noted, social media users perceive advice from social media sources to be as credible as that of medical institutions (Bäckström et al., 2017). Thus, individuals may be less inclined to discount misinformation promoted via social media. Furthermore, social media offers various social capital—a term referring to broader benefits accrued from social relationships (Phua, Jin, & Kim, 2017; Putnam, 2000). Certain platforms, such as Twitter, offer opportunities to engage in less in-depth but information-driven relationships that expand their perspectives on the world, a term referred to as bridging social capital. Conversely, other platforms, such as Facebook, provide bonding social capital with those in preexisting close-knit relationships that offer emotional support (Phua et al., 2017; Putnam, 2000). Taken collectively, the prevalence of COVID-19 conspiracy messaging on social media and the distinct value of these platforms should drive greater support for conspiracy beliefs:

*H3: COVID-19 information seeking on social media will predict COVID-19 conspiracy beliefs.*

Drawing from these relationships, we predict that COVID-19 information seeking on social media will operate as an intervening factor in the relationship between anti-vaccine attitudes and COVID-19 conspiracy beliefs. Social media is an appealing information resource to facilitate the promotion of conspiracy theories. Theoretical arguments from information seeking perspectives (Ball-Rokeach, 1985; Brashers et al., 2002; Johnson & Meischke, 1993) and research documenting the psychological foundation of vaccine hesitancy (Goldberg & Richey, 2020; Hornsey et al., 2018) suggest that COVID-19 uncertainty, coupled with general conspiracy ideology, drive those with anti-vaccine beliefs to select social media platforms for COVID-19 information. Next, the prevalence and nature of COVID-19 conspiracy messaging on social media should, in turn, increase COVID-19-specific conspiracy beliefs. While those with anti-vaccine beliefs may directly embrace COVID-19 conspiracy beliefs independent of social media use, the broader impact of the "crowd" on social media should offer additional support and arguments to foster these perceptions. This leads to the following prediction:

*H4: COVID-19 information seeking on social media will mediate the relationship between anti-vaccine attitudes and COVID-19 conspiracy beliefs.*

### **COVID-19 Preventative Health Actions**

Personal health decisions made during the COVID-19 pandemic are vital to preventing negative health outcomes. Although rates of COVID-19 vaccine hesitancy have improved over time, evidence suggests that many of Americans remain hesitant (Pew Research Center, 2021a). In particular, as of March 2021 more than 30% of Americans expressed COVID-19 vaccine hesitancy (Pew Research Center, 2021a). Notably, previous analyses centered on anti-vaccine sentiment related to immunizations improved after a substantially longer trial phase/time period (e.g., HPV, MMR). Conversely, the current pandemic has led to more expedited vaccine trials and initiatives such as "operation warp speed." In contrast to other vaccines, some of the resistance to the COVID-19 vaccine (both before vaccine approval and currently) relates to the speed of vaccine development (potentially lacking sufficient safety standards) as well as the politics surrounding it (Hamel, Kirzinger, Munana, & Brodie, 2020). Consequently, although universal anti-vaccine messaging is a likely driver of much COVID-19 vaccine resistance, more tailored COVID-19 anti-vaccine and conspiracy arguments provide increased rationale to avoid vaccination. As noted above, there exists unique COVID-19-related conspiracy messaging concerning political and powerful elites (i.e., Bill Gates injected vaccines with tracking devices; CCDH, 2020; Miller, 2020). These themes, combined with messages that highlight the speed of vaccine development or promote fear or risk messaging (CCDH, 2020), offer more contextualized appeals for COVID-19 vaccine resistance. Overall, it is unclear whether broader anti-vaccine sentiment remains the central mechanism contributing to COVID-19 vaccine efficacy and intentions.

Although broader vaccine hesitancy should directly contribute to COVID-19 vaccine resistance, we argue that a multistep process provides a more in-depth explanation of how general anti-vaccine sentiment drives this resistance. Misinformation reinforced by social media platforms should present barriers to public health vaccine promotion efforts. As discussed, social media is now a central platform to disseminate misinformation and promote anti-vaccine perspectives. Furthermore, individuals often perceive user-generated medical information to be as credible as that from traditional online resources (Bäckström et al., 2017; Witteman & Zikmund-Fisher, 2012). Given that social media serves as a central platform that attracts anti-vaccine

sympathizers through the promotion of conspiracy beliefs, those with general vaccine hesitancy may turn first to social media platforms to obtain COVID-19 information. The prevalence of COVID-19-specific conspiracy messaging on these platforms as opposed to other media sources (CCDH, 2020) may reinforce or bolster COVID-19-specific conspiracy beliefs leading to greater vaccine resistance.

Although a perceived threat motivates behavior change (Witte, 1992), conspiracy theories operate to reduce such threats (Romer & Jamieson, 2020). In particular, conspiracy beliefs frequently minimize threats or offer alternative measures to deal with these risks. Furthermore, because they are difficult to disprove, conspiracy beliefs can weaken motivation to take preventative action (Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012; Uscinski, Klofstad, & Atkinson, 2016). One recent investigation showed that COVID-19 conspiracy beliefs predicted reduced COVID-19 vaccine intentions (Romer & Jamieson, 2020). An earlier investigation found that HPV conspiracy beliefs links to lower vaccine uptake (Dunn et al., 2017).

The relationship among anti-vaccine beliefs, social media use, and conspiracy beliefs presents public health challenges that extend beyond COVID-19 vaccine hesitancy. In particular, recent data shows that acceptance of COVID-19 conspiracy beliefs negatively correlates with wearing masks and maintaining social distance (Romer & Jamieson, 2020). Given that conspiracy beliefs operate to reduce perceptions of a perceived threat, this factor should serve as a direct barrier to engaging in other COVID-19-specific preventative actions (e.g., wearing masks and social distancing). Overall, drawing from theoretical arguments and empirical findings, we argue that anti-vaccine beliefs will indirectly predict reduced COVID-19 preventative beliefs and action through a multistep process involving COVID-19 social media information seeking and COVID-19 conspiracy beliefs:

*H5: Anti-vaccine beliefs will indirectly predict lower COVID-19 preventative beliefs/action through a three-step process involving COVID-19 information seeking on social media and COVID-19 conspiracy beliefs. Specifically, anti-vaccine beliefs will lead to increased COVID-19 information seeking on social media that in turn predicts greater COVID-19 conspiracy beliefs and ultimately, reduced COVID-19 preventative action.*

## **Methods**

### ***Participants and Procedure***

Participants were recruited via Mechanical Turk in July 2020. To be eligible to take the study, participants had to be located in the United States, have had greater than 500 human intelligence tasks (HITS) approved, and a HIT approval rate greater than 95%. Each respondent received \$1 for participating. A total of 310 individuals completed the online survey.

Participants ranged in age from 20–72, with roughly 43% of respondents reported being between 30–40 years old and an additional 28% between the ages of 20–29. The majority of participants (71%) were White. Males comprised a larger percentage of the sample (61%) than females (39%).

## **Measures**

### *Anti-Vaccine Beliefs*

To assess anti-vaccine sentiment, we used the recently developed vaccine skepticism scale (LaCour & Davis, 2020). The vaccine skepticism scale is comprised of 16 items measured on a 1 (strongly disagree) to 7 (strongly agree) scale. Sample measures include "Vaccines are tampered with" and "Vaccine efficacy data is often fabricated." All items were summed together and averaged to create the composite scale ( $\alpha = .99$ ,  $M = 3.57$ ,  $SD = 1.98$ ).

### *COVID-19 Information Seeking via Social Media*

We adapted Liu's (2020) COVID-19 information seeking instrument—assessing social media platforms for a Chinese population—to fit the current U.S. context. All six items began with the following stem: "In the past month, how often did you seek COVID-19-related information from [social media source]?" The platforms included: Facebook, Twitter, YouTube, Instagram, Snapchat, and social live-streaming services (e.g., TikTok, YouNow, Tumblr).<sup>1</sup> Though not exhaustive of all social media, we selected these platforms based on the following rationale. First, we selected those most commonly examined in health information seeking or vaccine research, such as Facebook, Twitter, and YouTube (CCDH, 2020; Dunn et al., 2017). Second, in addition to these more traditional social media platforms, we incorporated emerging social platforms popular with young adults, such as Instagram, Snapchat, and social live-streaming services (Pew Research Center, 2021b). Two of these emerging platforms—Instagram and Snapchat—have been grouped with Facebook and Twitter in relation to its broader social capital implications (Phua et al., 2017). The "social live-streaming services" variable is an item borrowed directly from Liu's (2020) instrument. This includes platforms such as TikTok that have become particularly popular among younger demographics (Pew Research Center, 2021b). Items were measured on a 1 (never) to 5 (always) scale. All item responses were summed together, then averaged to create the social media information seeking scale ( $\alpha = .92$ ,  $M = 2.65$ ,  $SD = 1.23$ ).

### *COVID-19 Conspiracy Beliefs*

To assess COVID-19 conspiracy beliefs, the researchers used Miller's (2020) 11-item COVID-19 conspiracy beliefs scale. The items drew from themes circulating during spring 2020 (Lynas, 2020). Sample items include "The virus is a biological weapon intentionally released by China" and "The coronavirus was intentionally created to reduce the world's population." Scale responses ranged from 1–4 (1 = definitely not; 2 = probably not; 3 = probably; 4 = definitely) with higher numbers reflecting greater beliefs. All item responses

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<sup>1</sup> Participants were not asked whether they had accounts on these platforms, thus we did not filter based on account ownership. There are two reasons we do not think this is a concern. First, those who do not have an account may simply answer "never" to these questions. Additionally, however, a rationale for not filtering based on account ownership is that individuals can consume social media content without necessarily having accounts on those platforms (e.g., YouTube videos or Twitter posts).

were summed together and then averaged to create the COVID-19 conspiracy beliefs scale ( $\alpha = .92$ ,  $M = 2.11$ ,  $SD = .79$ ).

#### *COVID-19 Preventative Beliefs/Action*

*Vaccine efficacy beliefs* were assessed through a modified version of the influenza vaccine efficacy scale (Kim, Pjesivac, & Jin, 2019). Unlike previous investigations, the researchers created two three-item efficacy scales that varied based on whether the vaccine would be available within the next year or in two years. This decision was made based on concerns that perception of COVID-19 vaccine efficacy would potentially be influenced by the speed through which it came to market. The first three-item measure asked participants on a 1 (strongly disagree) to 7 (strongly agree) scale the following: (a) I believe that if a coronavirus/COVID-19 vaccine became available *within the next year*, it would be effective in preventing the virus; (b) I believe if I were to receive a coronavirus/COVID-19 vaccine *within the next year*, I would be less likely to get the virus; (c) I believe that a coronavirus/COVID-19 vaccine that became available *within the next year* would work in preventing the virus. All items were summed together and averaged to create this measure ( $\alpha = .90$ ,  $M = 5.22$ ,  $SD = 1.41$ ). The second three-item scale was identical to the first except for the wording "*within two years now*" replacing "*within the next year*" ( $\alpha = .91$ ,  $M = 5.40$ ,  $SD = 1.40$ ). The correlation between the two efficacy measures was high,  $r = .85$ ,  $p < .01$ . In addition, subsequent analyses of the central study variables revealed no meaningful differences when comparing these two measures. For parsimonious reporting purposes, we retained the "next year efficacy" measure only.

We measured *COVID-19 vaccine intentions* by drawing from a Zika vaccine intention measure (Ophir & Jamieson, 2018) and a measure of influenza vaccine intentions (Kim et al., 2019). Similar to the efficacy scale described above, the researchers created two scales. The first scale presented participants with the scenario:

If a coronavirus/COVID-19 vaccine became available *within the next year*, how likely is it that you would (a) consider receiving the vaccine, (b) try to receive the vaccine, (c) actually get the vaccine once it is available, and (d) receive the vaccine if a healthcare provider offers it to them within the next year.

The four items were summed together and averaged to create the next-year intention scale ( $\alpha = .96$ ,  $M = 5.14$ ,  $SD = 1.75$ ). The second scale was identical to the first with the exception of the wording "If a coronavirus/COVID-19 vaccine became available *two years from now*, how likely is it that you would." The combination of the four items addressing two-year availability formed this scale ( $\alpha = .96$ ,  $M = 5.25$ ,  $SD = 1.74$ ). Consistent with the findings from the efficacy scales, the correlation between the two intention measures was extremely high,  $r = .93$ ,  $p < .01$ . Additional tests of the central study variables revealed no meaningful differences when comparing these two measures. For these reasons, the researchers only retained the "within the next year" scale.

The researchers measured *COVID-19 nonvaccine preventative behaviors* through scale items taken by a similar recent investigation (Liu, 2020). Participants reported how frequently during the current pandemic they engaged in the following: (a) keeping away from crowded places, (b) washing hands more regularly with



soap and water, (c) cleaning or disinfecting things they touched, (d) avoiding public transport, (e) avoiding travel to affected areas, avoiding people who have flu-like symptoms, (f) wearing face masks in public places, (g) seeking medical advice with the onset of symptoms, and (h) taking preventative medication. Reliability analyses indicated that the "seeking medical advice" and "taking preventative medication" items had low item-total correlation ( $< .30$ ) with the remaining seven items. In addition, these analyses showed that the scale reliability improved considerably (from  $\alpha = .75$  to  $\alpha = .85$ ) by removing both items. Consequently, both items were removed, and the remaining seven items were summed together and then averaged to create the COVID-19 nonvaccine preventative behaviors scale ( $\alpha = .85$ ,  $M = 4.26$ ,  $SD = .66$ ).

### *Control Measures*

We included age, gender, and race/ethnicity as demographic control measures. In addition, participants reported perceived COVID-19 risk. The measures draw from one recent investigation of COVID-19 risk perceptions (Dryhurst et al., 2020) as well as traditional perceived risk measures (Witte, 1996). Perceived COVID-19 risk included a four-item perceived vulnerability scale and a three-item perceived severity scale. A sample vulnerability item was: "I will probably get sick with the coronavirus/COVID-19," measured from 1 (strongly disagree) to 5 (strongly agree). A sample severity item was: "If I get the coronavirus/COVID-19, it will be risky," measured from 1 (strongly disagree) to 7 (strongly agree). Items for the respective scales were summed together and then averaged to create the overall instrument (perceived vulnerability:  $\alpha = .84$ ,  $M = 4.23$ ,  $SD = 1.29$ ; perceived severity:  $\alpha = .85$ ,  $M = 3.24$ ,  $SD = 1.08$ ). Finally, as a control measure and for comparative purposes, we included a single-item online news information-seeking measure ( $M = 3.64$ ,  $SD = 1.13$ ). Consistent with the measurement of social media information seeking, the item began with the stem: "In the past month, how often did you seek COVID-19-related information from" with the option being "online news media." Response options ranged from 1 (never) to 5 (always).

### **Proposed Analyses**

Hierarchical regression analyses were run to assess the unique and incremental variance explained by central study variables. This allows the researcher to examine the incremental variance explained by a set of predictor variables after accounting for the variance explained by other measures (i.e., demographic measures). For the mediation analyses, the researchers formally assessed indirect effects via the PROCESS macro (Hayes, 2012).

### **Results**

Table 1 presents the results of preliminary Pearson correlation tests. Results indicate that anti-vaccine beliefs correlated positively with COVID-19 information seeking on social media ( $r = .66$ ,  $p < .01$ ) and conspiracy beliefs ( $r = .80$ ,  $p < .01$ ). Anti-vaccine beliefs also correlated negatively with preventive actions ( $r = -.32$ ,  $p < .01$ ), vaccine efficacy beliefs ( $r = -.29$ ,  $p < .01$ ), and intentions ( $r = -.27$ ,  $p < .01$ ). Similarly, COVID-19 information seeking on social media correlated positively with conspiracy beliefs ( $r = .65$ ,  $p < .01$ ) and negatively with nonvaccine preventative actions ( $r = -.18$ ,  $p < .01$ ). Contrary to expectations, COVID-19 information seeking on social media correlated positively with vaccine efficacy beliefs ( $r = .13$ ,  $p < .05$ ) and intentions ( $r = .14$ ,  $p < .05$ ).

**Table 1. Intercorrelations Between Central Study Variables.**

Variable	1	2	3	4	5	6
1. Anti-vaccine beliefs		.65**	.80**	-.29**	-.27**	-.32**
2. COVID-19 ISSM	-		.65**	.13*	.14*	-.18**
3. COVID-19 CB	-	-		-.22**	-.22**	-.36**
4. VEB	-	-	-		.80**	.32**
5. VI	-	-	-	-		.26**
6. NVPB	-	-	-	-	-	

N = 307

Note. The numbers reflect Pearson's  $r$  coefficients. COVID-19 ISSM = COVID-19 Information Seeking on Social Media; COVID-19 CB = COVID-19 Conspiracy Beliefs; VEB = Vaccine Efficacy Beliefs; VI = Vaccine Intentions; NVPB = Nonvaccine Preventative Behaviors.

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

### Information Seeking

H1 predicted a positive association between anti-vaccine beliefs and COVID-19 information seeking on social media. To formally test this prediction, we employed hierarchical regression analysis. The demographic variables (age, gender, ethnicity) and perceived risk measures were included as control items in block 1. Block 2 included anti-vaccine beliefs. In the final model, results indicated that anti-vaccine beliefs significantly predicted social media COVID-19 information seeking [ $\beta = .55$ ,  $p < .01$ ;  $\Delta R^2 = .27$ ,  $\Delta F(1, 293) = 184.32$ ,  $p < .01$ , see Table 2]. H1 was supported. The final model accounted for 57% of the variance ( $R^2 = .57$ ) in COVID-19 information seeking on social media.

**Table 2. Summary of Hierarchical Regression Analyses for Variables Predicting COVID-19 Information Seeking on Social Media.**

	$\beta$	SE	$R^2$	$\Delta R^2$
Model 1—Control measures			.30**	
Race/ethnicity (non-White)	.11*	.14		
Age	-.25**	.01		
Gender (female)	-.08	.13		
Perceived COVID-19 vulnerability	.32**	.07		
Perceived COVID-19 Severity	.16*	.08		
Model 2a—Predictors			.57**	.27**
Anti-vaccine beliefs	.55**	.03		

N for model = 299

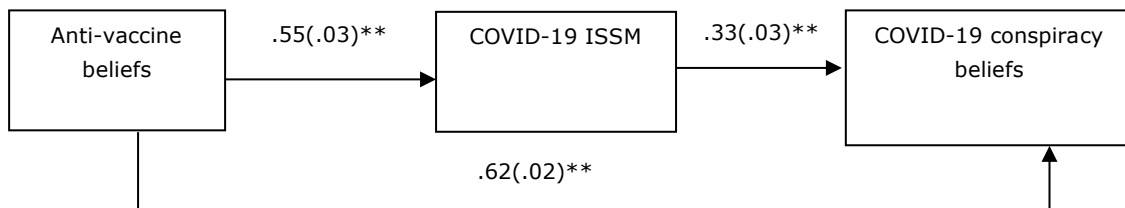
Note. Regression coefficients are standardized. \* =  $p < .05$ , \*\* =  $p < .01$ .

### Post Hoc Analysis

Although not a focus of this study, for comparative purposes we ran an identical hierarchical regression test predicting COVID-19 information seeking on online news sites. Results showed that anti-vaccine beliefs had no significant relationship with this outcome [ $\beta = -.02$ ,  $p > .05$ ;  $\Delta R^2 = < .01$ ,  $\Delta F(1, 293) = .17$ ,  $p > .05$ ].

### COVID-19 Conspiracy Beliefs

H2, H3, and H4 examined direct and indirect relationships among anti-vaccine beliefs, COVID-19 information seeking on social media, and COVID-19 conspiracy beliefs. The demographic variables (age, gender, ethnicity), perceived risk measures, and online news media information seeking were included as control measures. Hierarchical regression results showed that none of the demographic measures significantly predicted COVID-19 conspiracy beliefs. Step 2 of the model showed that both anti-vaccine beliefs ( $\beta = .62, p < .01$ ) and COVID-19 information seeking on social media ( $\beta = .33, p < .01$ ) emerged as independent positive predictors of COVID-19 conspiracy beliefs. H2 and H3 were supported. In addition, the indirect effects examined via model 4 of the PROCESS macro (Hayes, 2012) revealed a significant indirect effect of anti-vaccine beliefs on COVID-19 conspiracy beliefs through social media COVID-19 information seeking ( $B = .18, p < .05$ ; 95% confidence interval: .12 to .25; see Figure 1). H4 was supported. The final model accounted for 69% of the variance in COVID-19 conspiracy beliefs ( $R^2 = .69, p < .01$ ).

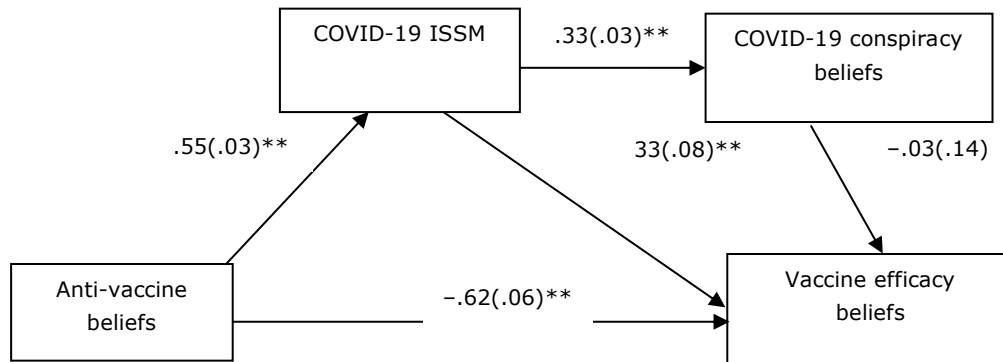


**Figure 1. COVID-19 information seeking on social media as mediator between anti-vaccine beliefs and COVID-19 conspiracy beliefs. COVID-19 ISSM = COVID-19 Information Seeking on Social Media. The numbers reflect standardized regression coefficients obtained through hierarchical multiple regression analysis. For the final model,  $\Delta R^2 = .62^{**}$ , overall  $R^2 = .69^{**}$ . Numbers in parentheses denote standard errors.  $** = p < .01$ .**

### Preventative Health

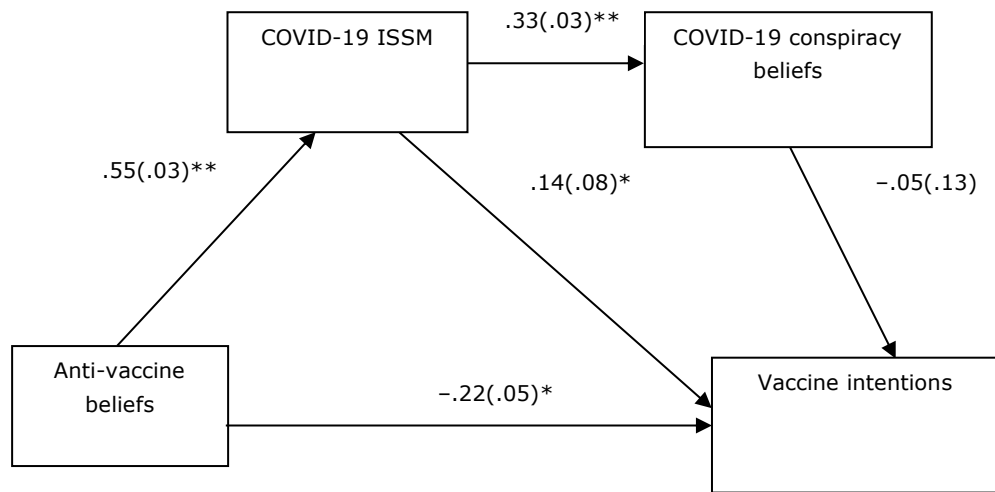
H5 predicted a sequential process leading from anti-vaccine beliefs to (a) COVID-19 information seeking on social media, (b) COVID-19 conspiracy beliefs, and finally, (c) preventative beliefs or behaviors (vaccine efficacy, intentions, nonvaccine preventative action). Serial mediation analysis using Model 6 from the Process Macro (Hayes, 2012) examined these processes. The first model predicted COVID-19 vaccine efficacy beliefs. Preliminary analyses revealed that of the control measures, COVID-19 information seeking on online news ( $\beta = .19, p < .01$ ) and perceived COVID-19 vulnerability ( $\beta = .24, p < .01$ ) significantly predicted efficacy beliefs. Among the central study variables, regression results showed that anti-vaccine beliefs emerged as an independent, negative predictor of COVID-19 vaccine efficacy beliefs ( $\beta = -.62, p < .01$ ). Conversely, COVID-19 information seeking on social media positively predicted COVID-19 vaccine efficacy beliefs ( $\beta = .31, p < .01$ ). COVID-19 conspiracy beliefs did not predict COVID-19 vaccine efficacy beliefs ( $\beta = -.03, p > .05$ , see Figure 2). This finding shows that the larger sequential mediation model was not significant. The final model accounted for 43% of the variance in efficacy beliefs ( $R^2 = .43, p < .01$ ). Notably, indirect effects tests showed that COVID-19 information seeking on social media significantly mediated the relationship between anti-vaccine beliefs and COVID-19 vaccine efficacy beliefs ( $B = .19, p < .05$ ; 95% confidence interval: .10 to .29). Overall, while the initial model predicted that COVID-19 information seeking via social media would operate as an indirect *negative* predictor of vaccine beliefs, the

results unexpectedly showed that COVID-19 information seeking via social media had a direct *positive* relationship with vaccine beliefs.



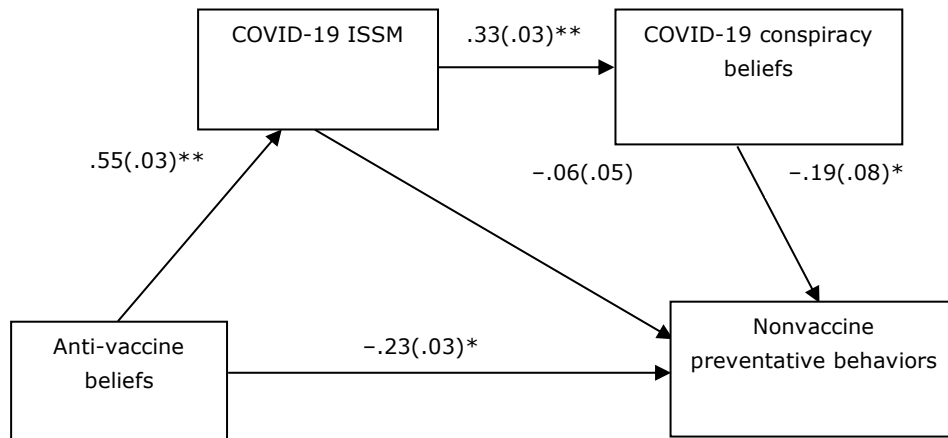
**Figure 2. Serial mediation model predicting COVID-19 vaccine efficacy beliefs. COVID-19 ISSM = COVID-19 Information Seeking on Social Media. The numbers reflect standardized regression coefficients obtained through hierarchical multiple regression analysis. For the final model,  $\Delta R^2 = .23^{**}$ ; overall  $R^2 = .43^{**}$ . Numbers in parentheses denote standard errors.  $** = p < .01$ .**

The second serial mediation test predicted COVID-19 vaccine intentions. The model included COVID-19 vaccine efficacy beliefs as a control measure. Step 1 of the regression model revealed that of the control measures, COVID-19 vaccine efficacy beliefs ( $\beta = .72, p < .01$ ) and perceived COVID-19 severity ( $\beta = .11, p < .05$ ) significantly predicted vaccine intentions. In step 2, hierarchical regression results show that anti-vaccine beliefs negatively predicted COVID-19 vaccine intentions ( $\beta = -.22, p < .01$ ) and social media information seeking positively predicted COVID-19 vaccine intentions ( $\beta = .14, p < .05$ ). COVID-19 conspiracy beliefs were not associated with COVID-19 vaccine intentions ( $\beta = -.05, p > .05$ , see Figure 3). Consistent with the findings above, no significant serial mediation model emerged. The final model accounted for 72% of the variance in vaccine intentions ( $R^2 = .72, p < .01$ ). Results did indicate a simple mediation effect, with social media information seeking significantly mediating the relationship between anti-vaccine beliefs and vaccine intentions ( $B = .13, p < .05$ ; 95% confidence interval: .02 to .25). However, this result also contradicted the directional expectations.



**Figure 3. Serial mediation model predicting COVID-19 vaccine intentions. COVID-19 ISSM = COVID-19 Information Seeking on Social Media. The numbers reflect standardized regression coefficients obtained through hierarchical multiple regression analysis. For the final model,  $\Delta R^2 = .03^{**}$ ; overall  $R^2 = .73^{**}$ . Numbers in parentheses denote standard errors. \* =  $p < .05$ , \*\* =  $p < .01$ .**

The final serial mediation test predicted COVID-19 nonvaccine preventative actions. Step 1 of the regression model revealed that of the control measures, COVID-19 online news information seeking ( $\beta = .21, p < .01$ ) and age ( $\beta = .13, p < .05$ ) significantly predicted preventative actions. When examining the main study variables, hierarchical regression results showed that anti-vaccine beliefs ( $\beta = -.23, p < .05$ ) and COVID-19 conspiracy beliefs ( $\beta = -.19, p < .05$ ) negatively predicted COVID-19 preventative actions (see Figure 4). Social media information seeking was not significantly associated with preventative actions ( $\beta = -.06, p > .05$ ). Results of formal indirect effects tests supported the three-step serial mediation model ( $B = -.03, p < .05$ ; 95% confidence interval:  $-.08$  to  $-.003$ ). In addition, results supported a two-step mediation involving conspiracy beliefs directly mediating the relationship between anti-vaccine beliefs and preventative actions ( $B = -.12, p < .05$ ; 95% confidence interval:  $-.24$  to  $-.003$ ). The final model accounted for 26% of the variance in preventative actions ( $R^2 = .26, p < .01$ ). Overall, across the three preventative beliefs/actions outcome measures, there emerged mixed support for hypothesis 5.



**Figure 4. Serial mediation model predicting COVID-19 nonvaccine preventative behaviors. COVID-19 ISSM = COVID-19 Information Seeking on Social Media. The numbers reflect standardized regression coefficients obtained through hierarchical multiple regression analysis. For the final model,  $\Delta R^2 = .03^{**}$ ; overall  $R^2 = .26^{**}$ . Numbers in parentheses denote standard errors. \* =  $p < .05$ , \*\* =  $p < .01$ .**

### Discussion

This investigation explored how anti-vaccine beliefs and COVID-19 information seeking on social media operate together to influence COVID-19 judgments and actions. Results indicate that those possessing anti-vaccine beliefs rely strongly on social media for COVID-19-specific information. This relationship in part drives conspiracy beliefs and broader resistance to nonvaccine preventative actions (e.g., wearing masks and social distancing). However, the findings also reveal that unlike anti-vaccine beliefs, social media information seeking can contribute to positive vaccine beliefs/intentions.

#### ***Anti-Vaccine Beliefs and Social Media Information Seeking***

This investigation highlights the role social media information seeking plays as an antecedent to specific health judgments and actions. In particular, the findings from this investigation suggest that greater use of social media sources known to provide conspiracy/vaccine-related information (e.g., Facebook, Twitter, YouTube), and emerging general-interest social media platforms (Instagram, Snapchat) act as (a) a central COVID-19 information source for those holding anti-vaccine sentiment and (b) a driver of COVID-19 judgments and actions. Greater anti-vaccine sentiments leads to increased reliance on social media for pandemic-related information to manage uncertainty. Post hoc analyses also revealed that those holding anti-vaccine beliefs do not appear more likely than other populations to rely on digital news sources for COVID-specific information. As documented in previous research (Briones et al., 2012; Dredze et al., 2016) social media is rife with conspiracy messaging—themes that resonate strongly with broader conspiracy beliefs held by anti-vaxxers (Hornsey et al., 2018). Given that uncertain situations (such as the current pandemic) foster conspiracy beliefs (Miller, 2020; van Prooijen & Acker, 2015), social media serves as an appealing information resource. Our findings indicate a robust association between anti-vaccine beliefs and COVID-19 information seeking on social media.

Furthermore, findings indicate that during the current pandemic, social media operates as a mediating factor in the relationship between anti-vaccine judgments and COVID-19 conspiracy beliefs. This intervening role takes on greater importance when examining preventative actions. Specifically, while COVID-19 information seeking on social media does not directly predict nonvaccine preventative actions, it appears to operate as a central step in a broader process leading from anti-vaccine sentiment to resistance to COVID-19 nonvaccine prevention behaviors (mask wearing and social distancing) through conspiracy beliefs. However, the findings also indicate that while anti-vaccine beliefs contribute to lower COVID-19 vaccine efficacy beliefs and intentions, COVID-19 information seeking on social media positively predicts these outcomes. This finding suggests that utilizing social media for COVID-19 information does not uniformly drive problematic beliefs and behaviors. Among individuals harboring broader vaccine skepticism, the mediation tests reveal that utilizing social media for COVID-19 information may potentially stimulate more favorable COVID-19 vaccine beliefs and intentions. During the time of data collection, various social media platforms (e.g., Twitter, Facebook, and YouTube) took steps to remove false or misleading COVID-19 vaccine claims (Heilweil, 2020). Consequently, the increased efforts of social media platforms to limit COVID-19 vaccine misinformation may more favorable vaccine beliefs/intentions.

### ***COVID-19 Conspiracy Beliefs***

Our findings indicate that COVID-19 conspiracy beliefs are associated with general anti-vaccine beliefs as well as social media information sources. Recent data suggests that social media sources provide an abundance of COVID-19-specific conspiracy messaging (CCDH, 2020). The increase in COVID-19 conspiracy beliefs in turn contribute to broader resistance to preventative actions. However, the results suggest that COVID-19 conspiracy beliefs does not predict less favorable vaccine beliefs and resistance to vaccine actions. Consequently, in terms of COVID-19 vaccine judgments and intentions, COVID-19 conspiracy beliefs are less consequential than either dispositional anti-vaccine judgments or social media information seeking. More broadly, while conspiracy theories may operate directly to disincentivize certain preventative actions (Lewandowsky et al., 2012; Uscinski et al., 2016), within the context of vaccine motivations, other factors drive beliefs and decision making.

### ***Public Health Implications***

These results highlight how social media can contribute to both negative and positive pandemic-related judgments and actions. It is vital that public health professionals engage in greater outreach efforts with social media organizations to minimize the proliferation of false or misleading claims pertaining to the virus. As noted above, social media platforms have removed or minimized the extent of false COVID-19 vaccine claims (Heilweil, 2020). During the same period, Facebook and Twitter penalized former President Trump for various false COVID-19 claims (i.e., downplaying impact on children; Kelly, 2020). Furthermore, in recent months, Facebook and Instagram implemented a mechanism that identifies all COVID-19 vaccine-related posts and subsequently redirects individuals to a COVID-19 vaccine information center. This center includes information from official sources such as local health ministries and the World Health Organization (Facebook, 2021). Overall, social media companies should continue to both restrict the spread of false or misleading information while promoting preventative actions approved by credible sources. Equally

important are digital literacy education campaigns to empower users to challenge COVID-19 misinformation and offer alternative, accurate data and narratives (Brørs, Norman, & Norekvål, 2020).

However, it is encouraging that COVID-19 information seeking on social media robustly predicts more positive vaccine beliefs and intentions. Rather than focusing primarily on the negative consequences of social media, the public health community and health educators should strategize about the most effective ways to use this platform to persuade and inform about COVID-19 preventative actions. Social media sources identified as influencing unfounded conspiracy beliefs may also offer messaging that persuades those possessing anti-vaccine beliefs to receive the COVID-19 vaccine.

### ***Limitations and Areas for Future Research***

The investigators collected data before the first administered vaccine doses in the United States. It is conceivable that vaccine judgments change as the vaccine becomes more readily available. Recent data suggests that vaccine confidence and intentions to receive the vaccine are improving (Pew Research Center, 2021a). Follow-up investigations may provide insight into whether social media use for COVID-19 information continues to contribute favorable vaccine judgments and intentions.

In addition, the sample for this analysis was primarily White (roughly 71%). Current surveys show that Black Americans express greater hesitancy to vaccinate than other racial/ethnic groups (Hamel et al., 2020), a finding that may be traced to broader medical distrust (Boulware, Cooper, Ratner, LaVeist, & Powe, 2003). Although 23% of participants reported race as Black—a percentage higher than real-world population statistics (United States Census, 2010)—the total number of Black participants was small ( $n = 69$ ). Our findings yielded no significant impact of race/ethnicity on vaccine beliefs or intentions; however, it is conceivable that a larger sample of Black U.S. participants could influence the findings. As shown in the regression data, non-White respondents were more likely to engage in social media information seeking than White respondents. A more nuanced examination of the mean differences across specific race/ethnicity shows that these differences are driven by higher use among Black respondents. Separate analyses showed that Black respondents reported significantly higher social media information ( $M = 3.29$ ) seeking than White respondents ( $M = 2.50$ ;  $t(283) = 4.79$ ,  $p < .01$ ). Furthermore, although the small sample size for other racial/ethnic groups does not permit similar comparative analyses, descriptive data shows that average social media information seeking for each of these groups was *lower* than that of White and Black respondents. With a substantially larger sample size, researchers may explore two competing arguments. First, Black Americans could conceivably rely more on social media sources for vaccine-related information rather than traditional medical information sources. In turn, this may lead to more potent, positive relationships between social media and COVID-19 vaccine intentions. In contrast, Black Americans may express higher COVID-19 vaccine resistance independent of social media use, thus weakening that relationship.

This study did not examine respondents' attitude toward former President Trump. As documented, former President Trump frequently promoted COVID-19 conspiracy beliefs and downplayed the significance of the pandemic (Hess, 2021). Future research should explore how exposure and support of pandemic-related messaging by political leaders influences conspiracy beliefs and prevention behaviors.



The broad measure of COVID-19 information seeking via social media does not address more directional vaccine motivations (seeking out pro- versus anti-vaccine information). Future research should address specific COVID-19 information sought out by pro- vs. anti-vaccine individuals.

Finally, the social media measures employed was not exhaustive of all social media platforms. Although we incorporated platforms traditionally explored in health information seeking research as well as platforms emerging as most popular among younger demographics, it would be valuable to explore other platforms catering to distinct interests and demographics. For example, LinkedIn, a platform tailored to professional and employee networking, may provide additional COVID-19-related messaging (perhaps tied to job-related initiatives) distinct from these other general-interest platforms.

### Conclusion

This study explored how anti-vaccine beliefs and COVID-19 information seeking on social media operate as interrelated factors contributing to COVID-19-specific beliefs and actions. Results show that those harboring more anti-vaccine sentiments rely strongly on social media sources for COVID-19 information. Tests of indirect effects showed that COVID-19 information seeking on social media operates as a mediator between anti-vaccine beliefs and COVID-19 conspiracy beliefs. Furthermore, COVID-19 information seeking on social media acts as an intervening factor in a larger three-step model linking anti-vaccine beliefs to COVID-19 nonvaccine preventative actions (e.g., mask wearing and social distancing). Although anti-vaccine beliefs and information seeking contribute to reduced nonvaccine prevention action, the results also indicate these factors have differing relationships with anti-vaccine intentions. Specifically, whereas anti-vaccine beliefs predict more vaccine resistance, COVID-19 information seeking on social media contributes to higher levels of perceived vaccine efficacy and intentions. These findings suggest that public health practitioners should push social media companies to continue to restrict the spread of false or misleading COVID-19 vaccine information while promoting vaccine uptake. In addition, it is critical for the public health community to promote digital literacy education campaigns so that users can more effectively combat COVID-19 misinformation.

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