Trends and predictors of COVID-19 information sources and their relationship with knowledge and beliefs related to the pandemic: a nationwide cross-sectional study

Shahmir H Ali, Joshua Foreman, Yesim Tozan, Ariadna Capasso, Abbey M Jones, Ralph J DiClemente

Table of Contents

Trends and predictors of COVID-19 information sources and their relationship with knowledge and beliefs related to the pandemic: a nationwide cross-sectional study

Shahmir H Ali[1] BA; Joshua Foreman[1,2] PhD; Yesim Tozan[3] PhD; Ariadna Capasso[1] MFA; Abbey M Jones[4] MPH; Ralph J DiClemente[1] PhD

[1]Department of Social & Behavioral Sciences School of Global Public Health New York University New York US
[2]Ophthalmology, Department of Surgery University of Melbourne Melbourne AU
[3]Global Health Program School of Global Public Health New York University New York US
[4]Department of Epidemiology School of Global Public Health New York University New York US

Corresponding Author:
Ralph J DiClemente PhD
Department of Social & Behavioral Sciences
School of Global Public Health
New York University
715 Broadway
New York
US

Abstract

Background: COVID-19 has emerged as a rapidly evolving global health crisis, leading to a heightened need to understand health information seeking behaviors in order to address disparities in knowledge and beliefs about the crisis.

Objective: This study assessed socio-demographic predictors of the use and trust of different COVID-19 information sources, and the association between information sources, knowledge and beliefs about the pandemic.

Methods: An online survey was conducted among U.S. adults in two rounds within March-April 2020 using social-media advertisement-based recruitment. Participants were asked on their use of eleven different COVID-19 information sources, followed by a single question which assessed participants' most trusted information source. Selection of COVID-related knowledge and belief questions was identified using past empirical literature and salient concerns at the time of survey implementation.

Results: The sample consists of 11,242 participants. Government websites were used less by 40-59-year-olds (AOR 0.59, 95%CI:0.46-0.74) and those ?60-years (AOR 0.49, 95%CI:0.37-0.64) compared to 18-38-years-olds. Participants in April were markedly less likely to use (AORuse 0.41, 95%CI:0.35-0.46) and trust government sources (AORtrust 0.51, 95%CI:0.47-0.56). The information source on COVID-19 knowledge was mixed, while many COVID-19 beliefs were significantly predicted by information source.

Conclusions: Study findings can help inform COVID-19 health communication campaigns and highlight the impact of using a variety of different and trusted information sources.

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?
    Please make my preprint PDF available to anyone at any time (recommended).
    Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.
    Only make the preprint title and abstract visible.
 ✔ **No, I do not wish to publish my submitted manuscript as a preprint.**

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✔ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**

    Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain v

    Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in <a href="http

Original Manuscript

Trends and predictors of COVID-19 information sources and their relationship with knowledge and beliefs related to the pandemic: a nationwide cross-sectional study

Shahmir H. Ali [1], Joshua Foreman [1,2], Yesim Tozan [3], Ariadna Capasso [1], Abbey M. Jones [4], Ralph J. DiClemente [1*]

1. Department of Social & Behavioral Sciences, School of Global Public Health, New York University, New York, NY, USA; sha371@nyu.edu , ac7113@nyu.edu, rjd438@nyu.edu

2. Ophthalmology, Department of Surgery, University of Melbourne, Melbourne, Australia; foremanj@unimelb.edu.au

3. Global Health Program, School of Global Public Health, New York University, New York, USA; tozan@nyu.edu

4. Department of Epidemiology, School of Global Public Health, New York University, New York, NY, USA; amj593@nyu.edu

* Corresponding author: Ralph J. DiClemente, 715 Broadway New York, NY 10003, Phone: +1 (212) 992-3709, Email: rjd438@nyu.edu

Main text word count: 3496; Pages: 12; Tables: 3; Figures: 1

Abstract

Background: The COVID-19 pandemic has led to a heightened need to understand health

information seeking behaviors in order to address disparities in knowledge and beliefs about the crisis.

Objective: This study assessed socio-demographic predictors of the use and trust of different COVID-19 information sources, and the association between information sources, knowledge and beliefs about the pandemic.

Methods: An online survey was conducted among U.S. adults in two rounds within March-April 2020 using social-media advertisement-based recruitment. Participants were asked on their use of eleven different COVID-19 information sources as well as their most trusted source of information. Selection of COVID-related knowledge and belief questions was identified using past empirical literature and salient concerns at the time of survey implementation.

Results: The sample consists of 11,242 participants. Traditional media sources (TV, radio or podcasts, or newspapers) when combined were the largest sources of COVID-19 information (91.2%). Among those using mainstream media sources for COVID-19 information (n=7,811, 69.5%), popular outlets included CNN (24.0%), Fox News (19.3%), and other local or national networks (35.2%). The largest individual information source was government websites (87.6%), which was also the most trusted source of information (43.3%); odds of trusting government websites were lower among males (AOR: 0.58, 95% CI:0.53-0.63) and those aged 40-59 and ≥60 years compared to aged 18-38 years (AOR: 0.83, 95% CI:0.74-0.92; AOR: 0.62, 95% CI:0.54-0.71). Participants used an average of 6.1 sources (SD: 2.3). Participants who were male, aged 40-59 or ≥60, not working/unemployed or retired, or Republican were likely to use fewer sources while those with children and with higher educational attainment were likely to use more sources. Participants in April were markedly less likely to use (AOR$_{use}$ 0.41, 95%CI:0.35-0.46) and trust (AOR$_{trust}$ 0.51, 95%CI:0.47-0.56) government sources. The association between information source and COVID-19 knowledge was mixed, while many COVID-19 beliefs were significantly predicted by information source; similar trends were observed with reliance on different types of mainstream media outlets.

Conclusions: COVID-19 information source was significantly determined by participant socio-demographic characteristics and was also associated with both knowledge and beliefs about the pandemic. Study findings can help inform COVID-19 health communication campaigns and highlight the impact of using a variety of different and trusted information sources.

Words: 364/450

Introduction

As of May 2020, the United States (U.S.) has experienced the most severe coronavirus disease (COVID-19) pandemic of any country in terms of confirmed numbers of cases and deaths [1]. The economic and social disruptions imposed by measures to contain the disease have been significant, with marked spikes in unemployment, poverty, and psychological suffering [2,3]. As such, authorities face the difficult task of convincing the public that compliance with these measures are justified and necessary to circumvent a potentially worse crisis. Therefore, the manner in which information is formulated, the channels through which it is disseminated, and the populations that are targeted must be considered when developing messaging and designing and implementing risk communication strategies.

In the current information age, there is an ever-growing multiplicity of available sources for health-related information, and the public has tended to shift in recent years from reliance on primarily mainstream news outlets towards other sources of information, including social media [4,5]. Sources of information vary in terms of their reliability, completeness, and verifiability, and in the context of the highly polarized political climate in the U.S. during an election year, anti-scientific rhetoric and political bias may underpin reporting by many information outlets [6]. Of particular concern are social media and other online platforms which are not subject to the stringent peer-review, fact-checking, or compliance with industry regulations to which mainstream sources are usually held [7]. For instance, an analysis of content on Twitter reported that a quarter of tweets about COVID-19 contained misinformation [7]. During past infectious disease outbreaks, mainstream media sources such as television or newspaper outlets have been significant sources of information [8-11]. However, findings on the most trusted sources of information during such outbreaks have been mixed, ranging from health officials [8], television [8], the internet [12], and government [12].

During the rapid emergence of the COVID-19 pandemic in March and April 2020, we conducted an online survey on the sources of information used and trusted by U.S. adults for acquiring COVID-19 information and ascertained how these sources varied according to key sociodemographic characteristics. Further, we assessed how differences in information sources were associated with variation in beliefs and levels of knowledge related to COVID-19.

Methods

Participant recruitment

Details of the methods have been reported in detail elsewhere [13]. Briefly, the sample was a self-selected non-probability sample of social media users on Facebook and its affiliated platforms that was recruited through an on-platform advertisement campaign. Past research supports the use of Facebook as a valid, efficient, and cost-effective recruitment tool in health research [14]. The advertisement campaign targeted adults aged 18 years and older of any sex residing in the U.S. Advertisements with links to an anonymous web-based survey via Qualtrics (Provo, UT) were placed on web- or mobile-based versions of Facebook, Messenger, Instagram, and the Facebook Audience Network (other mobile apps and websites partnered with Facebook). Participants were sampled in two rounds about one month apart; March 20-30 and April 16-21, 2020. To reduce redundant reporting, participants could only complete the survey once (based on IP address). Eligible participants for the current study included U.S. residents aged ≥18 years (confirmed through two screening questions). Survey reporting followed the American Association for Public Opinion Research (AAPOR) guidelines [15]. The analytic sample for this study included those with information on any of the information source variables. The [blinded for peer review] Institutional Review Board reviewed and exempted the study procedures, and the need for explicit written or oral consent was also waived. Participation in the study was also completely voluntary and did not involve compensation, monetary or otherwise.

Questionnaire

The survey was based on the Health Belief Model, which has been previously utilized in recent surveys on other viral outbreaks, such as H1N1 influenza and Middle East respiratory syndrome (MERS) [16,17], as well as U.S. public perceptions of Ebola [18-19]. The survey was also informed by the WHO Tool for behavioral insights on COVID-19 [20]. Sources of COVID-19-related information used by participants were measured in three ways. First, participants were asked whether or not they used any of the following sources to find information about COVID-19 (with an option for non-applicable): 1) spouse/partner; 2) other family members; 3) friends or coworkers; 4) religious leader; 5) doctor/medical provider; 6) television (TV); 7) radio or podcasts; 8) newspaper (printed or online); 9) government or other official websites; 10) social media and; 11) Google search, Wikipedia or other non-government websites. Of the eleven variables provided, some were collapsed into categories based on shared characteristics across certain sources, with participants needing to have responded 'yes' to using one or more of the listed information sources to be included in that category. The collapsed categories were: 1) traditional media (TV, radio or podcasts, or newspapers), 2) online media (social media, Google search, Wikipedia or other non-governmental websites), 3) interpersonal sources (spouse/partner, other family members and friends or coworkers). Participants were also asked if they used mainstream media sources of information for COVID-19; those who responded yes were asked which of the following mainstream media sources they received the most information from: 1) CNN, 2) Fox News, 3) MSNBC, 4) other local or national networks, 5) other international networks. Second, a variable indicating the total number of sources used by each participant was created by summing the number of 'yes' responses for each of the eleven information sources. Finally, participants were asked to identify which one of the eleven information sources they trusted the most. The full questionnaire utilized in this study has been published elsewhere [13].

Knowledge and awareness of the COVID-19 outbreak and protective practices were measured by 24

binary response format (True/False) items. Examples of knowledge questions included "Coronavirus

is a contagious disease" and "How can you protect yourself from being infected with Coronavirus?"

with options including "Getting a flu shot" and "Wearing a face mask". Responses were consistent

with information provided by the CDC as of March and April of 2020; accuracy of the information

was first assessed in March and then re-assessed in April, and no changes in information accuracy

were identified in this time frame. Correct responses were summed to create a composite knowledge

score. Items were adapted from surveys from previous epidemics [18,21,22] and updated to reflect

knowledge relevant to COVID-19.

Beliefs about COVID-19 were measured using 6 four-point (Strongly Agree, Agree, Disagree, and

Strongly Disagree) Likert scale items, which were then dichotomized into a binary Agree/Disagree

variable. Items were adapted from previous surveys on infectious disease outbreaks with

consideration for salient COVID-19-related beliefs at the time of March 2020 [19]. Three of the

belief questions concerned statements on the origin, spread, or severity of COVID-19 (e.g.

"Coronavirus is more deadly than the seasonal flu") for which the data were still emerging at the

time of the survey, while three questions concerned beliefs on the coverage and significance of the

Coronavirus outbreak (e.g. "The amount of media attention devoted to Coronavirus has been

adequate").

Demographic assessed included sex, race, age category, employment status, educational attainment,

living with children <18 years of age, state of residence (re-coded by U.S. Census region),

urban/rural residence, and political party affiliation. Since marital status and income were only

assessed at the second round of the survey and thus were missing for approximately half (55%) of

the study participants, these were not included in the regression analyses. Participants who selected

"prefer not to say" for any questions were removed from analysis, with the exception of political affiliation due to the significant number of participants selecting this option (18.9%).

Statistical analysis

Participant demographic characteristics were stratified by categories of information sources used. Multivariable logistic regression analyses were conducted to assess the effect of demographic determinants on the use and trust of COVID-19 information sources. Poisson regression was conducted to assess demographic determinants of number of COVID-19 information sources given its appropriateness for modeling count data. Separate logistic regression models were conducted on the effect of time of survey (March versus April) on the use, trust, and total number of COVID-19 information sources, adjusted for demographic covariates. Of the 21 knowledge questions assessed during both rounds, 7 displayed a correct response rate below 90%. Logistic regression analysis was conducted on these seven questions and six COVID-19-related beliefs to assess the odds of correct response (for knowledge questions) or of agreeing with the provided statement (for belief questions) according to the use, trust, and total number of information sources – each adjusted for the other information source variables, as well as all demographic covariates given their observed significance in health and health information seeking behaviors [23,24]. All tests were two-sided with significance level of p<0.05. Statistical analyses were performed using R version 4.0.0.

Results

Participant characteristics

A total of 13,201 respondents were eligible to participate, of whom 12,908 commenced the survey, and 11,242 had data on sources of COVID-19 information. Due to the small sample size of participants who identified "Other" for sex (n=8), this category was unable to be analyzed and thus removed for analysis. The sample size and proportion of participants who identified as races other

than Non-Hispanic White was small; Black, Non-Hispanic (n=66, 0.6%), Asian Pacific Islander

(n=86, 0.8%), Native American or American Indian (n=87, 0.8%), Interracial, Mixed race, or Other

(n=259, 2.5%), and Hispanic/Latinx (n=267, 2.6%). Therefore, in statistical analyses, participants

were pooled into a singular category to enhance power in data analysis (n=765, 7.3%). Table 1

provides a summary of the participant characteristics.

[INSERT TABLE 1]

Geographic representation of participants included all the U.S. states. Overall, most participants were

female (59.0%), Non-Hispanic white (92.7%), employed (59.5%), and living in suburban

environments (51.0%). Figure 1 displays an overview of the information sources used and most

trusted in the study population. Overall, traditional media was the most frequently utilized source of

information (n = 10,335, 91.2%); however, when all information sources were disaggregated from

the synthesized categories, the largest individual source of COVID-19 information was government

websites (n = 9,845, 87.6%). Participants used an average of 6.1 sources (SD: 2.3, Range: 0-11).

Among those who identified using mainstream media sources for COVID-19 information (n=7,811,

69.5%), other local or national networks were the most popular sources for the majority of COVID-

19 information (35.2%), followed by CNN (24.0%), Fox News (19.3%), MSNBC (11.9%), and other

international networks (5.3%).

[INSERT FIGURE 1]

Sociodemographic factors associated with sources of COVID-19 information

Males were significantly less likely than females to use all identified sources, excluding

spouses/family/friends or religious leaders (Table 2). Participants aged 40-59 years and ≥60 years

were less likely to use government websites compared to those aged 18-38 years (AOR [Adjusted Odds Ratio]: 0.59, 95% CI:0.47-0.71; AOR: 0.47, 95% CI:0.37-0.60). Participants identifying as races other than Non-Hispanic White were more likely to use doctors (AOR: 1.39, 95%CI:1.18-1.64) and religious leaders (AOR: 1.40, 95%CI:1.03-1.86) as a source of information. Those with a bachelor's degree or higher were more likely to use all of the sources, except traditional media.

Sociodemographic predictors of using mainstream media sources for COVID-19 information are displayed in Supplemental File 1. Republicans were significantly more likely to rely upon Fox News (AOR:33.56, 95%CI: 25.60 – 44.87), while were less likely to rely on all other mainstream media sources. In contrast, those with Bachelor's degree or higher were more likely to rely on CNN (AOR:1.25, 95%CI:1.04-1.52) or other international networks (AOR:3.68, 95%CI:2.21-6.68) and less likely to rely on Fox News (AOR:0.72, 95%CI:0.61-0.87). Participants aged 60+ years were more likely to rely on Fox News (AOR:1.41, 95%CI:1.12-1.77) and MSNBC (AOR:1.85, 95%CI:1.43-2.40) and less likely to rely on other international sources (AOR:0.67, 95%CI:0.47-0.95).

[INSERT TABLE 2]

With respect to predictors of the total number of COVID-19 sources used (not shown in tables), those using fewer sources included males compared to females (β:-0.03, 95%CI:-0.96-(-0.01)) and those aged 40-59 and ≥60 years compared to 18-39-year-olds (β:-0.05, 95%CI:-0.07-(-0.03)); β:-0.05, 95%CI:-0.08-(-0.03)). Factors associated with increased number of sources included having children in the home compared to those without children (β:0.03, 95%CI:0.01-0.05), and having some college or a bachelor's degree or a higher level of educational attainment compared to those with high school or less educational attainment (β:0.03, 95%CI:0.00-0.06; β:0.08, 95%CI:0.05-0.10).

The most trusted information source was government websites (43.3%); odds of trusting government websites were lower among males (AOR: 0.58, 95% CI:0.53-0.63) and those aged 40-59 and ≥60 years compared to aged 18-38 years (AOR: 0.83, 95% CI:0.74-0.92; AOR: 0.62, 95% CI:0.54-0.71) (not shown in tables).

Overall, participants were significantly less likely to use any of identified information sources in April compared to March (Supplemental File 2); the adjusted odds of using government websites in April compared to March were particularly low (AOR: 0.41, 95% CI:0.36-0.47). Similarly, compared to March, the odds of trusting government websites in April were significantly lower (AOR: 0.51, 95% CI:0.47-0.56) with the odds of trusting other websites, radios or podcasts, and spouses/partners more than doubling during that same time frame. Participants in April also on average used 0.58 fewer sources than those in March (p<0.001).

The adjusted associations between COVID-19 information sources and knowledge of COVID-19 varied considerably by knowledge question (Table 3). An increase in the total number of information sources used was only associated with improved awareness that wearing a face mask was protective measures against COVID-19 infection (AOR: 1.10, 95% CI:1.05-1.14). The use of some information sources, such as doctors and traditional media, were associated with improved knowledge for some questions but decreased knowledge for others. Overall, the use of government websites resulted in significantly better knowledge for three out of the seven examined questions, with the remaining four questions not significantly different between the groups.

Primary mainstream media source used for COVID-19 was also significantly associated with knowledge about the pandemic (not shown in table). When adjusted for socio-demographic

variables, total number of sources, and most trusted source of information, in comparison to other

local/national media sources, those relying on CNN were more likely to correctly answer 2 of the 7

questions, while those relying on Fox News were more likely to incorrectly answer 3 of the 7

questions.

[INSERT TABLE 3]

Changes in beliefs regarding COVID-19 were observed to be strongly and consistently associated

with both the use and trust in different information sources (Table 4). Those who used government

websites compared to those who did not were more likely to disagree that Coronavirus was released

as an act of terrorism (AOR: 0.64, 95%CI:0.54-0.76), that Coronavirus is not as big a problem as the

media suggests (AOR: 0.65, 95%CI:0.53-0.78), and that warmer weather will reduce the spread of

Coronavirus (AOR: 0.69, 95% CI:0.58-0.80). Compared to those with the most trust in government

websites, trust in most (at least six) of the other sources of information was associated with increased

agreement that Coronavirus was released as an act of terrorism, disagreement that Coronavirus is

deadlier than the flu, agreement that Coronavirus is not as big a problem as the media suggests and

disagreement that the amount of media attention on Coronavirus has been adequate. Mainstream

media source was also a significant determinant for COVID-19 beliefs (not shown in tables).

Compared to those relying on other national/local media, those relying on CNN or MSNBC were

more likely to agree that the Coronavirus is deadlier than the seasonal flu, the amount of media

attention to Coronavirus has been adequate, and Coronavirus is a bigger problem than the

government suggests, and disagree that warmer weather will reduce the spread of Coronavirus and

that Coronavirus is not as big of problem as the media suggests. Conversely, those relying on Fox

News were more likely to agree that Coronavirus was released as an act of bioterrorism, warmer

weather will reduce the spread of Coronavirus, and the Coronavirus is not as big of a problem as the

media suggests, while disagree that Coronavirus is deadlier than the seasonal flu, the amount of

media attention to Coronavirus has been adequate, and Coronavirus is a bigger problem than the

government suggests.

[INSERT TABLE 4]

Discussion

Overall, the choice of and trust in different COVID-19 information sources were observed to be

significantly different across demographic variables, including sex, age, race, region, residence type,

employment, education and political affiliation, and the type of source used and trust in each source

were associated with different levels of knowledge and differences in beliefs regarding COVID-19.

Despite advocacy by public health officials for the use of official or government sources of

information (such as CDC or WHO websites), only 45.2% of participants cited such sources as their

most trusted sources of information, dropping from 53.3% in March to 36.8% in April. These

findings suggest that public health professionals seeking to effectively communicate information on

COVID-19 must acknowledge and appropriately adapt to disparities in public trust and information

source preferences, particularly to address the differences in knowledge and beliefs regarding the

pandemic.

Popular and trusted information sources

The popularity of TV and newspapers as sources of information seen during the current outbreak

reflected past infectious disease outbreaks including the 2003 SARS outbreak [8], the 2009 H1N1

pandemic [9,10], and seasonal flu epidemics [11]. A qualitative study on communication during

pandemics found that mainstream media (such as newspaper and television news) were the most

used source of information among participants despite being perceived as relatively untrustworthy

[4], corroborating our study findings. However, while our study found government websites and doctors to be the most trusted sources, a study of the SARS outbreak in the Netherlands found that television and health officials were the most trusted sources of information [8], while a study of Ebola information in the U.S. found the Internet and the government to be the most trusted information sources [12].

Findings that men were less likely to use almost all of the identified information sources, used fewer sources in general, and were also less likely to trust government websites for COVID-19 information suggest significant sex disparities in COVID-19 information source utilization. This evidence corresponds with other preliminary research observing that men are less likely to abide by advocated COVID-19 health behaviors [25], and that young men are more likely to agree with COVID-19 myths [26] and underscores the need for sex-based targeted COVID-19 health information communication strategy. Moreover, age- and education-based disparities in COVID-19 knowledge and behaviors have also been observed in past research [27]. Given these disparities in COVID-19 information source usage, there is a clear need for targeted health communication campaigns to address these gaps. Lastly, disparities based on political affiliation also correspond with other evidence on its potential role in determining COVID-19 behaviors, including compliance with social distancing [27]. The use of specific mainstream media outlets was found to be significantly determined by political affiliation, sex and age, determinants which support past demographic analyses on mainstream media usage [29].

These findings suggest that trust in information sources may differ across time, place, culture, and type of disease outbreak, emphasizing the importance of updated surveillance on trends in information seeking behaviors during pandemics. For instance, the greater popularity and trust seen in government sources may be explained by strong efforts to promote official government websites

by non-governmental platforms, such as Facebook, Google, and Twitter [30]. Moreover, due to the small sample size of participants who identified as races other than Non-Hispanic White, we were unable to conduct a comprehensive analysis on disaggregated racial and ethnic differences. However, past research has found immigrant communities from Asia have also been observed to display less confidence in their doctors and government agencies compared to other populations [31], suggesting a need for further intensive research on COVID-19 information source trends among minority communities in the U.S, especially given their higher risk for morbidity and mortality from COVID-19 [32,33].

Likewise, unlike past research, the uniquely imminent and personal threat posed to members of the public responding to the survey should be considered. In other words, the Netherlands did not in fact experience a SARS epidemic, nor did the U.S experience an Ebola epidemic, and comparing perceptions regarding which information sources to consult and trust with these past case studies may differ depending on the level of perceived and actual risk within the population [34]. To meet the health communication needs of future pandemics or public health crises such as COVID-19, public health professionals and policy makers must conduct careful monitoring on up-to-date trends in information source usage to better target the delivery of public health information.

Importantly, findings also suggest that the likelihood of using different COVID-19 information sources changed between March and April, and findings that participants were less likely to trust in sources such as government websites in this time frame have significant implications on the speed that targeted public health information campaigns may need to be implemented in order to meet these rapid changes in information source utilization. Indeed, similar preliminary research has also observed a decline in trust of COVID-19 information provided by government sources [35]. Such evidence provides insight into how perceptions and utilization of information sources may

significantly vary across different stages of a health crisis, supporting the need for continued, longitudinal public health surveillance to help understand and take action according to these trends.

COVID-19 knowledge and information sources

There have been concerns about the surge and spread of dangerous misinformation related to COVID-19 [36], such as through online platforms like social media [37], particularly because there are many aspects of this novel disease that are presently little understood or subject to change as new evidence becomes available. Likewise, mainstream media sources have also garnered greater scrutiny over concerns that COVID-19 misinformation is being perpetuated by certain media outlets [38], which was supported by the disparities in knowledge observed across those relying on different mainstream media sources. However, our findings also suggested that the use of, and trust in, information sources other than official government websites may not be associated with significantly different awareness of information about an emerging health crisis, such as COVID-19. For instance, while social media has garnered increased attention due to its use as a platform to promulgate COVID-19 misinformation [37], the use of social media or web-based sources was in fact associated with increased awareness of one of the seven knowledge questions and had no effect on the other questions, and those who trusted social media information the most (compared to government websites) only displayed reduced knowledge for two questions. Moreover, the sources from which members of the public obtain COVID-19 information may themselves be interdependent; in previous influenza pandemics, doctors (who themselves are a major source of health information) have reported deriving much of their information from the Internet and mass media [39,40]. These insights suggest that certain sources of information may not inherently result in compromised awareness of information pertaining to a health crisis, but other factors, such as the actual content, how the source is used by an individual, and the specific knowledge being assessed, may all play a relevant role in determining disparities in knowledge.

COVID-19 beliefs and information source

Unlike with knowledge outcomes, the strong associations observed between both trust in and use of different information sources and COVID-19 beliefs suggest that different communication platforms are indeed having an impact on how the public subjectively perceives and interprets COVID-19 information. These associations were also observed in the reliance on different types of mainstream media sources, suggesting specific media outlets may also have a salient role in perpetuating certain beliefs about the pandemic. The perception that Coronavirus is deadlier than the flu was significantly higher among those who used and put the greatest trust in government websites, suggesting that these platforms have been able to effectively communicate the relative greater danger of COVID-19. Beliefs regarding communication of COVID-19 information displayed similar trends, with individuals trusting of different non-government sources expressing greater agreement that Coronavirus is not as serious a problem as the media suggests, and disagreement that Coronavirus is a bigger problem than the government suggests. In a review on attitudes and beliefs during pandemics, various subjective understandings of the spread and significance of an infectious disease were directly associated with protective behaviors [41], suggesting that differing levels of seriousness and perceived significance of a pandemic can have consequences for the collective public response.

Strengths and limitations

This study was subject to a number of key limitations. First, the study sample was derived from non-probability convenience sampling of Facebook and affiliated platform users, and although 70% of Americans use Facebook [5], certain demographic groups may be underrepresented (e.g. racial, ethnic, and gender minorities), which is one component of why national representativeness cannot be assumed. Second, many of the information sources categorized are themselves inconsistent, such that

within each source, the types and veracity of information vary markedly, and these disparities must be considered in interpreting the study findings. For example, given the wide variety of internet-based information sources, it is likely that many non-official or non-governmental websites are providing valid, up-to-date information on COVID-19 and thus correlations between knowledge and beliefs about the pandemic may be significantly dependent on the specific internet sources being utilized rather than simply the platform itself, as observed in other health contexts [42]. Likewise, in recent years, other information source categories (such as social media) have significantly diversified (e.g. web-based and app-based platforms, or those more video-based platforms such as TikTok), and this internal diversity may also influence trends in COVID-19 information source. Therefore, further research targeting more specific, stratified sources of information is warranted. Finally, given the emerging nature of the COVID-19 crisis, knowledge and salient beliefs are constantly evolving, and while the survey reflects a number of key questions at the time of March and April 2020, many of these may not be relevant in future months or years of the crisis. To address this, the survey used in the study will be adapted and re-implemented periodically over the course of the COVID crisis.

Conclusion

As the need to rapidly communicate information on the ongoing COVID-19 pandemic continues, our study findings provide key insights to policy makers seeking to understand what impact these information seeking behaviors are having on knowledge and beliefs regarding the outbreak. Likewise, information on the demographic profiles of who is using and trusting different information sources allows public health professionals to adapt communication strategies to reach a more diverse population. Future research should consider greater sampling of minority populations in the U.S. (notably racial and ethnic minorities, or non-English speakers and non-Internet users) to provide further perspective on disparities in information seeking behaviors during COVID-19 and other health crises.

References

1. Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. *Lancet Infect Dis.* 2020.

2. Nirmita Panchal RK, Kendal Orgera, Cynthia Cox, Rachel Garfield, Liz Hamel, Cailey Muñana, and Priya Chidambaram. The Implications of COVID-19 for Mental Health and Substance Use. Health Reforms (Kaiser Family Foundation) Web site. https://www.kff.org/health-reform/issue-brief/the-implications-of-covid-19-for-mental-health-and-substance-use/. Published 2020. Accessed May 11, 2020.

3. Zachary Parolin CW. Forecasting Estimatess of Poverty during the COVID-19 Crisis. *Poverty & Social Policy Brief.* 2020;4(6).

4. Henrich N, Holmes B. Communicating during a pandemic: information the public wants about the disease and new vaccines and drugs. *Health Promot Pract.* 2011;12(4):610-619.

5. Perrin A, Anderson M. Share of US adults using social media, including Facebook, is mostly unchanged since 2018. Pew Research Center Web site. https://www.pewresearch.org/fact-tank/2019/04/10/share-of-u-s-adults-using-social-media-including-facebook-is-mostly-unchanged-since-2018/. Published 2019. Accessed May 23, 2020.

6. Frenkel S, Alba D, Zhong R. Surge of Virus Misinformation Stumps Facebook and Twitter. The New York Times Web site. https://www.nytimes.com/2020/03/08/technology/coronavirus-misinformation-social-media.html. Published 2020. Accessed April 4, 2020.

7. Kouzy R, Abi Jaoude J, Kraitem A, et al. Coronavirus Goes Viral: Quantifying the COVID-19 Misinformation Epidemic on Twitter. *Cureus.* 2020;12(3):e7255.

8. Brug J, Aro AR, Oenema A, de Zwart O, Richardus JH, Bishop GD. SARS risk perception, knowledge, precautions, and information sources, the Netherlands. *Emerg Infect Dis.*

2004;10(8):1486-1489.

9.   Wong LP, Sam IC. Public Sources of Information and Information Needs for Pandemic Influenza A(H1N1). *J Community Health.* 2010;35(6):676-682.

10.   Walter D, Bohmer M, Reiter S, Krause G, Wichmann O. Risk perception and information-seeking behaviour during the 2009/10 influenza A(H1N1)pdm09 pandemic in Germany. *Euro Surveill.* 2012;17(13).

11.   Gargano LM, Underwood NL, Sales JM, et al. Influence of sources of information about influenza vaccine on parental attitudes and adolescent vaccine receipt. *Hum Vaccin Immunother.* 2015;11(7):1641-1647.

12.   Rolison JJ, Hanoch Y. Knowledge and risk perceptions of the Ebola virus in the United States. *Prev Med Rep.* 2015;2:262-264.

13.   Ali SH, Foreman J, Capasso A, Jones A, Tozan Y, DiClemente RJ. Social media as a recruitment platform for a nationwide online survey of COVID-19 knowledge, beliefs, and practices in the United States: Methodology and feasibility analysis. *BMC Med Res Methodol.* 2020;20(116).

14.   Whitaker C, Stevelink S, Fear N. The Use of Facebook in Recruiting Participants for Health Research Purposes: A Systematic Review. *J Med Internet Res.* 2017;19(8):e290.

15.   The American Association for Public Opinion Research. *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys.* AAPOR;2016.

16.   Hasan F, Khan MO, Ali M. Swine Flu: Knowledge, Attitude, and Practices Survey of Medical and Dental Students of Karachi. *Cureus.* 2018;10(1):e2048-e2048.

17.   Al-Rabiaah A, Temsah M-H, Al-Eyadhy AA, et al. Middle East Respiratory Syndrome-Corona Virus (MERS-CoV) associated stress among medical students at a university teaching hospital in Saudi Arabia. *J Infect Public Health.* 2020.

18.   Painter JE, DiClemente RJ, von Fricken ME. Interest in an Ebola vaccine among a U.S.

national sample during the height of the 2014-2016 Ebola outbreak in West Africa. *Vaccine.* 2017;35(4):508-512.

19.   Painter JE, von Fricken ME, Viana de OMS, DiClemente RJ. Willingness to pay for an Ebola vaccine during the 2014-2016 ebola outbreak in West Africa: Results from a U.S. National sample. *Hum Vaccin Immunother.* 2018;14(7):1665-1671.

20.   World Health Organization. *Survey Tool and Guidance: Rapid, simple, flexible behavioural insights on COVID-19.* Geneva: World Health Organization;2020.

21.   Jalloh MF, Li W, Bunnell RE, et al. Impact of Ebola experiences and risk perceptions on mental health in Sierra Leone, July 2015. *BMJ Global Health.* 2018;3(2):e000471.

22.   Lau JT, Kim JH, Tsui H, Griffiths S. Perceptions related to human avian influenza and their associations with anticipated psychological and behavioral responses at the onset of outbreak in the Hong Kong Chinese general population. *Am J Infect Control.* 2007;35(1):38-49.

23.   Health UDo, Services H. Agency for Healthcare Research and Quality.(2018). 2017 National healthcare quality and disparities report (AHRQ Publication No. 18-0033-EF). In.

24.   Somera LP, Lee H-R, Badowski G, Cassel K. Health Information Seeking, Source Trust, and Culture: A Comparative Analysis of Health Information Trends and Needs Between Guam and the United States. *J Health Commun.* 2016;21(4):469-478.

25.   Clark C, Davila A, Regis M, Kraus S. Predictors of COVID-19 voluntary compliance behaviors: An international investigation. *Global Transitions.* 2020;2:76-82.

26.   Pickles K, Cvejic E, Nicel B, et al. COVID-19: Beliefs in misinformation in the Australian community. medRxiv (preprint). https://www.medrxiv.org/content/10.1101/2020.08.04.20168583v1. Accessed August 17, 2020.

27.   Clements JM. Knowledge and Behaviors Toward COVID-19 Among US Residents During the Early Days of the Pandemic: Cross-Sectional Online Questionnaire. *JMIR Public Health*

Surveill. 2020;6(2):e19161.

28. Painter M, Qiu T. Political Beliefs affect Compliance with COVID-19 Social Distancing Orders. SSRN (preprint). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3569098. Accessed August 17, 2020.

29. Who's watching? A look at the demographics of cable news channel watchers. Public Opinion Strategies. https://pos.org/whos-watching-a-look-at-the-demographics-of-cable-news-channel-watchers/. Accessed August 17, 2020.

30. Romm T. Facebook, Google and Twitter scramble to stop misinformation about coronavirus. The Washington Post Web site. https://www.washingtonpost.com/technology/2020/01/27/facebook-google-twitter-scramble-stop-misinformation-about-coronavirus/. Published 2020. Accessed April 29, 2020.

31. Voeten HA, de Zwart O, Veldhuijzen IK, et al. Sources of information and health beliefs related to SARS and avian influenza among Chinese communities in the United Kingdom and The Netherlands, compared to the general population in these countries. *Int J Behav Med.* 2009;16(1):49-57.

32. Centers for Disease Control and Prevention. COVID-19 in Racial and Ethnic Minority Groups. https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/racial-ethnic-minorities.html. Published 2020. Accessed May 8, 2020.

33. Wortham JM, Lee JT, Althomsons S, et al. Characteristics of Persons Who Died with COVID-19 — United States, February 12–May 18, 2020. MMWR Morb Mortal Wkly Rep 2020;69:923-929. DOI:

34. Sadique MZ, Edmunds WJ, Smith RD, et al. Precautionary behavior in response to perceived threat of pandemic influenza. *Emerg Infect Dis.* 2007;13(9):1307-1313.

35. Boyl J, Brassel T, Dayton J. American trust in COVID-19 information from federal and state/local government is trending downward. ICF International.

https://www.icf.com/insights/health/covid-19-survey-trust-government-response-erodes.

Accessed August 17, 2020.

36.   Mian A, Khan S. Coronavirus: the spread of misinformation. *BMC Medicine.* 2020;18(1):89.

37.   Gordon Pennycook, Jonathon McPhetres, Yunhao Zhang, Rand D. Fighting COVID-19 misinformation on social media: Experimental evidence for a scalable accuracy nudge intervention. *PsyArXiv.* 2020.

38.   Ingraham C. New research explores how conservative media misinformation may have intensified the severity of the pandemic. Washington Post Website. https://www.washingtonpost.com/business/2020/06/25/fox-news-hannity-coronavirus-misinformation/. Accessed August 17, 2020.

39.   Torre GLA, Semyonov L, Mannocci A, Boccia A. Knowledge, attitude, and behaviour of public health doctors towards pandemic influenza compared to the general population in Italy. *Scand J Public Health.* 2011;40(1):69-75.

40.   Gholami J, Hosseini SH, Ashoorkhani M, Majdzadeh R. Lessons Learned from H1N1 Epidemic: The Role of Mass Media in Informing Physicians. *Int J Prev Med.* 2011;2(1):32-37.

41.   Bish A, Michie S. Demographic and attitudinal determinants of protective behaviours during a pandemic: A review. *Br J Health Psychol.* 2010;15(4):797-824.

42.   Fisher JH, O'Connor D, Fexman A, Shapera S, Ryerson CJ. Accuracy and Reliability of Internet Resources for Information on Idiopathic Pulmonary Fibrosis. Am J Respir Crit Care Med. 2016;194(2):218-225

Table 1. Characteristics of 11,242* participants with data on COVID-19 sources of information in online COVID-19 survey, March-April 2020

		Source of information used					
	Total	Traditional Media	Government	Online Media	Interpersonal Sources	Doctor	Religious Leader
	(n=11,242)	(n=10,335)	(n=9,845)	(n=9,653)	(n=7,850)	(n=5,361)	(n=768)
Time of survey (%)							
March	51.8	52.3	54.2	52.8	53.8	56.1	65.1
April	48.2	47.7	45.8	47.2	46.2	43.9	34.9
Sex (%)							
Female	59.0	59.8	60.7	59.5	59.7	60.1	61.5
Male	41.0	40.2	39.3	40.5	40.3	39.9	38.5
Age (%)							
18-39 years old	21.0	20.9	22.3	21.4	23.9	21.1	21.4
40-59 years old	45.0	44.7	45.5	44.7	45.0	46.4	44.0
60+ years old	34.0	34.4	32.2	33.9	31.1	32.4	34.6
Race (%)							
White, Non-Hispanic	92.7	92.7	92.6	92.8	92.5	91.6	90.9
Non-White	7.3	7.3	7.4	7.2	7.5	8.4	9.1
Region (%)							
Northeast	26.4	26.8	26.4	26.5	26.4	25.7	20.1
Midwest	27.8	27.9	27.7	27.6	28.0	27.9	29.0
South	28.4	28.0	28.4	28.5	28.1	29.0	34.8
West	17.4	17.2	17.5	17.4	17.6	17.4	16.1
Residence (%)							
Suburban	51.0	51.6	51.4	51.1	51.3	51.7	43.2
Urban	16.2	16.2	16.1	16.3	16.2	16.3	13.7
Rural	32.8	32.2	32.4	32.5	32.4	32.0	43.2
Employment status (%)							
Employed	59.5	59.1	60.8	59.2	62.3	61.5	60.8
Student/Unpaid work	6.1	6.2	6.4	6.1	6.6	5.7	6.8
Not working/Unemployed	11.9	11.9	11.8	12.3	10.9	11.4	10.2
Retired	22.4	22.7	21.0	22.3	20.1	21.4	22.2
Children <18 at home (%)							
No	71.7	71.9	70.6	71.5	69.9	70.7	66.5
Yes	28.3	28.1	29.4	28.5	30.1	29.3	33.5
Educational attainment (%)							
High School and below	13.0	12.7	12.5	13.3	11.4	10.8	11.1
Some college / Associate's degree	34.2	33.6	33.4	33.8	33.1	33.6	32.6
Bachelor's degree or higher	52.8	53.7	54.1	52.8	55.4	55.5	56.3

Political affiliation (%)							
Democrat	36.0	37.8	37.1	36.7	38.8	37.8	25.1
Republican	25.0	24.1	23.9	24.8	22.5	24.2	39.0
Other	20.1	19.6	20.1	19.8	20.1	19.5	14.3
Prefer not to say	18.9	18.5	19.0	18.6	18.7	18.4	21.6
Marital status (%)							
Married/cohabiting	70.9	71.0	71.6	70.6	74.3	73.2	74.6
Single	16.4	16.4	16.3	16.7	15.4	15.6	13.7
Divorced/separated	8.5	8.4	8.2	8.7	6.8	7.4	7.7
Widowed	4.2	4.2	3.9	4.0	3.5	3.8	4.0
Income (%)							
Less than $30,000	13.3	13.0	12.7	13.3	11.3	11.9	15.5
$30,000 to less than $50,000	15.5	15.6	15.5	15.8	15.0	14.2	14.0
$50,000 to less than $75,000	17.7	17.4	16.9	17.4	16.6	17.3	22.2
$75,000 to less than $100,000	20.8	21.0	20.9	20.5	21.2	22.1	21.3
$100,000 or more	32.7	33.1	33.9	32.9	35.9	34.5	27.1
Most trusted source (%)							
Government or other official websites	45.2	45.4	49.4	44.4	43.8	41.2	42.9
TV	4.7	5.1	3.8	5.0	4.4	2.6	3.0
Social media	1.2	1.1	0.9	1.4	1.1	0.6	1.4
Newspaper	6.5	7.0	6.3	6.9	6.9	5.2	4.8
Other web-based sources	5.1	4.6	4.5	5.7	4.6	3.0	3.0
Friends or Coworkers	0.5	0.4	0.4	0.4	0.6	0.3	0.4
Doctor/medical provider	31.6	31.6	30.8	31.3	32.4	43.5	35.9
Radio or Podcasts	1.1	1.2	0.9	1.1	1.0	0.8	1.7
Other family members	1.1	1.1	0.8	1.1	1.4	0.8	1.4
Spouse/Partner	2.9	2.6	2.3	2.7	3.7	2.0	4.4
Religious leader	0.1	0.1	0.1	0.1	0.1	0.1	1.0

*Total number of responses with data on sources of information, excluding those selecting non-applicable for all sources

Table 2. Socio-demographic factors associated with of COVID-19 information source^, n = 11,242

	Traditional Media	*Government*	*Online Media*	*Interpersonal Sources*	*Doctor*	*Religious Leader*
Sex						
Female	Ref	Ref	Ref	Ref	Ref	Ref
Male	[3] **0.74 (0.64-0.87)**	[1] **0.58 (0.51-0.66)**	[1] **0.88 (0.78-0.99)**	0.96 (0.88-1.06)	[1] **0.91 (0.84-0.99)**	0.89 (0.75-1.06)
Age						
18-39 years	Ref	Ref	Ref	Ref	Ref	Ref
40-59 years	0.99 (0.80-1.21)	[3] **0.58 (0.47-0.71)**	[2] **0.80 (0.68-0.94)**	[3] **0.61 (0.54-0.70)**	1.10 (0.96-1.23)	0.86 (0.69-1.08)
60+ years	1.12 (0.85-1.46)	[3] **0.47 (0.37-0.60)**	0.91 (0.74-1.11)	[3] **0.52 (0.45-0.62)**	1.02 (0.88-1.17)	1.07 (0.81-1.42)
Race						
White	Ref	Ref	Ref	Ref	Ref	Ref
Non-White	0.96 (0.72-1.29)	0.95 (0.74-1.23)	0.87 (0.71-1.09)	1.02 (0.85-1.22)	[3] **1.39 (1.18-1.64)**	[1] **1.40 (1.03-1.86)**
Region						
Northeast	Ref	Ref	Ref	Ref	Ref	Ref
Midwest	0.88 (0.71-1.09)	0.95 (0.80-1.13)	0.94 (0.71-1.09)	0.98 (0.87-1.11)	1.07 (0.96-1.20)	[1] **1.30 (1.03-1.65)**
South	[2] **0.74 (0.60-0.92)**	1.09 (0.92-1.29)	1.06 (0.90-1.23)	0.97 (0.86-1.09)	1.10 (0.98-1.23)	[1] **1.50 (1.20-1.89)**
West	[2] **0.69 (0.55-0.88)**	1.07 (0.88-1.30)	1.00 (0.84-1.19)	1.03 (0.89-1.18)	1.04 (0.91-1.18)	1.28 (0.97-1.67)
Residence						
Suburb.	Ref	Ref	Ref	Ref	Ref	Ref
Urban	0.81 (0.65-1.01)	0.95 (0.79-1.14)	1.05 (0.90-1.23)	1.02 (0.89-1.16)	1.00 (0.89-1.13)	1.28 (0.97-1.67)
Rural	[2] **0.80 (0.67-0.94)**	1.01 (0.88-1.17)	0.94 (0.83-1.25)	1.07 (0.96-1.18)	0.99 (0.90-1.09)	[3] **1.56 (1.31-1.86)**
Employment						
Employed	Ref	Ref	Ref	Ref	Ref	Ref
Student/Unpaid	1.26 (0.89-1.83)	0.99 (0.71-1.39)	0.97 (0.76-1.25)	0.97 (0.79-1.20)	[1] **0.81 (0.68-0.97)**	1.05 (0.74-1.47)
Not Working/Unemp.	1.11 (0.87-1.42)	[1] **0.79 (0.65-0.96)**	[2] **1.30 (1.07-1.59)**	[3] **0.70 (0.61-0.80)**	[1] **0.87 (0.76-0.99)**	0.94 (0.71-1.23)
Retired	1.16 (0.91-1.48)	[3] **0.68 (0.57-0.82)**	0.96 (0.81-1.15)	[3] **0.78 (0.68-0.89)**	0.90 (0.79-1.03)	0.91 (0.71-1.16)
Children at home						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.94 (0.78-1.12)	1.18 (1.00-1.39)	1.04 (0.91-1.19)	1.05 (0.94-1.17)	1.06 (0.96-1.17)	[1] **1.25 (1.03-1.51)**
Education						
High School or below	Ref	Ref	Ref	Ref	Ref	Ref
Some Col. / Assoc. D.	0.94 (0.74-1.17)	1.09 (0.90-1.31)	[2] **0.75 (0.62-0.91)**	[3] **1.28 (1.12-1.48)**	[2] **1.29 (1.13-1.48)**	1.21 (0.92-1.61)
Bachelor's D. +	1.23 (0.98-1.55)	[2] **1.49 (1.23-1.79)**	[1] **0.78 (0.64-0.94)**	[3] **1.62 (1.42-1.86)**	[3] **1.39 (1.22-1.59)**	[3] **1.56 (1.20-2.06)**
Political affiliation						
Democrat	Ref	Ref	Ref	Ref	Ref	Ref
Republican	[3] **0.30 (0.23-0.38)**	[3] **0.63 (0.53-0.74)**	0.86 (0.73-1.00)	[2] **0.83 (0.74-0.94)**	[3] **0.71 (0.64-0.80)**	[3] **2.24 (1.81-2.79)**
Other	[3] **0.32 (0.25-0.41)**	[1] **0.79 (0.66-0.96)**	[2] **0.80 (0.68-0.94)**	[3] **0.77 (0.67-0.87)**	0.90 (0.80-1.01)	1.03 (0.79-1.34)
Prefer not to say	[3] **0.31 (0.24-0.40)**	[1] **0.80 (0.66-0.96)**	[2] **0.78 (0.66-0.92)**	[2] **0.83 (0.73-0.94)**	[2] **0.90 (0.80-1.01)**	[3] **1.71 (1.35-2.18)**

[1] p<.05; [2] p<.01; [3] p<.001; ^Odds of using source compared to those not using source, adjusting for all other covariates in tables

Table 3. Adjusted odds^ of Coronavirus knowledge (correct answer) by information source, n = 11,242

	Currently, there is an FDA approved drug for treating individuals with Coronavirus.	Children are at high risk for complications from Coronavirus.	Alcohol-based hand sanitizers cannot protect you from Coronavirus.	Coronavirus originated from animals	How can you protect against Coronavirus infection? Getting a flu shot.	How can you protect against Coronavirus infection? Wearing a face mask.	How can you protect against Coronavirus infection? Stop going to school/work.
# Sources	1.03 (0.97-1.10)	1.03 (0.98-1.08)	1.04 (0.98-1.09)	0.96 (0.92-1.02)	0.97 (0.92-1.02)	[3] 1.10 (1.05-1.14)	[1] 1.07 (1.00-1.14)
Source group							
Traditional Media	1.24 (0.95-1.61)	0.93 (0.72-1.19)	[1] 1.28 (1.00-1.63)	[1] 0.78 (0.61-1.00)	1.09 (0.83-1.40)	[3] 1.45 (1.18-1.77)	[3] 1.93 (1.50-2.48)
Government	[1] 1.30 (1.04-1.61)	1.21 (0.99-1.46)	1.12 (0.91-1.36)	0.90 (0.73-1.10)	[1] 1.33 (1.08-1.62)	0.88 (0.74-1.05)	[2] 1.44 (1.16-1.79)
Online Media	1.07 (0.85-1.35)	1.03 (0.84-1.25)	0.92 (0.74-1.13)	1.09 (0.89-1.34)	1.06 (0.86-1.30)	0.96 (0.82-1.13)	[1] 1.34 (1.06-1.68)
Interpersonal Sources	1.00 (0.81-1.22)	0.91 (0.77-1.08)	0.99 (0.83-1.18)	1.01 (0.85-1.20)	1.08 (0.91-1.29)	0.98 (0.85-1.12)	1.16 (0.94-1.42)
Doctor	0.91 (0.77-1.07)	[2] 0.82 (0.72-0.94)	0.99 (0.86-1.15)	1.01 (0.87-1.16)	0.88 (0.76-1.02)	[2] 1.17 (1.05-1.31)	1.09 (0.92-1.31)
Religious Leader	[2] 0.65 (0.49-0.86)	0.86 (0.68-1.10)	1.09 (0.83-1.44)	0.92 (0.69-1.21)	0.91 (0.71-1.17)	[1] 0.81 (0.67-0.99)	1.02 (0.72-1.45)
Most trusted source*							
Government	Ref	Ref	Ref	Ref	Ref	Ref	Ref
TV	[3] 0.54 (0.40-0.75)	0.83 (0.63-1.09)	0.85 (0.64-1.14)	1.18 (0.88-1.55)	0.82 (0.62-1.09)	[1] 1.38 (1.08-1.79)	0.81 (0.55-1.22)
Social Media	[2] 0.43 (0.26-0.73)	1.12 (0.65-2.07)	0.67 (0.41-1.17)	1.48 (0.85-2.46)	1.46 (0.78-3.04)	0.77 (0.49-1.23)	[3] 0.29 (0.17-0.49)
Newspaper	1.40 (0.92-2.22)	1.11 (0.84-1.47)	1.32 (0.98-1.79)	0.76 (0.56-1.02)	1.17 (0.88-1.58)	0.97 (0.78-1.20)	0.98 (0.66-1.49)
Websites	[3] 0.54 (0.40-0.72)	1.12 (0.84-1.53)	0.89 (0.67-1.18)	1.13 (0.84-1.49)	[2] 1.67 (1.18-2.42)	[1] 0.67 (0.53-0.84)	[3] 0.32 (0.24-0.42)
Friends	[2] 0.41 (0.19-1.01)	0.81 (0.37-2.06)	1.96 (0.70-8.20)	0.51 (0.12-1.44)	1.00 (0.42-2.97)	0.80 (0.40-1.66)	[3] 0.25 (0.11-0.56)
Doctor	[1] 0.84 (0.71-1.00)	0.88 (0.77-1.01)	0.97 (0.84-1.13)	1.03 (0.88-1.19)	[2] 0.81 (0.70-0.93)	1.05 (0.94-1.18)	[3] 0.63 (0.52-0.75)
Radio	[2] 0.42 (0.25-0.73)	1.34 (0.73-2.72)	[2] 0.46 (0.28-0.77)	[2] 2.19 (1.30-3.58)	0.83 (0.48-1.56)	0.82 (0.51-1.37)	[3] 0.28 (0.17-0.47)
Partner	[2] 0.60 (0.42-0.86)	1.01 (0.72-1.46)	[1] 0.71 (0.50-1.01)	[1] 1.42 (0.99-1.99)	0.83 (0.59-1.21)	0.89 (0.66-1.20)	[3] 0.33 (0.23-0.47)
Family	0.77 (0.42-1.54)	0.68 (0.41-1.19)	0.96 (0.55-1.81)	1.04 (0.55-1.83)	0.65 (0.38-1.14)	0.85 (0.53-1.40)	[1] 0.49 (0.27-0.95)

[1] p<.05; [2] p<.01; [3] p<.001; *due to small sample size of those identifying religious leaders as their most trusted source (n=8), these were removed for analysis

^ Adjusted for all other information source variables in the model, as well as time of survey, sex, age, race, region, type of residence, working status, children, education, political affiliation

Table 4. Adjusted odds^ of agreement of Coronavirus beliefs by information source, n = 11,242

	I think that Coronavirus was released as an act of bioterrorism.	*Coronavirus is more deadly than the seasonal flu.*	*I think warmer weather will reduce the spread of Coronavirus.*	*The amount of media attention devoted to Coronavirus has been adequate.*	*Coronavirus is not as big of a problem as the media suggests.*	*Coronavirus is a bigger problem than the government suggests.*
# Sources	1.02 (0.97-1.06)	[3]1.13 (1.08-1.19)	1.02 (0.98-1.06)	[3]1.13 (1.07-1.19)	[2]0.91 (0.86-0.95)	[2]1.08 (1.03-1.12)
Source group						
Traditional Media	[3]0.51 (0.42-0.64)	[2]1.60 (1.29-1.98)	[2]0.76 (0.63-0.92)	[3]1.54 (1.24-1.19)	[3]0.47 (0.37-0.58)	[2]1.53 (1.24-1.89)
Government	[3]0.64 (0.54-0.76)	[2]1.48 (1.23-1.77)	[3]0.69 (0.58-0.80)	1.10 (0.90-1.32)	[3]0.65 (0.53-0.78)	1.25 (1.05-1.48)
Online Media	0.98 (0.81-1.17)	1.09 (0.90-1.31)	1.07 (0.92-1.25)	1.05 (0.87-1.27)	1.05 (0.87-1.27)	1.03 (0.87-1.21)
Interpersonal Sources	0.89 (0.76-1.04)	0.96 (0.82-1.13)	0.97 (0.85-1.11)	[1]0.81 (0.69-0.96)	0.90 (0.77-1.06)	0.95 (0.82-1.09)
Doctor	[1]0.85 (0.75-0.96)	1.02 (0.89-1.17)	[2]0.84 (0.75-0.93)	0.97 (0.85-1.12)	[2]0.84 (0.73-0.96)	[2]1.24 (1.10-1.39)
Religious Leader	[2]1.38 (1.11-1.70)	[1]0.78 (0.61-1.00)	[2]1.36 (1.12-1.64)	[1]0.74 (0.58-0.95)	[3]1.58 (1.25-1.99)	[3]0.57 (0.47-0.70)
Most trusted source*						
Government	Ref	Ref	Ref	Ref	Ref	Ref
TV	[2]1.53 (1.19-1.97)	0.96 (0.71-1.32)	0.95 (0.75-1.19)	[1]1.55 (1.10-2.25)	1.00 (0.74-1.43)	[1]1.34 (1.04-1.74)
Social Media	[3]2.52 (1.58-4.03)	[2]0.50 (0.31-0.81)	[2]1.99 (1.25-3.26)	[2]0.50 (0.32-0.81)	[2]2.46 (1.48-4.14)	0.83 (0.51-1.35)
Newspaper	[2]0.66 (0.48-0.90)	1.07 (0.78-1.48)	0.89 (0.73-1.09)	[2]1.67 (1.21-2.36)	0.86 (0.63-1.15)	[1]1.44 (1.13-1.84)
Websites	[3]2.08 (1.65-2.62)	[3]0.43 (0.34-0.55)	[2]1.37 (1.10-1.70)	[3]0.64 (0.50-0.82)	[3]2.27 (1.78-2.89)	[3]0.60 (0.48-0.76)
Friends	[2]3.01 (1.48-6.08)	0.65 (0.30-1.49)	1.43 (0.73-2.86)	[1]0.42 (0.21-0.88)	[1]2.58 (1.18-5.58)	0.52 (0.24-1.07)
Doctor	[3]1.45 (1.27-1.64)	[3]0.70 (0.61-0.81)	1.07 (0.96-1.20)	[2]0.82 (0.71-0.94)	[3]1.37 (1.20-1.57)	0.97 (0.86-1.10)
Radio	1.55 (0.95-2.51)	[3]0.37 (0.23-0.61)	[2]2.15 (1.34-3.53)	0.72 (0.44-1.24)	[3]3.16 (1.88-5.38)	[1]0.54 (0.32-0.88)
Partner	[3]2.82 (2.09-3.81)	[3]0.48 (0.36-0.66)	[3]1.73 (1.30-2.33)	[2]0.60 (0.45-0.82)	[2]2.07 (1.49-2.89)	[1]0.66 (0.48-0.89)
Family	[3]3.78 (2.36-6.11)	[1]0.59 (0.36-1.00)	1.31 (0.83-2.07)	0.62 (0.37-1.05)	1.56 (0.92-2.59)	1.00 (0.62-1.63)

[1] $p<.05$; [2] $p<.01$; [3] $p<.001$; *due to small sample size of those identifying religious leaders as their most trusted source (n=8), these were removed for analysis

^ Adjusted for all other information source variables in the model, as well as time of survey, sex, age, race, region, type of residence, working status, children, education, political affiliation

Figure 1. Distribution of sources used and most trusted for information on COVID-19, n = 11,242
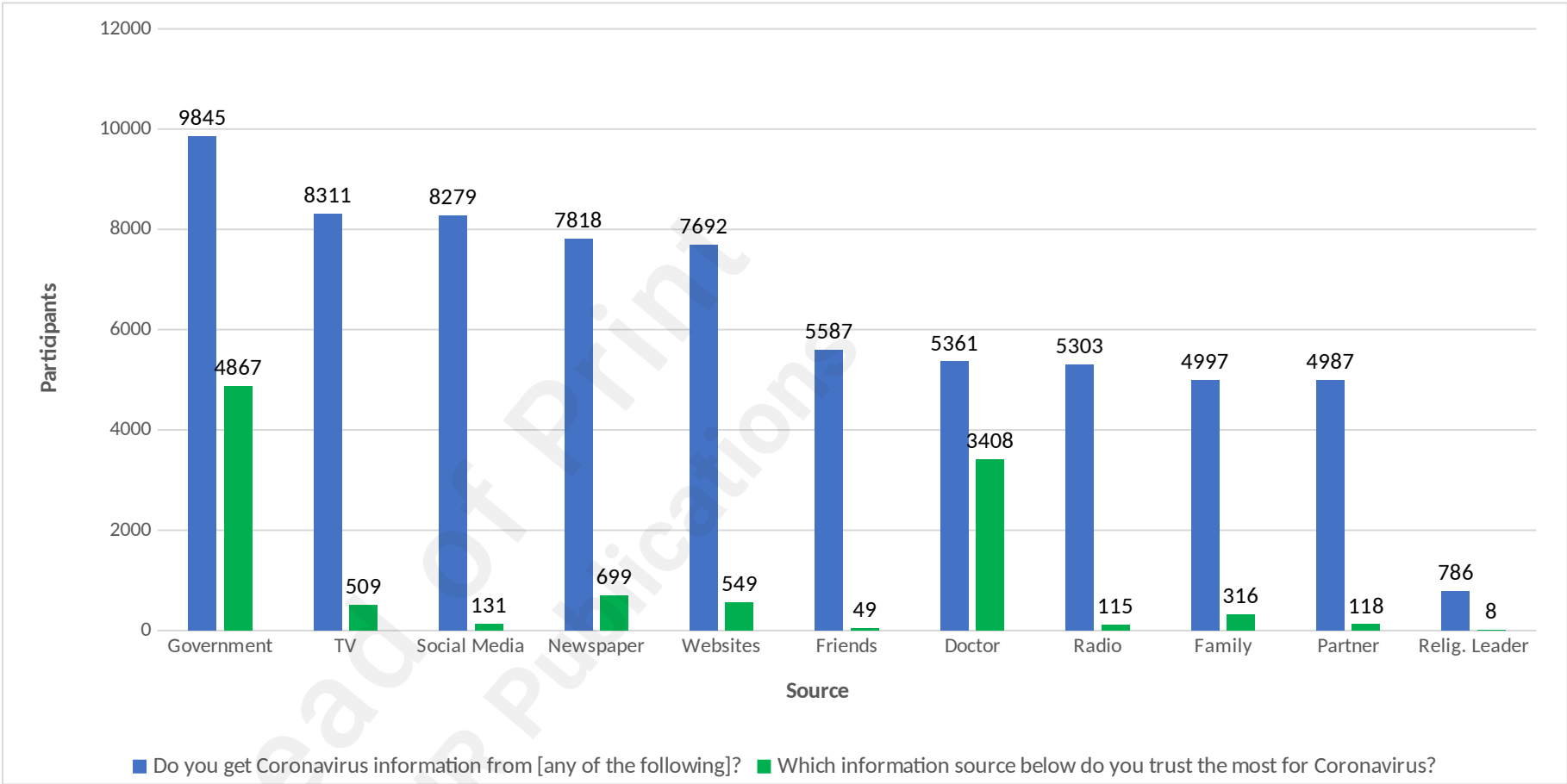
Supplemental File 1. Socio-demographic factors associated with mainstream media sources of COVID-19 information source^, n = 7,811

|	CNN	Fox News	MSNBC	Other national/local	Other international
Sex					
Female	Ref	Ref	Ref	Ref	Ref
Male	0.95 (0.84-1.06)	1.05 (0.92-1.19)	0.96 (0.82-1.12)	[3] **0.69 (0.63-0.76)**	1.08 (0.87-1.34)
Age					
18-39 years	Ref	Ref	Ref	Ref	Ref
40-59 years	1.00 (0.87-1.15)	1.18 (0.98-1.43)	1.16 (0.93-1.46)	1.10 (0.97-1.25)	0.89 (0.69-1.16)
60+ years	0.87 (072-1.05)	[2] **1.41 (1.12-1.77)**	[3] **1.85 (1.43-2.40)**	1.11 (0.95-1.30)	[2] **0.67 (0.47-0.95)**
Race					
White	Ref	Ref	Ref	Ref	Ref
Non-White	0.97 (0.79-1.19)	0.88 (0.66-1.15)	0.82 (0.60-1.11)	0.98 (0.82-1.17)	[3] **1.44 (1.03-1.97)**
Region					
Northeast	Ref	Ref	Ref	Ref	Ref
Midwest	0.87 (0.75-1.01)	0.99 (0.83-1.17)	0.95 (0.73-1.15)	0.93 (0.83-1.06)	1.11 (0.82-1.51)
South	1.13 (0.98-1.30)	1.00 (0.85-1.18)	0.85 (0.69-1.03)	[3] **0.78 (0.69-0.88)**	1.30 (0.97-1.75)
West	[2] **0.79 (0.67-0.93)**	[1] **0.80 (0.65-0.99)**	[3] **0.79 (0.63-0.98)**	0.89 (0.77-1.02)	[2] **1.55 (1.14-2.11)**
Residence					
Suburb.	Ref	Ref	Ref	Ref	Ref
Urban	1.06 (0.92-1.23)	[1] **0.79 (0.64-0.99)**	1.08 (0.88-1.31)	0.95 (0.83-1.08)	[1] **1.38 (1.06-1.78)**
Rural	[2] **0.83 (0.73-0.94)**	[2] **0.81 (0.71-0.93)**	0.99 (0.84-1.18)	0.99 (0.89-1.10)	0.92 (0.71-1.19)
Employment					
Employed	Ref	Ref	Ref	Ref	Ref
Student/Unpaid	0.99 (0.79-1.25)	0.74 (0.54-1.00)	0.78 (0.52-1.13)	[1] **1.22 (1.00-1.47)**	1.32 (0.87-1.94)
Not Working/Unemp.	1.04 (0.87-1.23)	0.92 (0.75-1.13)	0.93 (0.72-1.18)	1.07 (0.93-1.24)	1.09 (0.79-1.48)
Retired	0.98 (0.82-1.16)	1.15 (0.95-1.38)	[3] **1.48 (1.21-1.82)**	0.92 (0.80-1.06)	0.76 (0.52-1.09)
Children at home					
No	Ref	Ref	Ref	Ref	Ref
Yes	1.09 (0.95-1.24)	1.05 (0.90-1.22)	0.93 (0.77-1.13)	0.98 (0.88-1.10)	0.80 (0.62-1.02)
Education					
High School or below	Ref	Ref	Ref	Ref	Ref
Some Col. / Assoc. D.	1.10 (0.90-1.34)	0.87 (0.73-1.04)	0.99 (0.76-1.29)	0.97 (0.84-1.13)	[3] **3.13 (1.85-5.72)**
Bachelor's D. +	[1] **1.25 (1.04-1.52)**	[3] **0.72 (0.61-0.87)**	0.97 (0.76-1.26)	1.05 (0.91-1.22)	[3] **3.68 (2.21-6.68)**
Political affiliation					
Democrat	Ref	Ref	Ref	Ref	Ref
Republican	[3] **0.13 (0.11-0.16)**	[3] **33.56 (25.60-44.87)**	[3] **0.09 (0.06-0.12)**	[3] **0.70 (0.61-0.80)**	[3] **0.26 (0.17-0.39)**
Other	[3] **0.39 (0.34-0.46)**	[3] **5.94 (4.39-8.15)**	[3] **0.25 (0.20-0.32)**	[2] **1.23 (1.09-1.40)**	1.09 (0.84-1.40)
Prefer not to say	[3] **0.36 (0.31-0.42)**	[3] **8.94 (6.68-12.17)**	[3] **0.23 (0.18-0.29)**	[2] **1.25 (1.10-1.42)**	0.78 (0.57-1.04)

[1] $p<.05$; [2] $p<.01$; [3] $p<.001$; ^Odds of using source compared to those not using source, adjusting for all other covariates in tables

Supplemental File 2: Changes in COVID-19 Information source between March and April, 2020, n = 11,242

	March (%)	April (%)	Percentage change	Adjusted^ Odds Ratio (Ref=March)
Source group				
Traditional Media	93.3	91.2	-2.1	[3] 0.68 (0.58-0.79)
Government	91.9	83.8	-8.1	[3] 0.41 (0.36-0.47)
Online Media	87.9	84.2	-3.7	[3] 0.75 (0.67-0.84)
Interpersonal Sources	73.5	68.2	-5.3	[3] 0.78 (0.71-0.85)
Doctor	55.4	46.1	-9.3	[3] 0.66 (0.61-0.72)
Religious Leader	9.7	5.5	-4.2	[3] 0.59 (0.50-0.69)
Most trusted source*				
Government	53.3	36.9	-16.4	[3] 0.51 (0.47-0.56)
TV	3.9	5.6	1.7	[2] 1.40 (1.15-1.70)
Social Media	1.1	1.3	0.2	1.25 (0.86-1.83)
Newspaper	5.0	8.1	3.1	[3] 1.50 (1.27-1.78)
Websites	3.3	6.9	3.6	[3] 2.08 (1.72-2.53)
Friends	0.3	0.6	0.3	1.83 (1.00-3.49)
Doctor	29.5	33.9	4.4	[3] 1.25 (1.15-1.36)
Radio	0.6	1.6	1.0	[3] 2.54 (1.68-3.93)
Partner	2.0	4.0	2.0	[3] 2.21 (1.72-2.87)
Family	0.9	1.3	0.4	[1] 1.71 (1.14-2.61)

[1] $p<.05$; [2] $p<.01$; [3] $p<.001$; *due to small sample size of those identifying religious leaders as their most trusted source (n=8), these were removed for analysis

^ Adjusted for sex, age, race, region, type of residence, working status, children, education, political affiliation

Supplementary Files
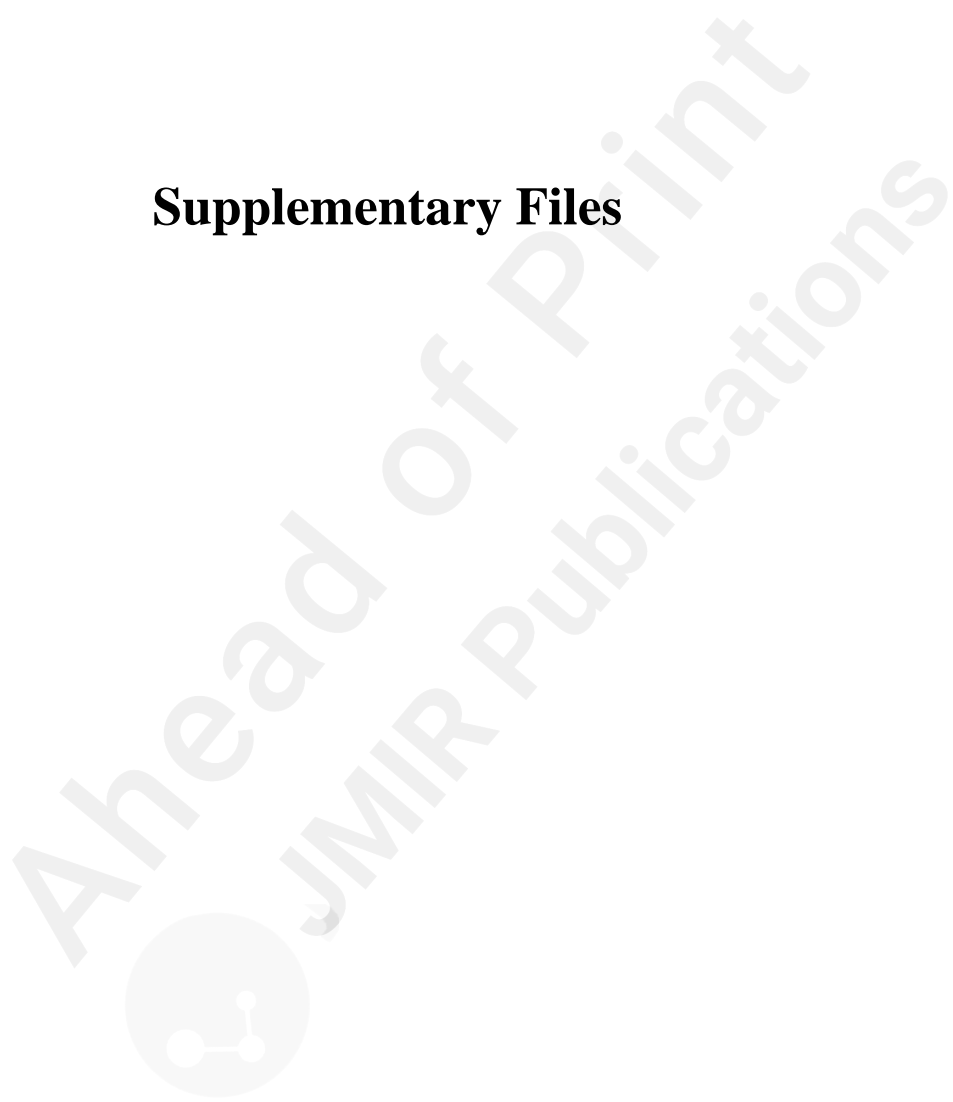
Figures

Distribution of sources used and most trusted for information on COVID-19, n = 11,242.