



Misinformation During the COVID-19 Pandemic: From Mainstream Media to Social Media

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HARVARD UNIVERSITY

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**"Misinformation During the COVID-19 Pandemic:
From Mainstream Media to Social Media"**

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Title Page

Misinformation During the COVID-19 Pandemic:
From Mainstream Media to Social Media

A dissertation presented by

Ella F. Douglas-Durham

To

The Department of Social & Behavioral Sciences

In partial fulfillment of the requirements

For the degree of

Doctor of Philosophy

in the subject of

Population Health Sciences

Harvard University

Cambridge, MA

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Misinformation During the COVID-19 Pandemic:
From Mainstream Media to Social Media

Abstract

Misinformation, which refers to false or misleading information, has drawn increasing attention in recent years and has been identified as a threat to public health. Misinformation's impact can be felt at multiple levels. Belief in misinformation can have several negative impacts, including people holding policy preferences that are different from those that they would hold if they were correctly informed, which can impact voting behavior, and in turn, public policy including public health policy. Misinformation can also impact health directly by influencing whether people engage in health-protective behaviors and indirectly by sharing health information within their social networks. This dissertation addresses several gaps in the literature related to the spread of and belief in health misinformation in the context of the COVID-19 pandemic.

Study 1 assessed whether three factors previously shown to be associated with belief in misinformation – conservative media use, anti-intellectualism, and conspiratorial thinking – are associated with health misinformation and whether their associations vary based on the type of health misinformation. The two pieces of health misinformation included in this study were: (1) that childhood vaccines cause autism; and (2) that hydroxychloroquine is a safe and effective treatment for COVID-19. Analyzing two-wave panel data from the 2020 American National Election Studies, Study 1 found that anti-intellectualism and conspiratorial thinking were positively associated with belief in both pieces of misinformation, whereas the use of conservative media was positively associated only with belief that hydroxychloroquine is a safe and effective treatment for COVID-19.

Study 2 explored the agenda-setting effects of mainstream news media coverage on public salience of public health misinformation. This study analyzed the association between news media coverage and public salience of three different pieces of COVID-19 misinformation: (1) hydroxychloroquine is a safe and effective treatment for COVID-19; (2) the COVID-19 vaccines cause infertility; and (3) ivermectin is a safe and effective treatment for COVID-19. Salience was measured by Google Trends relative search volume (RSV). News media coverage volume was a significant predictor of same-day RSV for hydroxychloroquine and ivermectin, but not for vaccines and infertility, indicating mainstream news media coverage may contribute to the public salience of certain forms of misinformation.

Study 3 explored the health behaviors and information sources of social media health mavens, individuals who provide and share health information with their networks via social media. This study also investigated whether social media health mavens are more likely to believe health misinformation than non-mavens. Using data from a cross-sectional survey among Ipsos KnowledgePanel® members collected during the summer of 2020, Study 3 found that healthier diet and exercise habits; being an occasional smoker; and using liberal and mainstream news sources were associated with higher odds of being a social media health maven. Social media health mavens were no more likely than non-social media mavens to believe COVID-19 misinformation.

This dissertation contributes to the literature on the spread of and belief in health misinformation during the COVID-19 pandemic. Taken together, Studies 1 and 2 demonstrate that the mainstream media can contribute to the salience of and belief in public health misinformation, but that several factors such as novelty, politicization, and volume of media coverage may influence this relationship. Study 3 found that social media health mavens are not

more likely to believe misinformation, but future research should explore what information they actually share with their social media networks.

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Introduction

Health misinformation

Misinformation, defined by Swire-Thompson and Lazer (2020) as “information that is contrary to the epistemic consensus of the scientific community regarding a phenomenon” (p.434) has drawn increasing attention in recent years and become a cause for global concern (Lazer et al., 2018). Misinformation is not a new problem, but elements of the current information ecosystem have led to changes in the ways misinformation is spread and consumed. For example, social media allows users to share information broadly, at a fast pace, and with increased anonymity; these features allow users to spread unverified information more quickly than prior to the advent of social media (Bode & Vraga, 2017). As these changes have facilitated the ongoing spread of misinformation, it has permeated many aspects of life, including public health. Indeed, Larson (2018) argues that the spread of misinformation, particularly on social media, should be recognized as a global public health threat.

Misinformation’s impact can be felt at multiple levels. Misinformation can result in people holding policy preferences that are different from those that they would hold if they were correctly informed (Kuklinski et al., 2000), which can impact voting behavior, and in turn, public policy. Misinformation can also impact health directly by influencing whether people engage in health-protective behaviors or adopt behaviors that may impede health. For example, if someone believes the misinformation that vaccines cause autism and the pharmaceutical industry has conspired to cover up evidence of this relationship, they may avoid vaccinating their children. Such decisions, based on belief in misinformation, have implications for the health of their children as well as society more broadly. In one study, Jolley and Douglas (2014) found that

among a sample of British parents, endorsement of anti-vaccine misinformation was associated with lower intentions to vaccinate a child in a hypothetical situation.

Misinformation & COVID-19

Misinformation often burgeons during times of crisis, including during pandemics (van Prooijen & Douglas, 2018). Crisis events are characterized by uncertainty; there are often information voids and the facts of the situation are subject to change. This is particularly true of pandemics of novel pathogens, as knowledge and understanding of the disease continues to evolve. Evolution of knowledge and scientific consensus may be perceived as inconsistency among scientists by some, leading to cynicism and mistrust, which can in turn contribute to belief in misinformation.

Misinformation has proliferated during the global COVID-19 pandemic. One nationally representative survey conducted in October, 2021 found that 78% of the public believed or was unsure about at least one piece of COVID-19 misinformation, and nearly a third believed four out of eight pieces of COVID-19 misinformation included in the survey (Hamel et al., 2021). The misinformation circulating during the COVID-19 pandemic has included misinformation about the origins of the pandemic (e.g. China intentionally created COVID-19 as a bioweapon) (Cassese et al., 2020); the extent of the pandemic (e.g. scientists were exaggerating the seriousness of Covid-19 to make then President Trump look bad) (Cassese et al., 2020); treatment for COVID-19 (e.g. Ivermectin is a safe and effective treatment for COVID-19) (Hamel et al., 2021); and the COVID-19 vaccines (e.g. the COVID-19 vaccines cause infertility) (Ognyanova, et al., 2021). As in other contexts, misinformation in the context of the COVID-19 pandemic had and continues to have real and negative consequences for public health. Among adults in several Western nations, belief in COVID-19 misinformation has been found to be

negatively associated with health protective behaviors such as social distancing, handwashing, mask-wearing, and vaccination intentions (Bridgman et al., 2020; Romer & Jamieson, 2020; Bekalu et al., 2021; Loomba et al., 2021; Viswanath et al., 2021). In the context of a global pandemic, the rejection of public health guidelines can have particularly dire consequences, impacting population morbidity and mortality.

Media use and misinformation

Although several studies have found that mainstream news media use (e.g. mainstream print, broadcast, and cable news) is associated with less endorsement of misinformation (Stecula et al., 2020; Jamieson and Albarracin, 2020; Dhawan et al., 2021), mainstream news media can still contribute to the spread of misinformation. Mainstream news media have the potential to increase the salience of misinformation through reporting about what politicians have said (Nan et al., 2021) or through refuting misinformation, as news coverage debunking misinformation can still increase its public salience (Weeks & Southwell, 2010). Indeed, Tsfaty et al. (2020) suggest that most people hear about fake news stories through their coverage by the mainstream media, rather than on fake news websites which reach only a small proportion of the population. During times of crisis, including public health emergencies, media use increases (Nielsen, 2020) which expands the potential for large-scale exposure to misinformation through the mass media.

The use of partisan news outlets is also associated with belief in misinformation. Use of conservative news outlets has been found to be associated with belief in misinformation about the Iraq War (Kull et al., 2003) and climate change (Feldman et al., 2014; Hmielowski et al., 2013; Feldman et al., 2012). During the COVID-19 pandemic, conservative media have been more likely to discuss COVID-19 misinformation than mainstream media (Motta, 2020) and users of conservative media have been more likely to believe COVID-19 misinformation (Motta,

2020) and conspiracy theories (Romer & Jamieson, 2020), which subsequently impacts vaccination intentions and uptake (Viswanath et al., 2021).

The contemporary information ecosystem has made the problem of misinformation even more acute. One factor that can contribute to the spread of and belief in health misinformation is media use. Social media has facilitated the spread of unverified information (Bode & Vraga, 2017); misinformation is known to be prevalent on social media (Suarez-Lledo & Alvarez Galvez, 2021), and exposure to misinformation is associated with increased likelihood of belief in misinformation (Lee et al., 2020). Indeed, past research has demonstrated an association between social media use and belief in misinformation about measles (Stecula et al., 2020) and COVID-19 (Jamieson and Albarracin, 2020).

Overview of the dissertation

Each study included in this dissertation fills a gap in the public health misinformation literature. Study 1 explores whether several factors associated with belief in misinformation – media use, anti-intellectualism, and conspiratorial thinking – vary across two different pieces of health misinformation: (1) childhood vaccines cause autism; and (2) hydroxychloroquine is a safe and effective treatment for COVID-19. The purpose of this study was to assess whether factors associated with a newer and more highly politicized piece of misinformation differed from factors associated with a less novel and less politicized falsehood. Analyzing two-wave panel data from the 2020 American National Election Studies, Study 1 found that anti-intellectualism and conspiratorial thinking were positively associated with belief in both pieces of misinformation, whereas the use of conservative media was positively associated with belief that hydroxychloroquine is a safe and effective treatment for COVID-19, but not with belief that childhood vaccines cause autism. Study 1 points to the need for future exploration of the

mechanisms of how beliefs in health misinformation are formed by conservative media use and underlying predispositions such as anti-intellectualism and conspiratorial thinking, and whether any of these factors may moderate or mediated the associations of the others with belief in health misinformation.

Study 2 examined whether an agenda-setting effect exists for three different pieces of COVID-19 misinformation: (1) hydroxychloroquine is a safe and effective treatment for COVID-19; (2) the COVID-19 vaccines cause infertility; and (3) ivermectin is a safe and effective treatment for COVID-19. The purpose of this study was to determine whether the mainstream news media contribute to the public salience of public health misinformation. To answer this question, this study used autoregressive integrated moving average (ARIMA) modeling to analyze the relationship between two time series: (1) media coverage volume; and (2) Google data. News media coverage volume was a significant predictor of same-day RSV for hydroxychloroquine and ivermectin, but not for vaccines and infertility, indicating mainstream news media coverage may contribute to the public salience of misinformation. Study 2 indicates a need for future research testing the factors that contribute to the existence of agenda-setting effects for health misinformation.

Study 3 explored the factors associated with being a social media health maven, defined as someone who shares health information with their social media networks. The purpose of this study was to characterize social media health mavens – a yet unstudied concept – and to determine whether they are more likely to believe health misinformation than non-mavens. Using data from a cross-sectional survey, Study 3 found that Hispanic ethnicity; healthier diet and exercise habits; being an occasional smoker; and using liberal and mainstream news sources were associated with higher odds of being a social media health maven. Social media health

mavens were no more likely than non-mavens to believe COVID-19 misinformation. Study 3 points to the need for future research focused specifically on what health information social media health mavens actually share with their social media networks.

Taken together, these three studies shed light on factors associated with belief in and salience of health misinformation during the COVID-19 pandemic. These findings can be used to better inform efforts of public health professionals, journalists, and editors to reduce belief in and salience of health misinformation.

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Chapter 1

Study 1

An Investigation of the Associations of Media Use, Anti-intellectualism, and Conspiratorial Thinking with Belief in Health Misinformation

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Abstract

Background: The growing spread of health misinformation is cause for concern. Previous research has indicated that conservative media use, anti-intellectualism, and conspiratorial thinking are associated with belief in misinformation.

Objective: This study tests whether conservative media use, anti-intellectualism, and conspiratorial thinking are associated with belief in two different pieces of health misinformation, and whether their associations vary across these pieces of health misinformation. The two pieces of health misinformation included in this study were (1) that childhood vaccines cause autism and (2) that hydroxychloroquine is a safe and effective treatment for COVID-19.

Methods: Data from the 2020 American National Election Studies were used. A pre-election survey of US adults (n=8,280) was conducted between August and November 2020 and a post-election survey with 7,449 of the same respondents was conducted between November 2020 and January 2021. The surveys measured media use, anti-intellectualism, conspiratorial thinking, belief that childhood vaccines cause autism, and belief that hydroxychloroquine is a safe and effective treatment for COVID-19.

Results: Anti-intellectualism and conspiratorial thinking were positively associated with belief in both pieces of misinformation. The use of conservative media was positively associated with belief that hydroxychloroquine is a safe and effective treatment for COVID-19, but not with belief that childhood vaccines cause autism.

Conclusion: The association of conservative media use with belief in health misinformation may depend on several factors including salience, politicization, and how recently scientific

consensus was established. Future research should continue to explore the relationships between the factors associated with belief in misinformation and their underlying relationships to better inform efforts of public health professionals, journalists, and editors of news media to reduce belief in health misinformation.

Introduction

Misinformation, which refers to false or misleading information, has proliferated in recent years and become an increasing cause for global concern (Lazer et al., 2018). Indeed, the spread of misinformation has been identified as a global public health threat (Larson, 2018). Belief in misinformation can have several negative impacts, including people holding policy preferences that are different from those that they would hold if they were correctly informed (Kuklinski et al., 2000), which can impact voting behavior, and in turn, public policy. Misinformation can also impact health directly by influencing whether people engage in health-protective behaviors. For example, belief in COVID-19 misinformation and conspiracy theories is negatively associated with health protective behaviors such as social distancing, handwashing, mask-wearing, and vaccine uptake (Bridgman et al., 2020; Teovanovic et al., 2020; Romer & Jamieson, 2020; Bekalu et al., 2021). In the context of a global pandemic, the rejection of public health guidelines can have particularly dire consequences, impacting population morbidity and mortality.

Media use and belief in misinformation

Agenda setting is a theory of media effects that posits a relationship between media coverage of issues and increased public salience of those issues (Kosicki, 1993). Decades of research indicates that the media environment does influence the public's interest in specific issues (Valentino & Nardis, 2013). The concept of second-level agenda setting moves beyond salience and refers to the process of shifting attitudes in the direction of the coverage through different modes of presentation of an issue (McCombs, 2004). In an increasingly partisan news landscape, as evidenced by certain media sources aligning their news content with the

predispositions of specific political parties and partisan news diets among audiences (Muisse et al., 2022), it is likely that second-level agenda setting effects would vary across media sources.

Indeed, over the last two decades, research has demonstrated a link between use of ideologically conservative media sources and belief in misinformation. For example, a 2003 study found that viewers of Fox News were more likely to believe falsehoods about the Iraq War than those who got their news from ABC, CBS, CNN, NBC, PBS, NPR, or print news (Kull et al., 2003). Several studies have also found that use of Fox News and other conservative media is negatively associated with belief in climate change (Hmielowski et al., 2014; Feldman et al., 2014), findings that reflect Fox News' dismissive coverage of human-caused climate change (Feldman et al., 2012). This association has proven to be true during the COVID-19 pandemic as well. In the early stages of the pandemic, conservative media were more likely to discuss COVID-19 related misinformation than mainstream outlets, and, correspondingly, viewers of conservative media were more likely to believe COVID-19 misinformation than consumers of left-leaning media (Motta et al., 2020). Use of conservative media is positively associated with belief in COVID-19 conspiracy theories (Romer & Jamieson, 2020) and was found to be predictive of increased acceptance of COVID-19 conspiracy theories over time (Romer & Jamieson, 2021a). This existing research illustrates that media use is an important predictor of belief in misinformation.

Anti-intellectualism and belief in misinformation

There is a growing body of research on individual-level psychological factors associated with belief in misinformation. One such factor is anti-intellectualism. According to Hofstadter (1963), there are three types of anti-intellectualism: (1) anti-rationalism, which refers to the rejection of critical thought as an important quality for individuals to have; (2) unreflective

instrumentalism, which refers to a preference for short term pay offs and an inability to think of broader or long-term implications, and (3) anti-elitism, which refers to a strong distrust of experts and a devaluation of education and expertise. Current research on anti-intellectualism and public opinion focuses on the third type of anti-intellectualism – anti-elitism – and is defined here and in previous research (e.g., Motta, 2018; Merkley, 2020; Merkley & Loewen, 2021) as a strong distrust of experts and intellectuals. Existing research has demonstrated that anti-intellectualism is associated with the rejection of matters of scientific consensus that are relevant for policy-making such as the severity of climate change and the safety of nuclear power (Motta, 2018), as well as issues of scientific consensus that have been less politicized, such as genetically modified foods and water fluoridation (Merkley, 2020). Anti-intellectualism is also positively associated with belief in COVID-19 misperceptions (Merkley & Loewen, 2021). Although the research described above indicates that anti-intellectualism can be an important predictor of belief in misinformation, it is still an understudied factor in science communication (Merkley & Loewen, 2021) and its association with belief in misinformation has not been extensively studied, indicating a need for further research on the topic.

Conspiratorial thinking and belief in misinformation

Belief in conspiracy theories is a long-studied phenomenon in the fields of political science and political psychology. A well-established attribute of conspiracy beliefs is that the belief in one conspiracy theory is associated with the belief in other conspiracy theories (Miller, 2020). This is true even of contradictory conspiracy theories; for example, Miller (2020) found that believing that the U.S. accidentally released the coronavirus, believing that China accidentally released the coronavirus, and believing that China intentionally released the coronavirus as a bioweapon were all positive predictors of each other (Miller, 2020). This is

explained by an underlying predisposition toward seeing conspiracies, referred to as conspiratorial thinking (Uscinski et al., 2016). Rather than looking at belief in specific conspiracies, conspiratorial thinking refers to the broad tendency to view events as the result of conspiracy (Uscinski & Parent, 2014). Several studies have demonstrated the association between conspiratorial thinking and belief in conspiracy theories, both prior to the current global pandemic (Edelson et al., 2017) and in the context of COVID-19 (Uscinski et al., 2020; Cassese et al., 2020). Further, research indicates that a predisposition to conspiratorial thinking increases the likelihood that conspiracy theories will impact beliefs (Uscinski et al., 2016), which can then impact behavior.

Health misinformation

In this study we explore belief in both the disproven link between childhood vaccines and autism and the claim that hydroxychloroquine is a safe and effective treatment for COVID-19. These two pieces of misinformation were selected because they have had an impact on individual and public health. Beliefs that childhood vaccines, such as the MMR vaccine, cause autism persist despite the retraction of the 1998 *Lancet* article that initially proposed the since disproven link between vaccines and autism (Colgrove & Bayer, 2005; Stecula et al., 2020). These beliefs are dangerous for public health, as belief in vaccine misinformation can impact intentions to vaccinate children for preventable diseases (Jolley & Douglas, 2014; Harrington et al., 2006). Further, decreasing vaccination rates within certain groups have led to outbreaks of disease, as exhibited by the measles outbreaks in the U.S. in 2014-2015, 2017, and 2019.

In the case of hydroxychloroquine, the U.S. Food & Drug Administration (FDA) found that use of hydroxychloroquine in COVID-19 patients not only had no benefit in recovery, but also resulted in serious heart rhythm problems and other safety issues (U.S. Food & Drug

Administration [FDA], 2020). Additionally, purchases of hydroxychloroquine spiked following President Trump promoting the drug in white house briefings and on Twitter, which led to temporary shortages of the drug, thus hindering its utility for approved uses such as the treatment of malaria (Niburksi & Niburski, 2020). The focus on hydroxychloroquine as a treatment for COVID-19 also distracted from effective COVID-19 preventive measures.

Using hydroxychloroquine and the vaccine-autism link as examples of misinformation allows for exploration of whether the factors associated with belief in misinformation vary across different pieces of health misinformation, as recommended by Wu et al (2022). In this study, we have selected older misinformation that has been in circulation since the late 1990s, as well as misinformation that began circulating much more recently in the spring of 2020 and was thus likely more salient at the time of this study. Looking at these two pieces of misinformation also allows for the comparison misinformation that has been highly politicized versus one that has not. Donald Trump repeatedly endorsed the use of hydroxychloroquine as a treatment for COVID-19 (Niburksi & Niburski, 2020), whereas neither political party has robustly endorsed the claim that childhood vaccines cause autism (Jones-Jang & Noland, 2022). Although Trump expressed anti-vaccine sentiments during his presidential campaign (Jones-Jang & Noland, 2022) and presidency (Hornsey et al., 2020), these sentiments have historically been held by individuals across the spectrum of political ideology.

Hypotheses

This study uses panel data to explore whether three factors previously shown to be associated with belief in misinformation – conservative media use, anti-intellectualism, and conspiratorial thinking – are associated with two different pieces of health misinformation and whether their associations vary across these pieces of health misinformation.

Building on the existing research described above, we hypothesize that:

- (1) Higher use of more conservative media outlets will be positively associated with belief in health misinformation, as measured by: (a) belief in the disproven link between childhood vaccines and autism; and (b) belief that hydroxychloroquine is a safe and effective treatment for COVID-19.
- (2) Those higher in anti-intellectualism will be more likely to believe health misinformation, as measured by: (a) belief in the disproven link between childhood vaccines and autism; and (b) belief that hydroxychloroquine is a safe and effective treatment for COVID-19.
- (3) Those higher in conspiratorial thinking will be more likely to believe health misinformation, as measured by: (a) belief in the disproven link between childhood vaccines and autism; and (b) belief that hydroxychloroquine is a safe and effective treatment for COVID-19.

Materials and Methods

Data source

To test these hypotheses, we analyzed the 2020 American National Election Studies (ANES) Time Series Study, a panel study consisting of two waves of data. Pre-election surveys (n=8,280) were conducted between August 18, 2020, and November 3, 2020, which was Election Day. Post-election surveys (n=7,449) were conducted between November 8, 2020, and January 4, 2021 (American National Election Studies [ANES], 2021).

Sample

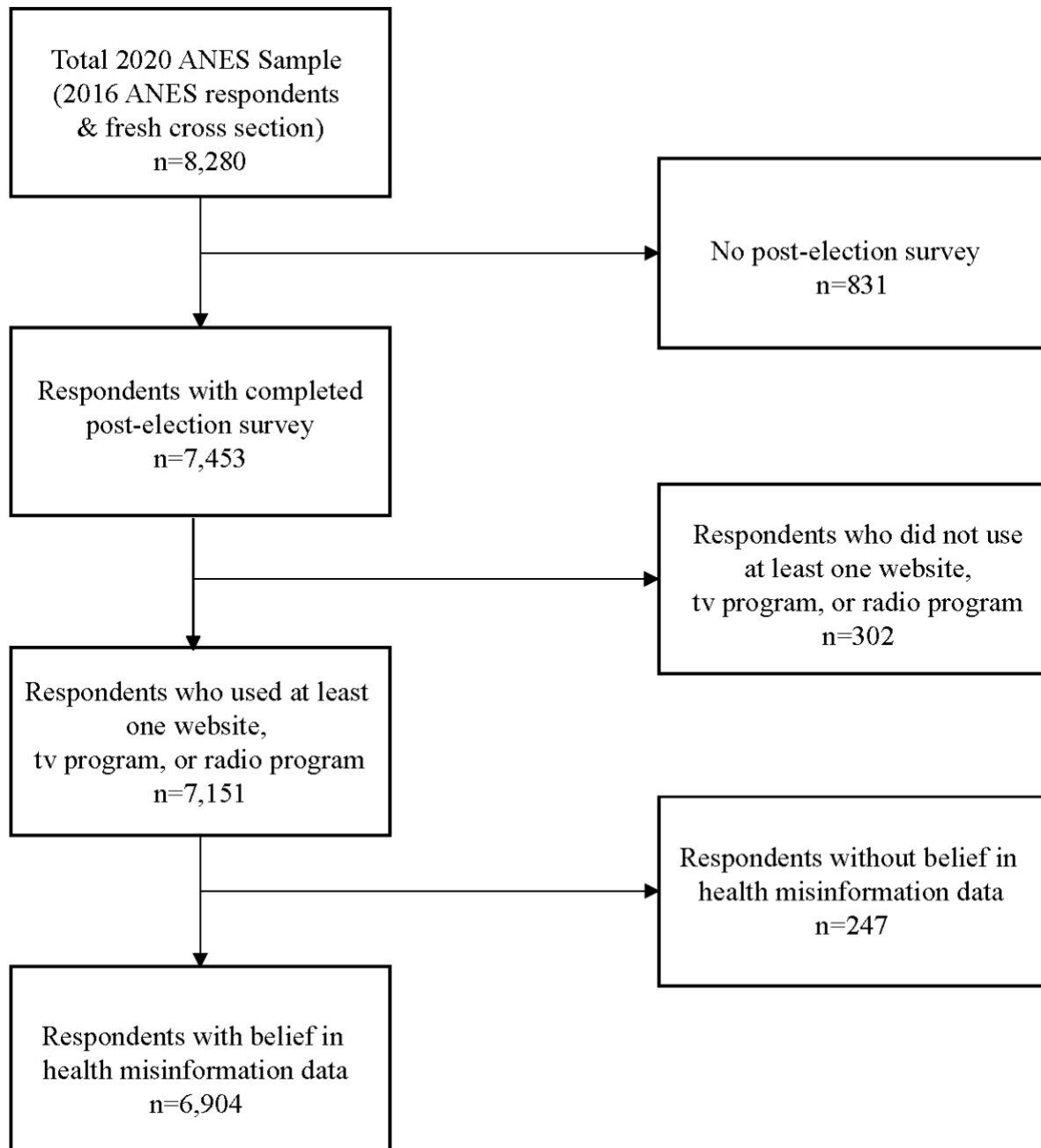
The study sample was made up of two groups: (1) 2016 ANES respondents; and (2) a fresh cross-sectional sample. The sampling frame for the 2016 ANES group was all respondents

who participated in the ANES 2016 Time Series Study and completed the post-election survey. The target population for the fresh cross-section was non-institutional U.S. citizens aged 18 or older living in the 50 states or the District of Columbia; the 2016 ANES respondents had the same eligibility criteria. The fresh cross-sectional sample was a random sample from the USPS computerized delivery sequence file (C-DSF). All residential addresses in the C-DSF had an equal probability of selection (ANES, 2021).

The data were collected using a sequential mixed-mode design including online surveys, telephone interviews, and video interviews conducted online. The response rate for the 2016 ANES respondents was 77.9%. The response rate for the fresh cross-section, computed using the RR1 formula American Association for Public Opinion Research (AAPOR), was 36.7% (ANES, 2021). Post-election surveys were completed by 90% of the pre-election respondents. The final sample for the current study was limited to respondents who completed both the pre- and post-election surveys and indicated using at least one website, television program, or radio program for news about the presidential election. Respondents who indicated that they had heard about the presidential campaign only through newspapers were excluded from the sample. Data on the use of newspapers was only publicly available for four newspapers – *New York Times*, *USA Today*, *Wall Street Journal*, and *Washington Post* – and three of these newspapers were also included in the question about website use. Respondents who had not heard about the presidential campaign via any of the media channels – television, radio, websites, or newspapers - were also excluded. Respondents who refused to answer questions about belief in health misinformation (the outcome of interest) or whose interviews were broken off prior to answering these questions were also excluded. Exclusion of respondents who did not use at least one of the above media channels and those who did not have responses for the outcome measures resulted

in a loss of seven percent of respondents and a final sample size of 6,904. See Figure 1.1 for details on the final sample. Additional details about the survey design and administration are available elsewhere (ANES, 2021). This study protocol was deemed exempt by the Harvard T.H. Chan School of Public Health Institutional Review Board.

Figure 1.1 Flowchart of final sample



Measures

Media use

Media use was measured using four questions from the pre-election survey. Two questions asked respondents to select all the television shows they watch regularly (at least once per month), the third question asked respondents to select all the radio shows they listen to regularly, and the fourth question asked respondents to select all websites they visit regularly. Participants were only asked to respond to these items if they indicated that they had heard about the presidential campaign through that specific channel (television, radio, or websites).

A total of 54 items were used to classify respondents' media use. Each item was a binary measure of whether a respondent regularly used a particular television program, radio program, or website (yes/no). Each television program, radio program, and website was classified as conservative, liberal, or centrist, based on existing classifications that are commonly used to categorize media in the US (AllSlides, 2022; Romer & Jamieson, 2021a; Greico, 2020; Weeks et al., 2016). These existing classifications are primarily used to classify channels rather than specific programs. In this study, all programs received the rating of the channel on which they air. For example, existing classification systems classify Fox as conservative, and accordingly, Tucker Carlson Tonight was classified as a conservative program. Items measuring use of entertainment programs (e.g., NCIS, American Idol) were excluded, as were items measuring use of programs that could not be easily classified and had low numbers of users (e.g., The Dave Ramsey Show, The Jim Bohannon Show). The full list of media classifications can be found in Supplementary Table 1.1.

Television programs, radio programs, and websites within each category – conservative, liberal, and centrist – were then used to create separate ordinal variables for conservative media

use, liberal media use, and centrist media use. The categories for each of the media use variables were non-users, one program, or two or more programs, with non-users as the reference category.

Anti-intellectualism

Drawing on Oliver and Rahn (2016), an item similar to one of the questions from the mistrust of expertise domain of their populism scale was used to measure anti-intellectualism. The following item from the post-election survey was used: “when it comes to public policy decisions, whom do you tend to trust more: ordinary people, experts, or trust both the same?”. This is an ordinal variable where trusting ordinary people more than experts represents the highest level of anti-intellectualism and trusting experts more than ordinary people represents the lowest level of anti-intellectualism.

Conspiratorial thinking

Conspiratorial thinking was measured with two separate items from the post-election survey, using a 5-point Likert scale from not at all to extremely well: (a) how well does the following statement describe your view – “most business and politics in this country are secretly controlled by the same few powerful people” – subsequently referred to as “conspiratorial thinking/dark forces”; and (b) how well does the following statement describe your view – “much of what people hear in schools and the media are lies designed to keep people from learning the real truth about those in power” – subsequently referred to as “conspiratorial thinking/deception”. These are ordinal variables; indicating the statements describe one’s worldview extremely well represents the highest level of conspiratorial thinking and indicating the statements describe one’s worldview not at all represents the lowest level of conspiratorial thinking. These items are similar in nature to items from the Uscinski et al. (2016) scale

commonly used to measure conspiratorial thinking. These items were included as separate measures of conspiratorial thinking because they were only moderately correlated ($R=0.54$).

Belief in health misinformation

Belief in health misinformation was measured with two separate measures. The first measure assessed belief in the disproven link between childhood vaccines and autism, subsequently referred to as the vaccine/autism link. The second measured belief in the false claim that hydroxychloroquine is a safe and effective treatment for COVID-19, subsequently referred to as hydroxychloroquine. Although use of hydroxychloroquine was initially considered by some as a viable treatment for COVID-19, the FDA revoked its Emergency Use Authorization (EUA) for use in hospitalized patients on June 15th, 2020 and issued a safety warning about the use of the drug on July 1st, 2020 (FDA, 2020) , several months prior to the collection of the data used in this study.

The first measure asked respondents which of two statements they thought was more likely to be true: (1) “most scientific evidence shows childhood vaccines cause autism”; and (2) “most scientific evidence shows childhood vaccines do not cause autism”. They were also asked how confident they were about their response (not at all/a little/moderately/very/ extremely). The responses from these two items were combined to create one scale ranging from -4 (extremely confident that the misinformation is true) to 4 (extremely confident that the correct information is true), with 0 representing individuals who were not at all confident in their response, regardless of which statement they chose. The second measure asked respondents which of two statements they thought was more likely to be true: (1) “there is clear scientific evidence that the anti-malarial drug hydroxychloroquine is a safe and effective treatment for COVID-19”; and (2) “there is not clear scientific evidence that the anti-malarial drug hydroxychloroquine is a safe and

effective treatment for COVID-19”. They were also asked how confident they were about their response. The responses to the two items were combined to create a scale following the same process described above. Below, more accurate beliefs refers to more confidently believing the scientifically accurate statement for each measure. A full description of the measures is in Supplementary Table 1.2.

Covariates

The following demographic variables were included as covariates: gender, level of education, ethnicity, and self-reported social class. Income level and race data were not publicly available. We controlled for political party identification and political ideology because they are associated with media use (Mitchell et al., 2014), anti-intellectualism (Motta, 2018; Gauchat, 2012), and belief in misinformation (Pennycook & Rand, 2021; Garrett & Bond, 2021), and are thus potential confounders of several of the relationships of interest. Although partisanship can drive belief in specific conspiracy theories, partisanship is not correlated with conspiratorial thinking (Uscinski et al., 2016). We also controlled for self-reported general health status and whether there had been a confirmed or suspected case of COVID-19 in the respondent’s household.

Statistical Analyses

We used multivariate linear regression models to test the above hypotheses. All analyses were conducted in R. We entered each of the independent variables (media use, anti-intellectualism, and the two measures of conspiratorial thinking) into separate models to predict each of the two dependent variables (vaccine/autism link and hydroxychloroquine) for a total of eight models. We calculated variance inflation factors (VIF) to assess multicollinearity in the

fully adjusted models and all the VIFs were 2.3 or below, indicating that there is no redundancy within the models.

Results

Sample and Measures Description

There were 6,904 participants in the final sample (see Table 1.1). The sample had more female than male respondents, was majority non-Hispanic, and a majority had some college education.

Slightly more respondents identified as Democrats (36%) than Republicans (31%) or Independents (30%). Within the final sample, there was greater centrist and liberal media use than conservative media use. For each type of media, more respondents reported using none or two or more programs than reported using one program (see Table 1.1). Overall, respondents trust experts more than ordinary people (41%) or experts and ordinary people the same (42%) than trust ordinary people more than experts (17%). On each of the two measures of conspiratorial thinking, a majority of respondents said the statements described their views somewhat well, very well, or extremely well (57 - 71%).

On average, respondents had stronger accurate beliefs about the vaccine/autism link ($M=1.58$, $SD=1.71$) than about hydroxychloroquine ($M=0.69$, $SD=2.18$). For each piece of misinformation, the mean response reflected accurate beliefs (any score >0), but on average respondents were more confident about their accurate beliefs about the vaccine/autism link than about hydroxychloroquine.

Table 1.1 Descriptive characteristics of the sample

n	Overall 6904
Conservative media use (n(%))	
None	3258 (47.2)
One program	1642 (23.8)
Two or more programs	2004 (29.0)
Center media use (n(%))	
None	2656 (38.5)
One program	1467 (21.2)
Two or more programs	2781 (40.3)
Liberal media use (n(%))	
None	2463 (35.7)
One program	1218 (17.6)
Two or more programs	3223 (46.7)
Anti-intellectualism (n(%))	
Trust ordinary people more	1161 (16.9)
Trust ordinary people and experts the same	2914 (42.3)
Trust experts more	2806 (40.8)
Conspiratorial thinking – dark forces (n(%))	
Not at all	592 (8.6)
Not very well	1408 (20.5)
Somewhat well	2452 (35.6)
Very well	1493 (21.7)
Extremely well	937 (13.6)
Conspiratorial thinking – deception (n(%))	
Not at all	1275 (18.5)
Not very well	1712 (24.9)
Somewhat well	2039 (29.6)
Very well	1023 (14.9)
Extremely well	828 (12.0)
<i>Other covariates</i>	
Gender (n(%))	
Female	3722 (54.2)
Male	3151 (45.8)
Education (n(%))	
High school or less	1296 (19.0)
Some college	1393 (20.5)
College or associates degree	2722 (40.0)
Post-graduate	1400 (20.6)
Ethnicity (n(%))	
Hispanic	588 (8.6)
Non-Hispanic	6287 (91.4)
Urbanicity (n(%))	
Rural	1024 (14.8)

Table 1.1 (Continued)

Small town	1699 (24.6)
Suburb	2128 (30.8)
City	2048 (29.7)
Political party (n(%))	
Democrat	2447 (35.6)
Republican	2145 (31.2)
Independent	2073 (30.2)
Other	205 (3.0)
Political ideology (n(%))	
Liberal	2174 (31.5)
Moderate	1518 (22.0)
Conservative	2304 (33.4)
Undecided	897 (13.0)
Political attention (n(%))	
Always	1709 (24.8)
Most of the time	2842 (41.2)
Half of the time	1290 (18.7)
Less than half of the time	1062 (15.4)
Social class (n(%))	
Lower or working	2791 (40.5)
Middle	3755 (54.5)
Upper	347 (5.0)
General health (n(%))	
Excellent	936 (13.6)
Very good	2371 (34.4)
Good	2343 (34.0)
Fair	994 (14.4)
Poor	242 (3.5)
COVID in household (n(%))	
Yes	5964 (86.5)
No	928 (13.5)
Vaccine/autism link beliefs (mean(SD))	1.58 (1.71)
Hydroxychloroquine beliefs (mean(SD))	0.69 (2.18)

Main findings***Media use and belief in health misinformation***

Our hypotheses that regular use of more conservative media outlets would be positively associated with belief in health misinformation was supported for one piece of health misinformation. The bivariate models indicated that conservative media use was significantly

associated with belief in hydroxychloroquine but not the vaccine/autism link, and that centrist and liberal media use were significantly associated with more accurate beliefs about both pieces of information. In the fully adjusted models, there is a threshold effect such that use of two or more conservative media programs was significantly associated with less accurate beliefs about hydroxychloroquine ($p=0.001$), whereas use of only one conservative media program was not ($p=0.678$) (Table 1.3). There is a similar pattern for centrist and liberal media use; use of two or more centrist media programs ($p=0.035$) and use of two or more liberal media programs ($p=0.004$) were both significantly associated with more accurate beliefs about hydroxychloroquine, whereas use of only one centrist or liberal media program was not (Table 3). The use of two or more liberal programs had a larger association with more accurate hydroxychloroquine beliefs than did the use of two or more centrist media programs. Use of two or more centrist media programs was also significantly associated with more accurate beliefs about the vaccine/autism link ($p=0.001$) (Table 1.2); this was the only category and level of media use that was a significant predictor of beliefs in the vaccine/autism link in the fully adjusted model.

Table 1.2 Linear regression models predicting belief in the vaccine/autism link

	Bivariate models Coef. (CI)	Fully adjusted model Coef. (CI)
<i>Key predictors</i>		
Conservative media use (referent group = no programs)		
One program	.00 (-.13, .13)	.03 (-.10, .15)
Two or more programs	.08 (-.06, .21)	.10 (-.03, .23)
Center media use (referent group = no programs)		
One program	.15 (.02, .29)*	.11 (-.02, .25)
Two or more programs	.30 (.16, .44)***	.25 (.12, .39)***
Liberal media use (referent group = no programs)		
One program	.11 (-.03, .25)	.03 (-.11, .16)

Table 1.2 (Continued)

Two or more programs	.29 (.16, .42)***	.06 (-.07, .20)
Anti-intellectualism (referent group = trust ordinary people more)		
Trust ordinary people and experts the same	.32 (.20, .45)	.16 (.04, .29)*
Trust experts more	.69 (.55, .82)	.32 (.17, .46)***
Conspiratorial thinking – dark forces (referent group = not at all)		
Not very well	.21 (-.01, 0.43)	.26 (.04, .48)*
Somewhat well	-.18 (-.39, .02)	.16 (-.05, .38)
Very well	-.30 (-.52, -.09)**	.13 (-.10, .35)
Extremely well	-.84 (-1.07, -.61)***	-.18 (-.43, .06)
Conspiratorial thinking – deception (referent group = not at all)		
Not very well	-.09 (-.26, .08)	-.06 (-.24, .12)
Somewhat well	-.69 (-.85, -.53)***	-.47 (-.65, -.30)***
Very well	-.82 (-1.00, -.64)***	-.59 (-.79, -.38)***
Extremely well	-1.20 (-1.38, -1.01)***	-.85 (-1.07, -.63)***
<i>Other covariates</i>		
Gender (referent group = female)		
Male		.07 (-.02, .17)
Education (referent group = high school or less)		
Some college		.19 (.05, .33)**
College or associates degree		.20 (.07, .33)**
Post-graduate		.36 (.19, .53)***
Ethnicity (referent group = Hispanic)		
Non-Hispanic		.22 (.05, .39)*
Urbanicity (referent group = rural)		
Small town		.14 (0, .29)
Suburb		.06 (-.08, .21)
City		.03 (-.12, .18)
Political party (referent group = Democrat)		
Republican		.17* (.02, .32)
Independent		.02 (-.11, .15)
Other		-.01 (-.30, .29)
Political ideology (referent group = liberal)		
Moderate		-.30 (-.45, -.15)***
Conservative		-.19 (-.35, -.03)*
Undecided		-.40 (-.56, -.23)***
Political attention (referent group = always)		
Most of the time		-.08 (-.21, .05)
Half of the time		-.24 (-.39, -.09)**
Less than half of the time		-.19 (-.35, -.02)*

Table 1.2 (Continued)

Social class (referent group = lower or working)	
Middle	.27 (.17, .38)***
Upper	.05 (-.23, .02)
General health (referent group = excellent)	
Very good	.15 (-.01, .30)
Good	.18 (.02, .34)*
Fair	.22 (.03, .40)*
Poor	-.04 (-.32, .24)
COVID in household (referent group = no)	
No	-.10 (-.25, .04)

* denotes p lower than 0.05, ** lower than .01, *** lower than .001

Table 1.3 Linear regression models predicting belief in hydroxychloroquine

	Bivariate models Coef. (CI)	Fully adjusted model Coef. (CI)
<i>Key predictors</i>		
Conservative media use (referent group = no programs)		
One program	-.27 (-.42, -.12)***	.03 (-.11, .17)
Two or more programs	-.92 (-1.07, -.77)***	-.27 (-.41, -.12)***
Center media use (referent group = no programs)		
One program	.04 (-.11, .20)	-.01 (-.15, .14)
Two or more programs	0.24 (.08, .40)**	.16 (.01, .31)*
Liberal media use (referent group = no programs)		
One program	.30 (.14, .47)***	.07 (-.08, .22)
Two or more programs	.90 (.75, 1.05)***	.21 (.07, .36)**
Anti-intellectualism (referent group = trust ordinary people more)		
Trust ordinary people and experts the same	.84 (.69, .99)***	.31 (.17, .45)***
Trust experts more	1.61 (1.45, 1.77)***	.54 (.38, .70)***
Conspiratorial thinking – dark forces (referent group = not at all)		
Not very well	0 (-.25, .25)	.07 (-.17, .3)
Somewhat well	-.25 (-.49, -.02)*	.09 (-.13, .31)
Very well	-.51 (-.75, -.26)***	.09 (-.15, .32)
Extremely well	-1.00 (-1.27, -.73)***	.07 (-.19, .34)
Conspiratorial thinking – deception (referent group = not at all)		

Table 1.3 (Continued)

Not very well	-0.31 (-0.50, -0.12)**	-0.13 (-0.31, .06)
Somewhat well	-1.13 (-1.31, -0.95)***	-0.59 (-0.78, -0.40)***
Very well	-1.73 (-1.93, -1.53)***	-0.91 (-1.13, -0.69)***
Extremely well	-2.64 (-2.85, -2.42)***	-1.64 (-1.89, -1.40)***
<i>Other covariates</i>		
Gender (referent group = female)		
Male		.09 (-0.01, 0.20)
Education (referent group = high school or less)		
Some college		.09 (-0.07, .25)
College or associates degree		.14 (-0.01, .29)
Post-graduate		.26 (.08, .45)**
Ethnicity (referent group = Hispanic)		
Non-Hispanic		.08 (-0.10, .27)
Urbanicity (referent group = rural)		
Small town		-.11 (-0.27, .06)
Suburb		-.06 (-0.22, .11)
City		-.03 (-0.20, .13)
Political party (referent group = Democrat)		
Republican		-.67 (-0.84, -0.50)***
Independent		-.23 (-0.38, -0.09)**
Other		-.32 (-0.63, 0)
Political ideology (referent group = liberal)		
Moderate		-0.35 (-0.51, -0.18)***
Conservative		-0.95 (-1.13, -0.77)***
Undecided		-0.52 (-0.71, -0.33)***
Political attention (referent group = always)		
Most of the time		.30 (.16, .44)***
Half of the time		.19 (.02, .36)*
Less than half of the time		.14 (-0.04, .32)
Social class (referent group = lower or working)		
Middle		.16 (.04, .27)**
Upper		.32 (.03, .61)*
General health (referent group = excellent)		
Very good		.20 (.03, .36)*
Good		.29 (.12, .46)***
Fair		.36 (.16, .56)***
Poor		.29 (-0.02, .61)

Table 1.3 (Continued)

COVID in household (referent group =
no)

No	-0.17 (-0.33, -0.02)*
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* denotes p lower than 0.05, ** lower than .01, *** lower than .001

Anti-intellectualism and belief in health misinformation

Anti-intellectualism was significantly associated with believing both pieces of misinformation, as hypothesized. Trusting experts and ordinary people the same was associated with more accurate beliefs about both pieces of health information, and trusting experts more than ordinary people was associated with even more accurate beliefs for both pieces of information, as compared with trusting ordinary people more than experts (see Tables 1.2 and 1.3). These data support our hypothesis that those higher (vs. lower) in anti-intellectualism would be more likely to believe health misinformation.

Conspiratorial thinking and belief in health misinformation

Our hypothesis that those higher (vs. lower) in conspiratorial thinking would be more likely to believe health misinformation was also partially supported. The bivariate analyses for both measures of conspiratorial thinking reveal a dose-response relationship with belief in both the vaccine/autism link and hydroxychloroquine, such that greater levels of conspiratorial thinking were associated with more inaccurate beliefs. However, in the fully adjusted models the relationship held only for conspiratorial thinking/deception. A dose response relationship was found between conspiratorial thinking/deception and belief in both the vaccine/autism link and hydroxychloroquine, with the magnitude of the association increasing with more extreme conspiratorial thinking (see Tables 1.2 and 1.3).

Other covariates

Other variables that were significantly associated with more accurate beliefs about the vaccine/autism link were higher levels of education (vs. high school or less), non-Hispanic ethnicity, Republican political party (vs. Democratic political party), self-reported middle-class status (vs. lower or working class), and fair or good general health status (vs. excellent health status). Variables that were associated with less accurate beliefs about the vaccine/autism link were moderate, conservative, and undecided political ideology (vs. liberal political ideology), and paying attention to politics less than half of the time (vs. always paying attention to politics). Variables that were significantly associated with more accurate beliefs about hydroxychloroquine were post-graduate education (vs. high school or less), paying attention to politics most or half of the time (vs. always paying attention to politics), self-reported middle-class and upper-class status (vs. lower or working class), and fair, good, and very good general health status (vs. excellent health status). Variables that were associated with less accurate beliefs about hydroxychloroquine were independent and Republican political party (vs. Democratic political party), moderate, conservative, and undecided political ideology (vs. liberal political ideology), and having a confirmed or suspected case of COVID-19 in the household.

Discussion

Our hypothesis that regular use of conservative media is associated with belief in health misinformation was supported for one piece of misinformation but not the other. Existing research has found that misinformation circulates widely on social media, whereas news media have covered and encouraged preventative public health measures during the COVID-19 pandemic (Bridgman et al., 2020). However, not all news media are created equal. Consistent with first our hypothesis, we found that conservative media use was associated with the

inaccurate belief that hydroxychloroquine is a safe and effective treatment for COVID-19. We also found that use of two or more centrist or liberal programs was associated with the accurate belief that hydroxychloroquine is not a safe and effective treatment for COVID-19. On the other hand, conservative media use was not associated with the inaccurate belief that childhood vaccines cause autism. Use of two or more centrist programs was associated with more accurate beliefs about childhood vaccines and autism. These findings confirm existing findings that conservative media viewers are more likely to believe misinformation (Motta, 2020; Romer & Jamieson, 2021a), but indicate this association may depend on the type of misinformation. At the time of data collection, hydroxychloroquine was being widely covered in the news given its relevance to the ongoing COVID-19 pandemic, whereas the vaccine/autism link was not. Further, hydroxychloroquine has been more politicized than the vaccine/autism link. The vaccine/autism link has not been actively adopted by either political party (Jones-Jang & Noland, 2022), whereas hydroxychloroquine was widely promoted by President Donald Trump on Twitter and in his press briefings (Niburski & Niburski, 2020). This politicization was also reflected in news coverage, as conservative media outlets provided the majority of coverage about hydroxychloroquine (Niburski & Niburski, 2020). Additionally, despite being a persistent myth, the vaccine/autism link has been refuted for several years, whereas the scientific consensus that hydroxychloroquine was not a safe and effective treatment for COVID-19 was more recently established. It is possible that the scientifically accurate belief that hydroxychloroquine is not a safe and effective treatment for COVID-19 had not yet taken hold among the public at the time of data collection. The salience of a piece of misinformation at a particular moment in time, how much it has been politicized, and how recently the scientific consensus was established may determine whether media use is associated with misinformation belief.

Consistent with our hypothesis, we also found that higher levels of anti-intellectualism were associated with more inaccurate beliefs about both the vaccine/autism link and hydroxychloroquine. This finding is consistent with previous studies that have found an association between anti-intellectualism and belief in health and other misinformation (Motta, 2018; Merkley & Loewen, 2021), and indicates that increasing anti-intellectualism, particularly among the political right (Gauchat, 2012), should be an area of focus in efforts to address belief in misinformation across different types of misinformation.

Our hypothesis that those higher (vs. lower) in conspiratorial thinking would be more likely to believe health misinformation was partially supported; conspiratorial thinking/dark forces was not significantly associated with belief in either piece of misinformation, whereas higher levels of conspiratorial thinking/deception were significantly associated with belief in both pieces of misinformation. Previous research has established that conspiratorial thinking is associated with belief in conspiracy theories (Edelson et al., 2017; Uscinski et al., 2020; Cassese et al., 2020). These findings indicate that conspiratorial thinking is also associated with belief in misinformation that may be less explicitly conspiratorial in nature, as neither of the two pieces of misinformation included in this study were phrased as conspiracies, and that conspiratorial thinking is associated with belief in different types of misinformation.

Lastly, in the fully-adjusted model for hydroxychloroquine, the magnitude of the associations between anti-intellectualism and belief in hydroxychloroquine and between conspiratorial thinking and belief in hydroxychloroquine is greater than the magnitude of these associations with the vaccine/autism link. This indicates that anti-intellectualism and conspiratorial thinking are more strongly associated with belief in hydroxychloroquine than with belief in the vaccine/autism link. The results of one previous study indicated that the magnitude

of the impact of anti-intellectualism on belief in misinformation may vary across pieces of misinformation (Merkley & Loewen, 2021), but overall the existing literature has not focused on which types of misinformation may have larger or smaller associations with anti-intellectualism or conspiratorial thinking.

Implications

These findings reiterate the need for interventions in conservative media, as called for by Jamieson and Albarracín (2020), especially for misinformation that has been highly politicized. As a potential starting point to address this issue, they called for “public health officials to place public service announcements, encourage hyperlinks to the CDC information pages, and seek interviews on outlets whose audiences are less knowledgeable, more misinformed, or more accepting of conspiracy theories” (p.3). These types of interventions are particularly crucial during public health crises when misinformation and conspiracy theories can take hold (van Prooijen & Douglas, 2018).

This study also points to the need for future exploration of the mechanisms of how beliefs in health misinformation are formed by conservative media use and underlying individual predispositions. It is plausible that there are reciprocal relationships at play between conservative media use, anti-intellectualism, and conspiratorial thinking. For example, a predisposition toward conspiratorial thinking may increase conservative media use, which may in turn further increase the salience of one’s conspiratorial worldview. Indeed, Romer and Jamieson (2021b; 2022) found that users of conservative media were disproportionately likely to engage in conspiratorial thinking. They also found that conspiratorial thinking predicted conservative media use (Romer & Jamieson, 2022), indicating a potential reciprocal relationship. Future research should investigate whether the associations between the predictor variables in this study and belief in

health misinformation is mediated or moderated by any of the other predictors, and further examine whether reciprocal relationships may be at play.

Limitations and future research

First, the data used in the above analyses are cross-sectional and the reported associations do not imply causation. Future research should employ other study designs, such as longitudinal and experimental methods, to establish whether these relationships are causal.

Second, the media use and anti-intellectualism measures used have limitations. The media use measure does not reflect the potentially nuanced nature of respondents' media use behavior. For example, respondents who report regularly using the *New York Times* or *Washington Post*'s websites may be exposed to content with different political leanings depending on which columnists they read, or whether they primarily read the news or editorial content. However, this study does ask respondents about specific programs used rather than just channels watched, allowing a more nuanced reflection of media use than some existing research. Future research should continue to utilize more nuanced measures of media use.

The Oliver and Rahn (2016) mistrust of expertise domain of their populism scale, which includes three questions, has been used to measure anti-intellectualism. In this study, only one item similar to one of the questions from the mistrust of expertise domain is used and thus only one component of anti-intellectualism was measured. Although this is not a comprehensive measure of the concept of anti-intellectualism, others have used similar proxies to measure the construct (e.g., Motta, 2018). As called for by Merkley (2020), stronger theorization of anti-intellectualism is needed to better guide measurement of the concept. In addition to improving our understanding of how anti-intellectualism relates to mass behavior (Merkley, 2020), better

measurement of the concept will also facilitate standardized measurement of the concept across studies.

The generalizability of the findings of this study may be limited. The sample only includes respondents who had heard about the 2020 presidential campaign through at least one of the following channels: television, radio, or websites. Additionally, the data for this study were collected in the middle of an ongoing global pandemic, during a highly politicized presidential election, and in the wake of racial protests across the country. This specific context may impact the findings, particularly about highly politicized pieces of misinformation such as hydroxychloroquine. Future longitudinal studies could also allow for the examination of these associations over time and allow for the investigation of whether these associations change in the wake of highly politicized events.

Conclusion

Despite these limitations, this study underscores that the factors associated with belief in health misinformation can vary across types of misinformation and may depend on the context in which that misinformation exists. Whether conservative media use is associated with belief in health misinformation may depend on several factors including salience, politicization, and how recently scientific consensus was established. Future research should continue to explore the relationships between the factors associated with belief in misinformation to better inform efforts of public health professionals, journalists, and editors to reduce belief in health misinformation.

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Chapter 2

Study 2

The Relationship Between News Coverage of COVID-19 Misinformation and Online Search Behavior

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Abstract

Background: The spread of health misinformation poses a threat to public health as it can influence individuals' health beliefs and behaviors, and their support for public health policies. The mainstream news media may have the potential to inadvertently increase the salience of misinformation through their reporting.

Objective: This study explores the agenda-setting effects of mainstream news media coverage on public salience of public health misinformation during the COVID-19 pandemic.

Methods: We analyzed the association between news media coverage and public salience – as measured by Google Trends relative search volume (RSV) – of three different pieces of COVID-19 misinformation: (1) hydroxychloroquine is a safe and effective treatment for COVID-19; (2) the COVID-19 vaccines cause infertility; and (3) ivermectin is a safe and effective treatment for COVID-19. We plotted news coverage of each piece of misinformation against Google Trends RSV over time. Autoregressive integrated moving average (ARIMA) models were used to account for autocorrelation and analyze the relationship between the two time series.

Results: News media coverage volume was a significant predictor of same-day RSV for hydroxychloroquine and ivermectin. However, there was also evidence supporting a possible alternative explanation for ivermectin, as search volume was also a significant predictor of news media coverage seven days later. The relationship between news media coverage and searches for COVID-19 vaccines and infertility was not significant.

Conclusion: Mainstream news media coverage may contribute to the public salience of misinformation. Mainstream media outlets should contextualize their reporting on misinformation with verification from scientific consensus.

Introduction

Misinformation, which refers to false or misleading information, has become an increasing cause for global concern in recent years (Lazer et al., 2018). Health misinformation is a specific type of misinformation that “contains one or more health-related claims inconsistent with scientific consensus” at a given point in time (Nan et al., 2021, p. 318). Health misinformation has the potential to influence individuals’ level of support for public health policies, as well as individuals’ decisions about their health, including decisions that may impact the health of others. Indeed, in the context of the COVID-19 pandemic, belief in COVID-19 misinformation and conspiracy theories is negatively associated with health protective behaviors such as social distancing, handwashing, and mask-wearing (Bridgman et al., 2020; Teovanovic et al., 2020; Romer & Jamieson, 2020; Bekalu et al., 2021). Exposure to COVID-19 vaccine misinformation is also associated with lower intentions to vaccinate (Loomba et al., 2021). Although the magnitude of the impact of misinformation remains an ongoing area of research, these findings indicate that exposure to misinformation can have pernicious effects, especially during a health crisis such as a pandemic.

Mainstream news media use tends to be associated with more accurate beliefs. For example, Stecula et al. (2020) found that recent exposure to traditional media – defined by the authors as newspapers, magazines, radio, and television – was associated with more accurate beliefs about vaccines during a measles outbreak. Further, the authors found that among respondents whose vaccine misinformation levels changed over a five-month period, exposure to measles and MMR vaccine content on traditional media was associated with decreased belief in vaccine misinformation, whereas exposure to measles and MMR vaccine content on social media was associated with increased belief in vaccine misinformation, after controlling for

sociodemographic factors, political affiliation, and trust in medical experts. Similarly, Jamieson and Albarracin (2020) found that exposure to mainstream print, broadcast, and cable news was associated with more accurate beliefs about COVID-19, and lower belief in COVID-19 misinformation, after controlling for political party, political ideology, education, gender, and age. On the other hand, they found that exposure to social media was positively associated with belief in COVID-19 misinformation (Jamieson and Albarracin, 2020). Dhawan et al. (2021) also found that people who relied on mainstream print news for COVID-19 news were less likely to endorse COVID-19 misinformation, which in turn was associated with higher confidence in COVID-19 prevention strategies, after controlling for social factors.

Although this past research has found that mainstream news media use is associated with lower belief in misinformation, the mainstream news media may still contribute to the spread and salience of misinformation, and it is still unknown to what extent it does so. Although nearly half of Americans report often or sometimes getting news from social media (Walker & Matsa, 2021), television news remains a common news source as well, particularly among older Americans (Shearer, 2021). Further, Americans ages 30 and older who get their news through a digital device are more likely to say they get that news from news websites or apps, than from social media (Shearer, 2021). In addition to still being a widely used source for news, mainstream news media have the potential to increase the salience of misinformation through reporting about what politicians have said (Nan et al., 2021) or through refuting misinformation, as news coverage debunking misinformation can still increase its public salience (Weeks & Southwell, 2010). Corrections or retractions of misinformation in the news have the potential to fail or even backfire (i.e., increasing salience of or entrenching belief in misinformation) through repeating the misinformation and thus increasing its familiarity and retrievability (Lewandowsky

et al., 2012). Indeed, Tsfaty et al. (2020) suggest that most people hear about fake news stories through their coverage by the mainstream media, rather than on fake news websites which reach only a small proportion of the population. More research is needed to better understand the extent to which the mainstream news media may increase the salience of misinformation through agenda setting effects.

Agenda setting & agenda setting effects

Agenda setting is a theory of media effects that posits a relationship between media coverage of issues and increased public salience of those issues (Kosicki, 1993). Past agenda setting research has found that the news media can influence the public's interest in specific issues (Valentino & Nardis, 2013). Although there is not a large body of research looking at agenda setting effects and public interest in misinformation, Weeks and Southwell (2010) found that television news coverage of the rumor that President Obama is a Muslim predicted public salience of the rumor in the run up to the 2008 presidential election, as measured by Google Trends and described further in the next section.

Existing research indicates that need for orientation – defined in terms of relevance and uncertainty (McCombs & Weaver, 1973) – plays an important role in agenda setting effects (Camaj, 2014). When relevance and uncertainty are high, meaning an issue is important to someone and they do not have all the information they need about the issue, their need for orientation is also high. Individuals with high relevance and high uncertainty are the most susceptible to agenda setting effects (McCombs & Weaver, 1973; Weeks & Southwell, 2010). Indeed, some argue that high need for orientation is a necessary pre-condition for agenda setting effects (McCombs, 2004).

Much of the existing research on agenda setting effects focuses on political issues and presidential campaigns. Similarly, past research on agenda setting effects and misinformation has focused on political rumors (Weeks & Southwell, 2010). Using a method similar to Weeks and Southwell (2010), the present study examines whether the agenda setting effects observed for political misinformation exist for public health misinformation. Additionally, the current study explores whether their findings hold in a qualitatively different information ecosystem, as traditional media use has declined and social media use has increased since their data were collected in 2008. Importantly, the results from this study will contribute to a better understanding of whether mainstream news media coverage plays a role in the spread of health misinformation in the current media and information ecosystem. Understanding all the factors that contribute to the spread and salience of health misinformation is critical to public health, given health misinformation's potential influence on health beliefs and behaviors.

Online search behavior as an agenda-setting outcome

There is an existing body of research spanning the fields of public health, communication studies, and political science that uses Google Trends data as a metric of public interest and salience (e.g. Lee et al., 2021; Ayers et al., 2020; Rovetta & Bhagavathula, 2020). Google Trends data, as well as other measures of public information-seeking behavior on the Internet, have also been used specifically in agenda-setting research. According to Weeks and Southwell (2010), aggregate search behavior is a “theoretically crucial manifestation of a public agenda” and thus “offers a relevant indicator for work in the agenda-setting arena” (p.342). The use of public information-seeking behavior on the Internet as dependent variables in agenda-setting research reflects current media use and information-seeking behavior; 93% of Americans adults use the internet, up from about half of American adults in 2000 (Pew Research Center, 2021) and

about two thirds of adults get news from search engines like Google at least some of the time (Shearer, 2021). Further, Google is the most widely used search engine in the United States, making Google Trends a particularly relevant metric of public interest. Google Trends data are also a particularly useful metric to measure interest in public health issues, as millions of people search for health information online every day (Rovetta & Bhagavathula, 2020). This is especially true during times of crisis; during the COVID-19 pandemic, people worldwide have actively searched for COVID-19 information online, as indicated by Google Trends (Soroyo et al., 2021).

COVID-19 misinformation

As described above, agenda setting effects are more likely when relevance and uncertainty are high, resulting in high need for orientation. COVID-19 has arguably been highly relevant to most Americans, as the pandemic has had a significant impact on Americans' day-to-day lives and the economy. Additionally, COVID-19 is caused by a novel coronavirus about which little was initially known. Accordingly, there has been great uncertainty about COVID-19 and the trajectory of the pandemic. The combination of these two factors suggest that most Americans may reasonably have a high need for orientation regarding COVID-19.

Hypotheses

This paper examined how exposure to misinformation drove information seekers to look for more information online, an indication of agenda setting. Three pieces of COVID-19 misinformation were selected to test for agenda setting effects across different types of public health misinformation, and to cover different time periods of the COVID-19 pandemic, as they were all salient at different points in time: (1) hydroxychloroquine is a safe and effective treatment for COVID-19 (salient in spring and summer of 2020); (2) the COVID-19 vaccines

cause infertility (salient in late 2020 and early 2021); and (3) ivermectin is a safe and effective treatment for COVID-19 (salient in the summer of 2021). Two national reports on the prevalence of COVID-19 misperceptions found that beliefs related to ivermectin (Hamel et al., 2021) and infertility (Hamel et al., 2021; Ognyanova et al., 2021) were two of the more prevalent misperceptions. Hydroxychloroquine was widespread earlier in the pandemic due in large part to its promotion by then President Donald Trump (Liu et al., 2020; Niburski & Niburski, 2020). Building on existing research, this study examines whether agenda setting effects exist for these three COVID-19 misperceptions. Due to the American public's high need for orientation on issues related to the COVID-19 pandemic, we expect that agenda setting effects exist for each of these pieces of misinformation. Accordingly, we hypothesize that:

- (1) A day's mainstream news media coverage of the false claim that hydroxychloroquine is a safe and effective treatment for COVID-19 will be positively associated with the volume of Google searches about hydroxychloroquine.
- (2) A day's mainstream news media coverage of the false claim that the COVID-19 vaccines cause infertility will be positively associated with the volume of Google searches about vaccines causing infertility.
- (3) A day's mainstream news media coverage of the false claim that ivermectin is a safe and effective treatment for COVID-19 will be positively associated with the volume of Google searches about ivermectin.

Methods

Independent variable: News coverage

Data on volume of news coverage of the three COVID-19 misperceptions was obtained from the Nexis Uni database. We searched Nexis Uni for television transcripts from ABC, CBS,

CNN, FOX, NBC, MSNBC, and *PBS NewsHour* & *PBS NewsHour weekend*. These channels and programs were used by Weeks and Southwell (2010) and are broadly considered to be mainstream sources by the American public (Shearer & Mitchell, 2021). We also searched Nexis Uni for items from the following wire services, *Associated Press*, *United Press International*, and newspapers, *Alaska Dispatch News*, *Anniston Star* (Alabama), *Atlanta Journal-Constitution*, *Bismarck Tribune*, *Chicago Daily Herald*, *Columbian*, *Daily News* (New York), *Dayton Daily News*, *Dominion Post* (West Virginia), *Los Angeles Times*, *Monitor* (Texas), *New York Times*, *Philadelphia Inquirer*, *Pittsburgh Post-Gazette*, *Richmond Times Dispatch*, *Salt Lake Tribune*, *Santa Fe New Mexican*, *Star Tribune*, *Tampa Bay Times*, *USA Today*, *Wall Street Journal* (abstracts only), *Wyoming Tribune* *England*. These include several of the ten most widely read newspapers in the U.S., though some were not available via Nexis Uni (e.g., *Washington Post*). This list also includes newspapers with lower circulation but that increase the geographic diversity of the sample. Like Weeks and Southwell (2010), we sought to include newspapers that represented a range of locations and ideologies.

Different eight-month time periods were selected for each of the three pieces of misinformation to capture the time when each falsehood was most salient, based on the Google Trends relative search volume (RSV) for that topic. The start date for each piece of misinformation is approximately one month before the highest peak in salience. For hydroxychloroquine, COVID-19 vaccines and infertility, and ivermectin, Nexis Uni was searched for each day for the daily news coverage of each topic from February 8, 2020 to October 8, 2020, November 5, 2020 to July 5, 2021, and April 17, 2021 to December 17, 2021, respectively. The final search resulted in 1,678 television transcripts and 1,353 newspaper stories about hydroxychloroquine, 101 television transcripts and 202 newspaper stories about COVID-

19 vaccines and infertility, and 197 television transcripts and 348 newspaper stories about ivermectin. The number of television transcripts and newspaper stories on each day were added together to reflect the total number of media items each day.

We used the following search terms for the three pieces of COVID-19 misinformation: *hydroxychloroquine*, *vaccine AND infertility OR fertility*, and *ivermectin*. We included *infertility* and *fertility* as terms in the vaccine search to more comprehensively capture all news items that discussed the COVID-19 vaccines and their impact on fertility. Similar to the approach taken by Weeks and Southwell (2010), we included all news items about the three COVID-19 misperceptions regardless of whether they refuted the misperception, made no claim about the veracity of the misperception, or implied that it was true, as all types of news coverage can increase public salience.

Dependent variable: Aggregate online search behavior

Google Trends data on three COVID-19 misperceptions were used to measure public interest in those topics. Google Trends data serves as a good metric of the public's interests and concerns, but not their opinions (Stocking & Matsa, 2017). Google Trends provides a normalized measure of search volume – RSV – for a given search term over a selected period. Each data point is divided by the total searches of the geography and time range it represents to compare relative popularity. The resulting numbers are then scaled on a range of 0 to 100 based on a topic's proportion to all searches on all topics. In the current study, all Google Trends data are relative to the other observations for that specific piece of misinformation.

We used the following search terms for the three pieces of COVID-19 misinformation *hydroxychloroquine*, *vaccine infertility*, and *ivermectin*. *Vaccine infertility* was selected rather than *COVID-19 vaccine infertility* because of low Google Trends search volume. However, the

vaccine infertility trend mirrors that of *COVID-19 vaccine infertility* and peaks after administration of the COVID-19 vaccine began, indicating that the *vaccine infertility* search is a reasonable search term to capture salience of COVID-19 vaccine infertility. Only searches conducted in the United States were included in the results.

Analysis

To understand the relationships between two time series (news media coverage and Google searches) for each piece of misinformation, we followed Weeks and Southwell's (2010) approach and focused our analysis on the time correspondence of the observations in the two time series and the potential for autocorrelation in the dependent time series. In these models, we looked at the association between same day media coverage – rather than coverage a few days prior – and Google Trends because Weeks and Southwell (2010) found that same day media coverage is the best predictor of the number of Google Searches.

First, we looked at the correlations between news media coverage volume and Google RSV and ran an ordinary least squares (OLS) regression to predict online search behavior for each piece of misinformation as a function of news coverage. We then looked at the Durbin-Watson statistic for each model and Autocorrelation Function (ACF) plots, which indicated autocorrelation among the residuals for each piece of misinformation.

To address the autocorrelation, we fit a 1,0,0 ARIMA model for each piece of misinformation by adding an autoregressive predictor (i.e. the previous day's search volume) to each model. We used the Heteroscedasticity and Autocorrelation Consistent (HAC) Covariance Matrix procedure to address remaining autocorrelation.

Similar to Weeks and Southwell (2010), we also considered the possibility that public salience, as measured by online search behavior, drove news coverage of these pieces of

misinformation, rather than the other way around. To assess this, we looked at whether media coverage volume was a significant predictor of Google RSV seven days later, correcting for autocorrelation in the dependent time series. We chose a seven-day lag in the reverse causation model to allow for the time it would take for Google Searches to reach journalists and for relevant stories to move through the editorial and publication processes (Weeks & Southwell, 2010, p.354).

Results

Preliminary Assessment of Association of Mainstream Media Coverage with Google Searches: We found a significant correlation for each piece of misinformation, though the correlation for vaccines and infertility ($r = .20, p < .01$) was weaker than for hydroxychloroquine ($r = .69, p < .001$) and ivermectin ($r = .67, p < .001$). We next ran an OLS regression for each piece of misinformation. The results indicated that media coverage was a significant predictor of searches for each piece of misinformation (hydroxychloroquine, $\beta = .68, p < .001$; vaccines and infertility, $\beta = 2.31, p < .01$; ivermectin, $\beta = 3.92, p < .0001$) (See Supplementary Tables 2.1 and 2.2).

Assessment of Autocorrelation Among the Residuals: We ran the Durbin-Watson statistic for each model to test for autocorrelation (hydroxychloroquine = .69; vaccines and infertility = .58; ivermectin = .51) and examined the ACF plots, which indicated autocorrelation among the residuals. Next, we fit a 1,0,0 ARIMA model including the previous day's Google search volume for each piece of misinformation. Examination of the ACF plots indicated that adding the autoregressive predictor substantially reduced but did not completely remove the autocorrelation for each piece of misinformation. To address the remaining autocorrelation, we used the

Heteroscedasticity and Autocorrelation Consistent (HAC) Covariance Matrix procedure to correct the residuals.

Association of Mainstream Media Coverage with Google Searches After Addressing Autocorrelation: After correcting for the autocorrelation, media coverage continued to be a significant predictor of search volume for hydroxychloroquine (see Table 2.1). As illustrated in Figure 1, there was a positive relationship between media coverage volume and same-day Google searches for hydroxychloroquine misinformation; when there is a spike in news coverage, there is a corresponding spike in search volume.

Table 2.1 ARIMA Model Results

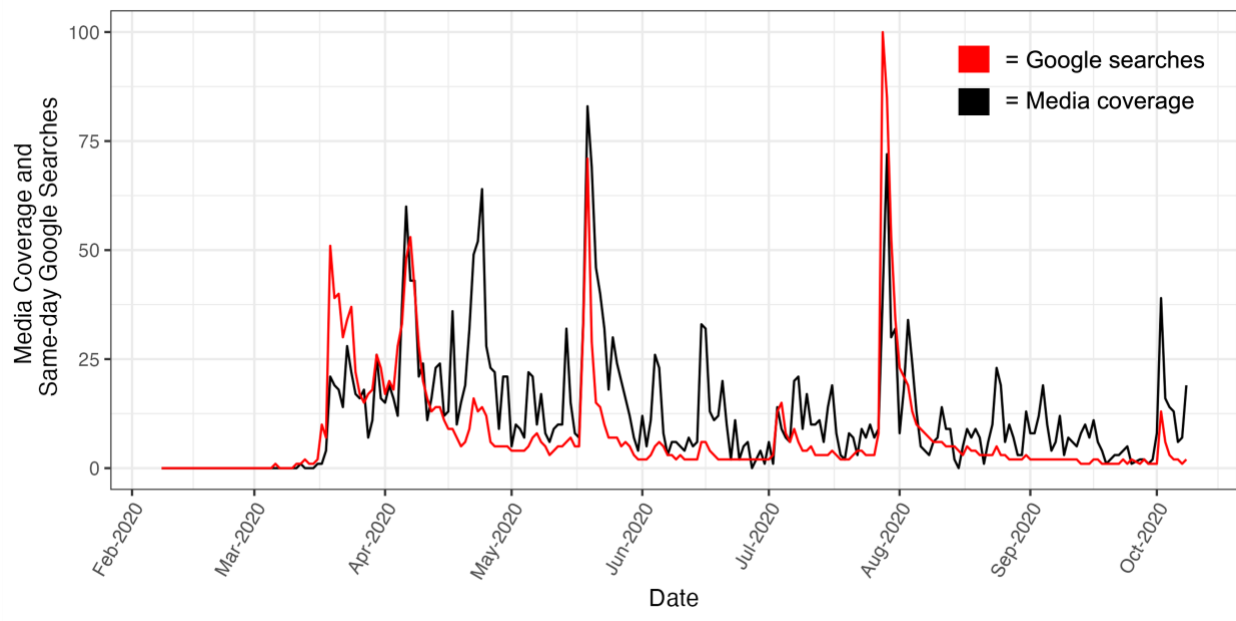
	ARIMA Model (1,0,0) ¹ for Volume of Media Coverage Predicting Online Search ²	ARIMA Model (1,0,0) for Online Search Predicting Media Coverage with a 7-day Lag
	Coef. (CI)	Coef. (CI)
<i>Piece of misinformation</i>		
Hydroxychloroquine	.32 (.09, .56)**	.02 (-.07, .12)
Vaccine infertility	.50 (-.22, 1.23)	.002 (-.007, .01)
Ivermectin	.45 (.14, .76)**	.04 (.02, .07)***

¹ A 1,0,0 ARIMA model is a first-order autoregressive model where the dependent variable is regressed on itself lagged by one period

² We used the Heteroscedasticity and Autocorrelation Consistent Covariance Matrix procedure to address remaining autocorrelation for all models reported in this table

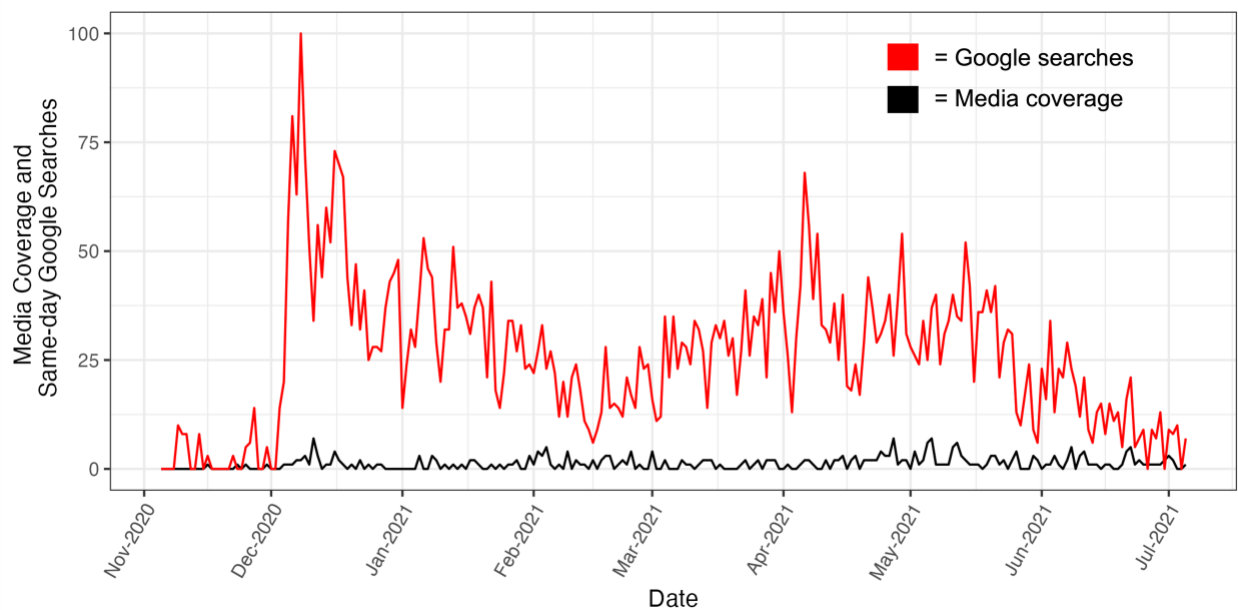
* denotes p lower than 0.05, ** lower than .01, *** lower than .001

Figure 2.1 Media coverage of hydroxychloroquine and same-day searches for “hydroxychloroquine” from February 8, 2020 to October 8, 2020



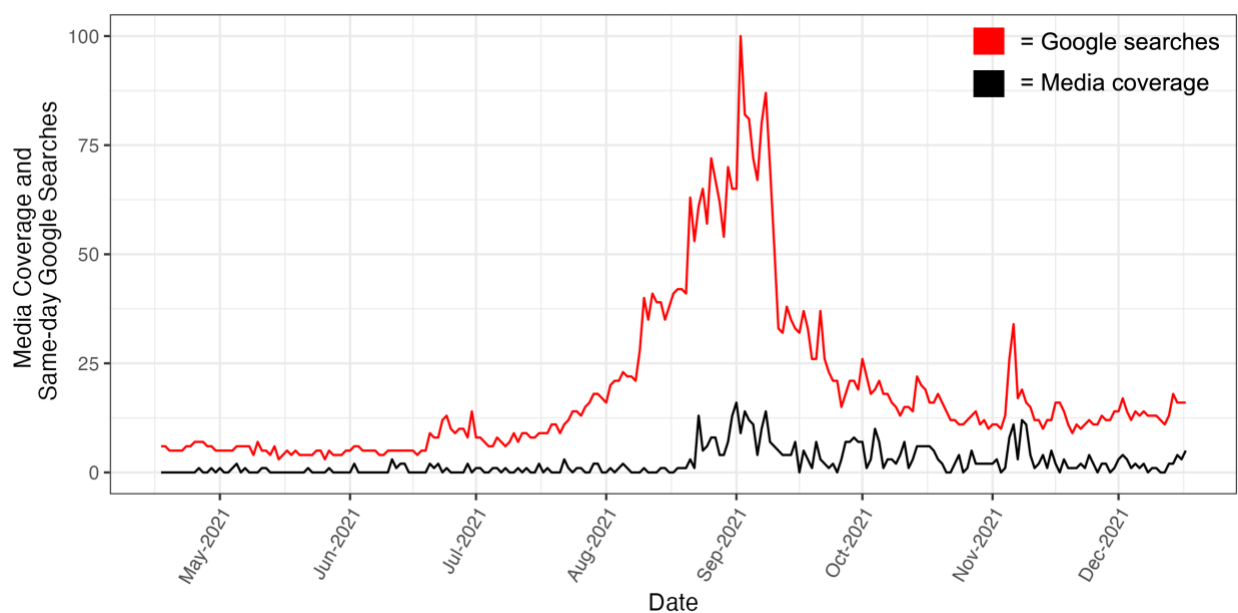
The relationship between media coverage and searches for COVID-19 vaccines and infertility was not significant following correction for autocorrelation (see Table 2.1). As Figure 2.2 illustrates, media coverage of the vaccine and infertility link was relatively limited across the period assessed.

Figure 2.2 Media coverage of vaccines and in/fertility and same-day searches for “vaccine infertility” from November 5, 2020 to July 5, 2021



After addressing autocorrection, media coverage also remained a significant predictor of search volume for ivermectin (see Table 2.1). Figure 2.3 illustrates the relationship between media coverage volume and same-day Google searches for ivermectin.

Figure 2.3 Media coverage of ivermectin and same-day searches for “ivermectin” from April 17, 2021 to December 17, 2021



Evaluation of Reverse Causation: We explored the possibility of reverse causation by assessing whether Google Trends may be driving media coverage volume. We found that search volume was a significant predictor of media coverage volume one week later for ivermectin but was not for hydroxychloroquine or vaccines and infertility (see Table 2.1).

Discussion

These results indicate that, as predicted, mainstream media coverage of hydroxychloroquine was associated with public salience about hydroxychloroquine, and that reverse causation was not at play. Similarly, we found that mainstream news media coverage of the false claim that ivermectin is a safe and effective treatment for COVID-19 was positively associated with the volume of Google searches about ivermectin on that same day. However, we also found that Google searches about ivermectin were positively associated with news media coverage volume seven days later. We are not able to determine the causal direction of these associations based on our study design. Future research should continue to explore whether there may be a reciprocal relationship at play particularly given the novelty of the topic. There was no relationship between mainstream news media coverage and searches related to the false claim that the COVID-19 vaccines cause infertility, contrary to our prediction.

Our results for hydroxychloroquine are consistent with past findings that mainstream media coverage influenced public salience of political misinformation (Weeks & Southwell, 2010). Southwell et al. (2016) also found that daily news story volume predicted search trends related to the Zika virus in the United States. Our findings for ivermectin are also consistent with existing research indicating that mainstream media coverage influences public salience. However, our findings for ivermectin also indicated there is evidence to support a potential alternative explanation, wherein volume of Google searches about ivermectin were positively

associated with media coverage volume seven days later. One previous study found that public interest in several COVID-19 topics peaked *before* news coverage of those same topics (Ming, et al., 2021), but to our knowledge existing research has not explored more deeply what may explain media coverage volume predicting Google searches and Google searches predicting media coverage volume. Our findings for vaccine infertility are not consistent with past research (Weeks & Southwell, 2010).

The fact that we found evidence of an agenda setting association for two issues and not the third is consistent with past research. Although we cannot say with certainty why the results were not consistent across all three pieces of misinformation, there are some potential explanations. First, the lack of any significant associations between media coverage and public salience for vaccine infertility may be due to the low volume of media coverage returned in our search. Past research has found that agenda setting effects may only exist after a certain threshold of media coverage – i.e., that a certain volume of coverage is needed in order to influence public salience – which may not have been met in this study (Neumann, 1990).

Second, vaccines causing infertility is not a new topic, whereas potential treatments for a new infectious disease are inherently novel. For example, a since-retracted paper in the *Journal of Toxicology and Environmental Health* reported a link between the Human Papillomavirus vaccine and infertility in 2018 (DeLong, 2018). Additionally, the anti-vaccine movement promoted the false link between vaccines and infertility on social media prior to the COVID-19 pandemic (Dhaliwal & Mannion, 2020). Through offering new or surprising information, novel content “attracts an audience’s attention by inviting them to ‘stop and think’” (Cappella et al., 2015, p. 409). Novelty can also direct an audience’s interest and attention in a media ecosystem characterized by overabundant information on social media, the 24-hour news cycle, search

engines (Song et al., 2023). This may explain, in part, why there was an association between news coverage and public salience for hydroxychloroquine and ivermectin but not vaccines and infertility. Future research should explore further whether agenda setting effects are more pronounced for newer topics than older ones.

Implications

Our results for hydroxychloroquine and ivermectin support findings from existing research that mainstream news media can play a role in increasing the public salience of health misinformation (Nan et al., 2021; Tsfaty et al., 2020; Weeks & Southwell, 2010), but that this may be dependent on different factors such as volume of news coverage or novelty of the piece of misinformation. These findings indicate that even in a media ecosystem where individuals are spending more time on social media and digital platforms, mainstream news media coverage continues to have agenda setting effects in certain situations. Further, our results suggest that the mainstream news media should not be ignored as one channel that may influence the spread and salience of health misinformation. Even credible media coverage aimed at refuting or correcting misinformation can increase its familiarity and its salience (Lewandowsky et al., 2012).

These findings have implications for how the mainstream media cover misinformation in their reporting. Although our study looked only at *salience* of misinformation and not *belief* in misinformation, mainstream media outlets may still want to pair their reporting on misinformation with evidence-based efforts to reduce belief in misinformation. For example, inoculating messages that highlight scientific consensus or expose the flawed arguments of those peddling misinformation have been effective in reducing belief in misinformation (Cook et al., 2017; Traberger et al., 2022). Additionally, our findings indicate the ongoing importance of investment in good journalism, including responsible reporting on misinformation.

Our findings for ivermectin also suggest that the relationship between media coverage and public salience is not straightforward, as there was also evidence that volume of Google searches about ivermectin were positively associated with media coverage volume seven days later. The current study was not designed to test for a reciprocal relationship, but these findings indicate the relationship between media coverage and public salience may be increasingly complex in an ever-changing media environment. Future research should further explore these relationships, including whether and how public salience may influence news coverage, potentially through bottom-up, user-generated content.

Limitations and future research

Several limitations of this work should be noted. First, the findings reported in this study are associations and do not imply causation. Although our results for hydroxychloroquine indicate that reverse causality is unlikely, this does not establish a causal link between news coverage and public salience. Second, there are limitations to using Google Trends data. Despite being increasingly used as a measure of public salience, these data only reflect the search behavior of individuals with access to the Internet and who use Google to search, and we do not have information on important demographic characteristics of those conducting Google searches, such as socioeconomic status. Accordingly, the results in this study cannot be generalized beyond Google users.

Third, our list of news media sources is not exhaustive. Although all the mainstream network and cable television channels typically included in media research were included in our search, some newspapers with high daily circulation were not included in this study because they were not available via NexisUni (e.g. *Chicago Tribune*, *Boston Globe*). However, if the exclusion of these newspapers has any impact on the number of daily news stories, it would

result in an undercount of news stories and thus a more conservative estimate of the actual association between news coverage and Google searches. Additionally, two of the most commonly believed misperceptions identified by the Kaiser Family Foundation – (1) the government exaggerated the number of COVID-19 deaths and (2) deaths due to the COVID-19 vaccine are being hidden by the government – were not included in this study due to a lack of Google Trends data (Hamel et al., 2021). Our media volume search for vaccine infertility may also include news items focused on vaccines other than the COVID-19 vaccines due to the search terms used.

Lastly, this study looks at one small piece of the media environment. The data in this study only allow us to examine the relationship between volume of news media coverage and public salience, but there are other important factors that likely play a role. For example, politically motivated actors promoting a piece of misinformation, or media events that may unfold or spread more widely on social media, may influence both news media coverage and public salience of misinformation. Although online search behavior and social media interaction have been shown to respond to news coverage (Southwell et al., 2016; Weeks & Southwell, 2010), more research is needed to better understand the complex relationships between media events, mainstream news coverage, social media, and public salience.

Conclusion

Despite these limitations, this study underscores that the mainstream news media coverage may contribute to the public salience of misinformation. The existence of an agenda setting association may depend on several factors including the volume of news coverage, the novelty of a given piece of misinformation, and the media environment at a given point in time. Mainstream media outlets should contextualize their reporting on misinformation with

verification from scientific consensus. Future research should continue to explore the complex relationships between news coverage, social media, and public salience of public health misinformation.

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Chapter 3

Study 3

Health Behaviors, Information Sources, and Misinformation Beliefs Among Social Media

Health Mavens during the COVID-19 Pandemic

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Abstract

Background: Social media health mavens are individuals who provide and share health information with their networks via social media. Given the proliferation of social media use over the past two decades and increased reliance on social media for information, understanding the health behaviors and beliefs of individuals who share health information with their social media networks is important to public health.

Objective: This study explores whether social media health mavens are a subset of health mavens and investigates the characteristics and behaviors of social media health mavens. Additionally, this study assessed whether social media health mavens are more likely to believe COVID-19 misinformation than non-mavens.

Methods: Data came from a cross-sectional analysis of 1,012 Ipsos KnowledgePanel® members. Multivariable logistic and linear regression models were used to explore our lines of inquiry.

Results: Thirty percent of the sample were both social media health mavens and health mavens, and 43% were neither; only 2% were social media health mavens only. Social media health mavenism was associated with Hispanic ethnicity, healthier diet, healthier exercise habits, but also with being an occasional smoker. Using liberal and mainstream news sources and spending more time looking for COVID-19 news on a variety of sources was associated with higher odds of being a social media health maven. Social media health mavens were no more likely than non-mavens to believe COVID-19 misinformation.

Conclusion: We identified sociodemographic factors, health-related variables, and information sources associated with being a social media health maven. We also found that social media health mavens are not more likely to believe health misinformation than non-mavens. Future

research should explore the content and process by which information social media health mavens share information with their networks.

Introduction

Health information mavenism

Accurate health information is critical to individuals making evidence-informed decisions about their health (Nan et al., 2021). Individuals may turn to a variety of sources when seeking health information, including healthcare professionals, government health agencies, the Internet, and friends and family members. Indeed, interpersonal communication can influence exposure to, and processing and interpretation of health information (Ackerson & Viswanath, 2009), which can ultimately impact health outcomes.

There is a nascent body of research exploring characteristics of health information mavens, defined as “those who provide and share health information with others via interpersonal communication based on their own knowledge, belief, and experiences” (Hayashi et al., 2020, p.804; Kontos et al., 2011; Abratt et al., 1995; Feick & Price, 1987). The concept of health information mavens applies the marketing and advertising concept of market mavens – individuals who are interpersonal sources of communication “whose influence and consumer product information is based on general knowledge and experience” (Kontos et al., 2011, p.23; Abratt et al., 1995; Feick & Price, 1987) – to public health. Mavens do not need to have specific knowledge, and they typically share more general information (Kontos et al., 2011; Feick & Price, 1987). Health information mavens likely share health information to members of their social network through their interpersonal communications. Given that exposure to health information can influence health beliefs and behaviors, understanding who health information mavens are and the quality of information they share warrants more scrutiny. It is particularly of interest to better understand the quality of information they share, as little is currently known about health mavens’ role in misinformation.

Health misinformation

In recent years, there has been growing concern about the widespread proliferation of misinformation (Lazer et al., 2018). Misinformation, defined by Swire-Thompson and Lazer (2020) as “information that is contrary to the epistemic consensus of the scientific community regarding a phenomenon” (p.434), can influence health behaviors. Even before the onset of the COVID-19 pandemic, the spread of misinformation was recognized as a public health threat (Larson, 2018). This concern has been borne out during the COVID-19 pandemic; several studies have demonstrated a negative association between belief in health misinformation and protective health behaviors including social distancing, handwashing, mask-wearing, and vaccine uptake (Bridgman et al., 2020; Teovanovic et al., 2020; Romer & Jamieson, 2020; Bekalu et al., 2021; Viswanath et al., 2021). As noted by the Office of the U.S. Surgeon General, belief in misinformation can also undermine support for public health policies such as mask mandates and vaccination requirements (Office of the U.S. Surgeon General, n.d.).

Health mavens and information sharing

Health mavens are potential sources of both accurate and inaccurate information within their social networks. Past research has found that health mavens are more likely to maintain certain accurate health beliefs and engage in certain healthy behaviors. In their sample of lower-socioeconomic position and racial/ethnic minority individuals (n=325), Kontos et al. (2011) found that health mavens were more likely than non-mavens to maintain accurate beliefs regarding diet. In their cross-sectional study of older Japanese adults (n=27,414), Hayashi et al. (2020) found that health mavens were more likely to maintain healthy dietary and exercise behaviors compared to non-mavens.

However, Hayashi et al. (2020) have argued that health information mavens also have the potential to disseminate inaccurate health information within their networks, as past research has found that health mavens do not necessarily always have the correct health information. Kontos et al. (2011) found that nearly half of their sample of identified as health mavens, had more extensive social networks than non-mavens, and – aside from diet – were no more likely than non-mavens to have health beliefs in agreement with national public health recommendations. Importantly, the authors note that these findings indicate that there are “a substantial number of individuals who maintain misaligned [with established medical evidence] health beliefs engaging in interpersonal information exchange regarding health matters within their larger social networks” (Kontos et al., 2011, p.31). Another study, albeit with a small convenience sample (n=139), found that health information mavenism was not strongly correlated with beliefs about the safety and effectiveness of the COVID-19 vaccines (Smith et al., 2022). These findings indicate that there is a need for research explicitly focusing on belief in health misinformation among health mavens, given their ability to and interest in disseminating those beliefs within their social networks.

Online health information mavenism

A smaller body of research has started to explore the concept of health information mavenism as it relates to Internet use. Sun et al. (2015) proposed the concept of health e-mavens: “individuals who are consistently and actively involved with health information acquisition and information transmission on the web space” (p.1073). Here we focus on the more narrow concept of social media health maven, defined as individuals who provide and share health information with others specifically via social media. We focused on information sharing through social media sites because they have increased individuals’ ability to share health information quickly

and widely, and because of the increase in social media use in recent decades. Over 4 billion people in the world are currently estimated to be on social media (Bouchrika, 2022). In 2021, 72% of adults in the U.S. used at least one social media platform, up from 50% in 2011 and 5% in 2005 (Pew Research Center, 2021). Because of the nature of social media, social media health mavens have the capacity to share information with more people in their networks and at greater speed than traditional health mavens. Additionally, we know that misinformation is prevalent on social media, that social media sites are one channel through which misinformation spreads (Suarez-Lledo & Alvarez Galvez, 2021), and that exposure to misinformation is associated with increased likelihood of belief in misinformation (Lee et al., 2020). Given the proliferation of social media use in the past two decades, and the spread and amplification of misinformation on social media, particularly during the COVID-19 pandemic (Viswanath et al., 2020), a specific focus on sharing of health information within the social media context is needed.

Objectives

In this study we add to the existing health mavenism research by further characterizing social media health mavens. To do this, we proposed the three lines of inquiry. First, we explore the relationship between health mavenism and social media health mavenism, specifically to determine if these are the same population, or if they represent different people. Second, we explore differences in the characteristics, health behaviors, and information sources of social media mavens and non-mavens. Finally, we expand upon past health mavenism research by investigating the relationship between social media health mavenism and belief in health misinformation, which has not been previously explored. We hypothesize that social media mavens will be more likely to hold incorrect beliefs about COVID-19 than those who are non-mavens, because their likelihood of exposure to misinformation is higher, given the widespread

availability of misinformation on social media. Given existing research that indicates conservatives are more likely to believe misinformation than liberals (Garrett & Bond, 2021; Pennycook & Rand, 2021; Pasek et al., 2015), including during the COVID-19 pandemic (Hamel et al., 2021), we also explored whether the association between social media mavenism and belief in health misinformation was modified by political party identification. This work will shed light on whether social media mavens could be an important target for efforts to combat health misinformation online. Here we focus specifically on COVID-19 misinformation, as the data were collected during the COVID-19 pandemic.

Methods

Study design and sample

To investigate these research questions, we analyzed data from a survey that was administered to members of the Ipsos KnowledgePanel® from July 30, 2020 through August 12, 2020. Members of the Ipsos KnowledgePanel® are randomly recruited through probability-based sampling using address-based sampling from the USPS delivery sequence file. Selected households that did not have internet access were provided a web-enabled device and free internet service. KnowledgePanel® members selected to participate in the current study received a participation invitation via email.

The target population for this study was non-institutionalized adults aged 18 and older residing in the United States. Survey administration began with pretesting the survey among 25 participants, followed by the main survey which was completed by 1,012 respondents. The final sample includes oversamples of African Americans, Hispanics, and adults living below the Federal Poverty Level. A total of 1,822 KnowledgePanel® members were contacted for this

study, yielding a response rate of 55.5%. Ethical clearance was obtained from the Harvard T.H. Chan School of Public Health Institutional Review Board (Protocol number: IRB20-1171).

Measures

Health mavenism and social media health mavenism

Health mavenism was measured using a five-item health mavenism scale used in past research (e.g. Kontos et al., 2011 and Hayashi et al., 2020). The five items included: 1) I like introducing new health topics to my friends and family; 2) I like helping people by providing them with information about health; 3) People ask me for information about health; 4) If someone asked where to get the best information about a particular health topic, I could tell him or her where to go; 5) My friends think of me as a good source of information when it comes to new information about health. Respondents were instructed to indicate how often each statement applied to them, with the following response options: 1. Never, 2. Rarely, 3. Often, 4. Always. The health mavenism index measures had high internal consistency ($\alpha = 0.92$) in the current study. Respondents had to answer “Often” or “Always” to at least one of the scale items to be classified as a health maven.

Social media health mavenism was measured using the same items as the health mavenism scale, but updated to ask specifically about sharing health information on social media. Accordingly, the five items were: 1) I like introducing new health topics to my social media friends and contacts; 2) I like helping people by providing them with information about health on social media; 3) People ask me for information about health on social media; 4) If someone asked on social media where to get the best information about a particular health topic, I could tell him or her where to go; 5) My social media friends think of me as a good source of information when it comes to new information about health. The response choices were the same

as for the health mavenism scale. The social media health mavenism index measures also had high internal consistency ($\alpha = 0.94$) in the current study. Similar to the health maven measure, respondents had to answer “Often” or “Always” to at least one of the scale items to be classified as a social media health maven.

Health related variables

Past research on health mavenism has found that certain health-related factors are associated with health mavenism in different populations, including certain health behaviors (Hayashi et al., 2020), health beliefs (Kontos et al., 2011), and having a chronic health condition (Hayashi et al., 2020, Sun et al., 2015). Accordingly, we included several health-related independent variables in our analyses: self-rated overall health; presence of a chronic condition; amount of exercise per week; cups of fruits and vegetables eaten per day; days of alcohol use per week; current smoking status; and intention to receive a COVID-19 vaccine once available (the data were collected prior to the vaccine becoming available). A full description of these measures is in Supplementary Table 3.1.

Information sources variables

Existing research on health mavenism has also found that media exposure is a significant predictor of health mavenism (Hayashi et al., 2020; Kontos et al., 2011). We included two questions that asked about participants’ mainstream and social media use. The first question asked respondents whether several different media sources – including television programs, newspapers, and social media sites – were sources of news for them about the COVID-19 outbreak. Response options were 1. Major source, 2. Minor source, 3. Not a source. These sources were grouped into conservative (e.g. Fox News, Rush Limbaugh, Breitbart News, OAN, and Drudge Report), liberal (e.g. MSNBC, Bill Maher, and Huffington Post), and mainstream

(e.g. ABC News, CBS News, NBC News; *Associated Press*, *New York Times*, *Washington Post*, and *Wallstreet Journal* categories) (Romer & Jamieson, 2021), though they were not described as such in the survey instrument. The second question asked respondents how much time they spent in a typical day looking at several sources for COVID-19 information. A full description of these measures is in Supplementary Table 3.1.

Sociodemographic variables

We also included several sociodemographic variables including age, gender, education, race/ethnicity, and income. Past research has found that female gender (Hayashi et al., 2020; Sun et al., 2015; Kontos et al., 2011), higher educational attainment (Hayashi et al., 2020; Sun et al., 2015), age (Hayashi et al., 2020; Kontos et al., 2011) and perceived financial condition (Hayashi et al., 2020) are associated with being a health maven.

Belief in COVID-19 misinformation

Belief in COVID-19 misinformation was measured with 13 items. Each item was a false statement about COVID-19 and respondents were instructed to indicate whether each statement was true or false. These items included statements such as “Spraying and introducing bleach or another disinfectant into your body can protect you against COVID-19”; “People who are not feeling sick may not transmit COVID-19”; and “Anti-malaria medication will cure COVID-19”. See Supplementary Table 3.1 for a complete list of items. The items used in this study were taken from a longer scale that included true statements as well as misinformation; we selected only the items measuring belief in misinformation, all of which were coded in the same direction. Response options were: 1. True, 2. False, 3. Don’t know. The belief in COVID-19 misinformation items had good internal consistency ($\alpha = 0.87$). These items were subsequently recoded to create a scale of belief in health misinformation. Responses were recoded in the

following manner: 0. False, 1. Don't know and 1. True. In this approach, we classified the "Don't knows" the same as the "Trues" because both reflected a lack of belief in accurate information and the misinformation items used were unambiguous. Respondents' scores were then summed to create a scale reflecting their overall belief in health misinformation.

Analysis

We used a two-by-two table to answer our first research question of whether social media health mavens are a subset of health mavens. To answer our second research question – whether those who are higher on social media mavenism differ across sociodemographic factors, information sources, health status and health behaviors compared to those who are lower on social media mavenism – we conducted multivariable logistic regression. For these analyses, health mavenism and social media health mavenism were dichotomized such that any respondent who responded "Often" or "Always" to any of the respective scale items was classified as a health maven or social media health maven. For the multivariable logistic regression models, we first ran a model including our five sociodemographic variables (age, education, gender, income, and race/ethnicity) as predictors. We subsequently ran models for each of our other predictors one by one, controlling for the sociodemographic variables. To answer our third research question and test our hypothesis that social media mavens are more likely to believe COVID-19 misinformation than those who are not social media mavens, we ran a t-test, controlling for the sociodemographic variables. To test whether the association between social media mavenism and belief in COVID-19 misinformation was modified by political party, we ran a linear regression model that included an interaction between social media mavenism and political party. Across all variables in our dataset, the missingness ranged from 0 to 3.9%, and multiple imputation was used for the missing data. All analyses were conducted in R.

Results

Sample and Measures Description

There were 1,102 participants in the final sample (see Table 3.1). The sample had more female than male respondents and a majority had some college education. As noted in the methods section, the sample included an oversample of Black (27%) and Hispanic (28%) respondents.

Just over half (53%) of respondents reported having one or more chronic health conditions, and most respondents described their health as good or very good (36% and 37%, respectively). Most respondents reported eating a half cup to two cups of fruits and vegetables per day, and exercising three or more days per week. Half of respondents reported drinking alcohol zero days per week, and a majority (87%) reported being current nonsmokers.

Most respondents said they did not use conservative and liberal leaning news as COVID-19 news sources (60% and 54%, respectively). The most commonly reported major news sources among respondents were sources such as ABC News, CBS News, NBC News (45%) followed by sources such as *Associated Press*, *New York Times*, *Washington Post*, and *Wallstreet Journal* (29%). A majority of respondents reported spending less than ten minutes per day looking for COVID-19 information across all sources.

Over half of respondents (56%) were classified as health mavens, and about one third (32%) were classified as social media health mavens. The average score on the belief in health misinformation scale ($M=3.37$, $SD=3.30$) roughly corresponds to respondents believing or not being sure about three out of 13 pieces of COVID-19 misinformation.

Table 3.1 Descriptive characteristics of the sample

n	Overall 1012
Age (n(%))	
18-28	144 (14.2)
30-44	259 (25.6)
45-59	288 (28.5)
60+	321 (31.7)
Gender (n(%))	
Male	491 (48.5)
Female	521 (51.5)
Education (n(%))	
Less than high school	142 (14.0)
High school	316 (31.2)
Some college	282 (27.9)
Bachelor's degree or higher	272 (26.9)
Income (n(%))	
<\$20,000	165 (16.3)
\$20,000-\$34,999	150 (14.8)
\$35,000-\$49,999	92 (9.1)
\$50,000-\$74,999	173 (17.1)
\$75,000-\$99,999	138 (13.6)
\$100,000-\$149,999	151 (14.9)
>\$150,000	143 (14.1)
Race/ethnicity (n(%))	
White	403 (39.8)
Black, non-Hispanic	276 (27.3)
Other, non-Hispanic	23 (2.3)
Hispanic	286 (28.3)
2+ races, non-Hispanic	24 (2.4)
Self-described overall health (n(%))	
Excellent	116 (11.5)
Very good	357 (35.5)
Good	371 (36.8)
Fair	131 (13.0)
Poor	32 (3.2)
Chronic condition (n(%))	
No	475 (47.4)
Yes	527 (52.6)
Weekly exercise (n(%))	
0x/week	195 (19.3)
1-2x/week	257 (25.4)
3-4x/week	268 (26.5)
5 or more x/week	292 (28.9)
Daily fruit and vegetable intake (n(%))	

Table 3.1 (Continued)

None	74 (7.4)
½ cup or less	169 (16.8)
½ cup to 1 cup	255 (25.4)
1 cup to 2 cups	287 (28.6)
2 to 3 cups	118 (11.8)
3 to 4 cups	68 (6.8)
5 or more cups	32 (3.2)
Weekly alcohol intake (n(%))	
0 days/week	507 (50.1)
1-2 days/week	173 (17.1)
3-4 days/week	103 (10.2)
5 or more days/week	229 (22.6)
Current smoking status (n(%))	
None	871 (86.7)
Some days	39 (3.9)
Every day	95 (9.5)
COVID-19 vaccination intention (n(%))	
Not at all likely	174 (17.5)
Unlikely	180 (18.1)
Likely	299 (30.1)
Very likely	339 (34.2)
Please indicate whether each of the following is a source of news for you about the COVID-19 outbreak:	
Sources such as Fox News, Rush Limbaugh, Breitbart News, OAN, Drudge Report (n(%))	
Not a source	591 (59.8)
Minor source	220 (22.2)
Major source	178 (18.0)
Sources such as MSNBC, Bill Maher, Huffington Post (n(%))	
Not a source	524 (53.6)
Minor source	318 (32.5)
Major source	136 (13.9)
Sources such as ABC News, CBS News, NBC News (n(%))	
Not a source	204 (20.6)
Minor source	342 (34.6)
Major source	443 (44.8)
Sources such as AP, the New York Times, the Washington Post, the Wall Street Journal (n(%))	
Not a source	355 (36.3)
Minor source	345 (35.2)
Major source	279 (28.5)
Sources such as Google News or Yahoo News (n(%))	
Not a source	355 (36.2)
Minor source	436 (44.4)
Major source	191 (19.5)

Table 3.1 (Continued)

Sources such as Facebook, Twitter, or YouTube (n(%))

Not a source	533 (54.0)
Minor source	339 (34.3)
Major source	115 (11.7)

In a typical day, how much time do you spend on each of the following sources looking for COVID-19 information:

Television (n(%))

Less than 10 minutes	561 (56.3)
10-30 mins	192 (19.3)
31-59 mins	98 (9.8)
60-119 mins	61 (6.1)
2-3 hours	35 (3.5)
More than 3 hours	49 (4.9)

Radio (n(%))

Less than 10 minutes	777 (79.0)
10-30 mins	105 (10.7)
31-59 mins	54 (5.5)
60-119 mins	19 (1.9)
2-3 hours	17 (1.7)
More than 3 hours	12 (1.2)

Print or online news sources, including newspapers or magazines (n(%))

Less than 10 minutes	660 (67.1)
10-30 mins	188 (19.1)
31-59 mins	87 (8.8)
60-119 mins	27 (2.7)
2-3 hours	11 (1.1)
More than 3 hours	11 (1.1)

Social media (e.g. Twitter, Facebook) (n(%))

Less than 10 minutes	703 (71.6)
10-30 mins	145 (14.8)
31-59 mins	54 (5.5)
60-119 mins	37 (3.8)
2-3 hours	26 (2.6)
More than 3 hours	17 (1.7)

Individuals (e.g. friends, family members, colleagues) (n(%))

Less than 10 minutes	664 (67.3)
10-30 mins	213 (21.6)
Less than 10 minutes	61 (6.2)
31-59 mins	28 (2.8)
60-119 mins	10 (1.0)
2-3 hours	11 (1.1)
More than 3 hours	664 (67.3)

Healthcare providers (e.g. doctors, nurses) (n(%))

Less than 10 minutes	712 (72.8)
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Table 3.1 (Continued)

10-30 mins	182 (18.6)
31-59 mins	45 (4.6)
60-119 mins	19 (1.9)
2-3 hours	8 (0.8)
More than 3 hours	12 (1.2)
Health maven (n(%))	
Yes	552 (55.6)
No	441 (44.4)
Social media health maven (n(%))	
Yes	316 (32.2)
No	666 (67.8)
Health misinformation scale score (range: 0 - 13) (mean(SD))	3.37 (3.30)

Main findings

Are social media health mavens a subset of health mavens: Based on our definition of health mavens and social media health mavens, only a small percentage (2%) of respondents were classified as social media health mavens but not as health mavens. Notably 300 respondents (30%) were both social media health mavens and health mavens. Two hundred and forty-six respondents (25%) were classified as health mavens but *not* as social media health mavens, 419 respondents (43%) who were classified as neither health mavens nor social media health mavens (see Table 3.2). Not surprisingly, these findings indicate that not all health mavens use social media for their health information sharing, but almost all social media health mavens were classified as those who share health information in general (i.e. not specifically on social media). Indeed 95% of social media health mavens were also health mavens, suggesting that social media health mavens are a subset of health mavens.

Table 3.2 Overlap between health mavens and social media health mavens

		Social media health maven		Total
		Yes	No	
Health maven	Yes	30.6%	25.1%	546
	No	1.6%	42.7%	435
	Total	316	665	981

What factors are associated with social media health mavenism: Of our five sociodemographic variables (age, education, gender, income, and race/ethnicity), only Hispanic ethnicity was significantly associated with higher odds of being a social media health maven ($p=0.010$) (see Table 3.3).

Table 3.3 Logistic regression model with sociodemographic variables predicting likelihood of being a social media health maven

	Model 1 Coef. (CI)
Age (referent group = 18-29)	
30-44	1.04 (0.66, 1.62)
45-59	0.96 (0.62, 1.49)
60+	0.84 (0.54, 1.31)
Gender (referent group = male)	
Female	1.19 (0.90, 1.57)
Education (referent group = less than high school)	
High school	0.91 (0.58, 1.41)
Some college	1.02 (0.65, 1.61)
Bachelor's degree or higher	1.34 (0.82, 2.18)
Income (referent group <\$20,000)	
\$20,000-\$34,999	1.20 (0.74, 1.92)
\$35,000-\$49,999	0.90 (0.51, 1.58)
\$50,000-\$74,999	0.62 (0.37, 1.01)
\$75,000-\$99,999	0.96 (0.58, 1.60)
\$100,000-\$149,999	0.69 (0.40, 1.17)
>\$150,000	0.85 (0.50, 1.43)
Race/ethnicity (referent group = white, non-Hispanic)	
Black, non-Hispanic	1.33 (0.94, 1.88)
Other, non-Hispanic	1.00 (0.38, 2.65)
Hispanic	1.58 (1.11, 2.24)*
2+ races, non-Hispanic	1.03 (0.39, 2.69)

* denotes p lower than 0.05, ** lower than .01, *** lower than .001

Several health-related factors were significantly associated with being a social media health maven. Compared to those with excellent self-rated health, those with self-rated poor health had lower odds of being a social media health maven, controlling for age, education, gender, income, and race/ethnicity ($p=0.037$). Exercising more was associated with increased odds of being a social media health maven; exercising one to two times per week ($p=0.020$), three to four times per week ($p=0.003$), and five or more times per week ($p=0.045$) were all associated with greater odds of being a social media health maven compared to exercising zero times per week, controlling for sociodemographic factors (see Table 3.4). Eating more daily fruits and vegetables was also associated with higher odds of being a social media health maven.

Table 3.4 Logistic regression models with health-related variables predicting likelihood of being a social media health maven, controlling for age, gender, education, income, and race/ethnicity

<i>Predictor Variables</i>	Model 2 Coef. (CI)	Model 3 Coef. (CI)	Model 4 Coef. (CI)	Model 5 Coef. (CI)	Model 6 Coef. (CI)	Model 7 Coef. (CI)	Model 8 Coef. (CI)
Self-described overall health (referent group = excellent)							
Very good	0.8 (0.51, 1.26)						
Good	0.67 (0.42, 1.06)						
Fair	0.7 (0.40, 1.23)						
Poor	0.34 (0.13, 0.93)*						
Chronic condition (referent group = no)							
Yes		0.96 (0.71, 1.29)					
Weekly exercise (referent group = 0x/week)							
1-2x/week			1.68 (1.08, 2.60)*				
3-4x/week			1.91 (1.24, 2.92)**				
5 or more x/week			1.56 (1.01, 2.41)*				
Daily fruit and vegetable intake (referent group = none)							
½ cup or less				0.87 (0.44, 1.72)			
1 cup to 1 cup				1.53 (0.81, 2.89)			
1 cup to 2 cups				1.46 (0.78, 2.72)			
2 to 3 cups				2.83 (1.43, 5.61)**			
3 to 4 cups				2.21 (1.02, 4.77)*			
5 or more cups				4.56 (1.80, 11.56)**			
Weekly alcohol intake (referent group = 0 days/week)							
1-2 days/week					0.83 (0.56, 1.23)		
3-4 days/week					0.95 (0.59, 1.52)		
5 or more days/week					1.02 (0.72, 1.46)		
Current smoking status (referent group = none)							
Some days							
Every day						2.74 (1.38, 5.42)**	
COVID-19 vaccination intention (referent group = not at all likely)						1.49 (0.93, 2.40)	
Unlikely							0.97 (0.61, 1.53)
Likely							0.87 (0.57, 1.33)
Very likely							1.09 (0.73, 1.65)

* denotes p lower than 0.05, ** lower than .01, *** lower than .001

Eating two to three cups per day ($p=0.003$), three to four cups per day ($p=0.044$), and five or more cups per day ($p=0.001$) were all significantly associated with greater odds of being a social media health maven compared to eating no fruits and vegetables per day, controlling for sociodemographic factors. In contrast, being an occasional smoker was also associated with higher odds of being a social media health maven compared to being a current nonsmoker ($p=0.004$), controlling for sociodemographic factors. The presence of a chronic health condition, days of alcohol use per week, and COVID-19 vaccination intention were not significantly associated with social media health mavenism status.

A number of information source variables were also significantly associated with higher odds of being a social media health maven. Using liberal sources; mainstream newspaper and wire service sources; and sources such as Google News or Yahoo News as minor or major sources of COVID-19 news was associated with increased odds of being a social media health maven, as was having mainstream television sources as a minor news source (p -values ranging from $p<0.001$ to $p=0.045$). Using social media (e.g. Facebook, Twitter, YouTube) as a minor or major source of COVID-19 news was associated with higher odds of being a social media health maven. Having these social media sources as a major source of COVID-19 news was associated with the greatest increased odds of being a social media health maven of all of the news sources ($p<0.001$). Use of conservative news sources such as Fox News, Rush Limbaugh, Breitbart News, OAN, and Drudge was not significantly associated with being a social media health maven. See Table 3.5 for additional details.

Table 3.5 Logistic regression models with information source variables predicting likelihood of being a social media health maven, controlling for age, gender, education, income, and race/ethnicity

<i>Predictor Variables</i>	Model 9 Coef. (CI)	Model 10 Coef. (CI)	Model 11 Coef. (CI)	Model 12 Coef. (CI)	Model 13 Coef. (CI)	Model 14 Coef. (CI)
Please indicate whether each of the following is a source of news for you about the COVID-19 outbreak:						
Sources such as Fox News, Rush Limbaugh, Breitbart News, OAN, Drudge Report (referent group = not a source)						
Minor source	1.22 (0.87, 1.71)					
Major source	1.16 (0.80, 1.68)					
Sources such as MSNBC, Bill Maher, Huffington Post (referent group = not a source)						
Minor source		1.40 (1.03, 1.90)*				
Major source		1.59 (1.05, 2.39)*				
Sources such as ABC News, CBS News, NBC News (referent group = not a source)						
Minor source			1.50 (1.01, 2.23)*			
Major source			1.38 (0.93, 2.05)			
Sources such as AP, the New York Times, the Washington Post, the Wall Street Journal (referent group = not a source)						
Minor source				1.63 (1.15, 2.31)**		
Major source				2.43 (1.70, 3.48)***		
Sources such as Google News or Yahoo News (referent group = not a source)						
Minor source					1.43 (1.04, 1.97)*	
Major source					1.81 (1.21, 2.68)**	
Sources such as Facebook, Twitter, or YouTube (referent group = not a source)						
Minor source						1.95 (1.43, 2.65)***
Major source						4.24 (2.70, 6.68)***

* denotes p lower than 0.05, ** lower than .01, *** lower than .001

Time spent looking for COVID-19 information via various sources was also associated with higher odds of being a social media health maven. Compared to not looking for COVID-19 information on these sources, spending up to 59 minutes looking for COVID-19 information on television, radio, print or online news sources, and social media was associated with higher odds of being a social media health maven, controlling for sociodemographic factors (p-values ranging from <0.001 to $p=0.048$). Spending ten to 30 minutes looking for COVID-19 information from individuals such as friends, family members, and colleagues ($p=0.022$), and from healthcare providers ($p=0.001$), was also associated with higher odds of being a social media health maven, controlling for sociodemographic factors. Compared to spending no time looking for COVID-19 information, spending more than 59 minutes looking for COVID-19 information was significantly associated with being a social media health maven for certain sources (see Table 3.6 for details).

Are social media health mavens more likely to believe health misinformation than non-mavens: Our hypothesis that social media health mavens would be more likely to believe health misinformation than non-mavens was not supported. The results from the t-test indicated that there is not a statistically significant difference in average belief in COVID-19 misinformation between those who were classified as social media health mavens and those who were not ($p=0.725$). The results from our linear regression model also indicated that political party identification did not moderate the association between social media mavenism and belief in COVID-19 misinformation ($p=0.139$), controlling for sociodemographic factors.

Table 3.6 Logistic regression models with time spent looking for COVID-19 variables predicting likelihood of being a social media health maven, controlling for age, gender, education, income, and race/ethnicity

<i>Predictor Variables</i>	Model 15 Coef. (CI)	Model 16 Coef. (CI)	Model 17 Coef. (CI)	Model 18 Coef. (CI)	Model 19 Coef. (CI)	Model 20 Coef. (CI)
In a typical day, how much time do you spend on each of the following sources looking for COVID-19 information:						
Television (referent group = less than 10 minutes)						
10-30 mins	1.80 (1.26, 2.59)*					
31-59 mins	2.17 (1.37, 3.43)***					
60-119 mins	2.06 (1.17, 3.61)*					
2-3 hours	1.37 (0.64, 2.94)					
More than 3 hours	1.66 (0.89, 3.13)					
Radio (referent group = less than 10 minutes)						
10-30 mins		2.58 (1.69, 3.95)***				
31-59 mins		2.19 (1.23, 3.90)**				
60-119 mins		1.16 (0.41, 3.34)				
2-3 hours		2.17 (0.81, 5.82)				
More than 3 hours		2.80 (0.85, 9.28)				
Print or online news sources, including newspapers or magazines (referent group = less than 10 minutes)						
10-30 mins			1.58 (1.11, 2.25)*			
31-59 mins			1.94 (1.20, 3.12)**			
60-119 mins			2.25 (1.02, 4.98)*			
2-3 hours			3.41 (1.01, 11.47)*			
More than 3 hours			2.89 (0.85, 9.83)			
Social media (e.g. Twitter, Facebook) (referent group = less than 10 minutes)						
10-30 mins				2.74 (1.88, 3.98)***		
31-59 mins				3.04 (1.71, 5.39)***		
60-119 mins				3.05 (1.54, 6.07)**		
2-3 hours				1.73 (0.75, 4.00)		
More than 3 hours				1.92 (0.70, 5.29)		
Individuals (e.g. friends, family members, colleagues) (referent group = less than 10 minutes)						
10-30 mins					1.48 (1.06, 2.06)*	
31-59 mins					1.63 (0.94, 2.83)	
60-119 mins					2.38 (1.09, 5.19)*	
2-3 hours					5.57 (1.4, 22.16)*	
More than 3 hours					0.52 (0.11, 2.48)	
Healthcare providers (e.g. doctors, nurses) (Less than 10 minutes)						
10-30 mins						1.77 (1.25, 2.51)***
31-59 mins						2.57 (1.37, 4.81)***
60-119 mins						5.81 (2.13, 15.82)***
2-3 hours						8.20 (1.61, 41.82)*
More than 3 hours						2.34 (0.72, 7.58)

*denotes p lower than 0.05, ** lower than .01, *** lower than .001

Discussion

Our findings contribute to our understanding of the role of mavenism in the spread of health-related information. One-third of the sample were categorized as social media health mavens. We found several factors that are associated with the odds of being a social media health maven. Hispanic race was the only sociodemographic factor associated with higher odds of being a social media health maven. This finding diverges from one past study that found racial and ethnic minorities were less likely to be health e-mavens (Sun et al., 2015). This difference may stem from health e-mavens and social media health mavens being different concepts; whereas the health e-mavens concept captures both health information acquisition and transmission on the internet, the social media maven concept looks specifically at health information sharing on social media. This difference could also be explained in part by the context during which our study occurred; during the COVID-19 pandemic, Latinos began using social media, mobile apps and other digital platforms at higher rates than the general U.S. population (Acevedo, 2020). Some have suggested that this may be due to the Latino community – where personal and physical networks are heavily relied upon for information and social support – turning to digital platforms to maintain their trusted social networks during social distancing (Acevedo, 2020). Our sociodemographic findings also diverge from past research which found female gender and higher education status was associated with increased likelihood of being a health maven or health e-maven, whereas we found no significant association between gender or education and being a social media health maven. Again, the pandemic shifted social and communication patterns significantly, which may have at least in part accounted for these differences.

Having self-rated poor health was associated with lower odds of being a social media health maven. Several health-related factors including more weekly exercise and higher daily fruit and vegetable intake were associated with higher odds of being a social media health maven. These findings align with past research on health mavens; Hayashi et al. (2020) found that health mavenism was associated with healthier dietary and exercise behaviors, though their sample was limited to older Japanese adults. We also found that alcohol consumption was not related to social media health mavenism, which also aligns with Hayashi et al.'s findings (2020). In our study, being a sometimes smoker was also associated with being a social media health maven. This finding differs from past research – Hayashi et al. (2020) found no association between health mavenism and smoking status – and was surprising, as it was the only non-salubrious behavior associated with being a social media health maven. We do not know from our data if the occasional smokers in this study are people on the path to quitting smoking, though existing research indicates that smokers with a quit attempt in the last year are more likely to be occasional smokers (Reyes-Guzman et al., 2017). Future research should explore what type of health information these occasional smokers may be sharing with their social media networks.

Using certain news sources – including liberal news sources, and mainstream newspaper and television sources – for COVID-19 information and spending more time looking for COVID-19 news on a variety of sources, particularly social media sources, was associated with higher odds of being a social media health maven. Although our information source variables were specific to COVID-19, these findings were consistent with past research that found that higher frequency of internet use was associated with health information seeking and sharing

behaviors (Sun et al., 2015). Kontos et al. also found that higher exposure to health-related media content was associated with health mavenism, whereas overall media consumption was not.

Our hypothesis that social media mavens would be more likely to believe COVID-19 misinformation than those who are not social media mavens was not supported. This was an unexpected finding, given the prevalence of misinformation on social media, but may be due to the fact that use of reputable news sources, such as mainstream newspaper and television sources, was also associated with being a social media health maven. Although it is heartening that social media health mavens are not more likely to believe health misinformation than non-mavens, the average level of belief in COVID-19 misinformation in the sample did reflect believing or being unsure about three pieces of COVID-19 misinformation, which is still cause for concern. Additionally, we cannot definitively say that social media health mavens do not share misinformation with their networks given that we measured belief rather than sharing of misinformation. The structure of online sharing built into social media platforms encourages users to share information that attracts others' attention, regardless of its veracity (Ceylan et al., 2023). One study found that habitual sharers of information on social media platforms had limited discernment and shared both false and true news (Ceylan et al., 2023). In other words, those who share false information on social media platforms may not necessarily believe it. Although social media health mavens may differ from these habitual sharers, this indicates a need for future research exploring exactly what health information social media mavens are sharing with their networks.

Implications

The findings from this study have several practical implications. Through illuminating factors associated with being a social media health maven, these findings can help us target

future health communication strategies or interventions. Social media health mavens could be useful targets for public health information campaigns, especially in an increasingly online world.

Additionally, our findings can shed light on interventions to target the spread of misinformation on social media. More research is needed to understand what health information social media health mavens are sharing with their networks and whether or not they may be sharing health misinformation despite being no more likely to believe health misinformation than non-mavens, especially given that average health misinformation belief in the sample reflected believing or being unsure about three pieces of COVID-19 misinformation. If future research indicates that social media health mavens are sharing health misinformation, our findings can also be used to identify targets for misinformation interventions such as inoculation (where messages that highlight scientific consensus or expose the flawed arguments of those peddling misinformation are used to reduce belief in misinformation) (Cook et al., 2017; Traberg et al., 2022) and attention-based interventions (Pennycook et al., 2021).

Limitations

First, our data are cross-sectional, and the reported associations do not imply causal relationships. Future research should employ other study designs, such as longitudinal and experimental methods, to establish whether these relationships are causal. Second, like past research on health mavenism, this study did not include any measure of what health information social media mavens actually share with their networks. Further investigation is needed about the kinds of health information that social media health mavens are sharing with their networks. Third, our measures of information sources and belief in health misinformation were all specific to COVID-19. Although these measures were appropriate given that the data were collected

during the first year of the COVID-19 pandemic, future research should explore more general information-seeking and news consumption behavior that may be associated with social media health mavenism. Additionally, future research should explore the relationships between social media health mavenism and belief in other types of health misinformation.

Conclusion

This is the first study to investigate the characteristics of social media health mavens, and to explore whether social media health mavens are more likely to believe health misinformation than non-mavens. We identified sociodemographic factors, health-related variables, and information sources associated with being a social media health maven. Notably, having better self-rated health, healthier diet and exercise habits, and use of liberal and mainstream media sources were all associated with being a social media health maven, though so was being an occasional smoker. Future research should explore whether these findings are consistent across different populations and outside of the COVID-19 context. This information can help identify who is sharing health information with their social networks via social media, who may be important targets for health communication interventions. Although we found that social media health mavens are not more likely to believe health misinformation than non-mavens, future research should explore what type of health information social media health mavens share with their networks.

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CONCLUSION

The spread of and belief in misinformation has been identified as a public health threat given the potential to impact trust in science (Larson, 2018), policy preferences and support (Kuklinski et al., 2000), health behaviors (Bridgman et al., 2020; Romer & Jamieson, 2020; Bekalu et al., 2021), and health information shared within interpersonal social networks (Krishna & Thompson, 2021). There is still much to be learned about the individual, ideological, and social characteristics associated with belief in misinformation and factors that contribute to its salience. The findings of this dissertation contribute to the growing literature on health misinformation by filling three specific gaps in the literature.

Study 1 looked at whether three different factors – conservative media use, anti-intellectualism, and conspiratorial thinking – were associated with belief in two different pieces of health misinformation – 1) that childhood vaccines cause autism and (2) that hydroxychloroquine is a safe and effective treatment for COVID-19 – and whether their associations varied across these pieces of health misinformation. Anti-intellectualism and conspiratorial thinking were positively associated with belief in both pieces of misinformation. The use of conservative media was positively associated with belief that hydroxychloroquine is a safe and effective treatment for COVID-19, but not with belief that childhood vaccines cause autism. The association of conservative media use with belief in health misinformation may depend on several factors including salience, politicization, and how recently scientific consensus on that issue was established.

Study 2 explored agenda-setting effects of mainstream news media coverage on public salience of three pieces of health misinformation: (1) hydroxychloroquine is a safe and effective treatment for COVID-19; (2) the COVID-19 vaccines cause infertility; and (3) ivermectin is a

safe and effective treatment for COVID-19. For two of the three pieces of misinformation studied, this study found that mainstream news media coverage may contribute to the public salience of health misinformation, and that this association may depend on several factors such as volume of news coverage and novelty of the misinformation.

Study 3 examined the characteristics, health behaviors and information sources of social media health mavens – a yet unstudied topic – and explored whether they are more likely to believe misinformation than non-mavens. Social media health mavens were primarily a subset of health mavens. Social media health mavenism was associated with Hispanic ethnicity, healthier diet, and healthier exercise habits, but also with being an occasional smoker. Using liberal and mainstream news sources and spending more time looking for COVID-19 news on a variety of sources was associated with higher odds of being a social media health maven. Social media health mavens were no more likely than non-mavens to believe COVID-19 misinformation.

These findings have several practical implications. The findings from Study 1 emphasize the need for interventions in conservative media, particularly for misinformation that has been highly politicized. These should include public health officials placing public service announcements and seeking to do interviews with news outlets whose audiences may be more misinformed (Jamieson and Albarracín, 2020). The findings from Study 2 point to the importance of responsible reporting on misinformation and indicate that media outlets should contextualize their reporting on misinformation with verification from scientific consensus. Taken together, the findings of Studies 1 and 2 point to the importance of ongoing investment in high-quality journalism, including reflection on how one's reporting may contribute to the spread of misinformation and skill specific to reporting uncertainty. The findings from Study 3 illuminated factors associated with being a social media health maven, and these findings can

help target future health communication strategies or interventions. Social media health mavens could be useful targets for public health information campaigns in order to expand their reach, especially in an increasingly online world.

These studies also point to important directions for future research. Study 1 points to the need for future exploration of the mechanisms of how beliefs in health misinformation are formed by conservative media use and underlying predispositions such as anti-intellectualism and conspiratorial thinking, and whether any of these factors may moderate or mediate the associations of the others with belief in health misinformation. Study 2 indicates a need for additional testing of the factors that contribute to the existence of agenda-setting effects for health misinformation. Additionally, future research should investigate the possibility of a reciprocal relationship between mainstream news coverage and public salience, and explore the complex relationships between media events, mainstream news coverage, social media, and public salience. Together Studies 1 and 2 also suggest a need for more research on effective approaches to prevent news media from intentionally or inadvertently amplifying misinformation. Study 3 points to the need for future research focused specifically on what health information social media health mavens actually share with their social media networks, potentially using self-report or experimental data.

Taken together, these three studies shed light on factors associated with belief in and salience of health misinformation during the COVID-19 pandemic. These findings can be used to better inform efforts of public health professionals, journalists, and editors to reduce belief in and salience of health misinformation.

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Supplemental Materials

Supplementary Table 1.1 Media Item Classifications for Study 1

Program	Classification
<i>Television</i>	
20/20 (ABC)	Center
60 Minutes (CBS)	Center
ABC World News Tonight	Center
All In with Chris Hayes (MSNBC)	Liberal
Anderson Cooper 360 (CNN)	Liberal
CBS Evening News with Norah O'Donnell	Center
CBS This Morning	Center
Cuomo Prime Time (CNN)	Liberal
Dateline NBC	Center
Erin Burnett OutFront (CNN)	Liberal
Face the Nation (CBS)	Center
Fox & Friends (Fox)	Conservative
Good Morning America (ABC)	Center
Hannity (Fox)	Conservative
Meet the Press (NBC)	Center
Morning Joe (MSNBC)	Liberal
NBC Nightly News with Lester Holt	Center
PBS NewsHour	Center
Special Report with Bret Baier (Fox)	Conservative
The 11th Hour with Brian Williams (MSNBC)	Liberal
The Five (Fox)	Conservative
The Ingraham Angle (Fox)	Conservative
The Last Word with Lawrence O'Donnell (MSNBC)	Liberal
The Lead with Jake Tapper (CNN)	Liberal
The Rachel Maddow Show (MSNBC)	Liberal
The Story with Martha MacCallum (Fox)	Conservative
Today (NBC)	Center
Tucker Carlson Tonight (Fox)	Conservative
<i>Radio</i>	
All Things Considered (NPR)	Liberal
Fresh Air (NPR)	Liberal
Marketplace (NPR)	Liberal
Morning Edition (NPR)	Liberal
Rush Limbaugh	Conservative
The Dana Show	Conservative
The Glenn Beck Program	Conservative
The Mark Levin Show	Conservative
The Mike Gallagher Show	Conservative
The Savage Nation (Michael Savage)	Conservative
The Sean Hannity Show	Conservative
<i>Websites</i>	

BBC News	Center
Bloomberg	Liberal
Breitbart News	Conservative
Buzzfeed	Liberal
CNN.com	Liberal
Daily Caller	Conservative
Fox News	Conservative
Huffington Post	Liberal
NBC News	Center
New York Times	Liberal
NPR News	Liberal
The Guardian	Liberal
USA Today	Center
Washington Post	Liberal
Yahoo News	Center

Supplementary Table 1.2 Measures for Study 1

Construct	Item	Coded
Anti-intellectualism	When it comes to public policy decisions, whom do you tend to trust more: ordinary people, experts, or trust both the same?	1 = Trust ordinary people more 2 = Trust experts more 3 = Trust both the same
Conspiratorial thinking – dark forces	How well does the following statement describe your view? “Most business and politics in this country are secretly controlled by the same few powerful people.”	1 = Not at all 2 = Not very well 3 = Somewhat well 4 = Very well 5 = Extremely well
Conspiratorial thinking – deception	How well does the following statement describe your view? Much of what people hear in schools and the media are lies designed to keep people from learning the real truth about those in power.	1 = Not at all 2 = Not very well 3 = Somewhat well 4 = Very well 5 = Extremely well
Belief in vaccine/autism link	(Part I) Which of these two statements do you think is most likely to be true? 1. Most scientific evidence shows childhood vaccines cause autism 2. Most scientific evidence shows childhood vaccines do not cause autism And (Part II) How confident are you about that?	-4 = Extremely confident that misinformation is true -3 = Very confident that misinformation is true -2 = Moderately confident that misinformation is true -1 = A little confident that misinformation is true 0 = Not at all confident in either misinformation or accurate information

		1 = A little confident that accurate statement is true 2 = Moderately confident that accurate statement is true 3 = Very confident that accurate statement is true 4 = Extremely confident that accurate statement is true
Belief in hydroxychloroquine	(Part I) Which of these two statements do you think is most likely to be true? 1. There is clear scientific evidence that the anti-malarial drug hydroxychloroquine is a safe and effective treatment for COVID-19. 2. There is not clear scientific evidence that the anti-malarial drug hydroxychloroquine is a safe and effective treatment for COVID-19. And (Part II) How confident are you about that?	-4 = Extremely confident that misinformation is true -3 = Very confident that misinformation is true -2 = Moderately confident that misinformation is true -1 = A little confident that misinformation is true 0 = Not at all confident in either misinformation or accurate information 1 = A little confident that accurate statement is true 2 = Moderately confident that accurate statement is true 3 = Very confident that accurate statement is true 4 = Extremely confident that accurate statement is true

Supplementary Table 2.1 Correlations between media coverage volume and Google RSV for Study 2

	Correlations <i>Media coverage of relevant piece of misinformation</i>
Hydroxychloroquine SVI	.69***
Vaccine infertility SVI	.20**
Ivermectin SVI	.67***

* denotes p lower than 0.05, ** lower than .01, *** lower than .001

Supplementary Table 2.2 Ordinary Least Squares results for Study 2

Ordinary Least Squares Coef. (CI)

Piece of misinformation

Hydroxychloroquine .68 (.59, .77)***

Vaccine infertility 2.31 (.86, 3.75)**

Ivermectin 3.92 (3.38, 4.47)***

* denotes p lower than 0.05, ** lower than .01, *** lower than .001

Supplementary Table 3.1 Measures for Study 3

Construct	Item	Coded
<i>Mavenism measures</i>		
Health mavenism	On a scale of 1 to 4, with 1 being “Never” and 4 being “Always,” please indicate how often the following statements apply to you: (1) I like introducing new health topics to my friends and family. (2) I like helping people by providing them with information about health. (3) People ask me for information about health. (4) If someone asked where to get the best information about a particular health topic, I could tell him or her where to go. (5) My friends think of me as a good source of information when it comes to new information about health.	1 = Never 2 = Rarely 3 = Often 4 = Always
Social media health mavenism	On a scale of 1 to 4, with 1 being “Never” and 4 being “Always,” please indicate how often the following statements apply to you: (1) I like introducing new health topics to my friends and family. (2) I like helping people by providing them with information about health. (3) People ask me for information about health. (4) If someone asked where to get the best information about a	1 = Never 2 = Rarely 3 = Often 4 = Always

	particular health topic, I could tell him or her where to go. My friends think of me as a good source of information when it comes to new information about health.	
<i>Health-related variables</i>		
Self-rated overall health	In general would you say your health is:	1 = Excellent 2 = Very good 3 = Good 4 = Fair 5 = Poor
Amount of exercise per week	During the past few months, other than your regular job, how many times per week did you participate in any physical	_____ times per week
Cups of fruits and vegetables per day	About how many cups of fruit and vegetables (including 100% pure fruit or vegetable juice) do you eat or drink each day?	1 = None 2 = ½ cup or less 3 = ½ cup to 1 cup 4 = 1 cup to 2 cups 5 = 2 to 3 cups 6 = 3 to 4 cups 7 = 5 or more cups
Days of alcohol use per week	few months, how many days per week did you have at least one drink of any alcoholic beverages such as beer, wine, a malt beverage or liquor?	_____ days per week
Current smoking status	Do you now smoke cigarettes...?	1 = Not at all 2 = Some days 3 = Every day
Presence of a chronic condition	Has a doctor or other health professional ever told you that you had any of the following medical conditions? (1) Cancer (2) Diabetes or high blood sugar (3) High blood pressure or hypertension (4) A heart condition such as a heart attack, angina, or congestive heart failure (5) Chronic lung disease, asthma, emphysema, or chronic bronchitis (6) Arthritis or rheumatism	0 = No 1 = Yes These items were recoded to create one item measuring the presence or absence of a chronic condition. Respondents who responded yes to any of the chronic condition items were coded as having a chronic condition.

	(7) HIV	
Intention to receive a COVID-19 vaccine once available	If a vaccine for COVID-19 becomes available during the next 12 months, how likely do you think you would get it for yourself?	1 = Not at all likely 2 = Unlikely 3 = Likely 4 = Very likely
<i>Information source variables</i>		
News sources	Please indicate whether each of the following is a source of news for you about the COVID-19 outbreak. (1) Sources such as Fox News, Rush Limbaugh (Lim-BAH), Breitbart (Bright – _bart) News, One America News or The Drudge Report (2) Sources such as MSNBC, Bill Maher (MAR), or Huffington Post (3) Sources such as ABC News, CBS News, or NBC News (4) Sources such as Associated Press, The New York Times, the Washington Post, or the Wall Street Journal (5) Sources such as Google News or Yahoo News (6) Sources such as Facebook, Twitter, or YouTube	1 = Not a source 2 = Minor source 3 = Major source
Time spent looking for COVID-19 information	In a typical day, how much time do you spend on each of the following sources looking for COVID-19 information? (1) Television (traditional and online) (2) Radio (3) Print or online news sources, including newspapers or magazines (4) Social Media (e.g., Twitter, Facebook) (5) Individuals (example: friends, family members, colleagues) (6) Healthcare providers (example: doctor, nurses)	1 = Less than 10 minutes 2 = 10-30 minutes 3 = 31-59 minutes 4 = 60-119 minutes 5 = 2-3 hours 6 = More than 3 hours
<i>Belief in health misinformation</i>		
Belief in COVID-19 misinformation	Please indicate whether the following items are true or false.	0 = True 1 = Don't Know

	(1) Only people with underlying health conditions are at risk for COVID-19. (2) Eating garlic can help prevent infection with COVID-19. (3) COVID-19 is caused by the spread of bacteria. (4) Spraying and introducing bleach or another disinfectant into your body can protect you against COVID-19. (5) People who are not feeling sick may not transmit COVID-19. (6) Drinking alcohol can protect you against COVID-19. (7) 5G mobile networks spread COVID-19. (8) Exposing yourself to the sun or to high temperatures can protect you from COVID-19. (9) Currently, there is a vaccine for COVID-19. (Note: data was collected before there was a vaccine for COVID-19). (10) Regularly gargling with saltwater or saline can protect you from COVID-19. (11) COVID-19 is same as seasonal flu. (12) Anti-malaria medication will cure COVID-19. (13) Test and quarantine are needed only for older people.	1 = False
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