COVID-19 and digital health literacy in university students / narrative competence and cognitive mapping as a culturally sustaining pedagogy in the education of emergent bilinguals

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COVID-19 and Digital Health Literacy in University Students

by

Molly K. Hadley

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ABSTRACT

Early in 2020, the COVID-19 pandemic became a global public health concern. College students became dependent on the online environment for learning, but also for receiving COVID-19 information. Understanding digital health literacy (DHL) in this unique population and subsequent prevention behaviors in a digitally connected population during a public health crisis is crucial to prepare for future pandemics. This study explored DHL in college students, their main sources of pandemic information and other information seeking behaviors, adherence to public health guidelines, and intentions to receive a COVID-19 vaccine. During the summer of 2020, 245 New York state college students completed an online survey. DHL was found to be adequate in the sample of college students. A majority of the participants were seeking COVID-19 information for themselves and others and were generally satisfied with the information they found. DHL was found to predict using a reliable source of information and adherence to public health guidelines, but not vaccination intentions. Race and political affiliation were also found to predict COVID-19 prevention behaviors. Additionally, students who identified as African American were less likely to report plans to get the vaccine. This study also compared recruitment methods (community vs. panel-based) used to obtain two cross sectional samples of college students who took the same online survey. Results showed community recruitment to be lower cost, more time intensive, and to produce a more homogenous sample. The panel-based sample was easier to manage and resulted in a sample that matched the diversity of college students across the United States, but it was more costly. Sample compositions were significantly different for all demographic variables except race and DHL, and findings from the analyses for each sample were different in some ways and similar in others. Of note is that digital health literacy was associated with adherence to COVID-19 public health guidelines and race was
associated with intentions to receive a vaccine in both samples. With so much pandemic information being obtained online, understanding how DHL impacts information seeking and the perceptions college students hold about the pandemic and adherence to prevention recommendations, including the COVID-19 vaccine, is important to control the spread on campuses and throughout the surrounding communities throughout this pandemic and during future pandemics.
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Chapter 1: Introduction and Background

Statement of the problem

In late 2019, the COVID-19 pandemic began in mainland China with the city of Wuhan as its epicenter. At the end of February 2020, the pandemic had become a global public health concern as the rate of increase in cases became greater in the rest of the world than China. Early in the pandemic, substantial outbreaks were seen in Italy, the US, and Iran (Verity et al., 2020).

SARS-CoV-2, the virus that causes COVID-19, has proven to be a highly infectious, complex virus and reducing community spread has been more challenging than recent outbreaks of other coronaviruses (MERS and SARS). Individual level behaviors such as frequent hand washing, social/physical distancing, wearing masks in public, and only leaving home for essential trips have been recommended to help stop the spread of COVID-19. In order to understand and act appropriately to recommendations, individuals must be able to access, obtain, and understand credible health information, or have adequate health and digital health literacy (DHL).

During the COVID-19 pandemic, an infodemic developed. An infodemic is an excessive amount of information about a problem that can often be unreliable, making it harder to find and understand credible information (Zaracostas, 2020). This pandemic highlights the importance of having the skills to effectively sort through and obtain credible online health information during a rapidly evolving public health crisis. These skills have the potential to impact knowledge, attitudes, and behaviors about COVID-19, as well as intent to follow recommended preventative measures.
Across the United States, colleges and universities closed campuses in March 2020 and sent most students home to finish the semester with online courses. Thus, students were reliant on the internet to seek COVID-19 information and understand public health guidelines as opposed to receiving that information on their college campuses. Even though many students went back to in-person classes for the 2020-21 and 2021-22 academic years, the infodemic remains, and ongoing containment of COVID-19 has proved challenging. College campuses and college student lifestyles offer many opportunities for the virus to spread rapidly, plus college students seem to experience milder symptoms, many of which are asymptomatic, when infected with COVID-19. With pandemic information being obtained online, understanding how DHL impacts the perceptions college students hold about the pandemic and adherence to prevention recommendations, including the COVID-19 vaccine, will be important to control the spread on campuses and throughout the surrounding communities as the pandemic continues and during future pandemics.
Purpose of the study

The purpose of this dissertation was to assess DHL in college students based in New York state, their access to and understanding of COVID-19 related information, their perceptions towards the virus, and intentions to adhere to COVID-19 public health guidelines. This information will help inform DHL interventions and health communication materials targeting college students in the future. The Health Belief Model and Health Literacy Skills Framework were used to guide the investigation of factors affecting adherence to COVID-19 public health guidelines and vaccination intentions. Additionally, this project compared two different sampling methods (convenience vs. panel-based) of college students to better understand preferred sampling methods for health-related surveys to this population.

This dissertation included a cross-sectional survey of the college undergraduate student population in New York state (NYS) to answer the following research questions:

1. What is the relationship between demographic variables (age, gender, race, ethnicity, political affiliation, first-generation status) with DHL?
2. What is the relationship between DHL and COVID-19 information sources?
3. What is the relationship between (a) demographic variables, (b) DHL, and (c) perceived threat with adherence to COVID-19 public health guidelines?
4. What is the relationship between (a) demographic variables, (b) DHL and (c) perceived threat with intentions to receive a COVID-19 vaccine?
5. What are the benefits, challenges, and threats to validity using two different sampling methods (convenience vs. panel-based) for college students?
Review of the literature

*eHealth Literacy*

eHealth literacy (eHL) refers to “the ability to seek, find understand, and appraise health information from electronic sources and apply the knowledge gained to address or solve a health problem” (Huang et al., 2020a). It can include any of the following: electronic communication between patients and providers, personal health records, health education programs, patient portals, and web-based health applications (Kim & Xie, 2017). With the increase in these digital technologies, programs and websites for managing health, health information, and self-care have moved online and are accessed and understood independently. Given this, eHL has become an important area of study as health information seeking and health management, both with and without a medical professional, have moved online.

With this transition, a valid instrument to measure an individual’s eHL is essential. One such instrument, developed by Norman & Skinner (2006), the eHealth Literacy Scale (eHEALS) is an 8-item measure of eHL. It measures an individual's knowledge, comfort and perceived skills of obtaining online health information and applying that information to a health issue and asks questions like “I know how to use the health information I find on the Internet to help me” and “I know where to find helpful health resources on the Internet”. This tool is still widely used today, has been deemed reliable and valid, and provides insight into self-reported skills when seeking health information online.

In the general population, studies on eHL and related outcomes are minimal. Being younger, possessing more education (Mitsutake et al., 2016; Tennant et al., 2015) and increased amounts of internet use (Mitsutake et al., 2016) have been associated with higher levels of eHL
among baby boomers and older adults. Adults with higher levels of eHL were found to exercise more and eat a healthier diet (Mitsutake et al., 2016).

A newer concept, digital health literacy (DHL), shares core aspects with eHL in relation to seeking, finding, understanding, and appraising online health information, but adds on additional skills related to using digital technologies effectively. These include: computer literacy or the ability to use computers efficiently to complete tasks, media literacy and information literacy to evaluate multiple sources (Novillo, 2017). Van Der Vaart & Drossaert (2017), developed the Digital Health Literacy Instrument (DHLI) to better assess eHealth and digital skills more broadly and objectively. This 21-item self-report questionnaire assesses “operational skills, navigation skills, information searching, evaluating reliability, determining relevance, adding self-generated content, and protecting privacy”. The Cronbach’s alpha of the DHLI was found to be satisfactory at 0.87 as well as measures assessing content and construct validity. For the remainder of the dissertation, DHL will be used to refer to both DHL and eHL unless referring to a specific study of eHL.

**Digital health literacy and college students**

DHL is a critical part of health information seeking in young adults, or gathering information about health, whether in response to a concern, a health-related risk, or an interest in a topic seen in media (Pesala et al., 2017). The internet is an important source of health information for college students (Heuberger & Ivanitskaya, 2011; Percheski & Hargittai, 2011). Additionally, access to digital technology is ubiquitous among 18–29-year-olds, and as of 2019, 99% of young adults own a cellphone, of which 96% own a smartphone (PRC, 2019). Basch et al. (2018) found college students are more likely to visit the internet for health information than to ask a medical professional. As eHL increases, online health information seeking becomes
more effective (Britt et al., 2017). Displaying lower DHL could make it challenging for young adults to find, understand, and react appropriately to online health information or assess whether it is from a credible source.

When evaluating eHL in college students, studies find many students lack skills to conduct information searches online and judge a sources credibility (Ivanitskaya et al., 2011; Stellefson et al., 2011). Also, students’ perceived eHL skills are much higher than the skills they displayed (Stellefson et al., 2011).

With respect to health outcomes, adequate eHL skills in college students have been associated with good overall health (Britt et al., 2017). More specifically, eHL was correlated with all 8 areas of college student health identified by the American College Health Association (ACHA). These 8 areas are: general health, exercise, sleep, vaccinations, sexual health, diet, stable relationships and a lifestyle free of harmful substances (Britt et al., 2017). Other studies have found associations between eHL in college students and balanced diets (Huang et al., 2020a; Tsukahara, 2020; Yang et al., 2019), healthy exercise behaviors (Huang et al., 2020a; Tsukahara, 2020), and a higher likelihood to adopt positive health behaviors (Huang et al., 2020a).

Clearly, developing interventions to improve the DHL of young adults could be important to improve health outcomes. One such program, Get Health ‘e’, developed by Manganello et al. (2019) seeks to increase eHL in young adults. The program is an online course with 6 modules that teach participants about eHL, online health information seeking skills, patient portals, social media and health, health-related phone apps, and wearable health devices. The pilot study found participants enjoyed the program, but more importantly, their eHL increased.
Health literacy

The ideas of eHL and DHL are closely related to health literacy (HL) given that HL is “the achievement of a level of knowledge, personal skills and confidence to take action to improve personal and community health by changing personal lifestyles and living conditions” (WHO, 2020). With substantial amounts of health information available online, it’s imperative an individual has the digital skills to obtain accurate information, understand that information, and further use it to change their lifestyle and improve their health.

HL enables an individual to (1) navigate the healthcare system, (2) effectively communicate with providers, (3) practice self-care, (4) perform preventative and promotive health behaviors, (5) base decisions on credible, scientific knowledge. These are all closely tied to DHL. Many factors impact HL including receipt of appropriate and targeted health communication materials, understanding the health information, and effective communication with providers (Hansen, 2015).

Population level data have identified inadequate HL in half of adults residing in the USA and Australia, and globally, it is estimated that 28.7% to 92.7% of adults have low HL (Sansom-Daly et al., 2016; Sorensen et al., 2015). In the United States, the 2003 National Assessment of Adult Literacy (NAAL), the first large-scale national assessment of English literacy in adults, included a HL component (NCES, 2006). More than 19,000 adults took the survey and were classified into four HL performance levels: below basic (14%), basic (22%), intermediate (53%), and proficient (12%). Performance levels showed associations with demographic variables. Females were less likely to be in the two lower levels, individuals who identified as White or Asian/Pacific Islander had higher average HL than the other ethnic groups, adults in the oldest
age group (65+ years) had the lowest average HL, and average HL increased with higher levels of educational attainment (NCES, 2006).

**COVID-19 pandemic**

In late 2019, the COVID-19 pandemic began in mainland China and by late February 2020 the pandemic had become a global public health concern and drastically changed day-to-day life (Verity et al., 2020). Globally, as of October 2020, according to Alwan et al. (2020), COVID-19 has infected more than 35 million people and resulted in more than 1 million deaths. The COVID-19 virus is highly contagious and spreads through close contact in poorly ventilated areas. Contaminated surfaces might present a transmission risk, but this isn't considered a major threat (Wiersinga et al., 2020). Close contact with an infected person (at least 15 minutes) or shorter encounters with a symptomatic (coughing, sneezing, etc.) person increase transmission risk (Wiersinga et al., 2020). Many COVID-19 infections may be attributable to the ability of a host to spread the infection while asymptomatic (Huang et al., 2020b). Studies on COVID-19 are ongoing, but current knowledge suggests approximately 40-45% of COVID-19 infections present as asymptomatic (especially in younger, healthier populations), which can be transmitted to others during a 14-day window (Oran & Topol, 2020). The infection fatality rate is much higher than that of the seasonal flu (Verity et al., 2020) and, like other coronaviruses, COVID-19 is capable of reinfecting those who have already had it (Wiersinga et al., 2020).

COVID-19 presents with varying manifestations in different populations. Being older, or having a comorbidity increases the risk of experiencing negative outcomes. For example, of patients hospitalized for COVID-19, 74% to 86% are over 50 years of age and 60% to 90% have comorbidities. Children (under 18 years of age) account for 2% to 5% of confirmed COVID-19 infections and it remains unclear why they are less susceptible to the virus. Children rarely
experience negative outcomes and present with milder symptoms. Lower income and minority populations have been disproportionately impacted by COVID-19 and experience more severe infections, hospitalizations, and death. These disparities are likely in response to upstream disparities experienced by these populations like crowded housing, living in densely populated areas, being reliant on public transportation, being more likely to carry essential jobs, employment in the service industry, or less access to healthcare which could lead to more comorbidities (Wiersinga et al., 2020).

Countries have implemented varying combinations of prevention and infection control measures making it difficult to understand what measures are most effective. In general, interventions can be broken down into those that are personal actions (hand washing, masks, physical distancing, etc.), case and contact identification (testing and tracing), regulatory actions (crowd limits, indoor capacity limits, stay at home orders, etc.), and international border restrictions (Wiersinga et al., 2020). New York state, the initial epicenter of the pandemic in the United States was quick to implement and even mandate certain prevention strategies (wearing masks, washing hands, social distancing, staying home, business restrictions, etc.). At first glance these restrictions seemed to be highly successful as New York dramatically lowered its levels of cases/100,000, percent positivity, and deaths during the summer of 2020 (Dzhanova, 2020). However, the fall of 2020 is showing a new spike across the United States, including New York state, so it remains unclear what prevention measures are directly related to maintaining low case counts.

In relation to the COVID-19 pandemic, adequate DHL could assist an individual in understanding public health guidelines and justifying adherence to them in their personal life. These skills could also help people identify credible sources for COVID-19 related health
communication materials, how to get tested if needed, and when to seek out medical care. Having adequate DHL will help sort through the contradictory, and sometimes false, information about the pandemic (Paakkari & Okan, 2020). Yet, there have been limited research looking at DHL in relation to COVID-19 in New York state undergraduate college students in the United States.

**COVID-19 and college students**

The lifestyles and living environments of college students are perfect for COVID-19 super spreader events, thus it is important to understand COVID-19 in this population and potential impacts to the surrounding community. According to Walke et al. (2020), understanding COVID-19 transmission among college students is complex, but increased socialization in this population, plus crowded and shared residential settings likely pose significant transmission risk. Once college campuses reopened in August 2020, COVID-19 incidence increased by 144% among those aged 18-22 years old.

US college campuses reopened with increased numbers of hybrid or online courses and extensive rules on mandatory testing or pooled surveillance, face coverings, social distancing, and limits on gatherings on or off campus. Still, many cases and super spreader events have been tied to social gatherings. An estimated 214,000 cases and 75 deaths have occurred in campus populations since the pandemic began (NYT, 2020).

One example of asymptomatic transmission risk in this population comes from a study assessing a cluster of eight young people with COVID-19, aged 16-23 years, whose source of infection was traced back to different social outings with the same asymptomatic person. This evidence proves efficient human to human transmission, amongst a younger group of individuals, during the asymptomatic phase of COVID-19 (Huang et al., 2020b). Alternatively,
Cunningham et al. (2020) assessed 3222 young adults (aged 18-34 years old) hospitalized with COVID-19 across the US and found high rates of adverse outcomes, 21% needed intensive care, 10% required ventilation, and 2.7% died. Risk factors such as obesity, hypertension, and diabetes were common in the sample and associated with a greater risk of experiencing an adverse event. Clearly, even in younger people, infection can lead to chronic illness, complications, and sometimes death (Nature, 2020).

On college campuses, preventing spread of the virus through adherence to universal prevention strategies (wearing masks, washing hands, social distancing, staying home) and uptake of the vaccine, will be key catalysts to ongoing containment of the virus on college campuses, but more importantly in the surrounding communities where vulnerable populations reside. Seen in Figure 1, as universities reopened in the Fall, counties which house universities saw significant spikes in 14-day average case counts per 1,000 residents (Seltzer, 2020).

**Figure 1: 14-day average new confirmed cases per 1,000 residents (JHCRS, 2020)**
Finally, although uncommon, young adults are not immune to experiencing adverse outcomes from COVID-19 making prevention measures additionally important for their own protection and well-being.

Colleges and public health officials can reach college students through health communication campaigns. They offer the ability to reach, inform, and influence students about the choices they make about their health. However, in order to be effective, materials must be tailored to the unique needs and lifestyles of college students. Effective tailoring includes engaging the population in material creation, pre-testing the materials using members of that population, using appropriate distribution channels to reach the population, and receiving ongoing feedback once dissemination has taken place (CPSTF, 2018). Also, with the digital connectedness of college students, and many courses being offered remotely in response to the pandemic, digital COVID-19 health communication campaigns are a key strategy to reach and motivate students to adhere to public health guidelines both now and for future pandemics. Research is still needed to identify what dissemination strategies and messages are most effective in reaching college students during a pandemic.

**College students and prior pandemics**

Given the limited information about COVID-19 and college students, it is helpful to review the literature for prior pandemics and outbreaks to understand how students react to prevention measures like vaccines. In 2009, a novel strain of influenza (H1N1) was declared a pandemic by the WHO and a vaccine for the strain was released in October of that same year. During that fall and winter, individuals were motivated to receive their annual influenza vaccine, but also receive the vaccine for H1N1. A pandemic influenza surveillance network organized by the ACHA estimated the majority of influenza-like illnesses on college campuses reflected H1N1
symptoms and were likely H1N1 cases in college students. Because of this elevated risk, the CDC made additional efforts to target 19–24-year-olds in H1N1 vaccination campaigns. However, vaccine uptake of the additional H1N1 vaccine was minimal for college students, estimated at 8%. (Yang, 2012)

Ramsey & Marczinski (2011) assessed perceived risk and attitudes towards the H1N1 vaccine in 514 college students. A majority of respondents (54.3%) felt they had control over their influenza risk because they frequently engaged in protective behaviors (washing hands, etc.), 50% felt a decreased risk because they reported being healthy, and 72.8% of respondents believed they would not become seriously ill if they were to contract H1N1. Regarding the vaccine, only 15.8% reported planning to receive the vaccine, 53.1% reported they would not receive the vaccine, and 31.1% were undecided. Top reasons for refusing the vaccine included: the belief it would not work; lack of vaccine testing; fears the vaccine would give them H1N1; and concerns about serious side effects.

Similarly, during the swine flu (A/H1N1) outbreak, Teitler-Regev et al. (2011) examined factors affecting university students’ intentions to receive the swine flu vaccination. The top motivator for intention was ‘to reduce the chances of contracting influenza’ and the top reason to refuse the vaccine was ‘I do not have enough knowledge about the vaccine’s safety and its side effects’. In addition, this study analyzed Health Belief Model (HBM) constructs and found that students who intended to receive the swine flu vaccine perceived the illness to be more serious, felt they were more susceptible, perceived fewer barriers, and perceived more benefits than those who reported a lack of vaccination intention.
Routine vaccine uptake in college students

When looking at other infectious viruses requiring vaccinations, like seasonal influenza, college students are at a particularly high risk of contracting and spreading the virus because of shared living spaces, shared restrooms, classrooms, and participation in social activities. Yet, on college campuses flu vaccination rates remain low ranging from 8-39%, dramatically short of the 70% Healthy People 2020 target (NFID, 2016). Main challenges related to flu prevention in college students include: healthy students don’t worry about getting the flu (low perceived susceptibility); college students are transitioning to being responsible for managing their own health; students have varying levels of awareness of attitudes toward the flu vaccine; busy schedules and competing priorities (high perceived barriers); varying levels of on campus flu prevention efforts; and uncertainty about or limited insurance coverage (NFID, 2016).

Another vaccine frequently offered to college students who did not receive it as a teenager, the HPV vaccine, shows low uptake rates in the college population. One study found that although most surveyed students had heard of HPV, only 75.8% of females and 56.2% of males had heard of the vaccine. Students expressed low perceived susceptibility to HPV with less than a quarter of students agreeing that they were at risk of contracting HPV or likely to contract it in their lifetime. Vaccination intention was low as 51.7% of unvaccinated females and 52.5% of unvaccinated males reported they were “very unlikely” or “unlikely” to get the vaccine within the next six months (Barnard et al., 2017).

Although research on COVID-19 vaccine hesitancy in US college students is limited, one survey at a mid-size university in New England found hesitancy in this population. This survey, disseminated before the vaccine was available, found 50.6% of the sample responded ‘yes’ when asked whether they would get the vaccine, the rest responded ‘no’ (29.8%) or ‘not sure’ (19.3%).
Those who were on the fence, generally had fears regarding vaccine safety. Many students reported they would get the vaccine once early vaccination rounds were complete and the vaccine was deemed safe. Similarly, students who said they would not get the vaccine were worried about safety and fear of the unknown considering the vaccine is brand new. (Synnott, 2021)

Considering prior perceptions of college students during a pandemic and to other infectious diseases with vaccines, mixed with historically low vaccination uptake rates, motivating college students to engage in preventive behaviors and receive a COVID-19 vaccine may prove challenging. Understanding beliefs and attitudes college students hold about COVID-19 and how these perceptions predict behavior could help inform relevant and tailored messages to students during pandemics.

**Health Belief Model**

In order to explain or predict certain outcomes, it’s important to inform health behavior and health communication plans with theories. Developed in the 1950s by social psychologists Hochbaum, Rosenstock, and Kegels, the HBM (Figure 2) has been used to predict health behaviors by focusing on a person's attitudes and beliefs, and proposes that an individual who perceives a disease as threatening is more likely to take preventative action against that disease. The HBM consists of several constructs, perceived susceptibility [an individual’s assessment of the likelihood of the health outcome], perceived severity [an individual’s assessment of the seriousness of the outcome], perceived benefits [perceived rewards of the recommended behavior], perceived barriers [obstacles to performing the recommended behavior], cues to action [motivating factors] and self-efficacy [one’s confidence to successfully complete the behavior] (D’Souza et al., 2011; Rosenstock et al., 1988; Patterson et al., 2018). Combined, the
theory suggests these constructs will predict health behaviors, like wearing a mask in public or receiving a vaccine.

![Figure 2: Health Belief Model](image)

The HBM has been successfully used in the past to explore vaccination intentions in the college population (Donadiki et al., 2104; Mehta et al., 2013), and to identify communication strategies for vaccine promotion with college students (Sundstrom et al., 2015). Specifically, Teitler-Regev et al. (2011) found that having low perceived susceptibility and low perceived severity to a disease, or low perceived benefits and high perceived barriers to getting a vaccine negatively impacted vaccination intentions and uptake. Regarding COVID-19, in various studies the HBM was successfully used to understand the adoption of COVID-19 prevention behaviors in college students (Alsulaiman & Rentner, 2021; Hatteberg & Kollath-Cattano, 2022; Tam et al., 2021).

Mainstream media and messaging from public health entities have made it clear that being older, or having a comorbidity puts an individual at significantly more risk for
experiencing more severe COVID-19 outcomes. Thus, younger populations, including college students, may be personally perceiving low susceptibility and severity to COVID-19. Working to change these perceptions or approach them through tailored messaging could increase vaccination intention and uptake in college students when a vaccine is available. Also, focusing COVID-19 vaccine messaging on perceived benefits and barriers to receiving the vaccine, or identifying cues to action that are pertinent to college students could increase intentions and uptake.

Along with the Health Literacy Skills Framework (next section), the HBM will be used in this study to conceptualize predictors and mediators of COVID-19 public health guidelines (masks, hand washing, physical distancing, staying home) and COVID-19 vaccination intentions.

**Health Literacy Skills Framework**

There are no published frameworks or conceptual models related to DHL. The eHealth Literacy Framework (eHLF) provides a model for understanding a user’s ability to understand, access and use eHealth technologies (Norgaard et al., 2015). However, the eHLF was not a good fit for this study. The Health Literacy Skills Framework (HLSF) (Figure 3) conceptualizes how HL impacts health behaviors and outcomes. This framework is relevant to DHL as eHealth and information seeking are included under health literacy skills in the framework. First, this framework presents factors (demographics, resources, capabilities, prior knowledge) that can influence the development of HL and related skills (including digital health information seeking), how those factors influence comprehension, and finally, how comprehension and other mediators (health status, attitudes, emotions, motivation, self-efficacy, etc.) influence health related outcomes and behaviors. Also, this framework describes factors external to the individual that influence all relations. Examples of these external factors include: culture, community
resources, family, media, health care system, health care provider, etc. As previously mentioned, this framework, along with the HBM, will be used to conceptualize and assess predictors and mediators of COVID-19 behaviors. The HLSF developers mention the need for more understanding on how demographic variables influence HL skills and how mediators influence the pathway between HL skills and health outcomes. These gaps will be assessed in this project with DHL. (Squiers et al., 2012)

Figure 3: Health Literacy Skills Framework (Squiers et al., 2012)

Note: Written permission received from Linda Squiers to use this figure.
Chapter 2: Exploring predictors of digital health literacy and information seeking behaviors in college students during the COVID-19 pandemic

Abstract

Background: Early in 2020, the COVID-19 virus became a global public health concern. Since college students frequently seek health information online, this study focused on information seeking behaviors and the role of digital health literacy (DHL) in New York state, which was the epicenter for the first wave of the pandemic.

Methods: During the summer of 2020, we conducted an online survey with a cross sectional sample of 254 New York state college students using community recruitment methods. We measured DHL using the Digital Health Literacy Instrument (DHLI). We compared DHL with demographic variables utilizing ANOVA and used regression models to assess associations of DHL with information sources.

Results: Overall, the sample had adequate DHL. Findings suggest DHL was a predictor of only one information source, government agency websites, for COVID-19 information. Although this was the most popular information source after search engines, overall use was low (41%). Only 26% reported using their college website. In addition, students reported they most often sought information for themselves and others and were generally satisfied with the information they found.

Conclusion: DHL can improve health information seeking and help prevent the spread of misinformation. Findings suggest that even when DHL is high, less than half of college students used government sources about COVID-19, and even fewer sought information from their college website. Future programs should consider building DHL skills for college students and
helping college students learn where to find accurate public health information. Colleges should also incorporate reliable public health information into their websites.

**Introduction**

eHealth literacy (eHL) refers to “the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to address or solve a health problem” (Huang et al., 2020). eHL can also include electronic communications between patients and providers, personal health records, online health education programs, patient portals, and web-based health applications (Kim & Xie, 2017).

A newer concept, digital health literacy (DHL), shares core aspects with eHL in relation to seeking, finding, understanding, and appraising online health information, but includes additional skills related to using digital technologies effectively. Such skills include computer literacy or the ability to use computers efficiently to complete tasks, media literacy, and information literacy to evaluate multiple sources (Novillo, 2017). Van Der Vaart & Drossaert (2017) developed a 21-item Digital Health Literacy Instrument (DHLI) to better assess the broader concept of DHL. This instrument has been found to have adequate reliability and validity.

DHL has the potential to be a critical component of health information seeking in young adults, or gathering information about health (Pesala et al., 2017), especially since the internet is an important source of health information for college students (Percheski & Hargittai, 2011). This age group is more likely to visit the internet for health information than to ask a medical professional (Basch et al., 2018). Plus, access to digital technology is ubiquitous among young adults (18-29 years old). As of 2019, 99% of young adults owned a cellphone, 96% of which were smartphones (PRC, 2019).
As eHL increases, which is interchangeable with DHL, online health information seeking becomes more effective (Britt et al., 2017). Lower DHL could make it challenging for young adults to find online health information, assess its source, and make appropriate health decisions. Many college students lack skills to conduct information searches online and judge a source’s credibility (Ivanitskaya et al., 2011; Stellefson et al., 2011) and students often over-estimate their eHL (Stellefson et al., 2011). At the same time, adequate eHL skills in college students have been associated with good overall health (Britt et al., 2017). Studies have found associations between eHL in college students and balanced diets (Britt et al., 2017; Huang et al., 2020; Tsukahara, 2020; Yang et al., 2019), healthy exercise behaviors (Britt et al., 2017; Huang et al., 2020; Tsukahara, 2020), healthy sleep habits (Britt et al., 2017), and a higher likelihood to adopt other positive health behaviors (Britt et al., 2017; Huang et al., 2020).

In late 2019, the COVID-19 pandemic began in mainland China and by late February 2020, the pandemic had become a global public health concern drastically impacting day-to-day life (Verity et al., 2020). The lifestyles and living environments of college students are ideal for rapid spread of the highly contagious virus that causes COVID-19. According to Walke et al. (2020) understanding COVID-19 transmission among college students is complex, but increased socialization in this population, plus crowded and shared residential settings, likely pose significant transmission risk. Once many college campuses reopened in August 2020, COVID-19 incidence increased by 144% among those aged 18-22 years old. In August 2021, many colleges are reopening again while COVID-19 cases, including those caused by the Delta variant, continue to rise. Preventing spread of the virus through ongoing adherence to universal prevention strategies (wearing masks, washing hands, physical distancing) and uptake of the
vaccine will remain critical for containment of the virus both on campus and in the surrounding communities.

With respect to COVID-19, adequate DHL could assist an individual in identifying accurate information and understanding public health guidelines provided in online formats. It could also help them identify misinformation, or disinformation, which has been a significant challenge to public health during the COVID-19 pandemic (Paakkari & Okan, 2020). DHL in college students has been studied widely in other countries (Bak et al., 2022; Li et al., 2021). Yet, there has been limited research looking at DHL in relation to COVID-19 information sources in undergraduate students in the United States (Patil et al., 2021), and none have focused on New York state which was the epicenter of the first wave of the pandemic. To address this gap, the purpose of this study was to understand predictors of DHL, online information seeking during the COVID-19 pandemic, and the role of DHL in the use of COVID-19 information sources in a sample of New York State (NYS) undergraduate students.

**Methods**

**Sample**

This study used a cross-sectional sample (n=245) of undergraduate college or university students that lived in NYS and were enrolled as students during the spring 2020 semester at a NYS institution. The student could be completing a bachelor’s or an associate degree at full- or part-time status. Students needed to speak English. Surveys were completed from July 14th through September 14th, 2020.

Community-based survey recruitment was completed using multiple strategies, including departmental emails to students, sponsored Facebook and Instagram ads, and emails to personal contacts at higher education institutions across NYS. Students who participated in the survey
were entered into a gift card drawing for five $100 Amazon gifts cards. Qualtrics was used to administer the online survey. This study was approved by the University at Albany IRB.

Survey

The survey instrument came from a collaboration with an existing international consortium. This consortium was launched by the Public Health Centre Fulda at Fulda University of Applied Sciences and the Interdisciplinary Centre for Health Research at Bielefeld, Germany (COVID-HL Consortium, 2020). The survey contained 54 questions, some with sub-questions, and was estimated to take approximately 15 minutes to complete.

Demographic variables

Prior studies have shown associations between age, gender, family income, and grade level with health literacy (Dolezel et al., 2018; Joseph et al., 2016). Also, extreme bipartisanship in the U.S. and the politicization of the pandemic has been a contributing factor to some of the failure in controlling the spread of COVID-19 (Halpern, 2020). Thus, the following demographic variables were assessed by the survey: gender, age in years, race, ethnicity, political affiliation, and first-generation student status.

Digital health literacy

DHL was assessed using 12-items, across 4 subscales determined to be most relevant to this study (Table 1) from the DHLI. The Cronbach’s alpha for the DHLI was found to be satisfactory at 0.87. This instrument assesses health information seeking, finding, understanding, and appraising. It also assesses skills related to using digital technologies effectively. Answer choices (scoring) for each item included: very easy (1), easy (2), difficult (3), very difficult (4). Because 3 of the 12 items had a high number of missing values in this study, only 9 items from the following subscales: information seeking, evaluating reliability, and determining relevance
(bold text in Table 1) were used to assess DHL. An individual’s total DHL score was calculated by summing answer choice scores on the 9 items. Possible DHL scores ranged from 9 to 36 with lower scores on the DHLI corresponding to higher levels of DHL. For this study, the Cronbach’s alpha for the 9-item DHL measurement was 0.84.

**Table 1: Digital health literacy instrument (12-items)**

<table>
<thead>
<tr>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>When you searched the internet for information (e.g. “Googled”) about the coronavirus or related topics, how easy or difficult was it to......</td>
</tr>
<tr>
<td><strong>Information searching</strong></td>
</tr>
<tr>
<td>1. Understand the information you find?</td>
</tr>
<tr>
<td>2. Use the proper works or search terms to find the information you are looking for?</td>
</tr>
<tr>
<td>3. Find the exact information you are looking for?</td>
</tr>
<tr>
<td><strong>Evaluating reliability</strong></td>
</tr>
<tr>
<td>4. Decide whether the information is reliable?</td>
</tr>
<tr>
<td>5. Decide whether the information is biased by commercial interests (e.g. advertisers)?</td>
</tr>
<tr>
<td>6. Compare different websites to see if they provide the same information?</td>
</tr>
<tr>
<td><strong>Determining relevance</strong></td>
</tr>
<tr>
<td>7. Decide if the information is personally relevant?</td>
</tr>
<tr>
<td>8. Apply the information in your daily life?</td>
</tr>
<tr>
<td>9. Use the information to make decisions about your health regarding protective measures, hygiene regulations, transmission routes, risks and prevention strategies?</td>
</tr>
<tr>
<td>When you posted on forums or social media about the coronavirus or related topics, how easy or difficult is it to....</td>
</tr>
<tr>
<td><strong>Adding self-generated content</strong></td>
</tr>
<tr>
<td>10. Formulate your question or worry clearly?</td>
</tr>
<tr>
<td>11. Express your opinions, thoughts, or feelings in writing?</td>
</tr>
<tr>
<td>12. Control the sharing of your own or other’s private information?</td>
</tr>
</tbody>
</table>

Note: the 9 bolded items were used to calculate total DHL

**COVID-19 information seeking**

To better understand COVID-19 information seeking during the pandemic, students were asked, ‘In the last four weeks, have you searched the internet about the coronavirus or related topics’. Answer options assessed whether the information was just for them, for them and others,
or that they hadn’t sought COVID-19 information in the past four weeks. Next, students were asked about COVID-19 information satisfaction with the question, ‘When you searched the [internet for information (for example, “Googled”) or forums/social media] about the coronavirus or related topics, how satisfied are you with the information you find? Answers were on a 5-point Likert scale from very dissatisfied to very satisfied.

To measure main sources of COVID-19 information, the questions in the Consortium survey were used with the addition of American sources and examples. Sources included: search engines, government agency websites, online encyclopedias like Wikipedia, social media platforms, health websites (e.g., Mayo Clinic, Healthline), health blogs, internet forums, doctor or hospital websites, news websites, or college/university websites. For each item, if the individual answered often to the question ‘How often do you currently use various internet sources to get information about the coronavirus and related topics’, that source was considered a main source of COVID-19 information for that individual.

Data analysis

Data analysis of the cross-sectional survey was completed using SAS 9.4 statistical software. Univariate analyses were completed for demographic variables and COVID-19 information seeking variables. Descriptive comparisons of DHL with demographic variables utilized analysis of variance (ANOVA) and tests of correlation depending on whether the demographic variable was categorical, categorical with only two categories, or continuous, respectively.

Logistic regression analyses were conducted to assess the relationship between DHL and the odds of a news source being a main source of COVID-19 information. Odds ratios were calculated considering a five-unit change in DHL in order to show a relevant difference in DHL.
For example, an individual with a DHL of 9 compared to an individual with a DHL of 10 are not that different. However, a DHL of 9 compared to an individual with a DHL of 14 is displaying a more significant difference in individuals, thus the calculated odds ratio will be more relevant. Demographic variables of race, ethnicity, political affiliation, gender, first generation status and age were included as covariates in adjusted models.

Results

Demographics

Table 2 presents sample characteristics (n=245). The sample had a mean age of 20.9 years old, was largely female, White, non-Hispanic, non-first-generation students, and identified as Democrats.

Digital health literacy

The mean DHL score was 18 with a standard deviation of 4.3. Scores ranged from 9-36, with 9 meaning higher DHL. In Table 2, mean DHL scores and standard deviation (SD) can be seen for different demographic categories, none of which were significantly different.

Predictors of DHL

No statistically significant associations (r or F) were found between demographic variables and DHL (Table 2).
Table 2: Sample characteristics; Mean DHL score for different groups; Correlation (r or F) of demographic variables and DHL (n=245)

<table>
<thead>
<tr>
<th>Demographic variable</th>
<th>n</th>
<th>%</th>
<th>Mean DHL score (SD)</th>
<th>r or F (variable, DHL)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean, SD)</td>
<td>20.9 (4.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>196</td>
<td>80%</td>
<td>19.46 (3.64)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>43</td>
<td>17.6%</td>
<td>19.09 (3.69)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>2.4%</td>
<td>21 (1.41)</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>150</td>
<td>61.5%</td>
<td>19.57 (3.53)</td>
<td></td>
</tr>
<tr>
<td>Black or AA</td>
<td>44</td>
<td>18%</td>
<td>18 (3.55)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>27</td>
<td>11%</td>
<td>20.64 (2.98)</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>23</td>
<td>9.4%</td>
<td>18.69 (4.33)</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>208</td>
<td>84.9%</td>
<td>18.07 (4.21)</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>37</td>
<td>15.1%</td>
<td>17.37 (4.74)</td>
<td></td>
</tr>
<tr>
<td>Political affiliation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Democrat</td>
<td>145</td>
<td>60.2%</td>
<td>17.93 (4.16)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>77</td>
<td>32%</td>
<td>18.33 (4.64)</td>
<td></td>
</tr>
<tr>
<td>Republican</td>
<td>19</td>
<td>7.9%</td>
<td>17.27 (3.63)</td>
<td></td>
</tr>
<tr>
<td>First-generation student</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>167</td>
<td>68.2%</td>
<td>17.98 (4.25)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>78</td>
<td>31.8%</td>
<td>17.92 (4.42)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Lower scores on the DHLI correspond to higher levels of DHL.
*No correlations were significant at the p < 0.05 level.

**Online COVID-19 information seeking**

When asked about the last four weeks, 53% of the sample had sought COVID-19 information for themselves and other people, 23% had sought information for just themselves, and 21% had not sought any COVID-19 information. When asked about searching the internet or ‘googling’ for COVID-19 information, most of the sample was either partially satisfied/partially
dissatisfied (44%) or satisfied (45%) with the information they found. When using social media or forums, 49% of the sample was partially satisfied/partially dissatisfied and 30% were satisfied with the information obtained. The main COVID-19 information sources reported by college students were search engines (45%), government agency websites (41%), and social media (37%) (Table 3).

Table 3: Main source of COVID-19 information

<table>
<thead>
<tr>
<th>COVID-19 information sources</th>
<th>% reporting as a main source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search engines</td>
<td>44.8%</td>
</tr>
<tr>
<td>Government agency websites</td>
<td>40.8%</td>
</tr>
<tr>
<td>Social media</td>
<td>36.6%</td>
</tr>
<tr>
<td>College of university websites</td>
<td>26.3%</td>
</tr>
<tr>
<td>News websites</td>
<td>24%</td>
</tr>
<tr>
<td>Health websites</td>
<td>16.7%</td>
</tr>
<tr>
<td>Doctor, hospital, or insurance company website</td>
<td>9.3%</td>
</tr>
<tr>
<td>Internet forums</td>
<td>4.1%</td>
</tr>
<tr>
<td>Wikipedia or other online encyclopedias</td>
<td>2%</td>
</tr>
<tr>
<td>Health blogs</td>
<td>1.6%</td>
</tr>
</tbody>
</table>

Note: Separate questions were used to assess main sources of COVID-19 information. Thus, the total percent may be over 100%.

Impact of DHL on main COVID-19 information source

Only one information source was found to have a statistically significant relationship with DHL. In particular, the odds ratio of using ‘Government agency websites (for example, CDC, local department of health)’ as a main source of COVID-19 information was 1.44, with a p-value of 0.04. For every 5 units of higher DHL, individuals had 44% greater odds of using ‘Government agency websites (for example, CDC, local department of health)’ as a main source of COVID-19 information than not. In other words, those with higher DHL were more likely to use ‘Government agency websites (for example, CDC, local department of health)’ as a main
source of COVID-19 information. Adjusted logistic regression models included covariates (age, gender, race, ethnicity, political affiliation, and first-generation status). None of the covariates showed statistical significance, thus the unadjusted odds ratios are reported.

**Discussion**

This study sought to understand predictors of DHL, online information seeking behaviors during the COVID-19 pandemic, and the role of DHL in the use of COVID-19 information sources in a sample of NYS undergraduate students. Overall, DHL was generally adequate in our sample, students were satisfied with the COVID-19 information they were obtaining, and most were seeking information for themselves and others.

No demographic variables were found to be associated with overall DHL. This finding is similar to Patil et al. (2021) and Bak et al. (2022). However, Dadaczynski et al. (2021) found females students had more challenges on two subscales of the DHLI, determining the reliability of information and finding correct information. Similarly, Bak et al. (2022) found younger participants reported more difficulty with self-generated content and those with higher subjective social status reported less difficulty with self-generated content.

Regarding information sources, a concerning finding was that only 41% of students reported ‘Government agency websites (for example, CDC, local department of health, etc.)’ as a main source of their COVID-19 information. However, those with higher DHL were more likely to report this as a main source. Dadaczynski et al. (2021), using the same Consortium survey, found similar results; college students in Germany with sufficient DHL reported using 'Websites of public bodies (e.g., Robert Koch Institute)' more frequently. Fifty-two percent of the German sample reported using websites of public agencies as main sources of COVID-19 information. Similarly, a study of university students in Portugal found students who searched more
frequently on public institution websites had more sufficient DHL in the dimensions of appraising and applying health information (Rosario et al., 2020).

Results suggest ensuring college students have adequate DHL could help counter the spread of misinformation from less reputable sources during a pandemic. A majority of students were seeking COVID-19 information for themselves and others. Others could potentially be an older, more vulnerable family member or individual with less digital connectivity and lower DHL, making it even more important they know what sources are reputable and thus, what information is most useful for the other individual.

This study highlights the importance of prioritizing, developing, and implementing DHL interventions or adding DHL course curriculum for younger, digitally connected populations. This could support more effective online health information seeking, which could have the potential to positively impact health behaviors and outcomes. One such program, Get Health ‘e’, developed and evaluated by Manganello et al. (2019) seeks to increase eHL in young adults. The program is an online course with six modules that teach participants about eHL, online health information seeking skills, patient portals, social media and health, health-related phone apps, and wearable health devices. The pilot study found eHL increased from pre- to post-intervention. A similar program with the addition of modules on how to use digital technologies effectively could increase DHL in young adults.

**Limitations**

A few limitations of this study should be acknowledged. Because this study utilized an online survey, those with lower DHL might naturally have a lower likelihood of being recruited for the survey because of less digital connectivity or use. The survey used self-reporting, which potentially allows participants to respond inaccurately or to overestimate behaviors. In addition,
this sample of students resided in NYS, which was the epicenter of the first wave of the pandemic in the United States. Compared to the rest of the country, NYS had more stringent COVID-19 public health restrictions. This sample might have had higher adherence to public health guidelines because of their location during the pandemic. Disseminating this survey in the same population, but in a state with more relaxed public health guidelines during the pandemic, might have produced different outcomes. Another limitation is the small sample size, most of whom were female students, in the social sciences, at the same university. Thus, results may not be similar for other undergraduate student populations. Finally, since three of the twelve DHLI items had a high number of missing values, DHL was calculated using only nine of the items. This could have caused discrepancies in the 9-item total vs. 12-item total.

**Conclusion**

The COVID-19 pandemic presented a rapidly changing, global public health challenge and it was crucial to get current COVID-19 information to the public quickly and effectively. Health information is most frequently sought from online sources and during the pandemic, in person interactions like seeing a provider or attending college courses, moved to a virtual setting. Adequate DHL helps college aged individuals obtain and understand online public health information from reputable sources and since they seek information for themselves and others, the information gathered could have far reaching impact. Building DHL skills in younger people should be prioritized.

**Funding**

This work was generously supported by the University at Albany Faculty Research Awards Program (FRAP-B).
References


Chapter 3: Exploring key predictors and mediators of COVID-19 prevention behaviors and vaccine intentions in college students

Abstract

Background: SARS-CoV-2, the virus that causes COVID-19 began rapidly spreading across the globe in late 2019 dramatically changing daily life as public health restrictions were put in place to limit its spread. College students, and many professionals, transitioned online for their college courses or office environment. The internet quickly became the main platform to seek and obtain COVID-19 information. Additionally, college student lifestyles (e.g., shared and crowded residential spaces, frequent socializing, etc.) presented optimal conditions for the virus to spread quickly. Understanding key predictors and mediators in college students of adherence to daily COVID-19 prevention guidelines and intentions to receive a COVID-19 vaccine will be crucial for ongoing containment on campus, but additionally in the surrounding communities where more vulnerable individuals reside.

Methods: This study used a cross sectional sample of 254 New York state college students, located in the epicenter of the first wave of the pandemic in the United States, who took the survey ‘COVID-19 and Digital Health Literacy in University Students’ during the summer of 2020. Digital health literacy (DHL) was measured using a condensed version of the Digital Health Literacy Instrument (DHLI). Regression models were used to understand predictors and mediators of DHL.

Results: Findings confirm the importance of DHL as it was the only variable found to predict all four COVID-19 prevention behaviors asked on the survey. Additionally, race, political affiliation, and higher perceived severity were found to predict some, but not all,
COVID-19 prevention behaviors. Race and first-generation student status were found to predict vaccine intentions.

Conclusion: These findings confirm the importance of adequate DHL in the college student population, especially during a global public health crisis. In addition, this study confirms the disparities in vaccine hesitancy in African Americans and the impact of political affiliation in the United States on behaviors related to the pandemic.

Introduction

In late 2019, the COVID-19 pandemic began in mainland China and by late February 2020, COVID-19 became a global public health concern (Verity et al., 2020). Globally, as of December 2021, there have been over 262 million confirmed cases of COVID-19 resulting in approximately 5.2 million deaths (WHO, 2021a). The SARS-CoV-2 virus that causes COVID-19 is highly contagious and spreads through close contact (large droplets) and longer-range transmission (aerosols) in poorly ventilated areas (Wiersinga et al., 2020). Those with lifestyles that include increased socialization or shared and crowded living spaces, like college students, are ideal for rapid and ongoing spread (Walke et al., 2020). According to the World Health Organization, daily COVID-19 prevention practices include: physical distancing around 1 meter; wearing a properly fitted mask; washing hands frequently; covering your mouth or nose when coughing or sneezing; and isolating if symptoms develop (WHO, 2021b).

In December of 2020, two vaccines requiring two doses (Pfizer and Moderna) and in February of 2021, a one dose vaccine (Johnson and Johnson) gained emergency approval from the Food and Drug Administration (FDA) (Lovelace, 2020; J&J, 2021) and by the end of April 2021, individuals aged 16 and over were eligible to receive a vaccine in the U.S. (Anthes, 2021). Since then, vaccines have gained emergency approval for individuals aged 5 and over and as of
December 2021, 61% of eligible Americans were fully vaccinated (CDC, 2021a). However, vaccine uptake has been slower than expected in the United States and sociodemographic differences in vaccine hesitancy and resistance have been identified. Vaccine hesitancy seems higher in individuals who are younger, less educated, lower income, Black or African American, or identify as Republican (Callaghan et al., 2020; Khubchandani et al., 2020; Willis et al., 2021).

COVID-19 vaccine effectiveness is constantly changing as new virus variants emerge and breakthrough infections are still common (CDC, 2021b). Thus, it is extremely important that individuals, especially those with high transmission risk like college students, continue to follow public health guidelines (wearing masks, washing hands, physical distancing) even if fully vaccinated, and especially if unvaccinated. Preventing spread of SARS-CoV-2 in college students through adherence to public health guidelines, plus ongoing vaccine and booster uptake, will remain critical for containment of the virus both on campus and in the surrounding communities where the college or university is located. Understanding predictors of prevention behaviors in college students could help public health practitioners communicate more effectively to this high-risk population.

The internet is an important source of health information for college students (Heuberger & Ivanitskaya, 2011; Percheski & Hargittai, 2011) and college students are more likely to visit the internet for health information than to ask a medical professional (Basch et al., 2018). Similar to eHealth literacy (eHL) (Huang et al., 2020), digital health literacy (DHL) is the ability of an individual to successfully seek, find, understand, and appraise online health information, and use computers efficiently to complete tasks (Novillo, 2017). As eHL increases, which is comparable to DHL, online health information seeking becomes more effective (Britt et al., 2017). Having
lower DHL could make it challenging for young adults to find online health information, assess its reliability, and make appropriate health decisions.

While eHL can play an important role in the likelihood of adopting healthy behaviors (Britt et al., 2017; Huang et al., 2020b) an individual’s attitudes and behaviors about a health issue or condition could also impact predictors of behavioral outcomes. One theory that explains the mechanism for this is the Health Belief Model (HBM). Developed in the 1950s by social psychologists Hochbaum, Rosenstock, and Kegels, the HBM has been used to predict health behaviors by focusing on a person's attitudes and beliefs and proposes that an individual who perceives a disease as threatening is more likely to take preventative action against that disease, like wearing a mask in public, physical distancing, or receiving a vaccine. (D’Souza et al., 2011; Rosenstock et al., 1988; Patterson et al., 2018). In a sample of U.S. college students during the COVID-19 pandemic, Alsulaiman & Rentner (2021), found perceived threat, a combination of perceived susceptibility [an individual’s assessment of the likelihood of a health outcome] and perceived severity [an individual’s assessment of the seriousness of a health outcome] to have a significant relationship with wearing a mask in public and a positive correlation with washing hands frequently. Additional recent studies have successfully used the HBM to understand the adoption of COVID-19 prevention behaviors in college students (Hatteberg & Kollath-Cattano, 2022; Tam et al., 2021). Regarding vaccine intentions, perceived severity was found to have an association with intentions to receive a COVID-19 vaccine (Shmueli, 2021; Ruiz & Bell, 2021) and practicing physical distancing (Guidry, O’Donnell, & Austin, 2021) in adult samples. The current study will assess perceived severity and perceived susceptibility as predictors or mediators of COVID-19 prevention behaviors among college students.
Given the limited research on predictor or mediators of prevention behaviors or vaccine intentions in college students during a global pandemic in the United States, the purpose of this study was to understand key predictors and mediators of adherence to COVID-19 prevention behaviors and COVID-19 vaccine intentions in a sample of New York state (NYS) undergraduate students. NYS was the initial epicenter of the first wave of the pandemic in the United States. Findings will assist public health professionals in targeting and developing effective public health messages, reducing spread amongst college students and subsequently in the surrounding community where more vulnerable individuals reside.

Methods

Sample

Online survey responses were collected from a sample (n=245) of undergraduate college or university students that lived in NYS and were enrolled as students (bachelors or associates) during summer 2020 at a NYS institution. Students who participated in the survey were entered into a gift card drawing for five $100 Amazon gifts cards. Qualtrics was used to administer the online survey. This study was approved by the University at Albany IRB.

Survey

The survey instrument came from a collaboration with an existing international consortium launched by the Public Health Centre Fulda at Fulda University of Applied Sciences and the Interdisciplinary Centre for Health Research at Bielefeld, Germany (COVID-HL Consortium, 2020). The survey contained 54 questions and was estimated to take approximately 15 minutes to complete.

Additional questions added to the NYS survey included extra demographic questions, questions focused on perceived severity of COVID-19, perceived susceptibility to COVID-19,
perceived handling of the pandemic, political affiliation, health literacy, COVID-19 vaccine intentions, and adherence to COVID-19 public health guidelines.

**Demographic variables**

The following demographic variables were assessed by the survey: gender, age in years, race, ethnicity, political affiliation, and first-generation student status. Political affiliation was added because of the politicization of the pandemic and the idea that this has contributed to some of the failure in controlling the pandemic in the United States (Halpern, 2020).

**Digital health literacy**

Van Der Vaart & Drossaert (2017) developed a 21-item Digital Health Literacy Instrument (DHLI) to assess the concept of DHL. This instrument assesses health information seeking, finding, understanding, and appraising. It also assesses skills related to using digital technologies effectively. The Cronbach’s alpha of the DHLI was found to be satisfactory at 0.87. In this survey, DHL was assessed using 12-items (Table 1) from the DHLI across four subscales: information searching, evaluating reliability, determining relevance, and adding self-generated content. Answer choices (scoring) for each item included: very easy (1), easy (2), difficult (3), very difficult (4). Three of the 12-items had a large number of missing data, thus only 9-items were used (bold in Table 1) to assess DHL. An individual’s total DHL was calculated by summing answer choice scores on the 9 items. Cronbach’s alpha of the 9-items was 0.84.
Table 1: Digital health literacy instrument (12-items)

<table>
<thead>
<tr>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>When you searched the internet for information (e.g., “Googled”) about the coronavirus or related topics, how easy or difficult was it to……</td>
</tr>
<tr>
<td>Information searching</td>
</tr>
<tr>
<td>1. Understand the information you find?</td>
</tr>
<tr>
<td>2. Use the proper works or search terms to find the information you are looking for?</td>
</tr>
<tr>
<td>3. Find the exact information you are looking for?</td>
</tr>
<tr>
<td>Evaluating reliability</td>
</tr>
<tr>
<td>4. Decide whether the information is reliable?</td>
</tr>
<tr>
<td>5. Decide whether the information is biased by commercial interests (e.g., advertisers)?</td>
</tr>
<tr>
<td>6. Compare different websites to see if they provide the same information?</td>
</tr>
<tr>
<td>Determining relevance</td>
</tr>
<tr>
<td>7. Decide if the information is personally relevant?</td>
</tr>
<tr>
<td>8. Apply the information in your daily life?</td>
</tr>
<tr>
<td>9. Use the information to make decisions about your health regarding protective measures, hygiene regulations, transmission routes, risks, and prevention strategies?</td>
</tr>
<tr>
<td>When you posted on forums or social media about the coronavirus or related topics, how easy or difficult is it to……</td>
</tr>
<tr>
<td>Adding self-generated content</td>
</tr>
<tr>
<td>10. Formulate your question or worry clearly?</td>
</tr>
<tr>
<td>11. Express your opinions, thoughts, or feelings in writing?</td>
</tr>
<tr>
<td>12. Control the sharing of your own or other’s private information?</td>
</tr>
</tbody>
</table>

Note: the 9 bolded items were used to calculate total

**Perceived severity and perceived susceptibility**

Perceived severity and susceptibility to COVID-19 were assessed with two questions. For perceived severity, the question asked, ‘how would getting COVID-19 affect your life?’, with response options *this would make me very sick, this would make me a little sick, and this is not a big deal to me.* To assess perceived susceptibility, students were asked ‘what are your chances of getting COVID-19?’, with response options of *high chance, medium chance, and low chance.*

These variables were recategorized into binary variables to classify individuals as having either higher or lower perceived severity/susceptibility. For perceived severity, those who answered *this would make me very sick or this would make me a little sick* were considered to
have higher perceived severity and those who answered *this is not a big deal to me* were considered to have lower perceived severity. For perceived susceptibility, those who answered *high chance* or *medium chance* were considered to have higher perceived susceptibility and those who answered *low chance* or *no chance* were considered to have lower perceived susceptibility.

**COVID-19 public health guidelines and vaccine intentions**

Four common COVID-19 public health guidelines promoted throughout New York City and NYS were selected for the survey. These were wearing masks, washing hands frequently, social/physical distancing, and only leaving home for essential trips. These survey questions, plus the COVID-19 vaccination intention question were provided by the Pew Research Center (Table 2) (PRC, 2020).

Public health guideline variables were recoded into binary variables. Those who reported *always* for each behavior were considered to have higher adherence and those who chose the other choices were considered to have lower adherence. Vaccine intentions was recoded into a binary variable. Those who chose *very likely* were considered likely to get the vaccine and those who chose the other choice options were considered less likely to get the vaccine.
Table 2: COVID-19 Public Health Guidelines and Vaccine Intentions

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answer choices and (scores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>How often do you follow public health guidelines related to the coronavirus?</td>
<td></td>
</tr>
<tr>
<td>1. Frequent hand washing</td>
<td>Never, Rarely, Sometimes, Often, Always</td>
</tr>
<tr>
<td>2. Social/physical distancing</td>
<td>Never, Rarely, Sometimes, Often, Always</td>
</tr>
<tr>
<td>3. Wearing a mask in public spaces</td>
<td>Never, Rarely, Sometimes, Often, Always</td>
</tr>
<tr>
<td>4. Staying at home and leaving only for essential trips</td>
<td>Never, Rarely, Sometimes, Often, Always</td>
</tr>
<tr>
<td>How likely would you be to get a COVID-19 vaccine, if available?</td>
<td>Very likely, Somewhat likely, Not likely</td>
</tr>
</tbody>
</table>

Data analysis

Data analysis of the cross-sectional survey was completed using SAS 9.4 statistical software. Logistic regression analyses were conducted to assess the following as predictors of the outcome variables (adherence to COVID-19 public health guidelines and intentions to receive a COVID-19 vaccine in the future): demographic variables (age, race, ethnicity, gender, first-generation-status, and political affiliation), DHL, perceived severity, and perceived susceptibility. If a demographic variable was found to have a statistically significant relationship
with an outcome variable, logistic regressions were used to assess for mediators (Baron & Kenny, 1986). The following variables were considered as mediators: DHL, perceived severity, and perceived susceptibility. Odds ratios and probabilities were calculated for each variable.

**Results**

**Demographics**

Table 3 shows sample characteristics. The sample had a mean age of 20.9 years old, was largely female, White, non-Hispanic, non-first-generation students, and identified as Democrats.

<table>
<thead>
<tr>
<th>Demographic variable</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean, SD)</td>
<td>20.9 (4.2)</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>196</td>
<td>80%</td>
</tr>
<tr>
<td>Male</td>
<td>43</td>
<td>17.6%</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>2.4%</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>150</td>
<td>61.5%</td>
</tr>
<tr>
<td>Black or AA</td>
<td>44</td>
<td>18%</td>
</tr>
<tr>
<td>Other</td>
<td>27</td>
<td>11%</td>
</tr>
<tr>
<td>Asian</td>
<td>23</td>
<td>9.4%</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>208</td>
<td>84.9%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>37</td>
<td>15.1%</td>
</tr>
<tr>
<td>Political Affiliation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Democrat</td>
<td>145</td>
<td>60.2%</td>
</tr>
<tr>
<td>Other</td>
<td>77</td>
<td>32%</td>
</tr>
<tr>
<td>Republican</td>
<td>19</td>
<td>7.9%</td>
</tr>
<tr>
<td>First-generation status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>167</td>
<td>68.2%</td>
</tr>
<tr>
<td>Yes</td>
<td>78</td>
<td>31.8%</td>
</tr>
</tbody>
</table>
Predictors of adherence to public health guidelines

Seen in Table 4, statistically significant relationships were found between DHL and adherence to four public health guidelines (wearing a mask, social/physical distancing, washing hands, and staying home), meaning having higher DHL predicted higher adherence to the public health guidelines. More specifically, considering the significant odds ratios, for every 1 point of higher DHL, participants’ odds of adhering to the guidelines increased: washing hands (12%), physical distancing (11%), wearing a mask (13%) and staying home (12%).

Race had a statistically significant relationship with two public health guidelines (social/physical distancing and staying home and only leaving for essential trips). Fifty-five percent of African American students adhered to social distancing compared to only 36% of White students. Asian students were more likely (52%) to adhere to the staying home guideline compared to White students (28%). Political affiliation showed a relationship with staying home and only leaving for essential trips in which those who identified as Republican were less likely to follow this guideline (11%) than those who identified as Democrats (35%). Finally, having greater perceived severity predicted greater likelihood (82%) of hand washing and social/physical distancing (74%). Age, gender, ethnicity, and first-generation-status were not found to have any statistically significant relationships with adherence to public health guidelines, thus the unadjusted results are included in Table 4.
Table 4: Statistically significant relationships between predictor variables and the probability of higher adherence to public health guidelines (n=245)

<table>
<thead>
<tr>
<th></th>
<th>Unadjusted odds ratio</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequent hand washing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DHL</td>
<td>1.12*</td>
<td>-</td>
</tr>
<tr>
<td>Perceived severity</td>
<td>4.44*</td>
<td>82%</td>
</tr>
<tr>
<td><strong>Social/physical distancing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DHL</td>
<td>1.11*</td>
<td>-</td>
</tr>
<tr>
<td>Race (AA vs. White)</td>
<td>1.2*</td>
<td>55%</td>
</tr>
<tr>
<td>White (ref)</td>
<td>0.57</td>
<td>36%</td>
</tr>
<tr>
<td>Perceived susceptibility</td>
<td>0.58*</td>
<td>37%</td>
</tr>
<tr>
<td>Perceived severity</td>
<td>2.87*</td>
<td>74%</td>
</tr>
<tr>
<td><strong>Wearing a mask</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DHL</td>
<td>1.13*</td>
<td>-</td>
</tr>
<tr>
<td><strong>Staying at home and only leaving for essential trips</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DHL</td>
<td>1.12*</td>
<td>-</td>
</tr>
<tr>
<td>Race (Asian vs. White)</td>
<td>1.10*</td>
<td>52%</td>
</tr>
<tr>
<td>White (ref)</td>
<td>0.39</td>
<td>28%</td>
</tr>
<tr>
<td>Political affiliation (Rep vs Dem)</td>
<td>0.12*</td>
<td>11%</td>
</tr>
<tr>
<td>Democrat (ref)</td>
<td>0.54</td>
<td>35%</td>
</tr>
</tbody>
</table>

* = p < 0.05

Predictors of vaccination intention

Two variables showed statistically significant relationships with intentions to receive a COVID-19 vaccine in the future (Table 5). First-generation students were less likely to have higher intentions of receiving a vaccine (34%). African American students (25%) were less likely than White students (57%) to report higher intentions to receive the COVID-19 vaccine. DHL, age, gender, ethnicity, political affiliation, perceived susceptibility, and perceived severity were not found to have statistically significant relationships with vaccination intentions.
Table 5: Statistically significant relationships between predictor variables and high intention to receive a COVID-19 vaccine (n=245)

<table>
<thead>
<tr>
<th>Predictor Variables</th>
<th>Unadjusted odds ratio</th>
<th>p-value</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>First-generation</td>
<td>0.526</td>
<td>0.0214*</td>
<td>34%</td>
</tr>
<tr>
<td>Race (AA vs. white)</td>
<td>0.34</td>
<td>0.0004*</td>
<td>25%</td>
</tr>
<tr>
<td>White (ref)</td>
<td>1.35</td>
<td></td>
<td>57%</td>
</tr>
</tbody>
</table>

* = p < 0.05

Mediators of adherence to public health guidelines and vaccination intentions

No variables were found to be mediators in any of the above statistically significant relationships between predictor and outcome variables.

Discussion

This study assessed predictors and mediators of COVID-19 prevention behaviors in college students in NYS, the epicenter of the initial wave of the pandemic in the United States. Overall, we found higher DHL predicted greater adherence to all four common COVID-19 public health guidelines (frequent hand washing, social/physical distancing, wearing a mask, and staying at home except for essential trips). This finding is similar to Patil et al. (2021) in which DHL was independently associated with adherence to the same four public health guidelines during the COVID-19 pandemic. These findings justify the importance of interventions to build DHL skills for younger populations, especially given this populations’ reliance on digital health information.

Having higher perceived severity to COVID-19 predicted more hand washing and social/physical distancing. In contrast, perceived susceptibility was not found to have any significant impact on adherence to prevention behaviors. These findings could help inform and tailor health communication materials to college students to make them more effective at
changing or personally justifying prevention behaviors. In fact, according to Tolin (2020), most messaging to this age group has indicated high susceptibility, but low severity, in that most would experience minor, non-life-threatening symptoms, which is an honest depiction of outcomes for this younger age group (CDC, 2022). Perhaps messaging to college students should instead focus on the risk of spreading it to others, like an older family member or friend with a health condition, both of which are much more likely to experience severe outcomes (high severity). For example, Dunn et al. (2021) using a sample of 797 individuals aged 14-24 found that 85.9% were very or moderately concerned about spreading COVID-19 to others. A web search found few examples of this type of targeted messaging to college students (Figure 1) and an absence of research testing these types of messages with college students.

Figure 1: University health messaging focused on protecting loved ones (CSU, 2022)

![University health messaging focused on protecting loved ones](image)

Note: Written permission received from CSU to use this figure.

Additionally, this age group may feel a sense of invincibility (low susceptibility) when it comes to illnesses and disease, which in the past, was a reason given by college students when asked why they avoid annual flu vaccination (NFID, 2016). Similarly, Kulesza et al. (2021) found a sense of unrealistic optimism, or being unrealistically optimistic about future negative events, related to COVID-19 in an international sample of college students. Participants
perceived their chances of getting COVID-19 as smaller in comparison to another student at their college. Unfortunately, this unrealistic optimism creates a sense of personal security while putting those around them and in their communities at greater risk.

Two demographic variables, race and political affiliation, were found to predict prevention behaviors. In particular, African American students had a higher likelihood of adherence to social/physical distancing than White students and Asian students had a higher likelihood of staying home and only leaving for essential trips than White students. Observing racial differences in prevention behaviors is not unique, yet there is no clear pattern in the research. In one study, White and Asian-identified U.S. adults reported higher adherence to prevention guidelines than those who identified as Black or American Indian/Alaskan Native (Stockman, Wood, & Anderson, 2021). Another found Black, Latinx, and Asian respondents were more likely to report wearing a mask than White respondents (Hearne & Nino, 2021). Likely, these conflicting data suggests there are other, more influential variables at play in influencing adherence. These variables could be education, type of employment, access to information, living environment, etc. Future studies could assess a wide range of mediators between race and adherence to prevention guidelines.

As for political affiliation, Democrats had a higher likelihood of staying home and only leaving for essential trips than Republican students. Political affiliation did not predict adherence to the other three prevention behaviors. This is a surprising result giving the heavily politicized nature of the pandemic. For example, Shepherd, MacKendrick, & Mora (2020), found greater political conservatism to be negatively associated with believing public health prevention measures are effective. Perhaps since this sample came from NYS, which is a state that had strict mandates like mask requirements, it was harder for the students to choose whether to practice the
public health guideline or not. If true, this suggests policies can help ensure college students engage in prevention behaviors. It also suggests communication efforts should include messages that resonate with college students holding different political beliefs.

Regarding future vaccination intentions, African American and first-generation students had a lower likelihood of intending to get the vaccine than White students and non-first-generation students. The race finding is not unique and is validated by other studies (Hooper, Napoles, & Perez-Stable, 2021; Willis et al., 2021). Increased mistrust in healthcare by African Americans has longstanding roots and is related to historical events, discrimination, and systemic racism (Razai et al., 2021). Unfortunately, African Americans have been disproportionately impacted by the COVID-19 pandemic and are at a higher risk of experiencing COVID-19 related morbidity or mortality (Wortham, 2020), making it even more important to promote vaccine confidence to this population. As for first generation-students, there is minimal research looking at vaccine hesitancy in this population. In our sample, identifying as a first generation-student and identifying as African American was a common overlap, which could explain this finding. Addressing vaccine hesitancy in these populations will be crucial to ongoing containment of the COVID-19 pandemic, but to also reduce health inequities. This could be accomplished through tailored messaging by trusted voices in these communities.

No other variables, including political affiliation, were found to predict vaccine intentions. Again, this is surprising given other studies that have found Republican political affiliation to predict COVID-19 vaccine hesitancy in U.S. adult samples (Gerretsen et al., 2021; Khubchandani et al., 2021; El-Mohandes et al., 2021). This difference might be explained by our sample being an educated sample of college students, who disproportionately identified as Democrats.
Public Health Implications

In a digitally reliant society, this study highlights the importance of adequate DHL for more effective general health information seeking and better understanding of prevention guidelines during a pandemic. Individuals with low DHL will not only have a harder time recognizing reputable sources but will also find it challenging to understand and use the health information they find. DHL should be taught to youth and college students through their general education. One eHL intervention for college students (Manganello et al., 2019) increased eHL from pre- to post-intervention during the pilot study. The online program had six modules covering eHL, online health information seeking skills, patient portals, social media and health, health-related phone apps, and wearable health devices.

Next, the messaging used in health campaigns during a pandemic should be informed by data. For example, the present study concluded that having increased perceived severity to COVID-19 predicted better adherence to two of the public health guidelines. Using this information, materials can be developed to include messages focused on the severity of COVID-19 for the individual, but also for the more vulnerable individuals they could spread it to, like an older parent or grandparent.

Finally, this study further highlights COVID-19 vaccine hesitancy, particularly in African American and other minority students. This is an important finding as receiving a booster vaccine on a regular basis could become a new normal. For ongoing containment of COVID-19, vaccine hesitancy must be addressed. One idea for effective messaging to these populations is to have prominent figures in these communities use their voice to recommend and promote the vaccine and answer any questions or concerns. These could be physicians or other community
gatekeepers and leaders. It’s also crucial that any materials targeted at these populations are developed and tested by members of the same population before dissemination.

**Limitations**

A few limitations of this study should be noted. First, this utilized an online survey with no paper survey option. Thus, those with limited or no digital connectivity would have had a lower chance of being recruited for the survey simply because of limited access to the internet. This limitation could have given individuals with higher DHL higher chances of being recruited for the study. This survey collected self-reported data. Thus, individuals could have over or underestimated their behaviors (e.g., social desirability bias). In addition, this survey was disseminated in NYS, which had some of the stricter public health mandates during the COVID-19 pandemic. Because of these stricter mandates (e.g., public mask mandates), individuals in this state might have had higher adherence to public health guidelines than individuals in states with looser restrictions. Finally, 9-items of the 12-item DHLI had a high number of missing data and were not used to calculate DHL. This could have caused inaccuracies in this variable and any statistical tests ran using this variable.

**Funding**

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References


Chapter 4: Comparing experiences and results of internet-based digital health literacy research across two recruitment methods

Abstract

Background: Internet-based research has become a popular way to complete survey research and more easily reach priority populations. However, there remain gaps in understanding the usefulness, challenges, and validity threats of different online survey recruitment methods when adopting surveys for health literacy (HL) or digital health literacy (DHL) research. This includes understanding the most useful online measurement tool for these concepts. The purpose of this paper is to compare the experiences and results of two cross-sectional samples of undergraduate college students who took the same online survey but were recruited using different methods: an online panel and online community recruitment.

Methods: Two samples of college students took the survey ‘COVID-19 and Digital Health Literacy in University Students’ during the summer of 2020. The community recruitment survey targeting New York state college students and had a sample size of 254. The panel-based survey recruiting college students across the United States had a sample size of 256. Sample composition and outcomes were compared using chi-square test of independence, z-tests of proportions, and t-tests of independent sample means.

Results: There were distinct drawbacks and benefits with each recruitment modality. The main benefit to online community recruitment was the low cost. However, it was time consuming to secure the desired sample size, missing data was an issue, and it produced a more homogenous sample. The panel sample was easier to manage, much less time intensive, more costly, and produced a more diverse sample.
Conclusion: It’s important to consider how recruitment modalities can impact required resources, influence study limitations, and impact the results and conclusions of a HL or DHL research study.

**Background**

Internet-based research has transformed over the last 15 years. In 2005, “The value of online surveys” (Evans & Mathur, 2005) was published in a time when the potential of online surveys was starting to gain attention. Since then, advances in online technology and increasing internet access have resulted in online surveys being an easy and popular way to complete survey research (Evans & Mathur, 2018). According to the Pew Research Center, 93% of American adults are online regularly (2021), and 76% use social networking sites (2015). Meeting research participants where they already are makes internet-based research a potential time and cost saving option for many types of research, including health literacy (HL) and digital health literacy (DHL) research. Time and money spent on recruitment can be reduced, one can more easily reach a large segment of your priority population, and one can ensure anonymity (Temple & Brown, 2011). According to Wright (2005), the internet may be the only way to reach concentrated groups of individuals with certain identities or who are members of unique or rare communities. In addition, those who have a condition or disease that may be stigmatized offline (e.g., HIV, depression, etc.), or who have unpopular viewpoints, may find more comfort in an online environment.

However, internet-based survey research has its drawbacks. Concerning sampling, little is known about the characteristics of an online participant besides self-reported demographics, which have the potential to be inaccurate (e.g., social desirability bias). In addition, if you are recruiting participants from an online community, self-selection bias can occur; those who opt in
to take your survey may be different than those who do not (Wright, 2005). The additional anonymity afforded with online surveys can threaten your data quality as bots and fraudulent survey takers (those who say they meet your inclusion criteria, but don’t, or those that take the survey multiple times using different emails) may complete your survey. This has become a major threat to internet-based survey research, especially when an incentive is attached to participation (Konstan et al., 2005).

When performing internet-based research, researchers can choose from different recruitment strategies. One method is online community recruitment. Online community recruitment strategies vary, but include outreach, whether through emails or posts and ads on social media, that seek to motivate qualified individuals to take the survey. Minimal research has specifically examined email recruitment, which generally constitutes a mass email sent to a listserv containing a survey link. A systematic review of online survey recruitment using Facebook ads found them to be a cost-effective and feasible method to recruit study participants, particularly for hard-to-reach populations or those with a rare condition (Thornton et al., 2016). Batterham (2014) found online survey recruitment through social media ads to be considerably more cost-effective than telephone surveys and resulted in similar representativeness of the priority population. Spahrkas et al. (2021) found high potential in Facebook ads to reach qualified participants; however, they concluded this method to be very costly, and produced a mostly female (92%) sample.

Another online recruitment method, panel-based recruitment, involves hiring a panel vendor like Qualtrics or SurveyMonkey. In panel-based surveys, users opt in to become panel members and provide their demographic and location information. These ‘panelists’ are sent opportunities to participate in consumer surveys they qualify for (Poynter, 2010). According to
Craig et al. (2013), Qualtrics and other panel vendors provide a wide range of services that allow researchers to quickly secure survey respondents. On average, this costs researchers less than $10 per completed survey, though costs may be higher as eligibility criteria become narrower. Online panels have filled the void left as directories, like phone books and random-digit-dialing sampling techniques have become less useful (Poynter, 2010). While panel surveys are convenient, concerns remain around sample integrity and data quality. As in non-panel based online surveys, self-selection bias is a main concern. In addition, ‘professional survey takers’, or those who consistently take large numbers of incentive-based surveys, have been found to be inattentive, rushed, and more likely to provide inaccurate survey responses (Golden & Brockett, 2009).

Previous research comparing online research recruitment modalities using the same survey has conflicting results. For example, Dworkin et al. (2016) compared three online recruitment strategies for an online parent technology survey: email listservs, Facebook ads, and Amazon Mechanical Turk (MTurk), Amazon’s version of an online panel. They concluded email listservs to be the most cost-effective, but found they produced more missing data and took the most time to reach the sample size goal; the sample also lacked diversity. Regarding Facebook ads, the per-participant cost was extremely high and resulted in mostly female participants but had a low amount of missing data. The MTurk sample was the least time intensive, had a medium-cost, and resulted in the most demographically diverse sample with the least amount of missing data. Antoun et al. (2015) compared recruitment strategies targeting iPhone users for an online survey. They concluded ‘pull in’ methods (e.g., MTurk, Qualtrics panel, etc.) to be more cost effective, and ‘push out’ methods (e.g., Google AdWords, Facebook, etc.) to result in more demographically diverse samples.
No research could be found that compared online survey recruitment methods in the undergraduate student population. Therefore, this paper will compare two cross-sectional samples of college students who took the same survey ‘COVID-19 and Digital Health literacy in University Students’ but were recruited using two different online recruitment methods: community recruitment (Study 1) through online outreach, and panel-based recruitment (Study 2). We will compare experiences and results across these recruitment modalities. We aim to explain and compare the logistics of each method, including time spent securing the sample, ease of administration, and cost. Finally, we will compare sample characteristics, key outcome variables and associations, and number of missing data.

Methods

The current study used two recruitment methods for online survey research targeting the same population. Study 1 utilized community recruitment and targeted New York state (NYS) undergraduate college students. Study 2 utilized panel-based recruitment through Qualtrics and targeted undergraduate college students across the United States (US). The sample size goal for both samples was 250 participants.

Study 1

Study 1 was administered by researchers at the University at Albany (UAlbany). Qualtrics was used to build and administer the survey. The survey was 54 questions long and was estimated to take 15 minutes to complete. When an interested participant clicked on the hyperlink provided in an email or social media post, they were directed to a screening questionnaire to assess inclusion criteria. If they met the criteria, they were asked to provide a .edu email address. Next, a unique survey link was created for each .edu email address and sent to the participants. These prior techniques were used to minimize bots or fraudulent survey
takers, and to eliminate potential issues of the survey being taken multiple times by the same person or being shared with individuals that did not complete the screening questionnaire.

Recruitment for Survey 1 spanned two months (July 14th, 2020- September 14th, 2020) and was terminated when the sample size goal was reached (n=245). On July 14th, an email was sent to administrative assistants from UAlbany departments asking them to send the screening questionnaire hyperlink to undergraduate students in their departments. The initial email was sent to 14 departments, five of which offered to send it to their undergraduate listservs. The other nine departments did not respond to the email. Next, starting on July 21st, a 3-week sponsored (paid) Facebook and Instagram post was released using filters to reach undergraduate students at NYS colleges and universities. The total spent on sponsored social media posts was $450. On August 5th, an email was sent to a random selection of thirteen NYS college and university Institutional Research Offices inviting them to send the survey to undergraduate students at their institution. Five contacts responded, none of which were willing to pass along to students at their university. The main reason was that the research study needed to have an affiliation with their university. Next, as a follow up to the July 14th email to UAlbany department administrative assistants, a reminder email was sent out. Of the nine sent, five offered to send the recruitment email to their undergraduates and one declined the offer. Students who took the survey were entered into a gift card drawing for five, $100 Amazon gifts cards.

**Study 2**

Study 2 utilized and paid Qualtrics to secure a panel sample. Study 2 was completed by Researchers at the University of Hawaii-Manoa. Before survey dissemination, a Research Consultant from Qualtrics worked with the Primary Investigator to determine the requested sample pool (e.g., college undergraduate students throughout the US) and to set quotas (e.g.,
gender and racial/ethnic diversity). From there, a Project Manager checked the survey for technical issues before releasing the survey and monitoring respondents. After the first few surveys were completed, quality checks were done to determine a minimum time limit for valid responses. From there, through sequential sampling of a Qualtrics-managed research panel, 256 responses were collected. Sampling quotas were used to ensure the sample was representative of racial/ethnic and gender diversity in the US collegiate population. Responses were collected from July 7th to July 23rd, 2020. Students received digital gift cards or similar incentives for their participation. The survey was 54 questions long and was estimated to take about ten minutes to complete (Patil et al., 2021).

Survey

See Chapters 2 and 3 for a description of the Consortium Survey used in this study, including demographic variables, COVID-19 attitude variables, and COVID-19 public health behavior, including COVID-19 vaccine intention, variables.

Digital health literacy

DHL was determined using a condensed version of the Digital Health Literacy Instrument (DHLI) (Table 1). This instrument assesses health information seeking, finding, understanding, and appraising. It also assesses skills related to using digital technologies effectively (Van der Vaart & Drossaert, 2017). Each of the three skills asked in each subscale, was measured on a four-point scale from very easy to very difficult to determine a subscale average. From there, total DHL was calculated by averaging the averages of each subscale. Those who answered easy or very easy on each item were determined to have higher DHL. For this paper, DHL will be determined using 3 subscales (searching, reliability, and relevance) across 9-items (bold in Table 1).
Table 1: Digital health literacy instrument (12-items)

<table>
<thead>
<tr>
<th>Items</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>When you searched the internet for information (e.g. “Googled”) about the coronavirus or related topics, how easy or difficult was it to......</td>
<td></td>
</tr>
<tr>
<td><strong>Information searching</strong></td>
<td></td>
</tr>
<tr>
<td>1. Understand the information you find?</td>
<td></td>
</tr>
<tr>
<td>2. Use the proper works or search terms to find the information you are looking for?</td>
<td></td>
</tr>
<tr>
<td>3. Find the exact information you are looking for?</td>
<td></td>
</tr>
<tr>
<td><strong>Evaluating reliability</strong></td>
<td></td>
</tr>
<tr>
<td>4. Decide whether the information is reliable?</td>
<td></td>
</tr>
<tr>
<td>5. Decide whether the information is biased by commercial interests (e.g. advertisers)?</td>
<td></td>
</tr>
<tr>
<td>6. Compare different websites to see if they provide the same information?</td>
<td></td>
</tr>
<tr>
<td><strong>Determining relevance</strong></td>
<td></td>
</tr>
<tr>
<td>7. Decide if the information is personally relevant?</td>
<td></td>
</tr>
<tr>
<td>8. Apply the information in your daily life?</td>
<td></td>
</tr>
<tr>
<td>9. Use the information to make decisions about your health regarding protective measures, hygiene regulations, transmission routes, risks and prevention strategies?</td>
<td></td>
</tr>
<tr>
<td>When you posted on forums or social media about the coronavirus or related topics, how easy or difficult is it to....</td>
<td></td>
</tr>
<tr>
<td><strong>Adding self-generated content</strong></td>
<td></td>
</tr>
<tr>
<td>10. Formulate your question or worry clearly?</td>
<td></td>
</tr>
<tr>
<td>11. Express your opinions, thoughts, or feelings in writing?</td>
<td></td>
</tr>
<tr>
<td>12. Control the sharing of your own or other’s private information?</td>
<td></td>
</tr>
</tbody>
</table>

Note: the 9 bolded items were used to calculate total DHL

**Health literacy**

HL was determined using the single item screener (Morris et al., 2006). This screener asks, ‘*How often do you need to have someone help you when you read instructions, pamphlets, or other written materials from your doctor or pharmacy?*’ Response options include *never, rarely, sometimes, often, or always.* This variable was recoded into a binary variable in which those who answered *never, rarely,* or *sometimes* were considered to have lower HL, and those who answered *often* or *always* were considered to have higher HL.

To assess for statistically significant differences in demographic variables, COVID-19 attitudes, and COVID-19 behaviors between the two samples, chi-square tests of independence
for comparing categorical data (race, gender, political affiliation, perceived handling), $z$-tests of proportions for comparing percentages (ethnicity, first-generation status, HL, DHL, perceived severity, perceived susceptibility, and COVID-19 public health guidelines), and $t$-test of independent sample means (age) were used. Association outcomes were determined using ANOVA (associations with DHL), and chi-square test of independence and Fishers exact test (all other associations).

**Results**

**Cost**

Total cost for Study 1 was $950. This was spent on sponsored social media advertisements on Facebook and Instagram ($450) and on five, $100 gift card incentives. At the end of the 3-week campaigns, 783 people clicked on the social media posts which sent them to the screening questionnaire. It was estimated that this contributed to very few (~10-15) participants successfully completing the screening questionnaire and receiving the survey link. With this estimation, the per-participant cost would be between $30 - $45. Study 2 cost a total of $1,536 ($6/participant) on 256 survey takers. Additionally, both studies had a paid, part-time research assistant managing the study.

**Time**

Two months were needed to secure the sample size goal in Study 1 (n=245). These two months (63 days) involved daily upkeep by a Research Assistant. Ongoing tasks included sending the email invitation to university contacts, creating unique survey links for those who met inclusion criteria, and managing or creating new social media posts. For Study 2, 17 days passed to reach the sample size goal (n=254). Once Qualtrics disseminated the survey, the researchers did not have to do any daily upkeep to ensure the sample size goal was reached.
**Missing data**

In Survey 1, IRB protocol required that responses couldn’t be forced, thus missing data was an issue in this sample. For example, 3-items from the DHLI, one of the predictor variables assessed, had 153 surveys with missing scale items making it difficult to determine accurate DHL in this sample. Survey 2 was able to force responses, thus missing data was not an issue.

**Demographics**

Demographic data (Table 2) showed Study 1 to be primarily female, Democrats, completing a degree in the social sciences (public health, psychology, communication), and had a mean age around 21 years old. The sample was racially diverse and matched or exceeded the diversity seen at UAlbany. In Study 2, on average, respondents were 23.9 years old. This sample was more equally split by gender. As designed, the sample ethnic and racial composition was generally representative of the US college student population. As in Study 1, a majority identified as Democrats. Demographic characteristics were statistically significantly different across all categories except race and DHL.

**Digital health literacy and health literacy**

Concerning DHL, higher levels were observed in 51% of the sample in Study 1 and 57% in Study 2. This difference was not significant. In Study 1, 80.7% reported higher HL, and in Study 2, just less than half of the sample (49%) reported higher HL, this difference between the samples was statistically significant (Table 2).
Table 2: Total time, cost, sample characteristics, digital health literacy, and health literacy

<table>
<thead>
<tr>
<th></th>
<th>Study 1</th>
<th>Study 2</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total time</td>
<td>63 days</td>
<td>17 days</td>
<td></td>
</tr>
<tr>
<td>Total cost</td>
<td>$450</td>
<td>$1,536</td>
<td></td>
</tr>
<tr>
<td>Sample Characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average age</td>
<td>20.9 years old</td>
<td>23.9 years old</td>
<td>p&lt;0.0001†</td>
</tr>
<tr>
<td>Ethnicity †</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>85%</td>
<td>62%</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>15%</td>
<td>38%</td>
<td>p&lt;0.0001†</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>62%</td>
<td>57%</td>
<td></td>
</tr>
<tr>
<td>Black or AA</td>
<td>18%</td>
<td>18%</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>9%</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>11%</td>
<td>13%</td>
<td>p=0.40</td>
</tr>
<tr>
<td>Sex*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>18%</td>
<td>55%</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>80%</td>
<td>42%</td>
<td></td>
</tr>
<tr>
<td>Gender variant/non-conforming</td>
<td>2%</td>
<td>3%</td>
<td>p&lt;0.0001*</td>
</tr>
<tr>
<td>First generation status †</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>32%</td>
<td>57%</td>
<td>p&lt;0.0001†</td>
</tr>
<tr>
<td>No</td>
<td>68%</td>
<td>43%</td>
<td></td>
</tr>
<tr>
<td>Political affiliation*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Democrat</td>
<td>60%</td>
<td>52%</td>
<td></td>
</tr>
<tr>
<td>Republican</td>
<td>8%</td>
<td>28%</td>
<td></td>
</tr>
<tr>
<td>Independent/Other</td>
<td>32%</td>
<td>21%</td>
<td>p&lt;0.0001*</td>
</tr>
<tr>
<td>DHL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower</td>
<td>49%</td>
<td>43%</td>
<td></td>
</tr>
<tr>
<td>Higher</td>
<td>51%</td>
<td>57%</td>
<td>p=0.197</td>
</tr>
<tr>
<td>HL †</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower</td>
<td>19%</td>
<td>51%</td>
<td></td>
</tr>
<tr>
<td>Higher</td>
<td>81%</td>
<td>49%</td>
<td>p&lt;0.0001†</td>
</tr>
</tbody>
</table>

Note: * = p < 0.05 for chi-square test of independence; † = p < 0.05 for z-test of proportions; ♠ p < 0.05 for t-test of independent sample means.

COVID-19 perceptions

In Study 1, perceived handling around the COVID-19 pandemic showed most felt the public underreacted (35%) or that the reaction was just right (46%) (Table 3). In Study 2, almost half believed the pandemic was handled appropriately (48%), with the other half almost split on
overreaction (29%) and underreaction (23%). This difference in perceived handling was statistically significant. The sample in Study 2 displayed higher perceived severity (46%) than Study 1 (39%) and higher perceived susceptibility (57%) to COVID-19 than Study 1 (52%) (Table 3). However, these differences were not significant.

**COVID-19 public health guidelines and vaccine intentions**

Only two behaviors showed significant differences between the two samples, washing hands and wearing masks (Table 3). Both samples were fairly split on intentions to receive a COVID-19 vaccine in the future.

<table>
<thead>
<tr>
<th>Table 3: COVID-19 attitudes, behaviors, and vaccine intentions.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COVID-19 perceptions</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Perceived Handling</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Overreacted</td>
</tr>
<tr>
<td>19%</td>
</tr>
<tr>
<td>29%</td>
</tr>
<tr>
<td>p=0.003627*</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Underreacted</td>
</tr>
<tr>
<td>35%</td>
</tr>
<tr>
<td>23%</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Fair reaction</td>
</tr>
<tr>
<td>46%</td>
</tr>
<tr>
<td>48%</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Perceived severity</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Higher</td>
</tr>
<tr>
<td>39%</td>
</tr>
<tr>
<td>46%</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Lower</td>
</tr>
<tr>
<td>61%</td>
</tr>
<tr>
<td>54%</td>
</tr>
<tr>
<td>p=0.13</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Perceived susceptibility</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Higher</td>
</tr>
<tr>
<td>52%</td>
</tr>
<tr>
<td>57%</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Lower</td>
</tr>
<tr>
<td>48%</td>
</tr>
<tr>
<td>43%</td>
</tr>
<tr>
<td>p=0.27</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>COVID-19 Public health guidelines (those reporting higher adherence/intentions)</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Wearing mask †</td>
</tr>
<tr>
<td>89%</td>
</tr>
<tr>
<td>65%</td>
</tr>
<tr>
<td>p&lt;0.0001†</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Frequent hand washing †</td>
</tr>
<tr>
<td>64%</td>
</tr>
<tr>
<td>50%</td>
</tr>
<tr>
<td>p=0.00148†</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Social/physical distancing</td>
</tr>
<tr>
<td>42%</td>
</tr>
<tr>
<td>46%</td>
</tr>
<tr>
<td>p=0.36</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Staying at home</td>
</tr>
<tr>
<td>32%</td>
</tr>
<tr>
<td>39%</td>
</tr>
<tr>
<td>p=0.09</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Future COVID-19 vaccine</td>
</tr>
<tr>
<td>53%</td>
</tr>
<tr>
<td>48%</td>
</tr>
<tr>
<td>p=0.26</td>
</tr>
</tbody>
</table>

Note: * = p < 0.05 for chi-square test of independence; † = p < 0.05 for z-test of independence.
**Associations with COVID-19 public health guidelines**

Seen in Table 4, associations were assessed between predictor variables (demographic variables, DHL, and HL) and COVID-19 perceptions, adherence to public health guidelines (mask wearing, washing hands, staying at home, social/physical distancing), and COVID-19 vaccine intentions. In both studies, race was associated with one COVID-19 perception and vaccine intentions. In Study 2, race was associated with wearing a mask. In both studies, political affiliation was associated with COVID-19 attitudes (perceived handling and perceived severity), and one COVID-19 behavior (staying at home) in Study 2. In both studies, DHL was found associated with adherence to all four public health guidelines and in Study 2, DHL was associated with perceived severity, perceived susceptibility, and vaccine intentions. HL was associated with a few outcome variables (perceived handling, washing hands, wearing masks) in Study 2, but was not found associated with any outcome variables in Study 1.
Table 4: Associations between predictor and outcome variables

<table>
<thead>
<tr>
<th>Predictor Variables</th>
<th>Study 1</th>
<th>Study 2</th>
<th>Study 1</th>
<th>Study 2</th>
<th>Study 1</th>
<th>Study 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race</td>
<td>Perceived severity*</td>
<td>Perceived handling*</td>
<td>NS: all guidelines</td>
<td>Wearing masks*</td>
<td>Vaccine intentions*</td>
<td>Vaccine intentions*</td>
</tr>
<tr>
<td></td>
<td>NS: perceived susceptibility or handling</td>
<td>NS: perceived susceptibility or severity</td>
<td></td>
<td>NS: other guidelines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Political affiliation</td>
<td>Perceived severity*</td>
<td>Perceived handling*</td>
<td>NS: all guidelines</td>
<td>Staying at home*</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Perceived handling*</td>
<td>NS: perceived severity or susceptibility</td>
<td></td>
<td>NS: other guidelines</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NS: perceived susceptibility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health literacy</td>
<td>NS: perceived severity, susceptibility, or handling</td>
<td>Perceived handling*</td>
<td>NS: all guidelines</td>
<td>Washing hands*</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NS: perceived severity, perceived susceptibility</td>
<td></td>
<td>Wearing masks*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NS: other guidelines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital health literacy</td>
<td>NS: perceived severity, susceptibility, or handling</td>
<td>Perceived susceptibility*</td>
<td>All guidelines*</td>
<td>All guidelines*</td>
<td>NS</td>
<td>Vaccine intentions*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perceived severity*</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>NS: perceived handling</td>
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*p< 0.05; NS= no statistically significant association found

Discussion

Internet-based survey research has become a relatively easy and popular way for researchers to access their priority population. With online surveys increasing in popularity, it is
important to understand benefits and drawbacks of different online survey recruitment methods and how they may impact sample characteristics and outcomes. The goal of this study was to compare experiences and results of two studies that used the same survey targeting undergraduate college students in the U.S. but used different online recruitment methods. Findings suggest online community recruitment is less costly, but more time intensive, and could produce a more homogenous sample. The panel-based sample was higher cost, but less time intensive, and produced a much more diverse sample of college students.

The community recruitment strategy used in Study 1 relied heavily on the ability of the researchers to contact and motivate colleagues with immediate access to the priority population (e.g., through a departmental email listserv) to forward their survey. Forwarding the survey link through departmental email listservs secured most of the sample and cost no money except for the paid Research Assistant’s time. When recruitment was expanded using paid Facebook and Instagram ads, we had little success. One reason may be that college students are less likely to use Facebook as a social media platform (Knight-McCord et al., 2016), but instead prefer Instagram and Snapchat. Solely focusing our efforts on Instagram and Snapchat may have increased engagement. Similar to the findings of Spahrkas et al. (2021), but in contrast to the findings of Batterham (2014), paid social media ads did not seem to be a cost-effective recruitment method in our study. We estimated it cost $30-45 per survey taker secured by the social media ads.

Because other NYS institutions declined sending the survey to their student listservs, the sample was primarily from UAlbany, where the researchers were based. We found departments in the social sciences were more willing to help disseminate the survey. This could have greatly contributed to the homogenous sample, which was majority female, in a social science field at
the same university, lessening external validity. A collaborative study with researchers from multiple institutions could have alleviated some of this challenge as each researcher could have reached out to colleagues and/or departments at their institution for help with dissemination. Similar to the findings of Dworkin et al. (2016) some questions in Survey 1 had a significant amount of missing data. Having a high amount of missing data is a threat to data integrity and should be considered before using online community recruitment.

When comparing the results of both samples, Study 2 was more diverse by ethnicity, sex, first generation status, and political affiliation. Also, Study 2 reported substantially lower health literacy, one of the main predictor variables assessed. In Study 2, health literacy was determined to be an important predictor of many COVID-19 behaviors. However, health literacy was not found to be a key predictor of COVID-19 behaviors in Study 1. Importantly, DHL was found to be a predictor of adherence to public health guidelines in both studies and vaccine intentions in Study 2. With the differences in sample composition, this finding is exciting and presents DHL as a possible important predictor of health behaviors in this population.

Another key association observed for both samples was the association of race with future intentions to receive a COVID-19 vaccine, with students who identified as Black or African American expressing more vaccine hesitancy. This mutual result is not surprising as increased mistrust in healthcare by African Americans has longstanding roots and is related to historical events, discrimination, and systemic racism (Razai et al., 2021). Unfortunately, African Americans have been disproportionately impacted by the COVID-19 pandemic and are at a higher risk of experiencing COVID-19 related morbidity or mortality (Wortham, 2020), which is concerning given the increased vaccine hesitancy in this population.
Regarding DHL research, in order to make measuring and comparing DHL across research studies and in national datasets more streamlined, having one measurement tool for the concept will be crucial. The concepts of eHealth literacy and DHL have a variety of measurement tool options such as the eHLS-Web3.0, eHealth literacy scale, eHealth literacy scale-extended, eHealth literacy questionnaire, transactional eHealth literacy instrument, and the DHLI making it difficult to select the appropriate instrument or make comparisons across studies (Lee, Lee, & Chae, 2021; Liu et al., 2021; Van der Vaart & Drossaert, 2017).

**Limitations**

It is important to consider the limitations of this research. First, we made comparisons across two online recruitment methods. Making comparisons across more than two recruitment methods could have made the findings more relevant. For instance, having another sample take the survey offline, for example at in-person, routine medical visits, or through mall-intercept surveys, could have led to more valuable comparisons and conclusions.

As expected because of different sampling frames and methods, the samples had different results with respect to some demographic variables, HL, and associations with outcome variables. Thus, having conflicting results and conclusions drawn from each research study would be expected and weren’t necessarily in response to the different recruitment modality used. When considering the comparisons made between the samples, and in particular differences in adherence to COVID-19 public health guidelines, it is important to consider the differing levels of public health restrictions across the United States, acceptance of those restrictions, and how that could impact results. For example, the sample in Study 1 resided in New York state, a state that implemented very strict public health mandates and restrictions, which could have greatly influenced adherence to COVID-19 guidelines.
Conclusion

When choosing a recruitment modality for an internet-based research study, particularly one focused on DHL or HL, it is important to consider time constraints, funding, threats to data quality and integrity, and sample diversity. If funds are limited, community recruitment via email listservs or free social media posts is a reasonable option. However, obtaining a homogenous sample may be a risk with online community recruitment, it will take substantially more time to secure a large sample, and some IRBs will not allow answers to be forced. If the threat this poses to data quality and generalizability is a main concern, using a panel-based study could eliminate some of these challenges. Panel-based recruitment was medium-cost, low time-intensive, and produced a demographically diverse sample. Diverse samples are easy to obtain in panel-based samples as they can ensure your panel meets certain criteria (e.g., weighted by race/ethnicity, gender, etc.). Additionally, DHL may be an important concept to focus on in the college student population to impact health behaviors. This could be done through modules added to course curriculums, or through theory informed interventions.

Funding

This work was generously supported by the University at Albany Faculty Research Awards Program (FRAP-B).
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Chapter 5: Summary of the Research

Introduction and Purpose

The COVID-19 pandemic has significantly impacted the health and lifestyles of people around the world. Because COVID-19 is a new disease, efforts to understand the complex virus that causes COVID-19, SARS-CoV-2, is ongoing, and translating ever-changing information to the public has been a challenge. Throughout the COVID-19 pandemic, an infodemic developed, which has been defined as an excessive amount of information about a problem that can often be unreliable. This can make it even more difficult for people to find and understand credible online COVID-19 information (Zaracostas, 2020). Thus, individuals must have adequate digital health literacy (DHL) to find, understand, evaluate, and use COVID-19 information correctly. The ability to navigate the complex landscape of online information is an important first step towards learning about and applying COVID-19 prevention behaviors (e.g., wearing a mask, washing hands, physical distancing, vaccine adherence) that can limit virus spread and prevent unnecessary illness and death.

College campuses and college student lifestyles offer many opportunities for rapid spread of SARS-CoV-2. Additionally, when infected with SARS-CoV-2, college students may experience milder symptoms, or may be asymptomatic, making it potentially difficult for them to know they are infected and properly isolate from others. Understanding what demographic variables, including DHL, impact the perceptions college students hold about the pandemic and adherence to prevention recommendations, including the COVID-19 vaccine, is important to control the spread on campuses and throughout the surrounding communities as the pandemic continues. This information will help inform health communication materials and campaigns targeting college students.
Given the lack of research on DHL in college students in the United States during a global pandemic and the risk of high transmissibility of SARS-CoV-2 in this population, the purpose of this dissertation was to assess college students’ access to and understanding of COVID-19 related information (DHL), their perceptions towards the disease, and intentions to adhere to COVID-19 public health guidelines. The sample of college students used in this study resided in New York state (NYS), which was the initial epicenter of the pandemic in the United States.

The Health Belief Model and Health Literacy Skills Framework were used to guide the investigation of factors affecting adherence to COVID-19 public health guidelines and vaccination intentions. This project also compared two online recruitment methods (community vs. panel-based) for collecting survey data from college students to better understand preferred sampling methods. The dissertation primarily used a cross-sectional survey of the college undergraduate student population in NYS to answer four aims across three manuscripts. Chapter 3 compared results from the NYS sample and a national sample obtained by Researchers at the University of Hawaii-Manoa.

Summary of findings

Paper #1: Exploring predictors of digital health literacy and information seeking behaviors in college students during the COVID-19 pandemic

Aim #1 sought to understand the predictors of adequate DHL and the relationship of DHL with COVID-19 information seeking. Demographic variables (age, gender, race, ethnicity, political affiliation, first-generation status) were assessed as possible predictors of DHL. Thus, it was hypothesized that some demographic variables would show an association with DHL. Next, this paper looked at COVID-19 information seeking during the pandemic and assessed the
relationship between DHL and main sources of COVID-19 information. It was hypothesized that those with higher DHL would be more likely to use trustworthy sources (government agency websites, university websites, local public health department websites, or health websites e.g., WebMD, Healthline, Mayo Clinic) for COVID-19 information.

Paper #1 provided insight into predictors of DHL, the impact of DHL on information sources and information seeking behaviors during the pandemic in a population with high digital accessibility, reliability, and use. Overall, DHL was adequate in the college student sample. Interestingly, assessed demographic variables were not found to have any associations with DHL. In addition, a majority of students were seeking COVID-19 information for themselves and others and were generally satisfied with the information they were obtaining. Although higher DHL was associated with using ‘Government agency websites (for example, CDC, local department of health, etc.)’ as a main source of COVID-19 information, only 41% of the sample reported using government sites. This was the only information source found to have a relationship with DHL.

**Paper #2: Exploring key predictors and mediators of COVID-19 prevention behaviors and vaccine intentions in college students**

Paper #2 extended the analyses from paper #1 to assess the impact of DHL and other variables in predicting high adherence to COVID-19 public health guidelines (wearing masks, washing hands, staying home, physical distancing) and high intention to receive a COVID-19 vaccine in the future. Demographic variables (age, gender, race, ethnicity, political affiliation, first-generation status), DHL, perceived severity, and perceived susceptibility were assessed as predictors. Additionally, DHL, perceived severity and perceived susceptibility were assessed as mediators.
Higher DHL was associated with greater adherence to COVID-19 public health guidelines (wearing masks, washing hands, physical distancing, staying at home). For every 1 point of higher DHL, participants’ odds of adhering to the guidelines increased: washing hands (12%), wearing masks (13%), physical distancing (11%), and staying home (12%). However, there was no relationship between DHL and future intentions to receive a COVID-19 vaccine.

Two demographic variables, race and political affiliation, were found to predict prevention behaviors (physical distancing and staying at home). Race predicted adherence to physical distancing and staying home except for essential trips. Political affiliation showed a relationship with staying home and only leaving for essential trips. Finally, having higher perceived severity predicted a higher likelihood of frequent hand washing and social/physical distancing. Regarding intentions to receive a vaccine, two variables showed a relationship, first-generation-student status and race. Further analyses determined higher vaccine hesitancy in those students identifying as Black or African American and those who were first-generation students. Specifically, 74% of African American students reported being less likely to receive the vaccine compared to 26% of Asian students, 42% of White students, and 52% of those identifying as Other for race. No variables were found to be mediators in any of the above statistically significant relationships between predictor and outcome variables.

**Paper #3: Comparing experiences and results of internet-based digital health literacy research across two recruitment methods**

Paper #3 explored methodological considerations in DHL and HL research studies by assessing optimal sampling strategies for online surveys targeting college students including measures of DHL and HL. Using the same survey, samples were gathered through two different recruitment methods (community and panel-based). Then, sample composition, survey
recruitment experiences, and survey outcomes were compared to understand benefits, challenges, and threats to validity for each of these methods.

Online community recruitment (email listservs, social media ads, etc.) was found to be less costly, but more time intensive, and produced a more homogenous sample. The panel-based sample, secured through a panel vendor, was higher cost ($6/completed survey), but less time intensive, and produced a much more diverse sample of college students.

**Implications for future research**

This study highlights a few key implications for future research. First, race was found to predict COVID-19 public health guidelines and vaccine intentions. Considering daily COVID-19 public health guidelines, there was no clear pattern in our findings as far as a racial group that had higher adherence across multiple guidelines. Other studies have found race/ethnicity to predict COVID-19 public health guidelines, but outcomes across studies are conflicting (Stockman, Wood, & Anderson, 2021) (Hearne & Nino, 2021). Future studies could further understand these findings by employing qualitative research methods, like focus groups or key informant interviews, with members of racial subgroups. In addition, future studies could assess for mediator variables in this relationship, such as education, age, and income.

Additionally, this study found first-generation-student status to be a predictor of future COVID-19 vaccine intention. There is minimal research looking at predictors of health behaviors in first-generation college students; this seems to be an under researched population. Future studies could assess DHL and predictors of health behaviors in this population.

The pandemic became highly politicized in the United States, thus political affiliation was hypothesized to be a predictor of behaviors and vaccine intentions. However, political affiliation was only found to predict staying at home and only leaving for essential trips and had
no association with vaccine intentions. This was surprising as other studies have confirmed political affiliation to be an important variable in attitudes and behaviors related to COVID-19. In particular, political conservatism was found to be negatively associated with believing COVID-19 prevention measures were effective (Shepherd, MacKendrick, Mora, 2020). If political party affiliation continues to impact public health beliefs and attitudes, focus groups could be organized to better understand this relationship and create recommendations for targeting these groups.

The concept of DHL and its importance in individual health is becoming more established in the public health community. For example, Healthy People 2020 expanded the health communication objective to include digital health objectives, highlighting DHL as a promising area for improving illness, disability, and premature death (Jackson, Trivedi, & Bauer, 2020). In this study, DHL was the only variable found to predict adherence to all four COVID-19 public health guidelines. Future research should continue to assess DHL’s impact on health behaviors as DHL interventions could be developed, tested, and utilized to improve an individual’s DHL. In addition, it will be important to have national data on DHL so progress can be tracked, any disparities in population subgroups can be identified, and programs can be implemented to help reduce them.

As for information sources, this study showed a minority of students (41%) reported using government agency websites, a credible source for COVID-19 information. Future studies could further assess the primary online health information sources of college students in a more specific way. Our survey used broad categories for online COVID-19 information sources (e.g., search engines, online encyclopedias, social media sites, etc.). Future surveys with college students could assess the use of very specific online information sources (e.g., NPR, Healthline,
Reddit, CDC, etc.) and the key predictors of these online information sources (e.g., DHL, political affiliation, age, race, etc.). This information would be highly beneficial for public health campaigns, especially during public health crises, when disseminating accurate information quickly to the public is necessary.

To make measuring and comparing DHL across studies and in national datasets more streamlined, settling on the best measurement tool for the concept will be crucial. For example, the concept of eHL has many frequently used measurement tools, making it difficult to decide what tool is best to use in a study or comparing results across studies. Currently, there is only one published instrument for measuring DHL, the DHLI, which was used in this study.

Future research can continue to develop recommendations for health communication messages that work best to motivate college students to perform a health behavior. This study assessed the impact of perceived severity and susceptibility on prevention behaviors. Ongoing research could organize health materials with different types of messaging (e.g., persuasive messaging, risk communication, messaging based on behavioral change theories, social norms messaging, entertainment education, fear-based messaging, etc.) in focus groups with college students to understand what reactions they have to these messages and which messages motivate them to perform or change health behaviors. Often, public health practitioners rely on communication materials like pamphlets, fliers, social media posts, etc. as the quickest line of communication with the general public. Understanding what types of messaging on these mediums are the most effective to different populations could substantially improve health behaviors and outcomes.

Finally, when choosing a recruitment modality for an online survey disseminated to college students, it is important to consider the benefits and drawbacks of different recruitment
methods, how recruitment methods can impact the diversity of your sample, and what motivates college students to participate in a study. There is minimal research assessing the most effective online recruitment methods to obtain a sample of college students that meet diversity indicators at the University. Further studies could complete focus groups, key informant interviews, or surveys with college students to further understand optimal recruitment techniques for this population, especially given their digitally connected nature.

**Implications for practice**

This study emphasizes the importance of including DHL modules in high school and college curriculums and developing and evaluating theory-informed DHL interventions for young people. Having adequate DHL to obtain and understand public health guidelines during a pandemic, but also for more effective general online health information seeking, will help young adults stay healthy and could prevent future health issues. Previous generations relied on medical providers for health information, but the current college student generation is more likely to seek health information online (Basch et al., 2018). Britt et al. (2017) found online health information to be more effective when an individual has adequate eHL. Adequate DHL will assist students in identifying reputable sources, recognizing health misinformation, and preventing its spread.

Evaluation data from successful eHL interventions targeting college students, like Get Health’e’ (Manganello et al., 2019), could help inform DHL interventions or modules. Get Health’e’ sought to increase eHL in young adults and had promising results in its pilot study. The program contains six modules covering eHL, online health information seeking skills, patient portals, social media and health, health-related phone apps, and wearable health devices. Similarly, Xie (2011) implemented an eHL intervention with older adults aged 56-91 and found participants’ knowledge, skills, and eHL improved significantly from pre- to post-intervention.
However, Watkins and Xie (2014), completed a literature review of eHealth interventions for older adults and concluded a significant gap in the literature on eHL, a lack of theory-based interventions, and a lack of high-quality research designs.

A greater gap in the literature is found when looking for evaluations of DHL interventions. Jafree et al. (2021), justified the importance of increasing DHL in disadvantaged Pakistani women and proposed a randomized control trial to evaluate a DHL intervention targeting women in primary healthcare settings during the COVID-19 pandemic. However, the intervention and evaluation has yet to be completed. This was the only published article about a DHL intervention identified. Clearly, there is a need for developing and testing DHL interventions for a variety of populations, but especially college students because of their reliance on online health information.

Next, the messaging used in college student health campaigns during a pandemic should be informed by health behavior change theories and tested with students before wide scale distribution takes place. For example, this study concluded that having increased perceived severity to COVID-19 predicted better adherence to two of the public health guidelines. This finding is important as most health communications targeting college students has featured messages indicating high susceptibility (they are likely to get COVID-19) and low severity (COVID-19 won’t be severe to them) (Tolin, 2020). However, using these findings, materials could be developed to include messages focused on the severity of COVID-19 to an individual, but also the more vulnerable individuals they could spread it to, like an older parent or grandparent.

Focus groups could be conducted to test the materials with students and receive feedback for edits. Then, messages can be widely disseminated on campus and through social media
platforms. To assist with message development, health communication toolkits that support public health practitioners’ efforts to create messages based off identified behavior change constructs would be extremely useful. In addition, understanding current trends among college students with relation to social media platforms and popular mediums will increase the likelihood messages are seen and attended to by college students. According to Knight-McCord et al. (2016), college students prefer Instagram and Snapchat. Additionally, TikTok is becoming a very popular platform among young adults and 60% of TikTok’s 26.5 million users are between the ages of 16-24 (Roumeliotis, 2019).

This study found African American students to be the most vaccine hesitant. This is not a unique finding (Hooper, Napoles, & Perez-Stable, 2021; Willis et al., 2021) and can be explained through mistrust in the healthcare system in response to systemic racism and historical events (Razai et al., 2021b). Mistrust in healthcare has been further enhanced by negative experiences in a culturally insensitive healthcare system (Razai et al., 2021a) and has led to ongoing under representation in health research and vaccine trials (UKGSAG, 2020). Working to rebuild trust and strategically increase outreach to this community is crucial as vaccine hesitancy can have ongoing, serious implications. Already, African Americans have been disproportionately impacted by COVID-19 and have experienced more severe infections, hospitalizations, and death (Wortham, 2020).

**Limitations**

A few limitations of this research should be acknowledged. Because this research utilized an online survey, those with lower DHL might naturally have had a lower likelihood of being recruited for the survey because of less digital connectivity or use. The survey relied on self-reporting, which potentially allows participants to respond inaccurately or to overestimate
behaviors. In addition, this sample of students resided in NYS, a state that had rigorous COVID-19 public health restrictions. Potentially, this sample might have had higher adherence to public health guidelines because of their location during the pandemic. Disseminating this survey in the same population, but in a state with more relaxed public health guidelines during the pandemic, might have produced different outcomes. Another limitation was the small sample size of students, most of whom were female, in the same field, at the same university. Thus, results may not be generalizable to other undergraduate student populations. Finally, since three of the twelve DHLI items had a high number of missing values, DHL was calculated using nine of the items.

For Paper #3, only two recruitment methods were assessed. Having a sample take a paper version of the survey offline, or the addition of another online recruitment method, could have created more valuable comparisons. In addition, these samples were recruited using different sampling frames and methods, thus differing results across demographics, health literacy, and associations with outcome variables would be expected. Thus, the distinctive conclusions drawn from each study weren’t necessarily in response to the recruitment modality used.

**Conclusion**

The internet has become an important tool for providing individuals access to health information, especially in younger, digitally reliant populations like college students. However, the internet has its drawbacks, one of which is the large amount of misinformation available, which makes DHL a crucial aspect of online health information seeking. Adequate DHL became critical during the COVID-19 pandemic, especially in New York state, the epicenter of the COVID-19 pandemic in the United States, when schools and offices shut down and many services, including interactions with medical providers, moved online.
This dissertation found adequate DHL to be generally high among college students and a strong predictor of adherence to the four daily COVID-19 prevention behaviors and obtaining COVID-19 information from a reputable source. Increased perceived severity, race, and political affiliation were found to predict adherence to some, but not all, prevention behaviors. Importantly, race was found to predict intentions to receive a COVID-19 vaccine with African American students disproportionally more vaccine hesitant than other racial groups. Finally, there are distinct benefits and drawbacks to online recruitment methods, and it is important researchers consider these before selecting a recruitment method for online studies with college students. These results add to our knowledge in this area by discovering predictors of prevention behaviors in the college student population, most importantly, DHL which could be improved through additional education to younger individuals.

The findings of this dissertation justify the importance of improving DHL in younger age groups and highlights disparities across subgroups in vaccine hesitancy and adherence to prevention behaviors or intentions to receive a vaccine. These findings are timely and important as the COVID-19 pandemic heads into a more endemic state and ongoing containment is crucial to prevent unnecessary morbidity and mortality. Additionally, with high population density in many parts of the world and continued population growth, along with the interconnectedness of people globally, global pandemics could become more common, so ensuring college students are better prepared for rapid digital dissemination of effective health communications is critical.
References for Chapter 1 and Chapter 5


Sansom-Daly, U. M., Lin, M., Robertson, E. G., Wakefield, C. E., McGill, B. C., Girgis, A., Cohn, R. J. (2016). Health Literacy in Adolescents and Young Adults: An Updated Review. *Journal of Adolescent and Young Adult Oncology, 5*(2), 106-118.


Appendices

Appendix A: COVID-19 and Digital Health Literacy in University Students

Hello! Thank you for your interest in this study.

Why is this study being done?
This project seeks to understand digital health literacy, or how easy it is to sort through information online, in college students as it specifically relates to the COVID-19 pandemic. This project will help inform future COVID-19 information for college students.

Who is doing this study?
My name is Jennifer Manganello. I am a Professor at the University at Albany School of Public Health and I am leading this study. Molly Hadley, MPH, is a DrPH student at the University at Albany School of Public Health and is working with me on this study.

What will I be doing in the study?
You will complete an online survey. You will answer questions in the online survey about yourself, like your age, and questions about how you get health information and what technology you use. You will also answer questions about social media use and what you have been doing about COVID-19 recommendations. We will also ask questions about how easy or hard it is to get and understand information about COVID-19. Your email address will not be connected to your survey. This survey should only take 10-15 minutes to complete.

What are the risks of being in the study?
1. You may feel some embarrassment answering questions about your skills related to understanding COVID-19 health information or using technology.
2. It may be inconvenient for you to spend time completing the study.

What good things may happen if I'm in the study?
1. You may enjoy being in the study.
2. The results from the study will help inform how we design health information about COVID-19 for college students.

Do I have to be in the study?
Your participation in this study is voluntary. You do not have to be in the study. If there are some questions you do not want to answer, you can choose not to answer them.

Will my information be kept private?
Only Jennifer Manganello and Molly Hadley will see all of the survey data and emails, unless University or Government officials ask to inspect our records. When we talk about what we find in this study, we will not share any emails or information that could identify who you are. We will be sharing data with other researchers who are conducting similar studies so we can compare data with other states and countries. This data will have no identifiers in it so no one will know anything about you.
What else do I need to know?
Once we have collected enough surveys, we will draw 5 random emails from those that completed the survey, and if selected, you will receive a $100 Amazon gift card. Please note not everyone will receive a gift card. We will use the email address you provided to us in the eligibility survey to ensure you have completed the survey and to contact you if you are selected to receive a gift card.

Who should I contact with questions?
If you have any questions you can contact me at jmanganello@albany.edu. My phone number is 518-402-0304, but I am not currently in the office due to COVID-19.

Research at the University at Albany involving human participants is carried out under the oversight of the Institutional Review Board (IRB). This research has been reviewed and approved by the IRB. If you have any questions about your rights as a participants in this research, you can contact the following office at the University at Albany:

Institutional Review Board
University at Albany
Office of Regulatory and Research Compliance
1400 Washington Ave, MSC 100E
Albany, NY 12222
Phone: 1-866-857-5459
Email: rco@albany.edu

You can print or save a copy of this page for your records.

Q3 Now that you have read the information about the study, please read each of the following statements and check yes or no.
I have read the information about this study.

☐ Yes (1)
☐ No (2)
Q4 I confirm that I am 18 years of age or older.

☐ Yes (1)

☐ No (2)

Skip To: End of Survey If I confirm that I am 18 years of age or older. = No

Q5 I consent to be in the study.

☐ Yes (1)

☐ No (2)

Skip To: End of Survey If I consent to be in the study. = No

Q6 Thank you for being in our study!

Are you an undergraduate student (earning a bachelors or associates degree) who attended a college or university in New York State during the spring of 2020?

☐ Yes (1)

☐ No (2)

Skip To: End of Survey If Thank you for being in our study! Are you an undergraduate student (earning a bachelors or associ... = No

End of Block: Consent

Start of Block: Background
Q7 Which gender do you most identify with?

- Female (18)
- Male (19)
- Transgender female (20)
- Transgender male (21)
- Gender variant or non-conforming (22)
- Other (23) ____________________________________________

Q8 How old are you, in years?

________________________________________________________________


Q9 What is your ethnicity?

- Hispanic origin (1)
- Non-Hispanic origin (2)
Q10 What is your race?

- American Indian or Alaskan Native (1)
- Asian (2)
- Black or African American (3)
- Native Hawaiian or Other Pacific Islander (4)
- White (5)
- Two or more races (6)

Q11 Where you born in the United States?

- Yes (1)
- No (2)

Q12 In politics, as of today, do you consider yourself a Republican, a Democrat, or an Independent?

- Republican (1)
- Democrat (2)
- Independent (3)
- Other (4) ________________________________

Start of Block: Education

Q14 Are you a first-generation college student?

- Yes (1)
- No (2)
Q15 What is your major or intended course of study?

________________________________________________________________

Q16 What school are you primarily enrolled at?

________________________________________________________________

Q17 What degree will you obtain in your current undergraduate program?

- Associate degree (1)
- Bachelor’s degree (2)

Q18 How many semesters or quarters (including the current one) have you been enrolled at your current school?

- Semesters (1) ________________________________
- Quarters (2) ________________________________
Q19 How do you primarily finance your studies?
*You may select multiple response options, if necessary.*

- [ ] Parent or family support (1)
- [ ] Student loans and public grants (2)
- [ ] Employment during semesters (3)
- [ ] Employment during school breaks (4)
- [ ] Scholarships and fellowships (5)
- [ ] Other (6) __________________________________________

Start of Block: Security & Stability

Q21 Do you feel financially secure?

- [ ] Completely secure (1)
- [ ] Sufficiently secure (2)
- [ ] Somewhat secure (3)
- [ ] Not secure (4)

End of Block: Education
Q22 How is your current living situation?

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Q23 Please mark a field from 1-10 where you think you stand at this time in your life relative to other people in the United States.

Please think of a ladder as representing where people stand in the United States. At the top of the ladder are the people who are the best off – those who have the most money, the most education, and the most respected jobs. At the bottom are the people who are the worst off – those who have the least money, least education, the least respected jobs, or no job. The higher up you are on this ladder, the closer you are to the people at the very top; the lower you are, the closer you are to the people at the very bottom. Where would you place yourself on this ladder?

1 2 3 4 5 6 7 8 9 10

Relative Standing ()

-----------------------------
Q24 What are your current attitudes toward the future?
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<tr>
<th></th>
<th>Decidedly false (92)</th>
<th>Mostly false (93)</th>
<th>Somewhat false (94)</th>
<th>Hard to say (95)</th>
<th>Somewhat true (96)</th>
<th>Mostly true (97)</th>
<th>Decidedly true (98)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am afraid that the problems which trouble me now will continue for a long time. (1)</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>I am afraid that in the future my life will change for the worse. (2)</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>I am afraid that changes in the economic and political situation will threaten my future. (3)</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>I am disturbed by the thought that in the future I won’t be able to achieve my goals. (4)</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>
I am tense and uneasy when I think of my future affairs. (5)

I have the impression that the world is falling apart. (6)

I am disturbed by the possibility of a sudden accident or serious illness (e.g., cancer, COVID-19). (7)

Q25 How would getting COVID-19 affect your life?

- This would make me very sick. (1)
- This would make me a little sick. (2)
- This is not a big deal to me. (3)
Q26 What are your chances of getting COVID-19?

- High chance (1)
- Medium chance (2)
- Low chance (3)
- No chance (4)

Q27 All in all, do you think that the coronavirus outbreak has been made a bigger deal than it really is, made a smaller deal than it really is, or approached about right?

- Bigger deal (1)
- Just about right (2)
- Smaller deal (3)
Q29 In the last four weeks, have you purposefully searched the Internet for information (for example, “Googled”) about the coronavirus or related topics?

○ Yes, only information for me (1)

○ Yes, only information for other people (2)

○ Yes, information for me and other people (3)

○ No, I haven't searched for information in the last four weeks (4)

Skip To: Q32 If In the last four weeks, have you purposefully searched the Internet for information (for example,... = No, I haven't searched for information in the last four weeks
Q30 When you searched the Internet for information (for example, "Googled") about the coronavirus or related topics, how easy or difficult was it to…
<table>
<thead>
<tr>
<th></th>
<th>Very easy (1)</th>
<th>Easy (2)</th>
<th>Difficult (3)</th>
<th>Very difficult (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>understand the information you find? (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>use the proper words or search terms to find the information you are looking for? (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>find the exact information you are looking for? (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>decide whether the information is reliable? (4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>assess whether the information source is credible? (5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>decide whether the information is biased by commercial interests (for example, advertisers)? (6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>compare different websites to see if they provide the same information? (7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>decide if the information is personally relevant? (8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Q31 When you searched the Internet for information (for example, "Googled") about the coronavirus or related topics, how satisfied are you with the information you find?

- Very dissatisfied (1)
- Dissatisfied (2)
- Partly dissatisfied/satisfied (3)
- Satisfied (4)
- Very satisfied (5)
Q32 In the last four weeks, have you purposefully posted on forums, sharing platforms, or social media outlets for information about the coronavirus or related topics?

- Yes, only information for me (1)
- Yes, only information for other people (2)
- Yes, information for me and other people (3)
- No, I haven't posted in the last four weeks (4)

Q33 Please indicate if the following forums, sharing platforms or social media outlets are sources of information for you about the coronavirus or related topics.
You may select multiple response options, if necessary.

☐ Facebook (2)
☐ Instagram (3)
☐ LinkedIn (6)
☐ Medium (15)
☐ Quora (12)
☐ Reddit (7)
☐ Snapchat (14)
☐ Stack Exchange (11)
☐ TikTok (5)
☐ Tumblr (13)
☐ Twitter (4)
☐ YouTube (1)
☐ 4chan (10)
☐ Other (8) ____________________________________________
Q34 When you posted on forums or social media about the coronavirus or related topics, how easy or difficult is it to...

<table>
<thead>
<tr>
<th></th>
<th>Very easy (1)</th>
<th>Easy (2)</th>
<th>Difficult (3)</th>
<th>Very difficult (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>formulate your question or worry clearly? (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>express your opinion, thoughts, or feelings in writing? (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>control the sharing of your own or other's private information? (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q35 When you searched on forums or social media about the coronavirus or related topics, how satisfied are you with the information you find?

- Very dissatisfied (1)
- Dissatisfied (2)
- Partly dissatisfied/satisfied (3)
- Satisfied (4)
- Very satisfied (5)

End of Block: Information

Start of Block: Topics & Sources
Q36 What specific coronavirus-related topics are you searching or posting about?

You may select multiple response options, if necessary.

☐ Outbreak locations and severity (1)
☐ Virus spread and infection (2)
☐ Symptoms (3)
☐ Individual protective measures (for example, handwashing and mask wearing tips) (4)
☐ Hygiene measures (for example, disinfection and cleaning tips) (5)
☐ Testing (6)
☐ Restrictions (for example, social distancing, travel restrictions, stay-at-home orders) (7)
☐ Economic impact (for example, unemployment benefits, stimulus checks, student and business loans) (8)
☐ Mental health (9)
☐ Other (10) ____________________________________________________________
Display This Question:

If In the last four weeks, have you purposefully searched the Internet for information (for example,... != No, I haven’t searched for information in the last four weeks

Or In the last four weeks, have you purposefully posted on forums, sharing platforms, or social medi... != No, I haven’t posted in the last four weeks
Q37 How often do you currently use various Internet sources to get information about the coronavirus and related topics?
<table>
<thead>
<tr>
<th>Source</th>
<th>Don't Know (15)</th>
<th>Never (16)</th>
<th>Rarely (17)</th>
<th>Sometimes (18)</th>
<th>Often (19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search engines (for example, Google, Bing, Yahoo!)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Government agencies websites (for example, CDC, local department of health)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Wikipedia or other online encyclopedias</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Social media or media sharing platforms (for example, Facebook, Instagram, Twitter, YouTube, TikTok, LinkedIn)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Health websites (for example, WebMD, Healthline, Mayo Clinic)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Health blogs</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Internet forums (for example, Reddit)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
Display This Question:
If In the last four weeks, have you purposefully searched the Internet for information (for example,... != No, I haven't searched for information in the last four weeks

Or In the last four weeks, have you purposefully posted on forums, sharing platforms, or social medi... != No, I haven't posted in the last four weeks
Q38 How often do you encounter hoaxes, misinformation, propaganda, or "fake news" about the coronavirus and related topics from the following Internet information sources?
<table>
<thead>
<tr>
<th>Source</th>
<th>Don't Know (19)</th>
<th>Never (20)</th>
<th>Rarely (21)</th>
<th>Sometimes (22)</th>
<th>Often (23)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search engines (for example, Google, Bing, Yahoo!) (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government agency websites (for example, CDC, local department of health) (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wikipedia or other online encyclopedias (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social media or media sharing platforms (for example, Facebook, Instagram, Twitter, YouTube, TikTok, LinkedIn) (4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health websites (for example, WebMD, Healthline, Mayo Clinic) (5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health blogs (6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet forums (for example, Reddit) (7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Doctor, hospital, or insurance company websites (8)

News websites (for example, CNN, Fox News, New York Times) (9)

College or university websites (10)

Display This Question:

If In the last four weeks, have you purposefully searched the Internet for information (for example,... != No, I haven't searched for information in the last four weeks

Or In the last four weeks, have you purposefully posted on forums, sharing platforms, or social medi... != No, I haven't posted in the last four weeks
Q39 In what languages are your digital information sources regarding the coronavirus and related topics?

You may select multiple options, if necessary.

☐ English (1)

☐ Spanish (2)

☐ Chinese (including Mandarin and Cantonese) (3)

☐ Tagalog (4)

☐ Vietnamese (5)

☐ Arabic (6)

☐ French (7)

☐ Korean (8)

☐ Russian (9)

☐ German (10)

☐ Other (11) ________________________________
Q40 How often do you need help to read instructions, pamphlets, or other written material from your doctor or pharmacy?

- Never (1)
- Rarely (2)
- Sometimes (3)
- Often (4)
- Always (5)

Display This Question:
If In the last four weeks, have you purposefully searched the Internet for information (for example,... != No, I haven't searched for information in the last four weeks
Or In the last four weeks, have you purposefully posted on forums, sharing platforms, or social medi... != No, I haven't posted in the last four weeks

Q41 How important is it that the information is...

<table>
<thead>
<tr>
<th></th>
<th>Not at all important (1)</th>
<th>Rather not important (2)</th>
<th>Rather important (3)</th>
<th>Very important (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to date? (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>understandable? (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>comprehensive? (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>verified? (4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>from credible sources? (5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>representative of different opinions? (6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Q43 How often do you follow public health guidelines related to the coronavirus?

<table>
<thead>
<tr>
<th>Frequent hand washing (1)</th>
<th>Never (1)</th>
<th>Rarely (2)</th>
<th>Sometimes (3)</th>
<th>Often (4)</th>
<th>Always (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social/physical distancing (2)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Wearing a mask in public spaces (3)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Staying at home and leaving only for essential trips (4)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Q44 How likely would you be to get a COVID-19 vaccine, if available?

○ Very likely (1)

○ Somewhat likely (2)

○ Not likely (3)
**Q45** What would be your main reason for getting the vaccine?

- I do not want to get sick with COVID-19. (1)
- I want to do everything I can to stay healthy. (2)
- It will help protect those around me. (3)
- Somebody (for example, healthcare provider, parent, or friend) recommended it to me. (4)
- Other (5) ________________________________

**Q46** What would be your main reason for not getting the vaccine?

- I'm healthy; I do not need it. (1)
- I do not like needles. (2)
- I do not think vaccines work. (3)
- I worry about the risks of the vaccine. (4)
- Other (5) ________________________________

**Q47** Over the past month, how many people did you discuss important matters of your health with?

________________________________________________________________
Q48 Over the past month, how many people did you discuss important matters of their health with?

Q49 Do you have a disability that impacts activities of normal everyday life?

- Yes (1)
- No (2)

Q50 Do you have a chronic condition?
*This refers to diseases or health problems that last or are expected to last six months or longer.*

- Yes (1)
- No (2)

*Skip To: Q52 If Do you have a chronic condition? This refers to diseases or health problems that last or are expe... = No*

Q51 If you have a chronic condition, to what extent are you impaired by your chronic illness in activities of normal everyday life?

- Severely impaired (1)
- Moderately impaired (2)
- Slightly impaired (3)
- Not impaired (4)
Q52 Please indicate for each of the five statements which is closest as to how you have been feeling over the past two weeks. Over the past two weeks…

<table>
<thead>
<tr>
<th>Statement</th>
<th>At no time (1)</th>
<th>Some of the time (2)</th>
<th>Less than half of the time (3)</th>
<th>More than half of the time (4)</th>
<th>Most of the time (5)</th>
<th>All of the time (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have felt cheerful and in good spirits</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I have felt calm and relaxed</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I have felt active and vigorous</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I woke up feeling fresh and rested</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>My daily life has been filled with things that interest me</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
Q53 In the past six months, how often have you had the following symptoms?

<table>
<thead>
<tr>
<th></th>
<th>Rarely or never (1)</th>
<th>About every month (2)</th>
<th>About every week (3)</th>
<th>More than once a week (4)</th>
<th>About every day (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdominal pain (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back pain (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feelings of sadness (4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irritability or bad temper (5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nervousness (6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty getting to sleep (7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dizziness (8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q55 Thank you for completing the survey! Would you like to be entered into the gift card drawing? If you click 'yes', we will use the .edu email you provided on the screener questionnaire to contact you if you are selected. We will notify winners once surveys have been collected.

- Yes (1)
- No (2)
Appendix B: Digital Health Literacy Instrument (15-items used by the COVID-HL Consortium)

This instrument can be accepted as a new self-report measure to assess digital health literacy, using multiple subscales [1].

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>DHLIsearch</th>
<th>Information searching:</th>
<th>Very difficult</th>
<th>Difficult</th>
<th>Easy</th>
<th>Very easy</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHLIsearch1</td>
<td>... make a choice from all the information you find?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>DHLIsearch2</td>
<td>... use the proper words or search query to find the information you are looking for?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>DHLIsearch3</td>
<td>... find the exact information you are looking for?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>DHLIcont</th>
<th>Adding self-generated content:</th>
<th>Very difficult</th>
<th>Difficult</th>
<th>Easy</th>
<th>Very easy</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHLIcont1</td>
<td>... clearly formulate your question or health-related worry?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>DHLIcont2</td>
<td>... express your opinion, thoughts, or feelings in writing?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>DHLIcont3</td>
<td>... write your message as such, for people to understand exactly what you mean?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>DHLIrely</th>
<th>Evaluating reliability:</th>
<th>Very difficult</th>
<th>Difficult</th>
<th>Easy</th>
<th>Very easy</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHLIrely1</td>
<td>... decide whether the information is reliable or not?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>DHLIrely2</td>
<td>... decide whether the information is written with commercial interests (e.g., by people trying to sell a product)?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>DHLIrely3</td>
<td>... check different websites to see whether they provide the same information?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>DHLIrelev</td>
<td>Determining relevance:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>When you search the Internet for information on the coronavirus or related topics, how easy or difficult is it for you to...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DHLIrelev1</td>
<td>... decide if the information you found is applicable to you?</td>
<td></td>
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<tr>
<td>DHLIrelev2</td>
<td>... apply the information you found in your daily life?</td>
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<tr>
<td>DHLIrelev3</td>
<td>... use the information you found to make decisions about your health (e.g., on protective measures, hygiene regulations, transmission routes, risks and their prevention)?</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>DHLIpriv</th>
<th>Protecting privacy:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>When you post a message about the coronavirus or related topics on a public forum or social media, how often...</td>
</tr>
<tr>
<td>DHLIpriv1</td>
<td>... do you find it difficult to judge who can read along?</td>
</tr>
<tr>
<td>DHLIpriv2</td>
<td>... do you (intentionally or unintentionally) share your own private information (e.g., name or address)?</td>
</tr>
<tr>
<td>DHLIpriv3</td>
<td>... do you (intentionally or unintentionally) share some else’s private information?</td>
</tr>
</tbody>
</table>