

Spring 5-1-2022

The Importance of Health Anxiety and Emotional Reasoning to Understand Vaccine Hesitancy and Safety Behaviors: Implications for Public Health Campaigns in a COVID_19 Era

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Recommended Citation

Ballas, Samantha and Treadwell, Kimberli, "The Importance of Health Anxiety and Emotional Reasoning to Understand Vaccine Hesitancy and Safety Behaviors: Implications for Public Health Campaigns in a COVID_19 Era" (2022). *Honors Scholar Theses*. 917.
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Abstract

This study examined the impact of health anxiety and emotional reasoning on COVID-19 vaccine hesitancy and preventative behaviors, hypothesizing that high anxiety and emotional reasoning would predict lower vaccine hesitancy and higher COVID-19 preventative health behavior after controlling for demographic variables. A large international non-probability convenience sample of 532 individuals consented to an online survey in a cross-sectional period from March through August 2021 (one month following availability of vaccinations in the USA). Participants completed questionnaires online. Health anxiety and general anxiety were significantly correlated with COVID-19 preventative behaviors, including mask wearing and social distancing, and emotional reasoning. General anxiety and emotional reasoning significantly predicted vaccine hesitancy. Results suggest that addressing anxiety and emotional reasoning in public health campaigns may foster compliance with CDC vaccination recommendations.

Key Words: Health Anxiety, Anxiety, COVID-19 Vaccines, Vaccination Hesitancy, Public Health, Pandemics, Physical Distancing

The Importance of Health Anxiety and Emotional Reasoning to Understand Vaccine Hesitancy and Safety Behaviors: Implications for Public Health Campaigns in a COVID_19 Era

Psychological factors play a critical role in public response to epidemics and pandemics influencing multiple behaviors including vaccine hesitancy, risk communication, and protective behaviors such as social distancing. Given that vaccine hesitancy was listed as one of the top ten threats to global health in 2019 by the World Health Organization (prior to the COVID-19 pandemic; Geoghegan et al., 2020) identifying factors that increase vaccine acceptance are critical. Although preliminary data identify sociodemographic factors that impact vaccine hesitancy and preventative behaviors, relatively scant attention has been paid to individual differences predicting pandemic mitigating behaviors (Harper et al., 2020). Candidate factors such as health anxiety emerged as an individual factor that contributed to these behaviors in maladaptive ways in past epidemics including H1N1 (Taylor, 2019). Given general concerns across multiple areas affecting quality of life, examining the potential impact of anxiety and interpretations of health information as they impact these areas of concern, particularly given the dominance of COVID-19 information in the news across multiple mediums, general anxiety and responses to media may also inform responses to pandemics. It is imperative that health care professionals and public policy makers examine how health anxiety or anxiety more broadly impact responses to viral outbreaks, as well as how reactions to public health information impact containing the spread of pandemics, including the current COVID-19 pandemic.

Health Anxiety Impact on Vaccine Hesitancy and Preventative Behaviors

Health anxiety has emerged as an important construct in determining willingness to pursue vaccinations and influencing responses to guidelines for preventative behaviors (Tyrer,

2020). Health anxiety has a core component of distressing and uncontrollable anxiety focusing specifically on present and future health status (Rachman, 2012). The anxiety is often triggered by perceived changes in bodily function, appearance or by experiences that are misinterpreted. Individuals with heightened health anxiety are likely to be avoidant, isolate themselves from others, and practice repeated or excessive preventative behaviors such as hand washing. Health anxiety can impact vaccine hesitancy due to the likelihood to misinterpret ambiguous medical information as well as heighten fears about contracting the disease or impact of the symptoms (Salkovskis et al., 2002).

Health anxiety can impact behavior specific to pandemic outbreaks in several ways. While anxiety can lead patients to avoid going to the doctor there is evidence of specific patterns within this avoidance. Patients with high health anxiety will not avoid going to the doctor for small problems but given the chance will delay care-seeking when they believe the concern is something known to be serious (Kőszegi, 2003). Health anxiety also delays health-seeking behaviors due to fear of testing positive. Health anxiety thus has been shown to impact treatment seeking behavior, testing, and information preferences, which could potentially decrease help-seeking behaviors to avoid the knowledge of contracting a serious disease with symptoms that could impact multiple physiological systems.

Health anxiety during the H1N1 influenza epidemic impacted individuals as well as the healthcare system itself. Individuals high in health anxiety exhibited a surge in seeking tests when no danger was apparent in that outbreaks had not yet begun in that area (Asmundson & Taylor, 2020). High health anxiety was associated with maladaptive safety behavior such as panic purchasing, excessive handwashing, and social withdrawal given H1N1 fears. Although these behaviors are recommended by public health agencies, when taken to extreme measures

they can create a false sense of urgency leading to detrimental effects on community and individual health. Health anxiety also predicted social distancing and general hygiene in gen x and information seeking in baby boomers. High fear of COVID-19, which may be similar to health anxiety, was related to lower vaccine hesitancy in a French sample (Detoc et al., 2020). Similar results in a German sample indicated that COVID-related anxiety and fear of health-related consequences of COVID-19 were related to lower vaccine hesitancy whereas general anxiety was not related to vaccine hesitancy (Bendau et al., 2021). Thus, it is not clear if health anxiety or more general fears are related to vaccine hesitancy for COVID-19, especially in US and other populations. Finally, in a mixed international sample of adults, both anxiety and fear of the corona virus significantly predicted behavior change (hand washing, working from home, stockpiling food), but depression did not (Harper et al., 2020). In fact, models including fear and anxiety predicted public health-compliant behaviors whereas political and moral attitudes did not in this sample. Alternately, low health anxiety can contribute to vaccine avoidance as seen with H1N1 vaccination (Asmundson & Taylor, 2020). Those who believed themselves to be at low risk of infection were unlikely to change their behaviors or seek vaccination when one was available. During the H1N1 pandemic of 2009 those with low health anxiety were less likely to seek out vaccination as they viewed themselves as having a low risk of infection, and reported lower handwashing behavior.

The Role of Health Anxiety and Emotional Reasoning in Vaccine Communication

Strategies

A second area of impact for health campaigns is the influence of health anxiety and other negative emotions on interpretation of health information. It is postulated that a key reason health anxiety may be particularly heightened in the current COVID-19 pandemic is the

unprecedented access to social media and other news mediums showcasing news about COVID-19 which may reinforce health anxiety and increase inaccurate information regarding vaccine safety that impacts hesitancy to follow CDC guidelines (Tyrer, 2020). To complicate public health campaigns, scientific information is often not intuitive, making it more difficult to be disseminated (Salai & Uysal, 2020).

Misinformation regarding vaccine safety is postulated to be a worldwide threat, highlighting the importance of public information to confidently and accurately relay information in a manner that can be interpreted easily (Geoghegan et al., 2020). During this current COVID-19 pandemic, multiple misinformation sources have surfaced, particularly in social media, with the majority leveraging strong negative emotional reasoning and language (Bean, 2011). Individuals with heightened health anxiety might be at particular risk for falling sway to misinformation given negative bias present in information processing linked to health anxiety and risk perception. For instance, health anxiety for COVID-19 was associated with seeking greater COVID-19 information as well as automatic negative thoughts and automatic negative processing in a sample of Hungarian women (Marschalko et al., 2021). Individuals with health anxiety misinterpret ambiguous health-related information (Salkovskis et al., 2002). To further impact public messaging, some sources manipulate emotions to promote misinformation; 76%-88% of anti-vaccination websites studied leveraged emotional reasoning appeals to establish their ideologies (Bean, 2011). Thus, whether health information is misinterpreted due to cognitive biases associated with anxiety, or whether emotional reasoning factors misconstrue interpretations, emotional reasoning likely contributes to vaccine hesitancy (Chou & Bundenz, 2020). Unpleasant emotions and intuitive thinking have been found to be associated with vaccine refusal which supports the idea that emotional reasoning and negative affect can guide vaccine

hesitancy (Tomljenovic et al., 2019). Physicians observed these patterns of emotional thinking as a means for vaccine refusal and acceptance during the H1N1 influenza epidemic as well. While people initially were anxious for a vaccine to be developed and distributed, after six months individuals become more skeptical (Ofri, 2009). What was learned from the H1N1 epidemic was that ensuring adequate supply of vaccine and disseminating scientific information was not enough alone to ensure vaccinations. Emotional reasoning as well as anxiety played large roles in vaccine hesitancy as well as the behavior of low vaccination turnouts.

Emotional reasoning about personal risk has also been studied as a predictor of vaccine hesitancy. Emotional reasoning of increased risk of disease despite scientific evidence significantly predicted an increase in vaccine hesitancy (Dror et al. , 2020). Many concerns exist surrounding this vaccine such as doubts about efficacy and fear of side effects with many concerns being about safety of the COVID-19 vaccine.

To date, given the recency of the COVID-19 pandemic, most research regarding vaccine hesitancy has focused on demographic factors. For instance, in the US a nationally representative study conducted in November and December of 2020 reported that those adults stating they would not seek a vaccination were more likely to be Republican, ages 18-29 or ages 30-49, lived in rural areas, identified as Black, and reported lower SES (Kaiser Family Foundation, 2020). For those 27% who did not want to be vaccinated, the most likely reasons were worries about side effects, the newness of it, conspiracy theories and political reasons. Another study supports this high rate of vaccine hesitancy, reporting that 31.1% of Americans did not intend to get vaccinated (Callaghan et al., 2020). This study identified that concerns included safety, efficacy, previous COVID infection or lack of insurance. Refusal was higher for multiple demographic factors including identifying as Black, as a woman, and politically conservative. Adults reporting

greater concern about COVID-19 infection were less likely to report vaccine hesitancy. Two of the most cited reasons for vaccine hesitancy were concerns about safety and effectiveness. However, reasons for vaccine hesitancy varied among groups. These findings were similar to vaccine hesitancy in the UK and Ireland, where COVID-19 vaccine hesitancy was correlated with geographic location, age, gender and conspiracy beliefs (Murphy et al., 2021). Similarly, to the US, those in rural regions, younger adults and males were more likely to exhibit vaccine hesitancy. Given that the proportion of persons expressing hesitancy to receive a vaccination was greater than those required for effective herd immunity, it is important to develop more pointed communication efforts to encourage vaccine seeking behaviors among these demographics.

Given large-scale studies outlining significant demographic factors that impact vaccine hesitancy, such as younger adults, conservative political views, and rural living areas, finer-tuned analyses of individual factors are warranted. With emerging support that health anxiety, anxieties/fears, and emotional reasoning affecting hesitancy and behaviors during H1N1 concerns, the current study examined health anxiety and emotional reasoning as they impact COVID-19 vaccine hesitancy. It was hypothesized that health anxiety and emotional reasoning would predict lower vaccine hesitancy and great preventative behaviors, even after controlling for correlated demographic variables such as age. As well, it was hypothesized that health anxiety would specifically predict vaccine hesitancy and preventative behaviors, once controlling for general anxiety. This study aims to inform future campaigns to increase vaccine confidence using targeted methods based on the most frequently cited reasons and correlates for behavioral patterns of vaccine hesitance and to reduce emotional reasoning.

Methods

Participants and Procedure

A power analysis was conducted using G*Power to inform desired sample size. Given little research to predict an effect size this study utilized the psychological literature's definition of a medium, or typical, effect size of $r = .20$ (Funder & Ozer, 2019; Harper et al., 2020). As recommended, the Type I and Type II error were set to .05 and it was determined that an N of > 320 would achieve the typical effect size. Next ANOVAs were conducted to compare health anxiety and general anxiety across vaccine hesitancy. Then a baseline model of health anxiety and anxiety predicting vaccine hesitancy was examined with logistic regression, and then compared to a model including demographic variables, to examine impact on COVID-19 vaccine hesitancy. Health anxiety and general anxiety were then examined for differences in preventative behaviors with ANOVAs. Lastly, vaccine hesitancy and anxiety were examined across emotional reasoning by ANOVAs, correlations, and Chi square. Exploratory analyses were conducted to identify rationales that might increase likelihood to pursue vaccination.

Participants were 726 adults that accessed the study via a QR code or online link during the period of March 30 to August 6, 2020 in an online survey of a non-probability sample. The study was approved by the university institutional review board. Recruitment of the sample was done via social media platforms including Facebook, Instagram, Survey Circle, Reddit, a university daily digest and community fliers. Contact information was provided should individuals wish to contact the researcher with questions prior to agreeing to consent and complete the survey. The survey was carried out online via a university-based Qualtrics account accessed by scanning a QR code or a link. No incentives were given to participants. Mandatory for participation was a minimum age of 18 years and the ability to complete the survey in English language.

Of the 726 that gave consent, 190 completed <1% of the survey after providing consent, and four were under the age of 18. The remaining 532 that completed the survey completed >90% of survey items. Missing data were not replaced. The age range for the final sample was 18-90 years ($M = 34.03$, $SD = 14.88$). Gender was 75% female, 22% male, and 3% other gender (including nonbinary and transgender). 80% were White non-Hispanic, 3% Hispanic, 2% Black, 9% Asian American and 6% other. The sample's education was 8% completing high school or less, 24% some college, 2% a 2-year degree, 40% a 4-year college degree, and 24% a professional degree. 80% were US citizens, with 40% residing in the state of the study. Religious affiliation was reported as 11.5% Jewish, 48.7% Catholic or Christian, 1.9% Muslim, 1.9% Buddhist, 1.7% Hindu, 15.8% selected other religion, and 18.6% Agnostic/Atheist. Political affiliation was reported as 50.9% Democrat, 16.3% Republican, 3.9% Libertarian, 2.2% Green Party, .2% Constitution Party, .2% American Solidarity Party and 26.2 % selected other.

Measures

Demographic variables were collected based on previous COVID-19 hesitancy studies for consistency in reporting (Callaghan, 2020). Participants responded to seven demographic questions to ascertain age, race, ethnicity, gender, education, political affiliation, geographic residence and religious affiliation. Personal exposure to COVID-19 was assessed with questions rated on a 4-point frequency likert scale to evaluate exposure of self, exposure of significant others (friends and family), and suspected COVID-19 in absence of availability of test for self and family/friend. Severity of symptoms of past COVID-19 infection for self and friend/family was assessed on a six-point likert scale for self and other when relevant.

Health anxiety was assessed with the Short Health Anxiety Inventory (HAI; Abramowitz, Deavon, & Valentiner, 2007). This survey contains 18 items regarding the severity of health

anxiety and participants select which statement they most identify with on a 3-point scale ranging from “*not at all like me*” to “*a lot like me*”. Adequate reliability and validity have been reported for adults.

Anxiety symptoms were measured using the Generalized Anxiety Disorder-7 (GAD-7; Spitzer et al., 2006). This is a 7-item self-report survey that asks participant to respond about the frequency of 7 items on a scale from 0 (*not at all*) to 3 (*a lot like me*) over last 2 weeks. Adequate reliability and validity have been reported for adult.

Vaccine hesitancy and preventative behaviors were assessed based on research in the USA (Callaghan, 2020). Vaccination hesitancy was measured with one question. Participants could choose between receiving one of the three US approved COVID-19 vaccines, intent to get vaccinated when eligible, and no plan to get vaccinated. All three vaccines and plans to get vaccinated were combined into low hesitancy response. Those not intending to pursue vaccination were classified as vaccine hesitant. Frequency of preventative behaviors to reduce the spread of COVID-19 were measured with two questions on a 6-point scale for frequency of mask wearing and social distancing, items based on recommended behaviors for this pandemic and research on previous H1N1 pandemic (Asmundson & Taylor, 2020). Prevention behavior scores were calculated by adding the two questions about mask wearing and social distancing. Lower scores were equivalent to higher preventative behaviors. Social distancing ranged from “*I only see those I live with and essential services*” to “*I am living my life normally*”. Vaccination rates for routine vaccination for self and children were also assessed, such as influenza and measles.

Exposure to media and emotional reasoning in response to COVID-19 information were assessed. First, the number of media sources accessed about COVID-19 was evaluated as a sum

of 10 typical sources spanning social media, news and other outlets. Emotional reasoning to obtain vaccination was assessed with 14 items including “*I want to help end the pandemic*” and “*I am afraid of getting sick from COVID-19*” based on Kaiser Family Foundation (2020) national survey data. Emotional reasoning items were summed to yield an overall emotional reasoning score.

A similar scale was used for vaccine hesitant people to determine emotional reasoning for hesitancy. Those who did not intend to get vaccinated responded to 18 items reflecting multiple media sources for lack of vaccination for various reasons, including “*I don’t want unknown chemicals in my body*” and “*I am afraid of the vaccine*”. These were summed to yield an overall emotional reasoning score. All items are based on the USA national survey (Kaiser Family Foundation, 2020).

Finally, six items that might shift attitudes to pursue vaccination were assessed for all participants (Kaiser Family Foundation, 2020). These included items such as “*more testing*” and “*if I knew what was in it*” Respondents could endorse as many as items as they chose, and rationales were summed, ranging from 0-6.

Results

Sociodemographic Characteristics

Adults were recruited in the US and abroad including the UK, Spain, Algeria, Malaysia and Greece. 20.3% of the sample did not reside in the US. For continuous variables, distributions were examined for normality. No significant skew or kurtosis were noted. Study variables of health anxiety averaged 15.00 ($SD = 8.00$), and general anxiety averaged 6.28 ($SD = 5.21$); these variables were correlated as expected, $r = 0.36, p < .001$. 24.4% had had COVID-19, and 91.3% reported a family or friend that had had COVID-19. Average preventative measures were 5.25

($SD = 2.02$). Average emotional reasoning for vaccinated persons was 3.61 ($SD = 2.02$) and for vaccine hesitant, 2.48 ($SD = 1.66$).

In this sample, 9.7% reported vaccine hesitancy at the time of the survey. Vaccine hesitancy was not related to ethnicity, $X^2(12, N = 526) = 17.30, p = .14$. Vaccine hesitancy was not related to gender ($p = .80$). US residents were less likely to report vaccine hesitancy, $X^2(1, N = 535) = 100.0, p < .001$. Vaccine hesitancy was associated with age, with individuals ages 18-29 reporting greater vaccine hesitancy than those in older decades of life, $X^2(4, N = 504) = 20.42, p < .001$. COVID-19 vaccination hesitancy was also not significantly associated with vaccination status for chickenpox vaccine and measles vaccine (all $p > .05$). Religious affiliation was associated with vaccine hesitancy, $X^2(7, N = 535) = 49.52, p < .001$; in that those identifying as Jewish were significantly less likely to report vaccine hesitancy, whereas all other groups were significantly more likely to report vaccine hesitancy. Political affiliation was associated with vaccine hesitancy, but only those identifying as “other” were more likely to be vaccine hesitant, $X^2(6, N = 531) = 29.90, p < .001$. Those identifying as Democrat and Republican were less likely to be vaccine hesitant based on expected counts. Highest level of education was not associated with hesitancy ($p = .91$).

The Impact of Anxiety on Vaccine Hesitancy and Prevention Behaviors

Health anxiety was significantly correlated with preventative behaviors, $r = -.107, p = 0.01$, indicating that higher health anxiety was associated with greater mask wearing and social distancing. In one-way ANOVAs, health anxiety was not associated with vaccination hesitancy, self-reported risk for COVID-19 self-reported COVID-19 infection, self-reported severity of COVID-19 when experienced, or knowing someone with COVID-19 (all $p > .05$). Health anxiety

was associated with higher perceived risk for COVID-19 illness, $F(1, 536) = 5.09, p = .024$, and severity of COVID-19 illness for self, $F(4, 133) = 3.81, p = .006$.

In a one-way ANOVA, individuals reporting higher general anxiety were more likely to report COVID-19 vaccination hesitancy, $F(1, 533) = 7.653, p = .006$. Persons reporting vaccine hesitancy reported an average general anxiety of 8.21 ($SD = 5.7$) while those less hesitant averaged 6.12 ($SD = 5.1$). General anxiety was also correlated with preventative behaviors, $r = -.114, p = .01$, with higher general anxiety associated with more frequent mask wearing and social distancing. General anxiety was not significantly related to perceived risk to COVID-19 exposure, having contracted COVID-19, or with family/friend exposure risk ($p > .05$). A logistic regression created a model predicting vaccine hesitancy with demographic variables of age, gender and religious affiliation, and then general anxiety. This model predicted 19% of the variance of vaccine hesitancy, with religious affiliation emerging as a significant predictor, $Wald Z = 4.36, p = .04$. Once accounting for religion, general anxiety was not a significant predictor.

Emotional Reasoning, Anxiety, and Vaccine Hesitancy

Vaccine hesitant individuals had an average emotional reasoning score of 2.48 ($SD = 1.66$). Those individuals that were not hesitant averaged 3.61 ($SD = 2.02$). Vaccine hesitancy was associated with the emotional reasoning that COVID-19 vaccines were rushed, $X^2(1, N = 529) = 4.72, p = .03$, and believing the vaccine is dangerous, $X^2(2, N = 529) = 12.14, p = .002$. Vaccination hesitancy was not associated with emotional reasoning regarding skepticism of vaccine development, vaccine efficacy, or high risk for COVID-19 complications (all $p > .05$). General anxiety was associated with higher emotional reasoning for both vaccine hesitant, $r = .275, p = .022$, and vaccine accepting individuals, $r = .100, p = .023$. As shown in Figure 1,

health anxiety was associated with greater emotional reasoning for vaccine accepting individuals, $r = .093$, $p = .03$, and vaccine hesitant individuals, $r = .518$, $p < .001$.

Logistic regression models examined a possible moderation effect for whether increased health anxiety and increased emotional reasoning impacted vaccine hesitancy. Neither the interaction of health anxiety and emotional reasoning, nor the interaction of general anxiety and emotional reasoning, significantly predicted vaccine hesitancy (all $p > .05$).

Reasons That Decrease Vaccination Hesitancy

Reasons that would help people feel more comfortable pursuing the COVID-19 vaccine are represented in Figure 2. The 52 vaccine hesitant participants were examined. The most frequently endorsed reasons that might alter intent were “*More time*” and “*More testing*”, followed closely by “*More people getting it*” and “*More information on the vaccine*”. The option “*Nothing would make me more comfortable*” was rarely endorsed.

Discussion

This study evaluated health anxiety, general anxiety, and emotional reasoning as impacting COVID-19 vaccine hesitancy, examined within the context of identified demographic variables associated with vaccine hesitancy. Adults were recruited in the US and abroad including the UK, Spain, Algeria, Malaysia and Greece. 20.3% of the sample did not reside in the US. Participants were recruited via social media including Instagram, Facebook, and survey circle as well as community outlets such as daily digests and community postings. Participants that consented completed an anonymous online survey. The sample was primarily white and female. Vaccine hesitancy was reported by 10% of the sample, with typical levels of health anxiety and general anxiety. Higher vaccine hesitancy was associated with taking fewer preventative measures for COVID-19 infection. Vaccination is a preventative measure so it is

understandable that these variables would be related. COVID-19 vaccination hesitancy was associated with knowing someone who had had COVID-19 but not with oneself having COVID-19. During the H1N1 pandemic it was seen that attitudes towards vaccination and invulnerability to the virus changed after a single person they knew contracted the H1N1 virus (Taha, 2013). This study reaffirms this principle in the midst of the current pandemic. While exposure and contracting the illness is not ideal this does pose insight into which communities may need additional public health targeting to increase vaccination rates. Communities with minimal viral spread may need different strategies to decrease vaccine hesitancy.

Demographic Variables, Vaccine Hesitancy, and Preventative Behaviors

Our study noted that 10% reported vaccine hesitancy. This result is lower than some domestic and international samples (conducted at the outset of the pandemic), though similar to studies in Germany. A German sample found that 65.4% of individuals surveyed would absolutely accept a COVID-19 vaccination but 11.2% would not want to get vaccinated (Bendau et al., 2021). These levels of vaccine hesitancy were lower than results of 22% hesitancy identified in France (Detoc et al., 2020) and 28% in the UK in non-probability samples (Freeman et al., 2020). Vaccine hesitancy was relatively evenly spread across sociodemographic factors in the UK. However, France and the US have noted significant variation among sociodemographic variables associated with hesitancy, in that females and younger adults were more likely to be vaccine hesitant (Callaghan et al., 2021; Detoc et al., 2021).

Our results noted demographic factors of age, religious affiliation, and political affiliation as important contributors to vaccine hesitancy. Individuals in their 20's were more likely to report vaccine hesitancy, as were those in "other" political parties (not Democrat/Republican). Jewish individuals were less likely to be vaccine hesitant. Previous studies in the US have found

similar relationships with COVID-19 vaccination status and demographic variables. Age was associated with vaccination hesitancy in that these same ages were more likely to be hesitant (Callaghan et al, 2021). Previous studies have also found that those identifying as White were more likely to be vaccinated than other reported race/ethnicities and the present study's results replicate this finding (e.g., Callaghan et al., 2021). This could in part be due to various health disparities and inequities in access to care for many communities of color.

In addition, this study found associations with religion and political affiliation as expected from previous studies (Callaghan et al, 2021), although the current findings noted that "other" was the political affiliation that noted increased vaccine hesitancy. It might be that those falling outside of traditional political parties in multiple countries are more likely to be hesitant. Also, previous research did not identify specific religions which could have impacted results due to differences in belief systems and ideologies. In particular, this study had a higher Jewish percentage of participants than is representative of the US which could have impacted associations found. Jewish Americans have been found to be most likely to be vaccine acceptors when compared to other religious populations at 85% acceptance (PRRI, 2021). In addition, previous studies have found that 38% of Americans who attended religious services at least a few times a year and were vaccine hesitant stated that faith based approaches would make them more likely to get vaccinated. It is thereby important to know that religious affiliation itself is associated with vaccine hesitancy as this can better inform public health campaigns in terms of audience and language needing to be used.

US residency was found to be associated with vaccination status. Since this study evaluated intent to vaccine when eligible as well as those who had already been vaccinated it is unlikely the difference between Americans and others is due solely to access to vaccination or

eligibility. This could be due to several factors including differences in healthcare systems, government processes for COVID-19, and cultural differences. Americans should look to other countries to further evaluate the reasons behind differences across countries and how this gap can be decreased. This study mainly had responses in North America and Western Europe.

Therefore, other global regions need to be studied in order to have vaccine equity.

Emotional reasoning in response to media information about the pandemic was not associated with ethnicity, gender, or age. This could be indicative that vaccine hesitant populations are more homogenous across demographics in cognitive processes as there were no differences in reasons between populations. Broader strategies to combat vaccine hesitancy may work on multiple subsets of the population.

Anxiety, Vaccination Hesitancy and Preventative Behaviors

Health anxiety and generalized anxiety were found to be correlated which is consistent with current literature (Lee et al, 2014). Health anxiety was not associated with vaccine hesitancy whereas general anxiety was associated with being less vaccine hesitant. Both health anxiety and general anxiety were significantly associated with taking more preventative measures. Health anxiety was associated with self-reported high risk for complications from COVID-19 and severity of self COVID illness. This is consistent with previous literature that describes health anxiety being associated with certain behaviors, such as low health anxious individuals reporting less hand washing during the H1N1 pandemic (Asmundson & Taylor, 2020). However, it was not associated with fear related COVID attitudes.

Health anxiety correlates could help to inform public health campaigns of not only vaccination but those surrounding preventative measures such as social distancing or mask wearing. Low health anxiety individuals were less likely to take these preventative measures

which is important when determining who is at greatest risk of infection and transmission.

Health anxiety was not found to be associated with vaccination hesitancy or knowing someone who had had COVID-19. Further research should examine why some preventative behaviors are seemingly linked to health anxiety but not others.

Severity of COVID-19 illness was associated with increased health anxiety, but not family and friends COVID-19 illness severity. One theory surrounding anxiety and worry proposes that worry is involved with anxiety to maintain vigilance for personal danger (Mathews, 2002). It is therefore consistent with the literature that personal illness would be more likely to impact one's own health anxiety than the experience of others.

Emotional Reasoning for Media Information and Vaccination Hesitancy

Vaccination hesitancy was associated with emotional reasoning of media sources providing information about the pandemic. Previous research has found that vaccine supporting claims commonly appeal to reason and anti-vaccination campaigns appeal to emotion (Bean, 2011). In this study, vaccination hesitancy was associated with emotional reasoning surrounding several areas of misinformation. Significant associations were noted for believing the vaccines were rushed and that the vaccine is dangerous. However, it was not associated with skepticism of vaccine development, vaccine efficacy or being high risk for COVID-19 complications. These items can help public health officials to better understand why people may be choosing to remain unvaccinated and use this knowledge to help identify fears surrounding vaccination. These results suggest that focusing information campaigns regarding positive emotions regarding the time spent in developing vaccines in the past as they informed quick generation of current vaccines, as well as safety of the vaccine, might decrease hesitancy. Vaccination is an emotionally charged issue and these results fall in line with that notion (Chou & Budenz, 2020).

The reasons associated with vaccination status are more fear based (i.e., fear of danger) rather than logical based (i.e., not believing the vaccine is effective). Since there seems to be more emotions associated with hesitancy it is important to attempt to reduce fear regarding the vaccination and increase confidence in its background research and safety. These targeted messages may address specific reasons for why people refuse vaccination public health campaigns and can increase their effectiveness.

Vaccine hesitancy for COVID-19 was not associated with vaccine hesitancy or confidence towards regular vaccinations such as influenza and measles. This could be indicative of two separate vaccine hesitant populations: those who are hesitant for the COVID-19 vaccine and those who are hesitant towards routine vaccinations. There may be unique aspects concerning the current pandemic and vaccines that are related to the divide between routine vaccination and COVID-19 vaccination. These results suggest that public health strategies used previously to combat vaccine hesitancy may prove to be less effective for the current pandemic. Further research to explore the unique features of COVID-19 vaccine hesitancy compared to previous pandemics (i.e., H1N1, or routine vaccinations such as measles) may help to improve public health campaigns aimed to increase COVID-19 vaccination rates.

Emotional reasoning was negatively correlated with age in the present study. Young people seem to be more accepting of the vaccine than older adults and seem indicating by having more reasons they got the vaccine. Further research should continue to explore the generational divide within attitudes towards different aspects of healthcare. As well, higher emotional reasoning scores were associated with higher levels of both health anxiety and general anxiety for vaccine hesitant and vaccine accepting individuals. These results support the theory that more anxious individuals utilize emotional cognitive patterns to assess vaccination information in the

media. Decreasing anxiety in general, as well as specific health-related concerns, may increase the effectiveness of public health campaigns that focus on the scientific information of confidence and efficacy.

Previous literature has linked hesitancy with lower health anxiety (Asmundson & Taylor, 2020). However, the current study's results show that those who are more hesitant, on the emotional scale, were more likely to have higher health anxiety. This could mean that while overall vaccine hesitancy is linked to low health anxiety, emotional reasoning does not follow this association with higher anxiety. More anxious individuals seem to be using more emotional reasoning in both vaccine acceptance and vaccine hesitant groups.

Implications for COVID-19 Vaccination Campaigns

The reasons people cited that would make them feel more comfortable to get the vaccine were examined for the participants who did not intend to get vaccinated. The most common reasons were 'more testing' and 'more time'; thus future studies should examine if this pattern of thinking follows behavioral outcomes throughout the pandemic. However, "*Nothing would make me more comfortable*" was rarely endorsed by participants. This indicates that there is room to impact decision making and decrease hesitancy. Very few individuals would not change at all given new information or data. It does not appear that hesitancy is a stagnant cognitive bias but rather one that is open to change. This portion of the sample was relatively small (10%).

To combat emotional reasoning and decrease vaccine hesitancy, evidence-based public health campaigns and strategies are vital to increase confidence in vaccination efforts and dispel emotional reasoning and fears that were reported by those who were vaccine hesitant (Chou & Budenz, 2020). There are opportunities to use both positive and negative emotions when looking at ways to increase acceptance. On the negative side one strategy is to raise awareness of how

anti-vaccination campaigns can use emotional manipulation to the detriment of public health (Chou & Budenz, 2020). However, on the positive emotional side strategies can involve activating altruistic ideals. This study examined emotional reasoning while future studies might focus on the interpretation of scientific or logical information in regard to vaccination intent. Individuals who cite more emotional reasons for vaccine refusal should be met with measures that address those patterns of thinking and reasoning. This makes misinformation easy to spread and hard to dispel once accepted. Campaigns disseminating logical information may not be effective enough alone if people are not using logical reasoning to rationalize receiving a COVID-19 vaccination. Furthermore, campaigns disseminating logical information may not be enough alone as it may be harder to accept scientific beliefs in the face of more initiative misinformation

Limitations

The examination of different types of anxiety using well-established scales is a strength of the current study. The relatively short duration of data collection has the benefit of allowing a clear temporal context for the self-reports. However, as controversies and vaccine rates have changed over time, the generalizability of results is limited. As well, the self-selected convenience sample may not be representative of the US or other populations, particularly given the high rate of females and of Non-Hispanic Whites in the present sample. Thus ethnic/race diversity and elderly populations may be underrepresented. As well those persons with easier internet access and use of social media were potentially overrepresented. In future studies random samples would be advised. The cross-sectional nature of the data does not allow causal direction of the relationships noted for health anxiety, general anxiety, emotional reasoning, and vaccine hesitancy. As well this sample had a relatively low vaccine hesitancy report, and thus a

rather positive view of vaccinations, such that those individuals with less favorable views did not elect to participate in the study. Finally self-report questionnaires present report bias.

Future Directions

Future research should examine health disparities and access to care to determine if differences in race/ethnicity are truly due to race or due to other factors. Unlike previous findings this study found no difference for gender for vaccine status. This could be due to including gender as a nonbinary variable unlike previous studies.

The emotional reasoning of trusting anti-COVID media was not associated with health anxiety or vaccine hesitancy. Given the role of the media throughout this pandemic it is important to understand how the media affects individuals reasoning processes. Future research should delve deeper into the relationship of media and vaccination beliefs.

While the reasons vaccine hesitant individuals selected show important insight into why people may be electing to remain unvaccinated it is important that further research in larger and more diverse samples is conducted to better understand what would increase intention to vaccinate among hesitant individuals.

Preventative measures were associated with overall hesitancy scores. This correlation is indicative that those who are more hesitant are taking fewer preventative measures. This is understandable as vaccination is a preventative tool in a pandemic. Further research should explore reasons as to why individuals are less likely to take on preventive behaviors in general.

Conclusions

This study was able to evaluate several relationships that may prove to be key in understanding vaccine hesitancy in terms of the current pandemic. In addition, these results can help to start conversations and further research regarding social inequities in vaccinations.

Differences in various populations should be utilized to better target vaccine hesitant in an efficient and effective way. Research on vaccine hesitancy in the context of this pandemic and beyond should continue to strive for inclusion and diversity to mitigate social and healthcare inequities.

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Figure 1

Vaccination hesitancy and emotional reasoning scores.

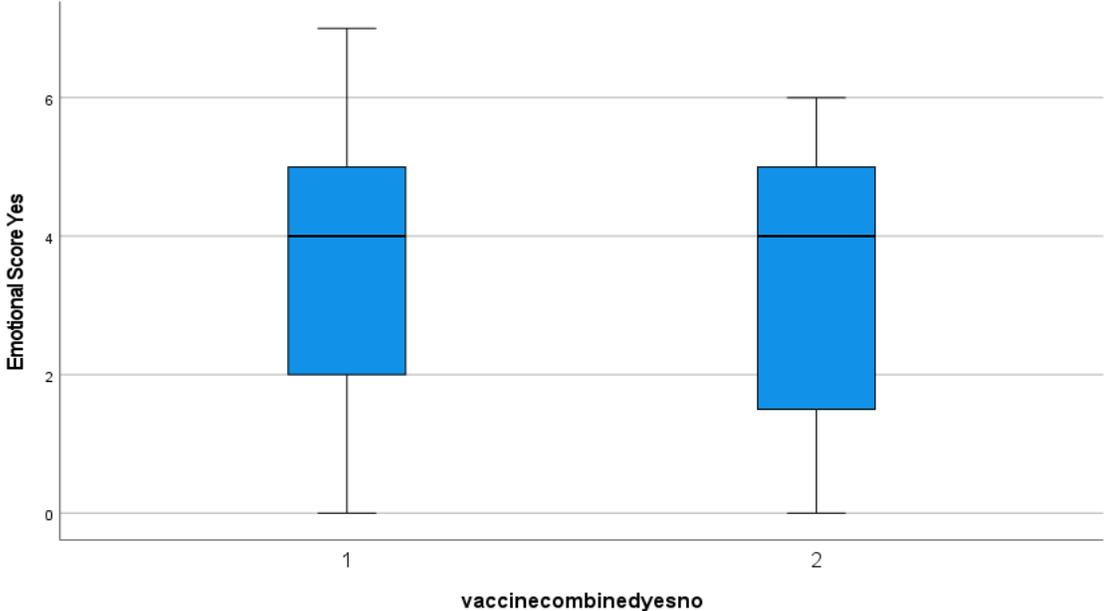


Figure 2

Reasons selected by vaccine hesitant individuals for increasing vaccination intent

