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Race and ethnicity, gender, and age on perceived threats and fear of COVID-19: Evidence from two national data sources

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ABSTRACT

Previous studies find preventative behaviors designed to reduce the number of infections during emerging disease outbreaks are associated with perceived risk of disease susceptibility. Few studies have attempted to identify underlying factors that explain differences in perceptions of risk during an infectious disease outbreak. Drawing from two early waves of American Trends Panel (n=7,441), as well as a National Science Foundation funded, Qualtrics national panel survey from the early stages of the pandemic (n=10,368), we test whether race and ethnicity, gender, and age were associated with six perceived threat and fear outcomes related to COVID-19. Results demonstrate race and ethnicity, gender, and age play a significant role in shaping threat and fear perceptions of COVID-19, but depending on the outcome, relationships vary in direction and magnitude. In some cases, historically marginalized racial and ethnic groups were more likely to report high fear and perceive coronavirus as a major threat to population and individual health, whereas, in others cases, the same marginalized racial and ethnic groups were less likely to perceive coronavirus to be a serious threat to the immune-comprised and the elderly population. We also find women were generally more likely to report high levels of threat and fear of COVID-19. Finally, we observe a clear age difference, whereby adults in older age groups report high-risk perceptions of COVID-19. Findings can inform public health programs designed to educate communities on the benefits of engaging in effective preventative practices during emerging infectious disease outbreaks.

Introduction

In late December of 2019, cases of a new highly pathogenic coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), were recorded in Wuhan, China. Much like two other highly pathogenic Human coronaviruses (HCoVs) - Middle East respiratory syndrome coronavirus (MERS-CoV) and severe acute respiratory syndrome coronavirus 1 (SARS-CoV-1) - SARS-CoV-2 can result in minor to severe symptomatic disease (COVID-19). More specifically, COVID-19 can range from mild respiratory illness to severe progressive pneumonia, organ failure, and death (Cao et al., 2020; Chen et al., 2020; Huang et al., 2020). While approximately 80 percent of COVID-19 patients exhibit mild symptoms (Wu & McGoogan, 2020), research indicates, depending on the country and contextual factors, the overall case-fatality rate ranges between 0.25 and 10 percent (Ritchie et al., 2020), which is significantly higher than seasonal influenza (0.1 percent).

Evidence of a potential worldwide COVID-19 outbreak emerged in late January of 2020, with approximately 9,976 confirmed cases reported in 21 countries (John Hopkins Coronavirus Resource Center, 2020). On March 11th, 2020, the World Health Organization classified COVID-19 as a pandemic, and a few days later, on March 15, the number of confirmed cases surpassed 150,000 worldwide, resulting in more than 5,800 COVID-19 related deaths. By the end of May 2020, there were over 6 million confirmed cases worldwide, with the United States reporting over 1 million confirmed cases and approximately 100,000 deaths.

Given the significant long-term social, economic, and health consequences associated with the COVID-19 pandemic, understanding perceptions of disease susceptibility is of critical importance. Studies find perceived risk (subjective), rather than actual risk (objective), often determine how populations respond to preventative practices during infectious disease outbreaks (Sjoberg, 2000; Smith, 2006; Weinstein, 1988). Across a myriad of infectious disease outbreaks, including the COVID-19 pandemic, perceived risk of disease susceptibility has been associated with a range of preventative behaviors, such as mask-wearing (Lau, Yang, Tsui, & Pang, 2004; Tang & Wong, 2003), disinfection of

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home dwellings (Lau, Yang, Tsui, & Kim, 2003; Rubin, Amlôt, Page, & Wessely, 2009; Wong & Tang, 2005), and handwashing (Brug et al., 2004; Harper, Satchell, Fido, & Latzman, 2020; Jones & Salathe, 2009; Tang & Wong, 2003; Wise, Zbozinek, Michelini, & Hagan, 2020).

Despite a growing body of research demonstrating the importance of perceived disease susceptibility to preventative practices, few studies have endeavored to identify underlying factors that could be linked to perceptions of risk during emerging infectious disease outbreaks. One area that has been particularly understudied is the role of race and ethnicity. Despite broad reductions in mortality and morbidity over time, studies continue to show elevated rates of disease and death for historically marginalized racial and ethnic groups. When compared to Whites, Black Americans persistently experience earlier onset of chronic disease (Hummer & Gutin, 2018, pp. 31–66), greater severity of illness (Erikson et al., 2011), and higher rates of mortality (Murray et al., 2006). For Latina/os, inequities in health are less consistent when compared to Whites. Despite having a higher prevalence of risk factors for cardiovascular disease (Daviglus et al., 2012), Latina/os have lower rates of cardiac disease (Dominguez et al., 2015) and congestive heart disease (Cortes-Bergoderi et al., 2013), but higher age-adjusted rates of diabetes (Geiss et al., 2014). Similar to Latina/os, Asian Americans show lower rates of cardiovascular disease (Centers for Disease Control and Prevention, 2020a) but are more likely to be diagnosed with diabetes than Whites (McNeely & Boyko, 2004). Studies also find, compared to other racial and ethnic groups, Asian Americans have the highest incidence and mortality rates of liver and stomach cancers, which are considered some of the most preventable cancers (Chen, 2005).

Racial inequalities in health should be understood in the context of broader racialized social structures that have historically created differential access to resources, opportunities, and risks (Phelan & Link, 2015; Williams, Lawrence, & Davis, 2019). More specifically, racism, as a structured system of domination designed to justify and perpetuate a racial hierarchy, has enabled Whites to accumulate and access a set of flexible resources (e.g., power, prestige, wealth, and social capital), facilitating the creation of new and reproducing old social, economic, and health advantages. For instance, compared to Whites, Black Americans and Latina/os have less wealth (Sullivan, Meschede, Dietrich, & Shapiro, 2015), lower household median income (U.S. Census Bureau, 2018), higher rates of unemployment (U.S. Bureau of Labor Statistics 2018), and are less likely to receive a college degree (Ogunwole, Drewery, Malcom, & Rios-Vargas, 2012). Asian Americans have comparable wealth accumulation and median household incomes to Whites, but also have higher poverty rates (Kochhar & Cilluffo, 2018; Weller & Thompson, 2016). In regard to health, historically marginalized racial and ethnic groups also tend to receive poorer quality care and less intensive care than Whites, even when accounting for socioeconomic status, age, and health condition (Institute of Medicine, 2003). Given the persistence of health inequalities, along with the differential access to material, social, and health resources for historically marginalized racial and ethnic groups, we argue that racial and ethnic background may contribute to differences in perceived risk of COVID-19.

Although there is limited scholarship attempting to identify underlying factors tied to risk perceptions during infectious disease outbreaks, there is evidence perceptions of disease susceptibility vary by gender and age, as well. For instance, studies find, compared to women, men report lower perceptions of disease susceptibility during several infectious disease outbreaks, including H1N1 (Gidengil, Parker, & Zikmund-Fisher, 2012), avian flu (de Zwart, Veldhuijzen, Richardus, & Brug, 2008, pp. 73–176), and SARS-CoV-1 (de Zwart, Veldhuizen, Richardus, & Brug, 2008, pp. 73–176). These findings also align with other studies that show women are more likely than their male counterparts to engage in precautionary behaviors, such as handwashing and physical distancing (Ibuka, Chapman, Myers, Li, & Galvani, 2010; Park, Cheong, Son, Kim, & Ha, 2010).

As humans advance in age, the immune system declines (Jiang et al., 2013; Weiskopf, Weinberger, & Grubeck-Lobenstein, 2009), increasing the risk for serious viral and bacterial infections. Given that age is tied to disease susceptibility, scholars theorize individuals in advanced age categories may have markedly different perceptions of risk during infectious disease outbreaks compared to younger age groups. Some evidence supports this assertion. For instance, in the Netherlands, risk perceptions of avian influenza infection were higher for respondents over the age of 60 compared to those in younger age categories (de Zwart et al., 2008, pp. 73–176). In South Korea, during the MERS-CoV outbreak, scholars found respondents over the age of 40 had higher risk perceptions as the epidemic progressed (Jang et al., 2020). While there is some limited evidence gender and age play a role in risk perceptions during infectious disease outbreaks, to our knowledge, no research has examined whether threat and fear perceptions of COVID-19 vary by gender and age.

Using data from two large national data sources, we attempt to fill these gaps in the literature by examining whether race and ethnicity, gender, and age were associated with threat and fear perceptions of COVID-19. Critically, the current study draws on multiple data sources to explore inequalities in perceived risk in the relatively early stages of the coronavirus pandemic (March 2020). Because this marks a period of time especially consequential for the adoption of personal and public mitigation strategies necessary to combat COVID-19's spread, disparities in perceived risk of the virus have "downstream" consequences for inequalities in infection and mortality. We draw data from two waves of the American Trends Panel (ATP) to first investigate the relationship between race/ethnicity, gender, and age on perceived threat of COVID-19 to population and personal health. To gain a more nuanced understanding of the role of race/ethnicity, gender, and age, second, we then use a sample of over 10,000 individuals taken from a recently funded National Science Foundation (NSF) project to examine outcomes related to fear and threat of COVID-19 to individuals, their family, the elderly, and persons who are immune-compromised.

Data and methods

Samples and study designs

Data used in this study come from (1) two waves of the American Trends Panel, a nationally representative panel of randomly selected U. S. adults managed by the Pew Research Center; and (2) an online national opt-in panel "Diffusion of Fear" (hereafter, DoF) survey, funded by the NSF, and administered through Qualtrics.

The ATP began in 2014 and recruited participants from three national landline and cellphone random-digit-dial surveys and two national address-based samples (ABS) surveys. Each month ATP participants are administered web surveys that cover numerous topics such as politics, immigration, religion, and technology use. For this study, we draw data from Waves 63.5 and 64 of the ATP. Wave 63.5 of the ATP was conducted from March 10th to March 16th, 2020. During this timeframe, the number of COVID-19 cases more than quadrupled, from 937 to 4,226. Wave 64 was conducted from March 19th to March 24th, 2020, a time period where the number of confirmed cases rose from 15,219 to 54,453 cases. At the end of the Wave 64 timeframe, the United States had recorded 154 deaths. In total, 8,914 panelists completed the Wave 63.5 survey with a response rate of 80.8%. The final Wave 64 sample was comprised of 11,537 ATP panelists with a response rate of 74.8%. For inclusion in the analytic sample, respondents must have had valid responses for all measures from Waves 63.5 and 64 and valid sampling weights.

The NSF funded DOF survey is an online, opt-in survey of 10,368 non-institutionalized U.S. adults (ages 18 and over) administered by Qualtrics. Given the online nature of survey administration, the sample is necessarily comprised of individuals who are least marginally digitally literate. The DoF survey focuses on perceived fear and anxiety related to COVID-19, as well as a range of social and behavioral health changes and physical/mental health assessments. The survey was released on

March 23rd, 2020 to a national panel of U.S. residents who participated in an IRB-approved survey and closed March 30th, 2020.

Perceived fear and threat of coronavirus measures

Our study focuses on six outcomes related to fear/threat of the coronavirus. All six outcomes capture two fundamental aspects of disease risk assessment: personal worry and worry for others (Cameron & Diefenbach, 2001; Diefenbach, Miller, & Daly, 1999; Kaptein et al., 2007). Using data from the ATP, we created measures of perceived threat of COVID-19 to (1) population and (2) personal health. *Threat to population health* was measured using the question "How much of a threat, if any, is the coronavirus outbreak for the health of the U.S. population as a whole?" Original responses included three categories not a threat, a minor threat, and a major threat. *Threat to personal health* was measured using the question "How much of a threat, if any, is the coronavirus outbreak for your personal health?" and includes the same response categories: not a threat, a minor threat, and a major threat. To more accurately capture personal worry and worry for others, and to simplify and ease in the interpretation of results, we construct a binary measure for both threat measures: (zero) not a threat/minor threat and (1) a major threat.

Drawing on our second data source, we include outcomes that address perceived fear and perceived threats of coronavirus to (3) individuals and their families, (4) the elderly, and (5) the immune-compromised. Respondents were asked: "What level of threat do you think the coronavirus (COVID-19) poses to each of the following?" where original responses for all three measures included the following response categories: very low threat, low threat, moderate threat, high threat, and very high threat. If respondents perceived each respective threat scenario to be high or very high, they receive a 1, and all others receive a zero. Finally, (6) *fear of coronavirus* measured respondent's overall perceived fear of coronavirus at the time of the survey. Respondents were asked to indicate their level of fear, ranging from (zero) not at all fearful to (10) very fearful. Respondents who rated their fear of coronavirus at 8 or higher received a 1 (i.e., high fear) and all others received a zero.[1]

Race/ethnicity, gender, and age

Race/ethnicity was measured using a respondent's self-reported racial and ethnic identity, which includes categories for White (reference), Black, Latina/o, and Asian/Asian American. Gender was measured using a dummy variable for female, with male as the reference. Age was divided into four categories: 18–29 (reference), 30–49, 50–64, and 65+.

Covariates

We also include a series of covariates that have previously been shown to play a role in perceived disease susceptibility. These factors include political party affiliation (Allcott et al., 2020; Jiang, Chen, Yan, Lerman, & Ferrara, 2020), nativity and citizenship (Edelman, Christian, & Mosca, 2009; Garcés-Palacio & Scarinci, 2012), U.S. Census region (Henrich & Holmes, 2011), household income (Henrich & Holmes, 2011), education level (Rubin, Amlôt, Page, & Wesely, 2009; Seale et al., 2009), and marital status (Commodari, La Rosa, & Coniglio, 2020). All of the covariates are comparable across both data sources, with one exception. In the ATP, political party affiliation includes party learning indicators, whereas the second data source asks whether respondents were Democrat, Republican, or Independent. For the ATP measure, party affiliation/party lean was constructed using two discrete items. The first item assessed current party affiliation across four categories: Republican, Democrat, independent, and "something else." If panelists self-reported independent or something else, the second item assessed which of the two major parties in the U.S. they leaned towards. For our analysis, we include a dummy variable for respondents who are *Democrat/leaning* in either of our two databases.

Nativity assesses whether respondents were born outside the fifty U.S. States or Washington, D.C. (foreign-born versus U.S. born). *Citizenship* captures whether panelists are U.S. citizens. Geographical region was categorized using the four U.S. Census regions: Northeast, Midwest, South, and West (reference). Given that income is not normally distributed, we construct a four-category measure with respondents' households categorized as earning *less than $30,000*, between *$30,000 and $50,000*, between *$50,000 and $75,000*, or more than $75,000 (reference). The measure for education attainment includes three-categories: *high school or less* and *some college*, with college graduate serving as the reference. A binary measure assessed whether respondents were *married*.

Analytic strategy

All analyses were performed using Stata (StataCorp) version 15. Analyses include descriptive statistics of sample characteristics for both data sources. Following these descriptive analyses, we present a series of multivariable models. Using data from Waves 63.5 and 64 of the ATP, we begin by assessing whether race and ethnicity, gender, and age correlate with perceived threat of coronavirus to population and personal health. We then investigate the role of race and ethnicity, gender, and age on four outcomes of perceived susceptibility of COVID-19 (i.e. perceived fear, personal threat, threat to the elderly, and threat to the immune compromised) using our second data source. Weighted logistic regression models were used to evaluate the likelihood of all of our perceived threat and fear of COVID-19 measures included in this study, given the dichotomous nature of our dependent variables.

When weighted, both data sources are representative of non-institutionalized adults livings in the United States. Both waves of the ATP were weighted to several population dimensions, including age, race and ethnicity, gender, education, and political party affiliation, and account for multiple stages of sampling and nonresponse. At each wave, panelists receive a base weight that represents the probability of selection at the time of the initial recruitment survey. Base weights are then calibrated to population benchmarks using iterative proportional fitting. This technique is designed to reduce the risk of bias derived from nonresponse at different stages of the panel design. With respect to the DoF survey, descriptive and inferential statistics were weighted using post-stratification weights by gender, age, race, income, and geography (state) in order to ensure the equitable contribution of respondents across their individual demographic and geographic strata relative to their representation in the overall population of the United States. National-level estimates of weighting criteria were taken from the most current United States Census Bureau's American Community Survey (5-year) estimates for 2018. Finally, collinearity diagnostics revealed that the Variance Inflation Factors (VIFs) did not exceed the recommended value of 10, suggesting there are no multicollinearity concerns among variables included in this study.

Sensitivity analyses

Given that there is the potential for loss of information when collapsing the threat and fear outcomes used in this study into the binary measures, we estimated a series of regression models using the full range of categories for each measure as a sensitivity check. More specifically, we estimated a series of ordinal logit and General Estimating Equation

[1] During the initial phases of this study, different thresholds (e.g., 7 and 9) capturing high overall fear of coronavirus were tested. Results from these tests revealed patterns that were similar in direction and statistical significance. Alternative models of this measure as a continuous variable using ordinary least squares regression produce substantively identical results.

(GEE) models to better understand the role of race and ethnicity, gender, and age on threat of coronavirus to population and individual health. We then used a series of ordinal logistic regressions to predict perceived threat of coronavirus to individuals and families, the elderly, and the immune compromised. Finally, OLS regression was used to predict overall fear of coronavirus. Results, which can be found in supplemental tables S1 and S2, were similar in direction and statistical significance.

Results

Descriptive results

Table 1 presents weighted descriptives for both waves of the ATP and the DoF survey. In column 1 of Table 1, descriptives from the ATP show that almost half (46 percent) of panelists in the initial wave perceive coronavirus to be a major threat to population health, whereas in the subsequent wave, the number of respondents increased to nearly two thirds (65 percent). More than a quarter of respondents perceive coronavirus to be a major threat to their personal health in the initial wave, with an increase to more than one-third by wave 64. Concerning racial and ethnic background, the majority of respondents were White (69 percent), followed by Latina/o (15 percent), Black (11 percent), and Asian American (4 percent). Results also indicate the majority of the sample were U.S. citizens (94 percent), unmarried (51 percent), and Democrat or Democrat-leaning (53 percent).

Table 1
Descriptive statistics for both data sources.

	ATP	DoF Survey
	Proportion(SD)	Proportion(SD)
Threat to population health		
Wave 63.5	0.46(.48)	–
Wave 64	0.65(.46)	–
Threat to individual health		
Wave 63.5	0.26(.43)	–
Wave 64	0.35(.46)	–
Perceived fear of coronavirus	–	0.45(.50)
Threat to individual and family	–	0.32(.47)
Threat to immune comprised	–	0.87(.90)
Threat to the elderly	–	0.85(.86)
Race and ethnicity		
Black	0.11(.31)	0.13(.26)
Latina/o	0.15(.34)	0.18(.27)
Asian American	0.04(.20)	0.05(.21)
White	0.69(.44)	0.61(.41)
Age		
18-29	0.19(.38)	0.20(.32)
30-49	0.34(.46)	0.33(.43)
50-64	0.26(.43)	0.26(.46)
65+	0.21(.40)	0.21(.48)
Citizenship		
U.S. citizen	0.94(.24)	0.96(.15)
Region		
Northeast	0.18(.37)	0.17(.40)
Midwest	0.21(.40)	0.21(.41)
South	0.38(.47)	0.38(.48)
West	0.23(.41)	.24(.41)
Education		
High school or less	0.34(.46)	0.39(.40)
Some college	0.31(.45)	0.17(.39)
College graduate	0.35(.46)	0.43(.49)
Income		
<$10,000 to <$30,000	0.28(.44)	0.37(.45)
$30,000 to <$50,000	0.20(.39)	0.13(.33)
$50,000 to <$75,000	0.17(.37)	0.17(.39)
>=$75,000	0.36(.47)	0.32(.49)
Marital status		
Married	0.49(.49)	0.45(.53)
Nativity		
Foreign born	0.14(.33)	0.11(.27)
Party affiliation		
Democrat/leaning	0.53(.49)	0.35(.47)
Gender		
Female	0.50(.49)	0.51(.50)
	N=7,441	*N*=10,368

In column 2 of Table 1, results from the DoF survey show that almost half of respondents (45 percent) report high fear of coronavirus in mid-to-late-March. When examining threat measures, approximately one-third of adults perceive coronavirus to be a high or very high threat to themselves and their family. This finding closely aligns with the pattern observed in the ATP sample. Interestingly, the two remaining threat measures produce markedly different patterns when compared to our other perceived threat outcomes. More specifically, more than 8 out 10 respondents perceive coronavirus to be a high or very high threat to the immune-compromised and the elderly. These findings suggest that more general perceived disease susceptibility measures may not fully capture threat perceptions of coronavirus to different segments of the U.S. population. Similar to the ATP, the majority of respondents were White (61 percent), U.S. citizens (96 percent), and unmarried (55 percent).

Multivariable results

Table 2 contains logistic regression estimates that assess relationships between race and ethnicity, gender, and age and perceived threat of coronavirus to population and personal health using ATP data, controlling for other key covariates. After adjusting for covariates, estimates from both waves reveal race and ethnicity, gender, and age play a significant role in perceived threat of coronavirus to population and personal health. Compared to Whites, Blacks and Latina/os were more likely to perceive coronavirus to be a major threat to population health at wave 63.5. We also observe significant racial and ethnic differences in perceived threat of coronavirus to population health at wave 64; however, patterns were inconsistent compared to those from wave 63.5. More specifically, we no longer observe a statistically significant difference between Black Americans and Whites but do find Asian Americans had significantly higher odds of perceiving coronavirus as a major threat to population health. Latina/os were the only racial and ethnic group to consistently show significantly higher odds of perceiving coronavirus to be a major threat to population health across both waves. With respect to gender, females, when compared to their male counterparts, were more likely to perceive coronavirus to be a major threat to population health across both waves. Age was not associated with statistically significant differences in perceived threat at wave 63.5, but the odds of perceiving coronavirus as a major threat to population health were higher for respondents age 65 and over when compared to respondents between the ages of 18 and 29 in wave 64.

Similar findings emerge in Table 2 with regard to the threat of coronavirus to personal health at wave 63.5 and wave 64. Across both waves, we find Black, Latina/o, and Asian Americans were more likely to perceive coronavirus to be a major threat to personal health when compared to their White counterparts, while females demonstrate significantly higher odds of perceiving coronavirus as a major threat compared to males at wave 64 (but not 63.5). We also observe that, compared to respondents between the ages of 18 and 29, the odds of perceiving coronavirus as a major threat to personal health were higher for all of the age categories included in this study. Moreover, the odds ratios progressively increased with each category, revealing a clear age gradient in threat perceptions of coronavirus to personal health.[2]

Table 3 provides regression estimates for perceived fear of coronavirus, as well as perceived threat of coronavirus to individuals and their families, the immune-compromised, and the elderly as measured in the DoF survey. In some cases, findings show similar patterns observed in Table 2, whereas for others, patterns diverge from the ATP data. For

[2] Additional Wald tests revealed significant differences in perceptions of coronavirus to personal health between age categories, providing further evidence of an age gradient.

Table 2
Logistic regression estimates predicting threat of coronavirus to population and individual health.
Source: Waves 63.5 and 64 of the American Trends Panel.

	Threat to Population Health		Threat to Individual Health	
	Wave 63.5	Wave 64	Wave 63.5	Wave 64
	OR(SE) [95% CI]	OR(SE) [95% CI]	OR(SE) [95% CI]	OR(SE) [95% CI]
Race/ethnicity				
Black	2.17(.33) *** [1.60, 2.93]	1.34(.25) [0.94, 1.92]	2.85(.44) *** [2.11, 3.84]	2.30(.36)*** [1.69, 3.14]
Latina/o	2.32(.32) ***[1.78, 3.03]	1.98(.32) *** [1.45, 2.71]	2.34(.34) *** [1.76, 3.11]	1.88(.26)*** [1.43, 2.47]
Asian American	1.61(.34)+ [1.05, 2.47]	1.90(.52)* [1.11, 3.25]	2.00(.51)** [1.21, 3.31]	1.66(.36)* [1.09, 2.54]
Gender				
Female	1.24(.10)** [1.06, 1.44]	1.57(.13) *** [1.34, 1.85]	1.15(.11) [0.96, 1.38]	1.33(.11)*** [1.14, 1.56]
Age				
30-49	0.94(.13) [0.72, 1.23]	1.15(.17) [0.86, 1.53]	1.53(.25)** [1.10, 2.11]	1.54(.24)** [1.13, 2.09]
50-64	1.04(.14) [0.80, 1.37]	1.31(.20)+ [0.98, 1.76]	1.92(.33) *** [1.37, 2.69]	2.57(.41)*** [1.88, 3.51]
65+	1.13(.16) [0.86, 1.48]	1.82(.28) *** [1.35, 2.45]	3.07(.53) *** [2.19, 430]	3.76(.61)*** [2.73, 5.16]
Nativity				
Foreign born	1.39(.21)* [1.04, 1.87]	1.31(.24) [0.92, 1.87]	1.51(.23)** [1.12, 2.06]	1.47(.22)** [1.09, 1.97]
Citizenship				
Citizen	1.04(.27) [0.63, 1.72]	1.36(.41) [0.75, 2.46]	1.22(.30) [0.76, 1.96]	1.06(.27) [0.65, 1.75]
Region				
Northeast	1.67(.20) *** [1.32, 2.10]	1.23(.16) [0.96, 1.59]	1.46(.21)* [1.09, 1.94]	1.05(.13) [0.82, 1.35)
Midwest	1.27(.15)* [1.01, 1.60]	1.02(.12) [0.81, 1.28]	0.96(.14) [0.80, 1.35]	0.91(.11) [0.73, 1.15]
South	1.32(.14)* [1.07, 1.63]	1.11(.12) [0.89, 1.38]	1.11(.14) [0.87, 1.41]	1.13(.12) [0.92, 1.39]
Education				
High school	1.07(.12) [0.87, 1.33]	0.82(.09)+ [0.66, 1.02]	1.71(.20) *** [1.37, 2.14]	1.281393 .1387309
Some college	1.05(.09) [0.89, 1.23]	0.96(.08) [0.82, 1.14]	1.37(.13) *** [1.14, 1.65]	1.290717 .1053856
Income				
<$30,000	1.27(.15)* [1.01, 1.60]	0.80(.10)+ [0.62, 1.03]	2.17(.28) *** [1.69, 2.79]	1.45(.18)** [1.14, 1.85]
$30,000 to <$50,000	1.45(.16) *** [1.16, 1.81]	1.04(.12) [0.82, 1.31]	1.67(.21) *** [1.31, 2.14]	1.45(.17)** [1.16, 1.83]
$50,000 to <$75,000	0.98(.10) [0.80, 1.21]	0.92(.10) [0.74, 1.15]	1.21(.15) [0.95, 1.53]	0.99(.10) [0.81. 1.22]
Marital Status				
Married	0.87(.07) [0.73, 1.02]	1.10(.10) [0.92, 1.32]	1.12(.11) [0.92, 1.35]	1.13(.10) [0.96, 1.34]
Party affiliation				
Democrat/ leaning	2.47(.20) *** [2.11, 2.91]	3.73(.33) *** [3.13, 4.44]	1.66(.17) *** [1.35, 2.02]	1.68(.15)*** [1.41, 2.00]
Constant	0.24(.07) *** [0.13, 0.43]	0.40(.14)** [0.21, 0.79]	0.04(.01) *** [0.02, 0.06]	0.08(.03)*** [0.04, 0.15]
N	7,455	7,455	7,464	7,464

Table 3
Logistic regression estimates predicting fear and threat of coronavirus to individuals and their families, the immune compromised, and the elderly
Source: DoF Survey.

	Perceived fear	Personal threat	Immune Threat	Elderly threat
	OR(SE) [95% CI]	OR(SE) [95% CI]	OR(SE) [95% CI]	OR(SE) [95% CI]
Race/ethnicity				
Black	1.03 (.10) [0.85, 1.25]	1.20 (.13)+ [0.97, 1.49]	0.50 (.07) *** [0.38, 0.64]	0.67 (.09)** [0.52, 0.87]
Latina/o	1.38 (.14)** [1.13, 1.70]	1.33 (.13)** [1.09, 1.63]	0.70 (.10)** [0.54, 0.92]	1.00 (.14) [0.75, 1.34]
Asian American	1.52 (.20)*** [1.18, 1.98]	0.93 (.13) [0.70, 1.22]	0.81 (.18) [0.52, 1.24]	1.10 (.21) [0.75, 1.61]
Gender				
Female	1.22 (.07)*** [1.09, 1.37]	0.93 (.06) [0.82, 1.04]	1.37 (.13)** [1.12, 1.66]	1.21(.11)* [1.02, 1.44]
Age				
30-49	1.53 (.15)*** [1.27, 1.84]	1.37 (.14)** [1.13, 1.66]	1.35 (.19)* [1.02, 1.78]	1.14 (.17) [0.85, 1.53]
50-64	1.62 (.15)*** [1.34, 1.95]	1.15 (.11) [0.95, 1.40]	2.23 (.30) *** [1.72, 2.90]	1.48 (.19)** [1.14, 1.91]
65+	1.55 (.15)*** [1.28, 1.86]	1.04 (.11) [0.85, 1.28]	2.47 (.36) *** [1.86, 3.29]	0.96 (.13) [0.74, 1.24]
Nativity				
Foreign born	1.16 (.15) [0.90, 1.51]	1.21 (.16) [0.94, 1.55]	0.75 (.13)+ [0.53, 1.05]	0.77(.14) [0.53, 1.10]
Citizenship				
Citizen	1.24 (.26) [0.82, 1.87]	1.24 (.27) [0.81, 1.89]	1.51 (.47) [0.82, 2.78]	1.45 (.47) [0.77, 2.75]
Region				
Northeast	1.44 (.13)*** [1.21, 1.72]	1.16 (.11) [0.96, 1.40]	1.19 (.17) [0.90, 1.59]	1.24 (.16) [0.96, 1.60]
Midwest	1.16 (.10)+ [0.98, 1.38]	1.01 (.10) [0.84, 1.22]	1.03 (.15) [0.77, 1.37]	1.02 (.13) 0.79, 1.32]
South	1.13 (.10) [0.97, 1.34]	1.07 (.09) [0.90, 1.27]	1.07(.15) [0.82, 1.39]	1.05 (.14) [0.81, 1.36]
Education				
High school	1.20 (.09)* [1.04, 1.38]	1.106378 .0811789	0.88 (.11) [0.69, 1.12]	0.86 (.09) [0.70, 1.05]
Some college	1.00 (.06) [0.87, 1.14]	1.019976 .0701935	1.06 (.12) [0.84, 1.33]	1.12 (.11) [0.93, 1.34]
Income				
<$30,000	0.96 (.07) [0.83, 1.12]	1.01 (.08) [0.86, 1.19]	0.81 (.11) [0.62, 1.06]	0.84 (.10) [0.66, 1.06]
$30,000 to <$50,000	0.95 (.09) [0.79, 1.13]	0.92 (.09) [0.77, 1.11]	0.91 (.13) [0.68, 1.20]	0.93 (.11) [0.74, 1.17]
$50,000 to <$75,000	0.95 (.07) [0.81, 1.10]	0.90 (.08) [0.76, 1.06]	1.02 (.14) [0.77, 1.34]	0.95 (.11) [0.76, 1.20]
Marital Status				
Married	1.21 (.08)** [1.07, 1.37]	1.25 (.09)*** [1.09, 1.43]	1.07 (.10) [0.89, 1.28]	1.11 (.10) [0.94, 1.32]
Party affiliation				
Democrat/ leaning	1.74 (.10)*** [1.56, 1.95]	1.45 (.09)*** [1.28, 1.64]	1.61 (.17) *** [1.30, 1.99]	1.75 (.16) *** [1.46, 2.10]
Constant	0.23 (.05)*** [0.15, 0.37]	0.23 (.06)*** [0.14, 0.38]	2.89 (1.03) ** [1.44, 5.81]	2.90 (1.06) *** [1.42, 5.93]
	10,368	10,368	10,368	10,368

perceived fear of coronavirus (column 1), we find those who self-identified as Latina/o, Asian/Asian American, and female were more likely report high fear of the coronavirus. Much like patterns we observed on perceived threat to individual health in the ATP data, results reveal differences by age categories. Compared to respondents between the ages of 18 and 29, the odds of reporting high fear of coronavirus progressively increase with each age group.

Shifting to perceived threat to individuals and families (column 2), regression estimates show Latina/os were more likely to report

coronavirus to be a high or very high threat to themselves and their families when compared to Whites, whereas Black and Asian American respondents do not differ from Whites. Overall, we find little evidence that gender and age play a significant role on perceived threat of coronavirus to individuals and their families: the one exception is respondents between the ages of 30 and 49 are more likely to perceive coronavirus to be a high or very high threat to themselves and their families.

Table 3 also shows that, in some cases, relationships between race and ethnicity and our remaining perceived threat measures were inconsistent with patterns observed with earlier outcomes. For instance, Black and Latina/os respondents were less likely to report coronavirus to be a high or very high threat to the immune comprised, while the odds of perceiving coronavirus to be a high or very high threat to the elderly were lower for Black Americans when compared to Whites. Patterns across gender and age aligned more closely with results observed with earlier outcomes and the ATP data: the odds of perceiving coronavirus to be a high or very high threat to the immune-compromised and elderly were higher for females when compared to males. Similar to other outcomes, we also found the odds of perceiving coronavirus to be a high or very high threat to the immune comprised progressively increase with each age category. Finally, respondents between the ages of 50 and 64 were more likely to report coronavirus to be a high or very high threat to the elderly compared to respondents between the ages of 18 and 29.

Although not central to our focus, it is worthwhile highlighting the consistent patterns observed between political party affiliation and the fear and threat of coronavirus measures included in this study. More specifically, when compared to Republican and Republication leaning respondents, Democrat and Democrat-leaning respondents were more likely to report high fear of coronavirus and perceive coronavirus to be a threat to population health, individual and family health, the immune compromised, and the elderly. These findings align with a growing body of research showing that political party affiliation shapes perceptions of COVID-19 in the U.S., particularly early in the pandemic (Badger & Quealy, 2020).

Discussion

Using two national data sources collected during the month of March of 2020, we examined whether race and ethnicity, gender, and age were associated with perceptions of fear and threat of COVID-19. Overall, we found all three factors were associated with perceptions of disease susceptibility, but the direction and magnitude of relationships were dependent on the outcome under investigation – that is, how respondents conceived threat and fear. With respect to race and ethnicity, we found, compared to Whites, all three historically marginalized racial and ethnic groups included in this study were more likely to perceive coronavirus to be a major threat to their personal health. The differential patterns in threat perceptions of COVID-19 by race and ethnicity could potentially be explained by prior evidence that shows historically marginalized racial and ethnic groups tend to have less access to flexible resources and quality care, making them perceive more risk in light of fewer healthcare resources. Furthermore, on average, historically marginalized racial and ethnic groups have higher rates of chronic diseases and death when compared to their White counterparts (Phelan & Link, 2015; Williams et al., 2019). It is plausible that these persistent and pervasive structural disadvantages that have disproportionately impacted the health, economic, and social lives of historically marginalized racial and ethnic groups may have led to differences in perceived threat of COVID-19 to personal and population health.

We also observed similar patterns concerning the direction of the remaining outcomes, with two exceptions. For perceived threat of COVID-19 to the immune-compromised and the elderly, results illustrated Black Americans were less likely to perceive coronavirus to be a high or very high threat to both groups when compared to Whites. We also found similar patterns for Latina/os with respect to perceived threat to the immune-compromised, but not for perceived threat of COVID-19 to the elderly. These unexpected patterns may be explained by differences in messaging concerning the risks of COVID-19 within Black and Latina/o communities. Despite the overall awareness and concern of COVID-19 to population and individual health, Blacks and Latina/os may perceive risks of COVID-19 to be more evenly distributed across other subpopulations. Thus, there is less distinction between targets of disease risk.

Our results also revealed a rather robust relationship between gender and perceived threat and fear of COVID-19. Estimates from the ATP indicated female respondents were more likely to perceive coronavirus as a major threat to population and personal health. Using data from the DoF survey, results demonstrated that the odds of perceiving coronavirus as a high or very high threat to the immune-compromised and the elderly were significantly higher for females when compared to males. Finally, females were also more likely to report high overall fear of coronavirus than their male counterparts. Although, on average, females exhibited a more robust biological immune response to infectious diseases, findings from this study clearly showed males tended to be less fearful and perceived COVID-19 a less of a threat compared to females.

Overall, these findings align with other scholarship that finds men perceive less risk across a myriad of health behaviors and health outcomes, such as smoking, alcohol use, and cancers (Charness & Gneezy, 2012; McQueen, Vernon, Meissner, & Rakowski, 2008; Nolen, 2004). Scholars argue gender differences in risk perceptions may be due to deeply entrenched gender roles and gendered structures that continue to create inequities in the division of labor and power relations, as well as differences in trusting authoritative figures and institutions (Siegrist, 2005). Although beyond the scope of our study, future studies should investigate whether these factors potentially explain gender differences in threat and fear perceptions of COVID-19 or other infectious disease outbreaks. Lastly, results showed clear age differences in threat and fear perceptions of COVID-19, including progressively higher threat and fear perceptions of COVID-19 as respondents age. These findings align with prior research that suggests older adults may have greater perceived risks of disease susceptibility due to a decline in immune function.

This study is not without limitations. First, while this is one of the first studies to examine threat and fear perceptions of COVID-19 across race and ethnicity, gender, and age using multiple data sources, findings from this study only reflect perceptions of COVID-19 during March 2020.

From April to November 2020, infections and COVID-related deaths increased substantially. For example, by early November, the United States recorded more than 9 million COVID-19 cases, and the number of COVID-19 related deaths exceeded 230,000. Moreover, since March, reports continue to show some groups have been disproportionally impacted by the pandemic. For instance, according to the Centers for Disease Control and Prevention, 2020b, Black and Latina/o adults are more likely to become infected; be hospitalized due to severe illness; and die from COVID-19 complications when compared to Whites. While Asian Americans do not present an increased risk of death from COVID-19, virologic surveillance data also indicate Asian Americans are more likely to be become infected and be hospitalized when compared to Whites. With respect to gender, men and women are as likely to be exposed SARS-CoV-2, though men are at greater risk of severe COVID-19 disease (Griffith et al., 2020). Given that COVID-19 infections and deaths continue to rise, and the probability of exposure and severity of disease differs across groups, future research should investigate whether threat and fear perceptions of COVID-19 changes over time and whether changes in perceptions vary by race and ethnicity, gender, and age. At the same time, the current study's focus on mid-to-late March 2020 marks a particularly important point in time given that early intervention and mitigation – and differences in perceived threat that may undermine adoption – affects the overall spread of the disease within and across communities.

Second, while this study examines multiple measures of perceived

threat and fear of COVID-19, there are other potential threats and fears not included here, including threats and fears to children, friends, neighbors, and coworkers. Including other perceived threat and fear measures can help scholars develop a more nuanced understanding of perceived disease susceptibility during the COVID-19 outbreak. Third, due to data limitations, we were unable to include more inclusive measures of race and ethnicity, and age. For instance, we were unable to account for respondents that self-identified as Native American and/or indigenous in this study. Recent reports show Native American communities have been particularly impacted by the COVID-19 pandemic (Centers for Disease Control and Prevention, 2020c), but little is known about threat and fear perceptions of COVID-19 within this community. As a result, future study designs should adopt sampling strategies that will allow scholars to better understand perceptions of COVID-19 among this often-overlooked population. Given that risk of hospitalization and death increases substantially for adults over the age of 65 (Centers for Disease Control and Prevention, 2020c), research designs would also benefit from developing age measures that allow for the inclusion of more nuanced categories for those 65 and over. Fourth, our results are only reflective of perceptions of COVID-19 in the U.S. Given the varied countrywide responses to COVID-19, as well as the unique history of race and racism in the United States, results from this study may not be applicable to other countries. Finally, future studies should consider other structural, psychological, and behavioral mechanisms that might underlie relationships between race and ethnicity, gender, and age and perceived threats of COVID-19.

Despite these limitations, our study provides important novel insights into the role of race and ethnicity, gender, and age on threat and fear perceptions of COVID-19. Findings from this study can aid policymakers and practitioners in the future development of targeted public health education programs that can lead to greater adherence to preventative practices designed to slow to infections during emerging infectious outbreaks, including amidst debates about how to safely and effectively re-open schools, businesses, and civic organizations. For instance, fear and threat of COVID-19 do not appear to coalesce as a single construct – the potential target of infection matters greatly. The tendency to conceive of the virus's impact as a population or personal health issue may obscure important differences in how specific groups (by race/ethnicity, age, and gender) assess risk. For instance, public health education efforts designed to target particular communities of color may be better served by stressing the importance of threat among specifically vulnerable populations (elderly, immune compromised) in ways that bolster their own personlly perceived risk. Overall, the current pandemic and the fear and perceived threat of the COVID-19 virus has fundamentally disrupted the lives of individuals throughout the United States. Our hope is that by better understanding inequalities in socio-emotional responses to its spread, the public health infrastructure may be better prepared for future crises.

Credit authorship contribution statement

Michael D. Niño: Conceptualization, Methodology, Formal analysis, Writing - original draft, Writing - review & editing. Casey Harris: Conceptualization, Methodology, Formal analysis. Writing - original draft, Writing - review & editing. Grant Drawve: Writing - original draft, Writing - review & editing. Kevin Fitzpatrick: Writing - original draft, Writing - review & editing.

Ethics statement

The authors declare that there are no financial or personal relationships with other people or organizations that could have inappropriately influenced or biased their work.

Disclosures

Dr.'s Niño, Harris, Drawve, and Fitzpatrick report no financial relationships with commercial interests.

Declaration of competing interest

The authors declare no financial conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssmph.2020.100717.

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