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Racial and ethnic disparities in COVID-19 vaccine hesitancy among a diverse community-based population in Connecticut

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Racial and ethnic disparities in COVID-19 vaccine hesitancy

Abstract

Objectives. To examine the role of sociodemographic factors and health-related beliefs in influencing COVID-19 vaccine hesitancy among a diverse community-based population.

Methods. A sample of 252 Connecticut residents completed an online survey between August–December 2020. Utilizing a network of community partners and advertisements via social media, we recruited from communities most impacted by COVID-19. We used descriptive and multivariate analyses to examine vaccine hesitancy within this diverse community.

Results. While 38.9% of participants were vaccine hesitant, African American/Blacks and Hispanics/Latinx were more vaccine hesitant (OR=3.62; 95% CI 1.77, 7.40) compared to non-Hispanic whites/others in multivariate adjusted models. Additional factors associated with hesitancy after adjustment included low perceived risk of COVID-19 infection, not receiving COVID-19 information from medical institutions and community health workers, and endorsement of conspiracy beliefs ($p<0.05$); moderation by conspiracies was observed.

Conclusions. Race/ethnicity, perceived risk, sources of health information, and conspiracy beliefs play a significant role in vaccine hesitancy in this sample. Interventions to promote vaccination should include trusted messengers and sources of information, while creating conditions where confidence in the vaccine and the healthcare system can grow.

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INTRODUCTION

The COVID-19 pandemic has highlighted systemic health inequities within the United States (US), with African American (AA)/Blacks and Hispanics/Latinx experiencing a disproportionate burden of related incidence, morbidity, and mortality.^{1,2} Transmission risk has been exacerbated by issues of homelessness, unemployment, housing density, and food insecurity, each of which are important social determinants of health (SDOH).^{3,4} Meanwhile, evidence is beginning to support more severe COVID-19 complications among cancer survivors, especially those who are undergoing, or recently received, treatment.⁵ Though little work has been done to assess the impact of COVID-19 on cancer survivors and patients, predictions suggest that the current mass delay of screening and treatment will negatively alter outcomes in these communities for years to come.⁶

Vaccination is among our strongest tools to prevent COVID-19 infections, yet uptake has proven challenging and controversial.⁷⁻⁹ Recent reports indicate that some populations, AA/Blacks in particular, are less willing to vaccinate for COVID-19.¹⁰⁻¹² Other studies have attempted to examine influences of vaccine hesitancy, but have neglected health beliefs and SDOH.¹³⁻¹⁵ Our study examines factors related to vaccine hesitancy through a SDOH lens, with special attention paid to race/ethnicity and other sociodemographic variables, including the examination of explanatory factors such as personal health characteristics, COVID-19 health beliefs, medical distrust, discrimination, and access to care.

Anticipating a surge of COVID-19 cases in fall of 2020, as well as the expectation that a vaccine might become available, we conducted a community-based cross-sectional study of 252 participants from the state of Connecticut (CT), targeting outreach to vulnerable communities, including AA/Black and Hispanic/Latinx members. In our recruitment materials, we also included

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the statement, “Cancer survivors welcome.” During the study period (August to December 2020), we collected data regarding the impact of COVID-19 on individuals and their households related to risk of infection, SDOH barriers, health behaviors, access to care, disruptions in cancer care, and health-related attitudes and beliefs. Here, we report on factors associated with vaccine hesitancy in a diverse population that lives in a part of the country that experienced a high number of cases early in the pandemic, resulting in significantly restricted commercial, recreational, and workplace activities for over a year.

METHODS

Study Population. From August 10 to December 9, 2020, we launched an electronic survey on Qualtrics®, available in English and Spanish. The survey instrument was adapted from several established questionnaires and included novel measures.¹⁶⁻¹⁹ In collaboration with a community partner, Community Alliance for Research and Engagement (CARE), we further modified our survey based on community feedback. Exclusion criteria included (a) non-CT zip code, (b) less than 26 or greater than 75 years of age, and (c) having not heard of COVID-19 prior to the start of the survey.

Building on Yale Cancer Center’s community outreach infrastructure, we recruited study subjects through an extensive network of community partners, email list serves, social media pages, and partner websites. This network provides services to populations that have a high burden of SDOH barriers and thus were assumed to be disproportionately impacted by the COVID-19 pandemic. Individuals could access the survey through a computer, tablet, or phone, making the survey accessible to a diverse community audience. Consent was recorded for each participant using an electronic signature feature on Qualtrics®. If participants were unable to complete the

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survey on their own, trained bilingual Health Navigators recorded their responses over the phone. Most respondents (50.4%) took less than 40 minutes to complete, with increased time observed for those that needed assistance. Participants that completed received a \$25 gift card. The Yale University Institutional Review Board exempted this study from review.

Variables and Measures. The main outcome, vaccine hesitancy, was evaluated with the following statement: “If a vaccine becomes available and is recommended for me by my health care provider, I am willing to get the vaccine.” Responses to vaccine hesitancy were based on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree) and later dichotomized to yes (strongly disagree, disagree, and neither agree nor disagree) versus no (strongly agree, and agree).

Sociodemographic and personal health characteristics were included in all analyses based upon the goal of understanding COVID-19-related impacts on high-risk populations. Sociodemographic variables included self-reported (*a*) age ($26 \leq 39$, $40 \leq 54$, and ≥ 55); (*b*) sex (female versus male); (*c*) race/ethnicity, dichotomously coded as non-Hispanic Black and Hispanic versus non-Hispanic white (NHW) and others; (*d*) annual household income ($< \$30,000$ versus \geq to $\$30,000$); (*e*) educational level (≤ 12 years versus > 12 years); and (*f*) SDOH barriers (as defined by difficulty paying utility bills, food insecurity, or housing insecurity, since the onset of the COVID-19 pandemic), dichotomized to ≥ 1 SDOH barrier versus 0 barriers. Personal health characteristics included (*a*) cancer survivorship status (yes versus no), and (*d*) self-rated health status (poor or fair versus good, very good, and excellent).

COVID-19 health beliefs, medical distrust, discrimination, and access to care were also examined for potential associations with vaccine hesitancy. COVID-19 health beliefs included (*a*) sources of COVID-19-related information, including medical institutions (yes versus no),

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community health workers (CHWs) (yes versus no), and healthcare providers (yes versus no); (b) confidence in the healthcare system (a variable indicating confidence in hospitals, local health departments, or national health organizations like the Centers for Disease Control and Prevention, to protect an individual from COVID-19) was created as a continuous measure with a minimum value of 0.00 (high confidence) and a maximum value of 12.00 (low confidence); (c) perceived risk of being infected with COVID-19 (low versus high); (d) and endorsement of conspiracy beliefs (a two-item composite measure indicating either fallacious beliefs in mask wearing or release of COVID-19 by another country), coded as yes versus no. Medical distrust, discrimination, and access to care consisted of (a) medical distrust, a dichotomous variable related to discriminatory experiences while seeking healthcare in the past year (trust versus distrust); (b) everyday discrimination, a composite measure of 10 variables related to experiences of discrimination in day-to-day life, coded as some versus none (i.e., no experiences of discrimination)²⁰; and (c) access to care, a composite measure of two variables assessing access to usual healthcare in the past year (no versus yes).

Statistical Analysis. Descriptive, bivariate, and multivariate analyses were conducted using SAS[®] version 9.4. Analyses focused on the association(s) between sociodemographic, personal health characteristic, COVID-19 health belief, medical distrust, discrimination, and access to care covariates and COVID-19 vaccine hesitancy. Adjusted associations between all covariates and vaccine hesitancy were explored in multivariable models. Multivariable models were created using stepwise logistic regression with entry and exit criteria set to $p=0.15$, and forced retainment of age, sex, race/ethnicity, household income, and the personal health characteristics (cancer survivorship and self-rated health status). Education was removed due to collinearity on household income

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(rho=0.45; $p < .0001$). After stepwise elimination, we used a manual backwards elimination strategy to select a reduced model, dropping the covariates that were not significantly ($p > 0.05$) associated with vaccine hesitancy. Model predictive capacity and decision-making utilized receiver operator characteristic (ROC) curve diagnostics, reported as area under the curve (AUC); Akaike information criterion (AIC); and Hosmer and Lemeshow goodness-of-fit tests.²¹ Multicollinearity was assessed with Spearman and Pearson's correlation coefficients and multicollinearity diagnostics.²² We tested for potential interactions with the inclusion of two-way interaction terms in the fully adjusted multivariate model where indicated. For significant two-way interactions, odds ratios (OR) and 95% confidence intervals (95% CI) were calculated for each subgroup. The bivariate and multivariate analyses used logistic regression to generate maximum likelihood estimates of ORs with 95% CIs and two-sided P values for predicting the odds of vaccine hesitancy. In the multivariable models, values for missing data were retained using the missing option in the logistic procedure.

RESULTS

Characteristics of the Study Sample. As shown in Table 1, a total of 252 participants completed the survey, including 23.5% non-Hispanic AA/Blacks and 17.5% Hispanics/Latinx. While more than two thirds of participants were female (69.8%), 21.9% of the sample had less than a college education. One third (33.3%) of respondents reported household incomes less than \$30,000 per year, and 37.3% were over the age of 55. Experiencing SDOH barriers, including difficulty paying utility bills, food insecurity, and housing insecurity, since the onset of the COVID-19 pandemic were reported by a substantial proportion of participants (44.2%, 49.6%, and 17.5%, respectively). Most respondents (74.7%) described being in good, very good, or excellent health. On average,

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participants had high confidence in the healthcare system to protect them from COVID-19 (median = 2.0; interquartile range=3.0). However, most participants did not get their information from a health source, such as a medical institution (47.6%), healthcare provider (49.2%), or CHW (20.2%). Eighty-three (32.9%) respondents indicated being cancer survivors. While medical distrust was uncommon, with only 35 (13.9%) participants indicating some level of distrust, a majority reported experiencing some discrimination (77.3%). Meanwhile, access to care was indicated by most respondents (68.1%) reporting that they had regular access to a clinic or doctor. High perceived risk of being infected with COVID-19 was reported in 68 (29.2%) individuals and more than one third (35.6%) endorsed conspiracy beliefs. Regarding the main outcome, 98 (38.9%) participants were hesitant about receiving a COVID-19 vaccine.

Bivariate Analysis. Table 2 shows an unadjusted increased odds of vaccine hesitancy among AA/Black and Hispanic/Latinx participants compared to NHW/others (OR, 3.60; 95% CI, 2.11–6.15). Female participants had a 1.87 (95% CI, 1.05–3.33) higher odds of vaccine hesitancy than males. In contrast to those with high SES, participants with a high school education or lower and with household incomes less than \$30,000 per year had a 2.31 (95% CI, 1.24–4.28) and 2.88 (95% CI, 1.66–5.01) higher odds of vaccine hesitancy, respectively. Participants that experienced at least one SDOH barrier since the onset of the COVID-19 pandemic had a 2.39 (95% CI, 1.40–4.07) increased odds of being vaccine hesitant when compared to participants facing no SDOH barriers.

Also indicated in Table 2, those with low perceived risk of becoming infected with COVID-19 had an increased odds of vaccine hesitancy (OR, 2.50; 95% CI, 1.33–4.69) compared to those with high perceived risk. Those who did not receive their COVID-19-related information from a medical institution or a CHW had a higher odds of being vaccine hesitant (OR, 2.56; 95%

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CI, 1.51–4.33; OR, 2.14; 95% CI, 1.08–4.27, respectively) compared to individuals who got their information from these sources. On the other hand, for every unit decrease in confidence in the healthcare system, individuals had a 1.17 (95% CI, 1.06–1.30) higher odds of hesitancy. Respondents endorsing conspiracy beliefs had a substantially increased odds (OR, 3.86; 95% 2.20–6.80) of vaccine hesitancy compared to those that did not endorse conspiracies.

Unadjusted associations between race/ethnicity and study covariates are reported in Table 4. AA/Black and Hispanic/Latinx participants are more likely to be $26 \leq 39$ years of age, have ≤ 12 years of education, a household income of less than \$30,000, and experience at least one SDOH barrier since the onset of COVID-19 when compared to NHW/others. AA/Blacks and Hispanics/Latinx were also significantly more likely to receive their COVID-19-related information from healthcare providers and CHWs (OR, 1.83; 95% CI 1.10–3.05; OR, 3.41; 95% CI 1.79–6.48, respectively) than NHWs/others. Additionally, AA/Blacks and Hispanics/Latinx were significantly more likely to endorse conspiracy beliefs (OR, 6.68; 95% CI 3.70–12.08) and report medical distrust (OR, 3.78; 95% CI 1.76–8.13) than NHWs/others.

Multivariate Analysis. Table 3 highlights the multivariate adjusted associations between the retained sociodemographic factors (age, sex, race/ethnicity, and household income) and personal health characteristics (cancer survivorship and self-rated health status), additional model-selected covariates, and vaccine hesitancy. In the final model accounting for the retained sociodemographic factors and personal health characteristics, and the additional covariates that met the inclusion criterion of $p < 0.05$ (perceived risk of COVID-19 infection, and COVID-19 information source: medical institutions and CHWs), AA/Black and Hispanic/Latinx respondents were significantly more likely to be vaccine hesitant (OR, 3.62; 95% CI, 1.77, 7.40) compared to NHWs/others. In

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this final model, low perceived risk of becoming infected with COVID-19 was also associated with a 3.41 (95% CI 1.52, 7.63) increased odds of hesitancy. On the other hand, participants reporting endorsement of conspiracy beliefs were at a 2.87 (OR, 2.87; 1.37, 5.99) higher odds of vaccine hesitancy, compared to those who did not endorse conspiracies. Respondents that relied on COVID-19 information from sources other than medical institutions or CHWs were at an elevated odds of hesitancy (OR, 2.53; 95% CI 1.35, 4.73; and OR, 3.17; 95% CI 1.27, 7.90, respectively) compared to those who engaged with these sources. The final model accounting for the retained and selected covariates had excellent discrimination (AUC, 0.82) and appropriate fit according to the Hosmer and Lemeshow test ($p>0.05$).

Based on the results of the correlation and multicollinearity diagnostic tests, we explored the possible interaction between race/ethnicity and conspiracy beliefs. In the final multivariate adjusted model, there was a significant interaction ($p=0.014$) between race/ethnicity and conspiracy beliefs. As outlined by Figure 1, endorsement of conspiracy beliefs was not a significant predictor of vaccine hesitancy for AA/Black and Hispanic/Latinx (OR, 1.05; 95% CI 0.38–2.89) participants compared to those who did not support conspiracies, whereas it was a significant predictor among NHW/others (OR, 7.50; 95% CI 2.60–21.60).

DISCUSSION

Among this community-based population, nearly four in ten participants were hesitant to receive the COVID-19 vaccine, which tracks with other studies conducted around the same time.^{12,23} Although greater efforts to increase vaccine uptake are needed in all communities, there remains significant disparities in vaccine acceptance between groups. As noted previously, females had almost a two times higher odds of vaccine hesitancy compared to males, signifying potential

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challenges related to both minority status and identifying as female.^{8,9} Generally, females are more likely to enact preventive behaviors and avoid risk, such as wearing masks, but that is not the case for COVID-19 vaccination.²⁴ While not included in this analysis, fallacious beliefs regarding infertility caused by the COVID-19 vaccine might be playing a role in vaccine-related hesitancy among females.²⁵ Participants from low SES backgrounds had significantly higher odds of vaccine hesitancy compared to those from more affluent backgrounds, as seen elsewhere.⁸⁻¹⁰ A unique aspect of this analysis indicated that SDOH barriers in the onset of the COVID-19 pandemic, including difficulty paying bills, food insecurity, and housing insecurity, were also significantly associated with hesitancy. COVID-19 vaccine hesitancy in lower socioeconomic groups might be attributed to existing vaccine hesitancy (such as that from the influenza vaccine), lack of awareness and health literacy, decreased trust, and the infrequency of interactions with healthcare professionals.⁹ Vaccine hesitancy in those that experience SDOH barriers, meanwhile, may be attributed to lack of access to vaccination and related information, yet no other analysis has presented this association.³

Even after adjustment for all associated covariates, AA/Black and Hispanic/Latinx participants had almost four-times the odds of vaccine hesitancy compared to NHW/others. Although other reports have indicated similar results, our study helps to elucidate additional factors associated with these attitudes.⁸⁻¹³ Prior explanations include decreased access to and interaction with healthcare professionals, historical mistrust with the healthcare system, lower awareness, and education.^{26,27} Although access to care and decreased interactions with healthcare professionals were not explanatory in our analysis, four health-related beliefs (perceived risk of COVID-19 infection, COVID-19 information sources: medical institutions and CHWs, and conspiracy beliefs) shed additional light on associations between racial/ethnic identification and hesitancy.

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Population-level interventions (e.g., public health media campaigns and community education programs) that provide messages aimed at increasing awareness of risk might be effective in promoting vaccine acceptance in vulnerable communities.²⁸ Additionally, fostering and seeding trustworthy and credible sources of healthcare information that resonate with AA/Black and Hispanic/Latinx communities is of the utmost importance. A task more complex than it sounds since our analysis reveals that AA/Blacks and Hispanics/Latinx are more likely to obtain COVID-19 information from health care sources, despite reporting lower levels of confidence in the healthcare system and more medical distrust. Interventions should therefore target increasing trust in the healthcare system, not necessarily aim to increase the frequency of engagement with the system.²⁹ Utilizing healthcare leaders from diverse backgrounds to give information to vulnerable communities might be a critical step in getting hesitant populations to trust public health interventions, such as COVID-19 vaccines.

Although endorsement of conspiracy beliefs was significantly associated with an increased odds of vaccine hesitancy, and AA/Black and Hispanic/Latinx respondents were more likely to support conspiracy beliefs than NHW/others, endorsement of conspiracy beliefs did not impact vaccine attitudes in AA/Blacks and Hispanics/Latinx. In contrast, NHW/others who endorsed conspiracies were significantly more likely to be hesitant. One reason conspiracy-related ideologies may not impact AA/Black and Hispanic/Latinx community members is that there are other mechanisms outside of conspiracies, such as healthcare distrust or confidence in the healthcare system, that lead to hesitancy in the lives of AA/Blacks and Hispanics/Latinx. This distrust likely stems from decades of mistreatment by the healthcare system and US government, from instances such as the Tuskegee trials and the legacy of Henrietta Lacks.¹⁴ When promoting vaccine-related information in communities of color, these issues must be addressed and

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acknowledged. This analysis supports the prior literature that AA/Blacks and Hispanics/Latinx are more likely to endorse conspiracy beliefs, but changes the narrative: conspiracy beliefs are not driving their hesitancy.^{30,31} Among NHW/others there was a causal link between conspiracy beliefs and vaccine hesitancy, which has not yet been reported.^{30,31} The inclusion of a disproportionately high number of low SES NHW/other participants compared to the general population of CT, may be the driver of these attitudes, while enabling us to capture this result.³² The racial/ethnic difference among those who endorse conspiracy beliefs may also be indicative of both the strong impact conspiracy ideologies have on NHWs/others, and other factors outside of conspiracy beliefs in the lives of AA/Black and Hispanic/Latinx individuals that may be impacting vaccine hesitancy.

Among the study's limitations was sample size, which was exacerbated by the COVID-19 pandemic. This sample size limitation, including representativeness, also hinders generalizability. These results may therefore align with those in similar communities, particularly in regards to sociodemographic composition, but not to the entire country. Due to the cross-sectional nature of this study, we are only able to assess correlates of vaccine hesitancy at a single point in time. Similarly, due to pandemic related delays and other factors implicated in our ability to get a large number of participants, our study was conducted over several months. Despite this issue, we don't believe vaccine attitudes in our population changed significantly in this period, due to the relative stability of infections in CT and lack of approval for a COVID-19 vaccine at the time.^{1,2} Although the sampling strategy relied heavily on internet access, and this may have selectively impacted participation, we offered an alternative participation strategy in which someone from our team administered the survey by telephone when needed. Strengths of this study included the successful ability to assess and access communities most impacted by the COVID-19 pandemic; partnership with a community-based organization (CARE) to receive community input on the questionnaire's

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development; survey depth and breadth, allowing for the assessment of various sets of covariates; availability in English and Spanish languages; and the diversity of respondents, including cancer survivors, which provides a unique snapshot of community-level needs in a time of a unique public health challenge.

PUBLIC HEALTH IMPLICATIONS

Our results suggest that there is substantial COVID-19 vaccine hesitancy among all populations and even more in AA/Black and Hispanic/Latinx communities. With herd immunity estimates at approximately 70%, vaccine hesitancy of the proportion seen in this analysis has considerable implications for the future of the COVID-19 pandemic response.³³ However, the results of this study provide actionable information that enable us to better target public health interventions. For example, in instances such as the California Civil Rights Initiative, which prohibits the state from explicitly using race or ethnicity as a factor for the allocation of pandemic relief, socioeconomic indicators and SDOH may be useful targets for the distribution of vaccine information and other forms of pandemic relief.^{34,35} As seen in our population, those from communities of color experience low SES and SDOH barriers more often than their NHW counterparts. Public health interventions aimed at abating vaccine hesitancy can therefore target locations that attempt to alleviate economic stressors and SDOH barriers in vulnerable populations. For instance, food banks can be used to distribute vaccine-related information to aid in the effective communication of the intervention's safety and efficacy. Furthermore, because these vulnerable communities also contain a disproportionate number of racially and ethnically diverse community members, we can be confident that these populations experience multiple layers of social fragility that might negatively impact their views on the COVID-19 vaccine. Increasing perceptions of risk

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through the utilization of health-related sources may be significant in altering vaccine attitudes. Interventions of this nature must also focus on growing trust and confidence, which may be achieved through cross-sectoral collaborations between healthcare workers, medical institutions, and community-based organizations that identify with the populations in greatest need. On the other hand, interventions may decrease focus on changing falsehoods in communities of color and transition to programs aimed at increasing assurance in the systems that developed the vaccines and their safety.¹⁴ Ultimately, this paper reveals significant and actionable associations that may be practically applied to decrease vaccine hesitancy among all racial/ethnic groups in vulnerable communities.

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Figures and Tables

TABLE 1 – Descriptive Characteristics of the Study Population: Connecticut, August–December, 2020^a

	<i>No. of Participants in Group (%)^b</i>
Sociodemographic Factors	
N = 252	
Age in years	
26 ≤ 39	71 (28.2)
40 ≤ 54	87 (34.5)
≥ 55	94 (37.3)
Sex	
Female	176 (69.8)
Male	76 (30.2)
Race/ethnicity	
Non-Hispanic Black	59 (23.5)
Hispanic	44 (17.5)
Other	13 (5.2)
Non-Hispanic White	135 (53.8)
Household income	
< \$30,000	81 (33.3)
≥ \$30,000	162 (66.7)
Educational level (years)	
≤12	53 (21.9)
>12	189 (78.1)
Social Determinant of Health barriers	
Difficulty paying utility bills	111 (44.2)
No difficulty paying utility bills	140 (55.8)
Food insecure	125 (49.6)
Food secure	127 (50.4)
Housing insecure	44 (17.5)
Housing secure	208 (82.5)
Personal Health Characteristics	
Cancer Survivorship	
No	169 (67.1)
Yes	83 (32.9)
Self-Rated Health	
Poor or Fair	63 (25.3)
Good / Very Good / Excellent	186 (74.7)
COVID-19 Health Beliefs	
Vaccine Hesitancy ^c	
No	154 (61.1)
Yes	98 (38.9)
Perceived Risk of COVID-19 ^d	
Low	165 (70.8)
High	68 (29.2)
Conspiracy beliefs ^e	
No	152 (64.4)
Yes	84 (35.6)
Confidence in the Healthcare System ^f	2.0 (3.0)
COVID-19 Information Source: Medical Institution	
No	132 (52.4)
Yes	120 (47.6)
COVID-19 Information Source: Healthcare provider	
No	128 (50.8)
Yes	123 (49.2)
COVID-19 Information Source: CHW	
No	201 (79.8)
Yes	51 (20.2)
Medical Distrust, Discrimination, and Access	

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Medical Distrust ^g	
Yes	35 (13.9)
No	217 (86.1)
Everyday discrimination ^h	
Some	191 (77.3)
None	56 (22.7)
Access to Care ⁱ	
No	80 (31.9)
Yes	171 (68.1)

^a Table values are n and (%) for categorical variables and median and interquartile ranges (IQR) for continuous variables.

^b Numbers may not sum to total due to missing data, and percentages may not sum to 100% due to rounding.

^c *Vaccine Hesitancy* is a dichotomous variable indicating disagreement or uncertainty (no) and agreement (yes) with receiving the COVID-19 vaccine if recommended by a healthcare provider.

^d *Perceived Risk of COVID-19* is a dichotomous variable corresponding to perceived risk of being infected with COVID-19, coded as low perceived risk versus high perceived risk.

^e *Conspiracy beliefs* is a composite measure of two variables indicating either fallacious beliefs in mask wearing or release of COVID-19 by another country.

^f *Confidence in the Healthcare System* is a composite measure of confidence in health care providers, hospitals, local public health authorities, and national health organizations in protecting individuals from COVID-19. The value is a continuous measure with a maximum of 12.00, indicating low confidence.

^g *Medical distrust* is a dichotomous variable related to discriminatory experiences while seeking healthcare (yes or no), in the past year.

^h *Everyday discrimination* is a composite measure of 10 variables related to experiences of discrimination, in day-to-day life. Coded as some versus no (none) experiences of discrimination.

ⁱ *Access to Care* is a composite measure of two variables assessing access to usual healthcare, in the past year. If no access to care was indicated for either question, access to care was coded as 'no'.

Abbreviations. No. = Number; CHW = Community Health Worker.

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TABLE 2 – Results of Bivariate Logistic Regression Models Predicting COVID-19 Vaccine Hesitancy: Connecticut, August–December, 2020^a

	<i>Vaccine Hesitancy^d</i>		<i>Unadjusted Point Estimate, OR (95% CI)^c</i>
	<i>Yes (%)^b</i>	<i>No (%)^b</i>	
Sociodemographic Factors			
Age in years			
26 ≤ 39	32 (45.1)	39 (54.9)	1.84 (0.97, 3.49)
40 ≤ 54	37 (42.5)	50 (57.5)	1.66 (0.90, 3.05)
≥ 55	29 (30.9)	65 (69.2)	1.00 (reference)
Sex			
Female	76 (43.2)	100 (56.8)	1.87 (1.05, 3.33)*
Male	22 (29.0)	54 (71.1)	1.00 (reference)
Race/ethnicity			
Non-Hispanic Black and Hispanic	58 (56.3)	45 (43.7)	3.60 (2.11, 6.15)*
Non-Hispanic White and Others	39 (26.4)	109 (73.7)	1.00 (reference)
Household income			
< \$30,000	45 (55.6)	36 (44.4)	2.88 (1.66, 5.01)*
≥ \$30,000	49 (30.3)	113 (75.8)	1.00 (reference)
Educational level (years)			
≤12	29 (54.7)	24 (45.3)	2.31 (1.24, 4.28)*
>12	65 (34.4)	124 (65.6)	1.00 (reference)
Social Determinants of Health ^e			
≥ 1 barrier	53 (47.8)	58 (52.3)	2.39 (1.40, 4.07)*
0 barriers	45 (32.1)	95 (67.9)	1.00 (reference)
Personal Health Characteristics			
Cancer Survivor			
No	72 (42.6)	97 (57.4)	1.63 (0.93, 2.84)
Yes	26 (31.3)	57 (68.7)	1.00 (reference)
Self-Rated Health			
Poor or Fair	30 (47.6)	33 (52.4)	1.65 (0.93, 2.95)
Good / Very Good / Excellent	66 (35.5)	120 (64.5)	1.00 (reference)
COVID-19 Health Beliefs			
Perceived Risk of COVID-19 ^f			
Low	75 (45.6)	90 (54.6)	2.50 (1.33, 4.69)*
High	17 (25.0)	51 (75.0)	1.00 (reference)
Conspiracy beliefs ^g			
Yes	48 (57.1)	36 (42.9)	3.86 (2.20, 6.80)*
No	39 (25.7)	113 (74.3)	1.00 (reference)
Confidence in the Healthcare System ^h	3.0 (4.0)	2.0 (4.0)	1.17 (1.06, 1.30)*
COVID-19 information source:			
Medical Institution			
No	65 (49.2)	67 (50.8)	2.56 (1.51, 4.33)*
Yes	33 (27.5)	87 (72.5)	1.00 (reference)
Healthcare Provider			
No	51 (39.8)	77 (60.2)	1.09 (0.65, 1.80)
Yes	47 (37.9)	77 (62.1)	1.00 (reference)
COVID-19 information source: CHW			
No	85 (42.3)	116 (57.7)	2.14 (1.08, 4.27)*
Yes	13 (25.5)	38 (74.5)	1.00 (reference)
Medical Distrust, Discrimination, and Access			
Medical Distrust ⁱ			
Yes	15 (42.9)	20 (57.1)	1.21 (0.59, 2.50)
No	83 (38.3)	134 (61.8)	1.00 (reference)
Everyday discrimination ^j			
Some	117 (61.3)	74 (38.7)	1.05 (0.57, 1.95)
None	35 (62.5)	21 (37.5)	1.00 (reference)
Access to Care ^k			
No	32 (40.0)	48 (60.0)	1.07 (0.62, 1.85)
Yes	68 (38.3)	103 (61.7)	1.00 (reference)

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^a Table values are n and (row %) for categorical variables and median and interquartile ranges (IQR) for continuous variables.

^b Numbers may not sum to total due to missing data, and percentages may not sum to 100% due to rounding.

^c OR predictions are predicting vaccine hesitancy for COVID-19.

^d *Vaccine Hesitancy* is a dichotomous variable indicating disagreement or uncertainty (no) and agreement (yes) with receiving the COVID-19 vaccine, if recommended by a healthcare provider.

^e *Social Determinants of Health* is a composite measure of food insecurity, housing insecurity, and inability to pay housing bills, since the onset of the COVID-19 Pandemic (March, 13, 2020).

^f *Perceived Risk of COVID-19* is a dichotomous variable corresponding to perceived risk of being infected with COVID-19, coded as low perceived risk versus high perceived risk.

^g *Conspiracy beliefs* is a composite measure of two variables indicating either fallacious beliefs in mask wearing or release of COVID-19 by another country.

^h *Confidence in the Healthcare System* is a composite measure of confidence in health care providers, hospitals, local public health authorities, and national health organizations in protecting individuals from COVID-19. The value is a continuous measure with a maximum of 12.00, indicating low confidence.

ⁱ *Medical distrust* is a dichotomous variable related to discriminatory experiences while seeking healthcare (yes or no), in the past year.

^j *Everyday discrimination* is a composite measure of 10 variables related to experiences of discrimination, in day-to-day life. Coded as some versus no (none) experiences of discrimination.

^k *Access to Care* is a composite measure of two variables assessing access to usual healthcare, in the past year. If no access to care was indicated for either question, access to care was coded as 'no'.

* Indicates statistical significance at $p < 0.05$.

Abbreviations. OR = odds ratio; CI = confidence interval; CHW = community health worker.

Racial and ethnic disparities in COVID-19 vaccine hesitancy

TABLE 3 – Results of Multivariate Logistic Regression Models Predicting COVID-19 Vaccine Hesitancy: Connecticut, August–December, 2020^a

	<i>Adjusted Point Estimate, OR (95% CI)^{b,c}</i>
Sociodemographic Factors	
Age in years	
26 ≤ 39	1.84 (0.82, 4.12)
40 ≤ 54	1.57 (0.72, 3.41)
≥ 55	1.00 (reference)
Sex	
Female	1.21 (0.60, 2.43)
Male	1.00 (reference)
Race/ethnicity	
Non-Hispanic Black and Hispanic	3.62 (1.77, 7.40)*
Non-Hispanic White and Others	1.00 (reference)
Household income	
< \$30,000	1.27 (0.61, 7.14)
≥ \$30,000	1.00 (reference)
Personal Health Characteristics	
Cancer Survivor	
No	0.93 (0.45, 1.92)
Yes	1.00 (reference)
Self-Rated Health	
Poor or Fair	1.53 (0.75, 3.14)
Good / Very Good / Excellent	1.00 (reference)
COVID-19 Health Beliefs	
Perceived Risk of COVID-19 ^d	
Low	3.41 (1.52, 7.63)*
High	1.00 (reference)
Conspiracy beliefs ^e	
Yes	2.87 (1.37, 5.99)*
No	1.00 (reference)
COVID-19 information source: Medical Institution	
No	2.53 (1.35, 4.73)*
Yes	1.00 (reference)
COVID-19 information source: CHW	
No	3.17 (1.27, 7.90)*
Yes	1.00 (reference)

^a OR predictions are predicting vaccine hesitancy for COVID-19.

^b All models included N=252 observations.

^c Adjusted by age, sex, race/ethnicity, household income, cancer survivorship status, self-rated health, perceived risk of COVID-19, conspiracy beliefs, COVID-19 information source: medical institution, and COVID-19 information source: CHW.

^d *Perceived Risk of COVID-19* is a dichotomous variable corresponding to perceived risk of being infected with COVID-19, coded as low perceived risk versus high perceived risk.

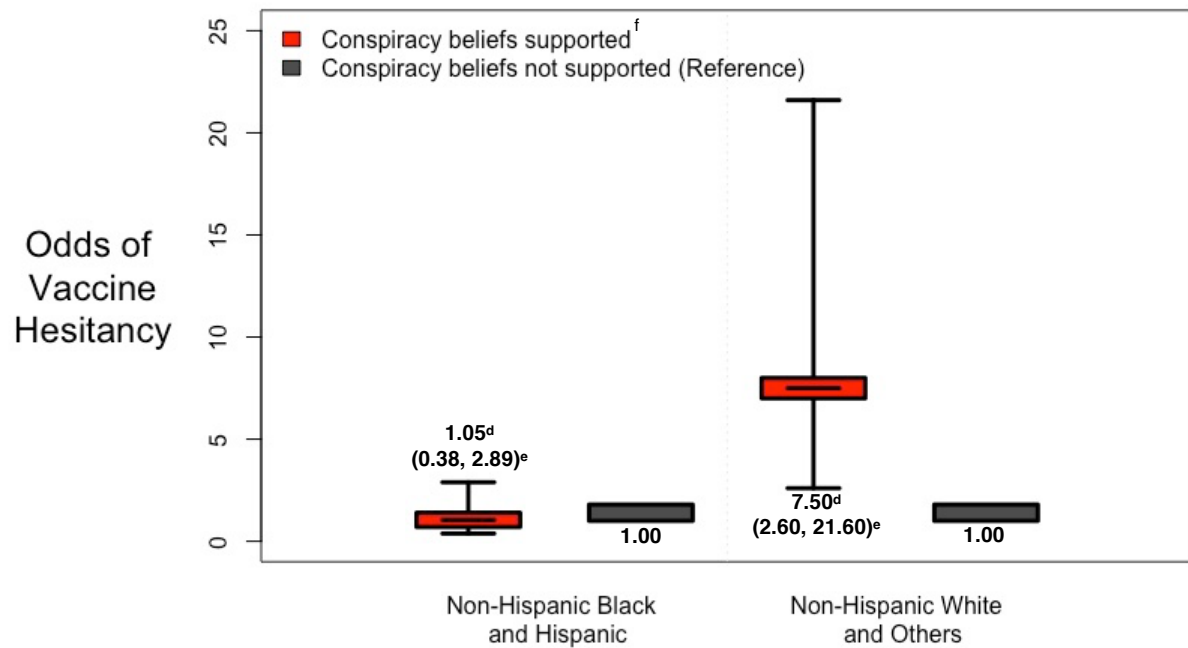
^e *Conspiracy beliefs* is a composite measure of two variables indicating either fallacious beliefs in mask wearing or release of COVID-19 by another country.

* Indicates statistical significance at p<0.05.

Abbreviations. OR = odds ratio; CI = confidence interval; CHW = community health worker.

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Figure 1 – Results of Multivariate Associations between Race/Ethnicity and Vaccine Hesitancy by Conspiracy Beliefs: Connecticut, August–December 2020^{a,b,c}



^a Odds ratio predictions are predicting vaccine hesitancy for COVID-19.

^b Adjusted by age, income, sex, cancer survivorship status, self-rated health, perceived risk of COVID-19, COVID-19 information source: medical institution, COVID-19 information source: Community Health Worker.

^c All models included N=252 observations.

^d Odds ratio (OR).

^e 95% confidence interval (CI).

^f *Conspiracy beliefs* is a composite measure of two variables indicating either fallacious beliefs in mask wearing or release of COVID-19 by another country.

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TABLE 4 – Results of Bivariate Logistic Regression Models Predicting Race/Ethnicity: Connecticut, August–December, 2020^a

	Race/Ethnicity		Unadjusted Point Estimate, OR (95% CI) ^c
	AA/Black or H/L (%) ^b n = 103 (40.9)	NHW or Other (%) ^b n = 149 (59.1)	
Sociodemographic Factors			
Age in years			
26 ≤ 39	33 (32.0)	37 (25.0)	1.90 (1.00, 3.61)
40 ≤ 54	40 (38.8)	47 (31.8)	1.82 (0.99, 3.32)
≥ 55	30 (29.1)	64 (43.2)	1.00 (reference)
Sex			
Female	78 (75.7)	97 (65.5)	1.64 (0.93, 2.88)
Male	25 (24.3)	51 (34.5)	1.00 (reference)
Educational level (years)			
≤12	35 (35.4)	18 (12.7)	3.77 (1.98, 7.17)
>12	64 (64.7)	124 (87.3)	1.00 (reference)
Household income			
< \$30,000	50 (50.5)	31 (21.7)	3.69 (2.11, 6.45)
≥ \$30,000	49 (49.5)	112 (78.3)	1.00 (reference)
Social Determinants of Health ^d			
At least one SDOH barrier	79 (76.7)	64 (43.2)	4.32 (2.47, 7.57)
None	24 (23.3)	84 (56.8)	1.00 (reference)
Personal Health Characteristics			
Cancer Survivor			
No	75 (72.8)	93 (62.8)	1.58 (0.92, 2.74)
Yes	28 (27.2)	55 (37.2)	1.00 (reference)
Self-Rated Health			
Poor or Fair	28 (27.5)	34 (23.3)	1.25 (0.70, 2.23)
Good / Very Good / Excellent	74 (72.6)	112 (76.7)	1.00 (reference)
COVID-19 Health Beliefs			
Perceived Risk of COVID-19 ^e			
High	33 (34.7)	35 (25.6)	1.55 (0.88, 2.75)
Low	62 (65.3)	102 (74.5)	1.00 (reference)
Conspiracy beliefs ^f			
Yes	56 (60.9)	27 (18.9)	6.68 (3.70, 12.08)
No	36 (39.1)	116 (81.1)	1.00 (reference)
Confidence in the Healthcare System ^g	3.0 (5.0)	2.0 (3.0)	1.07 (1.00–1.22)
COVID-19 information source: Medical Institution			
Yes	49 (47.6)	71 (48.0)	0.98 (0.60, 1.63)
No	54 (52.4)	77 (52.0)	1.00 (reference)
COVID-19 information source: Healthcare provider			
Yes	60 (58.3)	64 (43.2)	1.83 (1.10, 3.05)
No	43 (41.8)	84 (56.8)	1.00 (reference)
COVID-19 information source: CHW			
Yes	33 (32.0)	18 (12.2)	3.41 (1.79, 6.48)
No	70 (68.0)	130 (87.8)	1.00 (reference)
Medical Distrust, Discrimination, and Access			
Medical Distrust ^h			
Yes	24 (23.3)	11 (7.4)	3.78 (1.76, 8.13)
No	79 (76.7)	137 (92.6)	1.00 (reference)
Everyday discrimination ⁱ			
Some	73 (73.7)	117 (79.6)	0.72 (0.40, 1.31)
None	26 (26.3)	30 (20.4)	1.00 (reference)
Access to Care ^j			
No	33 (33.3)	47 (32.0)	1.06 (0.62, 1.83)
Yes	66 (66.7)	100 (68.0)	1.00 (reference)

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^a Table values are n and (column %) for categorical variables and median and interquartile ranges (IQR) for continuous variables.

^b Numbers may not sum to total due to missing data, and percentages may not sum to 100% due to rounding.

^c OR predictions are predicting identification with Non-Hispanic Black or Hispanic race/ethnicity.

^d *Social Determinants of Health* is a composite measure of food insecurity, housing insecurity, and inability to pay housing bills, since the onset of the COVID-19 Pandemic (March, 13, 2020).

^e *Perceived Risk of COVID-19* is a dichotomous variable corresponding to perceived risk of being infected with COVID-19, coded as low perceived risk versus high perceived risk.

^f *Conspiracy beliefs* is a composite measure of two variables indicating either fallacious beliefs in mask wearing or release of COVID-19 by another country.

^g *Confidence in the Healthcare System* is a composite measure of confidence in health care providers, hospitals, local public health authorities, and national health organizations in protecting individuals from COVID-19. The value is a continuous measure with a maximum of 12.00, indicating low confidence.

^h *Medical distrust* is a dichotomous variable related to discriminatory experiences while seeking healthcare (yes or no), in the past year.

ⁱ *Everyday discrimination* is a composite measure of 10 variables related to experiences of discrimination, in day-to-day life. Coded as some versus no (none) experiences of discrimination.

^j *Access to Care* is a composite measure of two variables assessing access to usual healthcare, in the past year. If no access to care was indicated for either question, access to care was coded as 'no'.

Abbreviations. AA/Black = African American or Black; NHW = Non-Hispanic white; OR = odds ratio; CI = confidence interval; CHW = community health worker.