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Association between COVID-19 vaccine hesitancy and trust in the medical profession and public health officials

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ABSTRACT

One's personal physician, national and state or local public health officials, and the broader medical profession play important roles in encouraging vaccine uptake for COVID-19. However, the relationship between trust in these experts and vaccine hesitancy has been underexplored, particularly among racial/minority groups where historic medical mistrust may reduce uptake.

Using an April 2021 online sample of US adults ($n = 3041$) that explored vaccine hesitancy, regression models estimate levels of trust in each of these types of experts and between trust in each of these experts and the odds of being COVID-19 vaccine takers vs refusers or hesitaters. Interaction terms assess how levels of trust in the medical profession by race/ethnicity are associated with vaccine hesitancy. Trust in each expert is positively associated with trust in other experts, except for trust in the medical profession. Only trust in one's own doctor was associated with trust in the medical profession, as measured by factor scores derived from a validated scale. Lower levels of trust in experts were significantly associated with being either a hesitater or a refuser compared to being a taker. Black respondents had higher odds of being either a hesitater or a refuser compared to white respondents but the interaction with trust was insignificant. For Hispanic respondents only, the odds of being a hesitater declined significantly when trust in the medical profession rose. Mistrust in the medical profession, one's doctor and national experts contributes to vaccine hesitancy. Mobilizing personal physicians to speak to their own patients may help.

1. Introduction

COVID-19 is now the third leading cause of death in the United States despite advances in treatment and prevention (Murphy et al., 2021). Despite repeated efforts by medical and public health officials to encourage vaccination, a substantial portion of Americans have rejected that advice. (The Centers for Disease Control and Prevention, 2022) As of August 22, 2022, 21% of adults had not received the first COVID-19 vaccination (CDC, 2022). As a SAGE Working Group on vaccine hesitancy noted in 2014, vaccine hesitancy is specific to context, "varying across time, place and vaccines" and complex in that factors "such as complacency, convenience and confidence" influence vaccine decision making. (MacDonald et al., 2015) Consistent with that assessment, distrust in the COVID-19 vaccine and in public health or medical experts may have had many sources: evolving science, political ideologies, the length of the pandemic, a pre-existing growing anti-vaccine movement, fragmented and underfunded public health systems, and the rising influence of disputatious social and mainstream news sources have led to confusion and distrust in the public health response to the pandemic (Kaiser Family Foundation, 2021; Davies et al., 2002; Bean, 2011; Smith and Graham, 2019; Romer and Jamieson, 2020; Raghupathi et al., n.d.). Even federal, state and local public health officials have strongly advocated adults get vaccinated, the Kaiser Family Foundation's Vaccine Monitor June 2021 survey found that 83% of adults trusted their own doctors regarding the COVID-19 vaccine, while 69% trusted their local health departments, and only 56% trusted their state ones (Hamel et al., 2021). The impact of distrust in state/local health departments, or national public health experts on COVID-19 vaccine uptake has gotten substantial attention in the media but has been less well explored in the literature (Romero and Jordan, 2020; Darrough, 2020).

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Earlier responses to infectious disease epidemics have also stirred controversy. Consistent messaging from state, local and federal public health officials has helped (alongside the tightening of laws that had previously allowed wide ranging exemptions from child vaccines in some states), as has the medical community's efforts to communicate the benefits of vaccines. Yet trust in the medical profession has declined over the past fifty years, such that in 2014 only 38% of respondents to the General Social Survey reported having high levels of confidence in medicine, down from over 60% in 1975, albeit still higher than confidence in other US institutions such as Congress, organized religion, or banks (Zheng, 2015; N.O.R.C, 2015). Platt found that trust in health care providers is higher than in other "information brokers" such as public health departments and university researchers (Platt et al., 2018).

A vast literature has explored trust in the health care system and trust in physicians, particularly as trust has been identified as crucial in promoting shared decision-making between patients and providers (Elwyn et al., 2012). Studies have also demonstrated that higher trust in physicians is associated with compliance with physician recommendations and better health outcomes, while lower levels of trust are associated with underutilization of preventive health screenings and flu vaccine uptake (Lee and Lin, 2009; Musa et al., 2009; Gupta et al., 2014; Ratanawongsa et al., 2013; Birkhauer et al., 2017; Richardson et al., 2012). Additional studies have demonstrated the importance of doctor's recommendations on their patients' intention to get vaccinated, and the SAGE Working Group on Vaccine Hesitancy identified trust in the health system and providers as a determinant of hesitancy (MacDonald et al., 2015; Berry et al., 2008; Chu et al., 2021; Yaqub et al., 2014; Zijtregtop et al., 2009). However, many studies have found that Blacks and Latinos have lower levels of trust in the medical profession and the health system than Whites, although trust in one's own doctor may modify that relationship (Gupta et al., 2014; Straits-Troster et al., 2006; Armstrong et al., 2006; Penner et al., 2017; Sewell, 2015; Smith, 2010; Sohler et al., 2007; Shen et al., 2018; Carter-Harris et al., 2020; Haywood Jr. et al., 2014). Evidence of medical mistrust is not consistent across ethnic and racial minority groups, but some studies have found that Hispanic men have lower levels of trust in doctor's recommendations for HPV vaccines than Black or White counterparts (Cooper et al., 2017). Notably, Wheldon et al. found that foreign-born Latinos had lower levels of trust in health information coming from governmental agencies than any other group (Wheldon et al., 2020). Moreover, studies have found higher rates of vaccine hesitancy for the influenza, COVID-19, H1N1 or HPV vaccines among some health care workers, minority groups and those of lower SES, than among the general public (Straits-Troster et al., 2006; Hajure et al., 2021; Peretti-Watel et al., 2014; Savoia et al., 2021). It is not clear, however, whether trust in the medical profession, as well as public health officials, has an independent role in predicting COVID-19 vaccine hesitancy for the population overall, and for racial and ethnic minority groups.

Trust in the health care system, in one's own doctor and in the medical profession has been explored through single-item questions and more complex scales (Hall et al., 2001). Ozawa & Sripad's systematic review of the measurement of health-related trust identified 45 validated multi-item measures of health system related trust (Ozawa and Sripad, 2013). In this study, we examine factors associated with trust in one's own doctor, national and state/local health officials, as well as the medical profession (using a validated scale) and assess whether trust in the these experts is associated with COVID-19 vaccine hesitancy. Given concerns that medical mistrust among African Americans and other minority groups prompted reluctance in these communities to be vaccinated, we also explore whether trust in the medical profession among different racial/ethnic groups is associated with COVID-19 vaccine hesitancy (Warren et al., 2020; Hamel et al., 2020).

2. Methods

2.1. Study sample

Our sample includes nationally representative US adults aged 18 or older recruited from Social Science Research Solutions (SSRS)'s Opinion Panel who responded to the COVID-19 Vaccine Hesitancy Survey in either English or Spanish between April 8th and 22nd, 2021, a period when vaccines had been approved for all US adults (*Solutions SSR*, 2021). Members of racial and ethnic minority groups and those in rural areas were oversampled. Data were unweighted to preserve our ability to investigate differences by race/ethnicity. Responses were included if they met quality control measures incorporated in the survey, resulting in a sample of 3014 respondents (for more details on the survey, see Anonymous, 2022) (Anonymous, 2022). The study was approved by the New York University Institutional Review Board (IRB).

2.2. Outcome measures

Acceptance of the COVID-19 vaccine: Respondents were asked "Have you received the COVID-19 vaccine" and the answer choices were 1) *yes, fully vaccinated*, 2) *yes, received 1 of 2 doses of multi-dose vaccine*, and 3) *not been vaccinated*. Those responding either 2 or 3 were asked how likely they were to get the COVID-19 vaccine. Options were: 1) *I will take it as soon as I can*, 2) *I will wait to see how it goes before taking it*, 3) *I am undecided if I will take the vaccine and 4) I will not take the vaccine*. Respondents were categorized into three groups: takers (either fully/partially vaccinated or eager to take it), hesitaters (wait and see or undecided), and refusers (answer 4). In analyses, takers were compared to hesitaters and refusers.

2.3. Independent variables

Trust in the medical profession: Respondents were asked their level of agreement with five questions of a validated scale capturing one's trust in the medical profession: (1) *Sometimes doctors care more about what is convenient for them than about their patient's medical needs[reverse coded for analysis]*, (2) *Doctors are extremely thorough and careful*, (3) *I completely trust doctors' decisions about which medical treatments are best*, (4) *A doctor would never mislead me about anything*, and (5) *All in all, I trust doctors (*Dugan et al., *2005)*. The answers ranged from 1 (strongly agree) to 4 (strongly disagree). Eigenvalues and scree plots from exploratory factor analysis (EFA) were used to determine the number of factors. Confirmatory factor analysis (CFA) tested model fit using a structural equation model. After CFA, summary scores and regression-based methods estimated a standardized factor score as a scale to represent a level of trust in the medical profession, validated using Cronbach's alpha.

Trust in national officials, state or local officials, and one's own doctor: Respondents were asked "How much do you trust each of the following sources to give you accurate information about the COVID-19 vaccine?" on a 5-point scale with 1 being the least amount of trust and 5 the highest trust. Here we analyzed responses to (1*) national experts in public health such as NIH or CDC representatives*, (2) *state or local public health officials*, and (3) *my doctor or healthcare provider*.

2.4. Covariates

Covariates included age, gender, race and ethnicity, educational attainment, employment status, household income, religion, area of residence, census region, type of health insurance, being a parent, and political party. Questions regarding COVID-19 exposure included whether the respondents have contracted COVID-19, personally knew someone who died of COVID-19, and financial hardship. A continuous variable measured the severity of the financial hardship (lost income, lost job, trouble paying rent/basic needs) experienced due to COVID-19

or measures taken to address it. After determining that these were not statistically significant in the models, we include a binary indicator that indicates any hardship vs no hardship.

2.5. Statistical analysis

Descriptive statistics for the sample were calculated. *t*-test or analysis of variance (ANOVA) with Tukey's post-hoc tests evaluated statistically significant associations between the variables and the crude average scores of the level of trust in the medical profession. Multiple linear and logistic regression models estimated how much variance in trust in the medical profession, measured by standardized factor scores, or in the high levels of trust in national, state/local or one's own doctor was explained by other independent variables and covariates. AIC was used to select cut-points for creating trust indicators for the other Likert-scaled trust measures. The two highest trust categories for trust in the national public health experts and in one's own doctor were selected for those models, while the highest level of trust category was selected for state/local experts. Unadjusted (see Appendix A) and adjusted logistic regression models (adjusted for socio-demographics and COVID-19 exposure variables) assessed the relationship between the independent variables and vaccine hesitancy by comparing takers with hesitaters, and takers with refusers, using an alpha level of 0.05. An interaction term between the standardized factor scores of the level of trust in the medical profession and race/ethnicity was included in the adjusted models with predicted margins estimated for its values. Analyses were performed using Stata/SE 17.0 (StataCorp, 2021).

3. Results

Table 1 presents the study sample's descriptive statistics. Most respondents were 30–64 years of age, and 54.3% were male. Consistent with oversampling, 56.3% of the sample was non-Hispanic White. Less than a third of the sample (28.1%) had post-college or professional degree training. A majority had private health insurance (52.0%), were employed (64.4%), were not a parent (70.4%), or lived in a metro area (82.1%). Over 60% of the survey population experienced financial hardship as a result of the pandemic. Most respondents reported they had not contracted COVID-19 (86.5%) and did not know anyone who had died of COVID-19 (59.2%). 69.4% indicated that they had been vaccinated or were eager to be, 19.4% stated they would wait and see about the vaccine or were undecided, and 11.2% responded they would refuse to be vaccinated. A majority of respondents indicated high levels of trust (4 or 5) in information messengers, with the level of trust highest for one's own provider (73.9%) and lowest for state/local public health officials (56.8% had high levels of trust).

Table 2 presents results from linear regression models estimating the relationship between factor scores measuring trust in the medical profession and measures of trust in national or state/local government officials and in one's own doctor (Model 1), and logistic regression models estimating the relationship between the highest level of trust in national experts (Model 2), state/local experts (Model 3) and one's own doctor (Model 4) and the other experts, adjusted for social, demographic, and COVID-19 characteristics. In the linear regression model, only trust in one's own doctor was associated significantly with trust in the medical profession: on average, every one unit increase in the level of trust in one's own doctor was associated with a 0.39 (95% CI = 0.35–0.43) increase in the trust factor score. In the logistic regression models, higher levels of trust in the medical profession or national public health experts or state/local public health experts or one's own doctor were significantly and positively associated with trust in each of them, controlling for other covariates.

Table 3 presents results from adjusted logistic regression models comparing hesitaters to takers (Models 1–3) and refusers to takers (Models 4–6). Models 1 and 4 test the relationship of the independent variables to the outcome. Models 2 and 5 add covariates to those models,

Table 1
Descriptive statistics for survey respondents, April 8–222, 2021 (n = 3014).

Sociodemographic factors	N (%)
Age group	
18–29	475 (15.8%)
30–49	1112 (37.1%)
50–64	786 (26.2%)
65+	625 (20.9%)
Gender	
Female	1370 (45.7%)
Male	1627 (54.3%)
Race/ethnicity	
Non-Hispanic white	1684 (56.3%)
Non-Hispanic black	570 (19.1%)
Hispanic	531 (17.8%)
Other	204 (6.8%)
Educational attainment	
Less than or graduated high school	615 (20.4%)
Less than or graduated college	1551 (51.5%)
Post-graduate/professional	847 (28.1%)
Employment status	
Unemployed	1071 (35.6%)
Employed	1941 (64.4%)
Household income	
<$25,000	515 (17.1%)
$25,000- < $50,000	656 (21.8%)
$50,000 - < $75,000	573 (19.0%)
$75,000 - < $100,000	464 (15.4%)
$100,000+	803 (26.7%)
Religion	
Protestant	615 (21.7%)
Evangelical	193 (6.4%)
Catholic	633 (21.1%)
Other	635 (21.1%)
Nothing in particular/ atheist/ agnostic	894 (29.7%)
Area of residence	
Rural	532 (17.9%)
Metro	2445 (82.1%)
Census region	
Northeast	546 (18.3%)
North central	626 (20.9%)
South	1158 (38.7%)
West	661 (22.1%)
Type of health insurance	
Private	1566 (52.0%)
Medicare	666 (22.1%)
Medicaid	401 (13.3%)
TRICARE/VA/Indian/other	187 (6.2%)
Uninsured	193 (6.4%)
Parent	
No	2110 (70.4%)
Yes	886 (29.6%)
Political party	
Republican	713 (23.7%)
Democrats	1162 (38.6%)
Independent	996 (33.1%)
Other	143 (4.7%)
COVID-19 exposure	

(continued on next page)

Table 1 (*continued*)

Sociodemographic factors	N (%)
Have you had COVID-19?	
No	2607 (86.5%)
Yes	407 (13.5%)
Do you personally know anyone who died of COVID-19?	
No	1785 (59.2%)
Yes	1229 (40.8%)
Financial impact: Lost income[a]	
No	2241 (74.4%)
Yes	773 (25.7%)
Financial impact: Lost job	
No	2695 (89.4%)
Yes	319 (10.6%)
Financial impact: Trouble paying rent/basic needs	
No	2520 (83.6%)
Yes	494 (16.4%)
Financial impact: None	
No	1803 (59.8%)
Yes	1211 (40.2%)
Trust in the medical profession	
Convenience and medical needs[b]	
1 strongly disagree	445 (14.8%)
2	894 (29.7%)
3	1394 (46.3%)
4 strongly agree	281 (9.3%)
Median	3
Mean	2.5
Thorough and careful	
1 strongly disagree	77 (2.6%)
2	496 (16.5%)
3	1849 (61.4%)
4 strongly agree	592 (19.6%)
Median	3
Mean	2.98
Trust doctor's decisions	
1 strongly disagree	97 (3.2%)
2	542 (18.0%)
3	1776 (58.9%)
4 strongly agree	599 (19.9%)
Median	3
Mean	2.95
Never mislead	
1 strongly disagree	208 (6.9%)
2	870 (28.9%)
3	1314 (43.6%)
4 strongly agree	622 (20.6%)
Median	3
Mean	2.78
All in all trust	
1 strongly agree	78 (2.6%)
2	282 (9.4%)
3	1673 (55.5%)
4 strongly disagree	981 (32.6%)
Median	3
Mean	3.18
Trust level of information messengers	
National experts in public health	
1 least amount of trust	281 (9.3%)
2	215 (8.6%)
3	464 (15.4%)
4	778 (25.8%)
5 greatest trust	1231 (40.9%)
State/local public health officials	
1 least amount of trust	263 (8.7%)
2	297 (9.9%)
3	742 (24.6%)
4	1022 (33.9%)
5 greatest trust	690 (22.9%)
My doctor or healthcare provider	
1 least amount of trust	70 (2.3%)
2	146 (4.8%)
3	542 (18.0%)
4	1139 (37.8%)
5 greatest trust	1117 (37.1%)
COVID-19 vaccine hesitancy spectrum	
Vaccination status	
Fully/partially vaccinated	1779 (59.0%)
Eager to get vaccinated	313 (10.4%)
Wait and see	274 (9.1%)
Undecided	310 (10.3%)
Refusal	337 (11.2%)

[a] Financial impact included four questions. After testing each question, they were treated as binary (whether or not one had suffered financial impacts due to pandemic) in final analyses.

[b] Reverse coded for analysis.

and Models 3 and 6 add an interaction term between the standardized factor scores for trust in the medical profession and race/ethnicity. As shown in model 1, those who trusted the medical profession had 27% lower odds of being hesitaters (AOR = 0.73, 95% CI = 0.64–0.83), those who trusted national officials had 64% lower odds (AOR = 0.36, 95% CI = 0.29–0.45), those who trusted state/local officials had 43% lower odds (AOR = 0.57, 95% CI = 0.42–0.78), and those who trusted their own doctor had 42% lower odds (AOR = 0.38, 95% CI = 0.30–0.29) of being vaccine hesitaters compared to takers. These relationships persisted when other covariates were added to the model (Model 2). When the interaction term was added to the model (Model 3) trust in the medical profession was no longer significant, but other relationships persisted. The interaction term was significant only for Hispanic respondents (AOR = 0.67, 95%CI = 0.46–0.95). Predictive margins plotting these relationships (Fig. 1) reveal that for Hispanic respondents, the probability of being in the hesitater group declines significantly as mean factor scores increased. Comparing refusers to takers revealed a different pattern: as shown in Model 4, greater trust in the medical profession (0.56, 95% CI = 0.47–0.67) was associated with a lesser likelihood of being a refuser compared to a taker, while lower levels of trust in national officials (AOR = 0.14, 95% CI 0.10–0.20) or in one's own doctor (AOR = 0.14, 95% CI 0.10–0.19) were associated with higher odds of being a refuser compared to a taker. Again, these relationships persist when covariates are added to the model (Model 5). As seen in Model 6, the interaction terms are insignificant when comparing refusers to takers.

Notably, across these models, non-Hispanic Blacks in our sample had higher odds than Whites of being both a hesitater or a refuser, compared to a taker, as did those who were 18–29, had less educational attainment, and were Republicans compared to Democrats, holding constant other covariates and the interaction terms. Knowing someone who had died of COVID-19 decreased one's odds of being a hesitater (Model 2, AOR = 0.70, 95% CI 0.56–0.89), compared to a taker (but not a refuser). Those who had contracted COVID-19 had higher odds (Model 5, AOR = 1.65 CI = 1.06–2.57) of being a refuser than being a taker. Sensitivity analyses revealed that relationships in both models persisted when the

Table 2
Association between levels of trust in the medical profession, national public health experts, state/local public health officials, and one's own doctor and socio-demographics, and COVID-19 exposure with 95% CI (n = 3014).

	Model 1: Medical profession[a]	Model 2: National public health experts[b]	Model 3: State/local public health experts[b]	Model 4: One's own doctor[b]
	Coefficient (95%CI)	Adjusted OR (95% CI)	Adjusted OR (95%CI)	Adjusted OR (95%CI)
Trust level of leaders				
Medical profession	–	**1.31***	**1.67***	**2.79***
		(1.14, 1.49)	**(1.46,1.91)**	**(2.40, 3.23)**
National Experts	0.03	–	**13.1***	**8.07***
	(0.00,0.07)		**(7.97, 21.61)**	**(6.29, 10.35)**
State/local experts	0.03	**12.79***	–	**4.73***
	(−0.01,0.07)	**(7.75, 21.07)**		**(2.85, 7.85)**
One's own doctor	**0.39***	**8.02***	**4.53***	–
	(0.35, 0.43)	**(6.25, 10.30)**	**(2.75,7.47)**	
Sociodemographic characteristics				
Age group				
18–29	−0.14	1.39	0.83	0.89
	(−0.28,0.00)	(0.81, 2.40)	(0.51, 1.36)	(0.50, 1.58)
30–49	**−0.15**	1.14	0.68	0.74
	(−0.27, −0.02)	(0.69, 1.91)	(0.42, 1.08)	(0.43, 1.27)
50–64	**−0.18**	1.30	0.71	1.01
	(−0.31, −0.06)	(0.81, 2.10)	(0.46, 1.09)	(0.60, 1.68)
65+	*Ref*	*Ref*	*Ref*	*Ref*
Gender				
Female	*Ref*	*Ref*	*Ref*	*Ref*
Male	**−0.15***	**1.44**	**1.26**	0.79
	(−0.21, −0.10)	**(1.15, 1.79)**	**(1.03, 1.55)**	(0.62, 1.00)
Race/ethnicity				
Non-Hispanic white	*Ref*	*Ref*	*Ref*	*Ref*
Non-Hispanic black	0.01	0.76	0.88	**0.63**
	(−0.07, 0.10)	(0.55, 1.06)	(0.65, 1.19)	**(0.44, 0.88)**
Hispanic	−0.01	1.21	1.03	**0.61**
	(−0.10, 0.07)	(0.88, 1.69)	(0.76, 1.40)	**(0.44, 0.85)**
Other	0.01	1.30	0.78	1.22
	(−0.11, 0.13)	(0.81, 2.10)	(0.52, 1.15)	(0.70, 2.11)
Educational attainment				
Less than/grad HS	**0.18***	**0.35***	**0.71**	0.72
	(0.09,0.27)	**(0.25, 0.49)**	**(0.50, 098)**	(0.51, 1.04)
Less than/ grad college	0.05	**0.59***	0.80	0.82
	(−0.02,0.12)	**(0.45, 0.77)**	(0.64, 1.01)	(0.61, 1.10)
Post-grad/professional	*Ref*	*Ref*	*Ref*	*Ref*
Employment status				
Unemployed	−0.02	1.07	1.22	1.02
	(−0.09,0.04)	(0.83, 1.39)	(0.95, 1.56)	(0.77, 1.35)
Employed	*Ref*	*Ref*	*Ref*	*Ref*
Household income				
<$25,000	0.00	1.16	1.44	**0.60**
	(−0.11,0.10)	(0.77, 1.75)	(0.98, 2.11)	**(0.39, 0.92)**
$25,000–$49,999	0.03	1.03	1.22	0.70
	(−0.06,0.12)	(0.73, 1.45)	(0.88, 1.67)	(0.49, 1.01)
$50,0000–$74,999	−0.02	1.02	1.05	0.96
	(−0.10,0.07)	(0.74, 1.42)	(0.78, 1.42)	(0.67, 1.36)
$75,000–$100,000	−0.03	1.03	0.89	1.14
	(−0.12,0.05)	(0.73, 1.44)	(0.65, 1.23)	(0.79, 1.68)
$100,00+	*Ref*	*Ref*	*Ref*	*Ref*
Religion				
Protestant	*Ref*	*Ref*	*Ref*	*Ref*
Evangelical	0.00	0.80	1.41	0.86
	(−0.12,0.13)	(0.51, 1.25)	(0.85, 2.34)	(0.56, 1.33)
Catholic	0.03	1.04	1.29	1.16
	(−0.06,0.12)	(0.75, 1.45)	(0.91, 1.81)	(0.82, 1.66)
Other	−0.03	1.19	**1.42**	1.14
	(−0.12, 0.05)	(0.86, 1.63)	**(1.03, 1.97)**	(0.82, 1.62)
Nothing/atheist/ agnostic	−0.07	**1.40**	1.26	1.15
	(−0.15,0.01)	**(1.03, 1.91)**	(0.91, 1.73)	(0.83, 1.59)

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Table 2 (*continued*)

	Model 1: Medical profession[a]	Model 2: National public health experts[b]	Model 3: State/local public health experts[b]	Model 4: One's own doctor[b]
	Coefficient (95%CI)	Adjusted OR (95% CI)	Adjusted OR (95%CI)	Adjusted OR (95%CI)
Area of residence				
Rural	*Ref*	*Ref*	*Ref*	*Ref*
Metro	**0.10**	1.26	0.73	0.99
	(0.03,0.17)	(0.96, 1.66)	(0.55, 0.96)	(0.74, 1.32)
Census region				
Northeast	*Ref*	*Ref*	*Ref*	*Ref*
North central	0.06	0.78	1.19	0.90
	(−0.03,0.14)	(0.56, 1.10)	(0.88, 1.62)	(0.63, 1.30)
South	−0.02	0.82	0.85	0.90
	(−0.10,0.06)	(0.60, 1.11)	(0.64, 1.12)	(0.65, 1.25)
West	−0.02	**0.65**	1.24	1.02
	(−0.11,0.06)	**(0.46, 0.92)**	(0.92, 1.68)	(0.70, 1.46)
Type of health insurance				
Private	*Ref*	*Ref*	*Ref*	*Ref*
Medicare	−0.02	0.94	0.68	1.47
	(−0.14,0.10)	(0.59, 1.50)	(0.44, 1.05)	(0.89, 2.41)
Medicaid	−0.06	0.98	0.85	1.02
	(−0.16,0.04)	(0.68, 1.42)	(059, 1.23)	(0.70, 1.48)
Tricare/VA/Indian/ other	0.02	0.81	1.18	1.33
	(−0.10,0.13)	(0.53, 1.25)	(0.77, 1.80)	(0.84, 2.10)
Uninsured	0.03	0.72	1.22	0.76
	(−0.09,0.15)	(0.46, 1.13)	(0.75, 1.99)	(0.48, 1.20)
Parent				
No	*Ref*	*Ref*	*Ref*	*Ref*
Yes	0.06	0.92	1.07	0.92
	(−0.01,0.13)	(0.71, 1.20)	(0.82, 1.38)	(0.70, 1.20)
Political party				
Democrats	*Ref*	*Ref*	*Ref*	*Ref*
Republican	0.06	**0.11***	**0.67**	0.83
	(−0.02,0.14)	**(0.08, 0.15)**	**(0.48, 0.92)**	(0.58, 1.17)
Independent	−0.07	**0.37***	0.89	0.82
	(−0.13,0.00)	**(0.28, 0.48)**	(0.71, 1.11)	(0.61, 1.10)
Other	−0.14	**0.34***	0.69	0.85
	(−0.27,0.00)	**(0.21, 0.55)**	(0.40, 1.17)	(0.50, 1.45)
COVID-19 exposure				
Have you had COVID?				
No	*Ref*	*Ref*	*Ref*	*Ref*
Yes	**−0.09**	0.92	0.94	1.10
	(−0.17,-0.01)	(0.68,1.23)	(0.69, 1.28)	(0.81, 1.50)
Know anyone who died of COVID?				
No	*Ref*	*Ref*	*Ref*	*Ref*
Yes	**−0.02**	**1.30**	**1.25**	1.25
	(−0.08,0.03)	**(1.05, 1.61)**	**(1.01, 1.53)**	(1.00, 1.58)
Financial hardship due to COVID				
No	***Ref***	*Ref*	*Ref*	*Ref*
Yes	**−0.04**	0.91	1.00	0.86
	(−0.08, 0.03)	(0.73, 1.15)	(0.80, 1.24)	(0.68, 1.10)
Adjusted R^2	28.3			

Bolded = $p < .05$.
Bolded* = − < 0.01.
[a] Results of adjusted linear regression models estimating the relationship between factor scores measuring trust in medical profession, trust in public health leaders/ one's physician and measures of socio-demographics, and COVID-19 exposure.
[b] Results of logistic regression models estimating the highest level(s) of trust in national public health leaders, state/local public health leaders, and one's own doctor.

sample was restricted to those who had not had COVID-19 (see Appendix B).

4. Discussion

This study finds that levels of trust in the medical profession, in national public health experts, in state/local officials and in one's own doctor are strongly associated with COVID-19 vaccine-related behaviors. Nearly three quarters of the sample in this study reported high levels of trust in their own doctor, while two thirds had high levels of trust in the national public health officials, and a bit more than half (55%) had high levels of trust in state/local ones. Trust in one's own

Table 3
Associations between trust in the medical profession, National public health experts, State/local public health experts and one's own doctor for hesitaters or refusers vs takers of the COVID-19 vaccine overall and for race/ethnic groups with 95% CI (n = 3014).

	Hesitators vs takers (95% CI)			Refusers vs takers (95%CI)		
Trust level of experts	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Medical profession	**0.73* (90.64,0.83)**	**0.76* (0.66,0.88)**	0.85 (0.70,1.03)	**0.56* (0.47,0.67)**	**0.51* (0.41,0.63)**	**0.48* (0.36,0.64)**
National Experts						
No	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Yes	**0.36* (0.29,0.45)**	**0.39* (0.30, 0.50)**	**0.38* (0.29, 0.50)**	**0.14* (0.10, 0.20)**	**0.17* (0.11, 0.25)**	**0.17* (0.11, 0.25)**
State/local experts						
No	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Yes	**0.57* (0.42,0.78)**	**0.57 (0.40, 0.80)**	**0.58 (0.41, 0.82)**	0.90 (0.49, 1.64)	0.93 (0.48, 1.81)	0.92 (0.48, 1.80)
One's own doctor						
No	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Yes	**0.38* (0.30,0.49)**	**0.45* (0.34, 0.60)**	**0.45* (0.35, 0.60)**	**0.14* (0.10, 0.19)**	**0.14* (0.10, 0.21)**	**0.14* (0.10, 0.21)**
Sociodemographic characteristics						
Age group						
18–29	–	**6.27* (3.37,11.65)**	**6.38* (3.42,11.90)**	–	1.39 (0.56,3.43)	1.38 (0.56, 3.41)
30–49	–	**5.57* (3.08,10.08)**	**5.68* (3.13,10.29)**	–	1.29 (0.56,2.98)	1.28 (0.56, 2.95)
50–64	–	**2.79* (1.59,4.91)**	**2.80* (1.59,4.94)**	–	0.92 (0.42,2.04)	0.92 (0.42, 2.04)
65+	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Gender						
Female	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Male	–	1.15 (0.90,1.46)	1.14 (0.90,1.46)	–	**1.51 (1.05,2.18)**	**1.52 (1.05,2.19)**
Race/ethnicity						
Non-Hispanic white	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Non-Hispanic black	–	**2.16* (1.52,3.05)**	**2.15* (1.51,3.05)**	–	**2.37 (1.37,4.08)**	**2.50 (1.39,4.49)**
Hispanic	–	1.28 (0.91,1.79)	1.19 (0.84,1.68)	–	1.02 (0.61,1.72)	1.10 (0.63,1.93)
Other	–	**0.47 (0.26,0.85)**	**0.51 (0.28,0.91)**	–	**0.24 (0.09,0.65)**	**0.22 (0.06,0.81)**
Educational attainment						
Less than/grad HS	–	**2.08* (1.42,3.05)**	**2.12* (1.45,3.11)**	–	**2.43 (1.39,4.26)**	**2.41 (1.37, 4.23)**
Less than/ grad college	–	**1.76* (1.29,2.40)**	**1.78* (1.31,2.44)**	–	1.42 (0.88,2.30)	1.42 (0.88,2.29)
Post-grad/professional	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Employment status						
Unemployed	–	0.93 (0.69, 1.23)	0.93 (0.70,1.24)	–	0.68 (0.45,1.05)	0.68 (0.45,1.05)
Employed	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Household income						
<$25,000	–	**2.38* (1.53,3.69)**	**2.44* (1.57,3.80)**	–	**2.40 (1.23,4.68)**	**2.36 (1.21, 4.62)**
$25,000–$49,999	–	**1.91 (1.31,2.80)**	**1.94 (1.32,2.84)**	–	1.07 (0.60,1.92)	1.08 (0.60, 1.93)
$50,0000–$74,999	–	**1.55 (1.07,2.24)**	**1.56 (1.08,2.26)**	–	1.18 (0.67,2.05)	1.18 (0.68, 2.07)
$75,000–$100,000	–	**1.54 (1.04,2.27)**	**1.54 (1.04,2.28)**	–	1.44 (0.80,2.57)	1.45 (0.81,2.60)
$100,00+	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Religion						

(*continued on next page*)

Table 3 (*continued*)

	Hesitators vs takers (95% CI)			Refusers vs takers (95%CI)		
Trust level of experts	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Protestant	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Evangelical	–	1.25 (0.79,1.97)	1.24 (0.78,1.96)	–	1.02 (0.52,1.99)	1.03 (0.53,2.01)
Catholic	–	0.80 (0.55,1.15)	0.81 (0.56,1.17)	–	1.10 (0.64,1.91)	1.10 (0.63,1.90)
Other	–	0.98 (0.69,1.39)	0.97 (0.68,1.38)	–	1.23 (0.73,2.06)	1.24 (0.74,2.08)
Nothing/atheist/agnostic	–	0.95 (0.68,1.32)	0.94 (0.67,1.31)	–	1.23 (0.75,2.03)	1.24 (0.75,2.04)
Area of residence						
Rural	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Metro	–	0.98 (0.72,1.33)	0.97 (0.71,1.32)	–	0.83 (0.53,1.26)	0.83 (0.54,1.26)
Census region						
Northeast	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
North central	–	0.92 (0.631.33)	0.92 (0.63,1.33)	–	1.34 (0.77,2.34)	1.35 (0.77,2.36)
South	–	0.94 (0.67, 1.30)	0.94 (0.67,1.30)	–	0.96 (0.58, 1.60)	0.96 (0.58,1.60)
West	–	0.87 (0.60,1.26)	0.88 (0.61,1.27)	–	1.25 (0.70,2.21)	1.25 (0.70,2.23)
Type of health insurance						
Private	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Medicare	–	1.10 (0.66,1.82)	1.10 (0.66,1.84)	–	1.08 (0.50,2.35)	1.08 (0.50,2.35)
Medicaid	–	1.05 (0.72,1.53)	1.03 (0.71,1.50)	–	1.76 (0.99,3.12)	1.78 (1.00,3.15)
Tricare/VA/Indian/other	–	0.86 (0.54,1.38)	0.86 (0.54,1.37)	–	**2.17 (1.09,4.32)**	**2.19 (1.10, 4.36)**
Uninsured	–	1.12 (0.70,1.80)	1.13 (0.70,1.82)	–	**2.28 (1.18,4.38)**	**2.25 (1.17, 4.34)**
Parent						
No	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Yes	–	1.29 (0.99,1.68)	1.31 (1.00,1.71)	–	**2.32*** **(1.54,3.52)**	**2.32*** **(1.53,3.51)**
Political party						
Democrats	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Republican	–	**3.61*** **(2.52,5.15)**	**3.65*** **(2.55,5.23)**	–	**6.18*** **(3.50, 10.92)**	**6.22*** **(3.52, 10.99)**
Independent	–	**2.14*** **(1.60,2.87)**	**2.18*** **(1.62,2.93)**	–	**2.78*** **(1.68, 4.60)**	**2.76*** **(1.67, 4.57)**
Other	–	**1.80 (1.04,3.10)**	**1.84 (1.06,3.19)**	–	2.11 (0.95, 4.71)	2.06 (0.92, 4.60)
COVID-19 exposure						
Have you had COVID?	–			–		
No	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Yes	–	1.10 (0.81,1.50)	1.11 (0.81,1.51)	–	**1.65 (1.06, 2.57)**	**1.66 (1.07,2.59)**
Know anyone who died of COVID?						
No	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Yes	–	**0.70 (0.56,0.89)**	**0.70 (0.56,0.89)**	–	0.79 (0.55,1.13)	0.78 (0.55,1.12)
Severity of financial hardship due to COVID						
No	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*	*Reference*
Yes	–	1.18 (0.93, 1.50)	1.19 (0.93, 1.51)	–	1.20 (0.83, 1.74)	1.20 (0.83, 1.73)
Interaction terms: Medical profession x race/ethnicity						
Non-Hispanic white	–	–	*Reference*	–	–	*Reference*
Non-Hispanic black	–	–	0.82 (0.57,1.20)	–	–	1.14 (0.66, 1.96)

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Table 3 (*continued*)

	Hesitators vs takers (95% CI)			Refusers vs takers (95%CI)		
Trust level of experts	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Hispanic	–	–	**0.67 (0.47,0.95)**	–	–	1.19 (0.70, 2.01)
Other	–	–	1.35 (0.69,2.61)	–	–	0.91 (0.33, 2.51)

Bolded = p < .05.
Bolded* = – < 0.01.
Results from logistic regression models with 95% confidence intervals estimating the relationship between independent variables, covariates and interaction terms for hesitater vs takers, refusers vs takers.

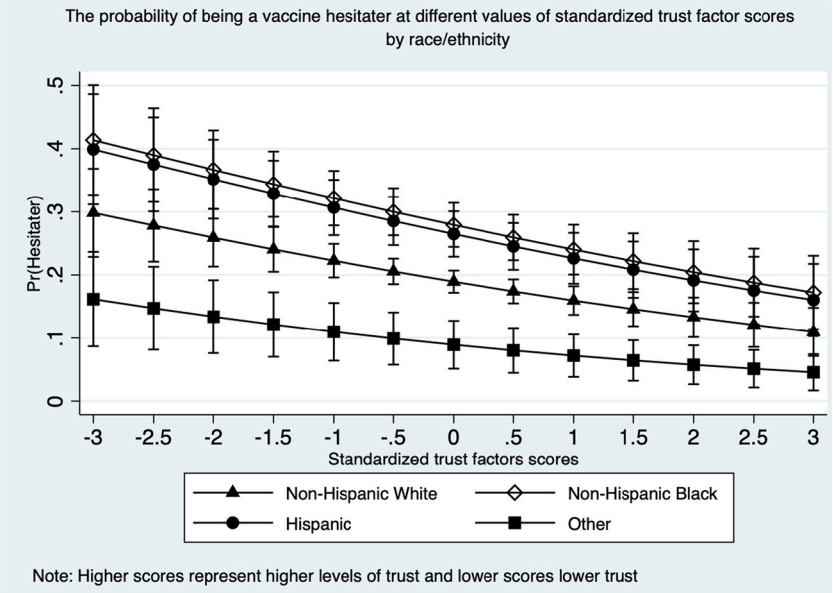

Fig. 1. The probability of being a hesitater by race/ethnicity at different values of trust in the medical profession standardized trust factor scores.

doctor was associated with higher levels of trust in the medical profession overall, but one's trust in national or state/local officials was not. While previous studies have demonstrated a relationship between trust in one's own doctor and in the medical profession and vaccine behaviors, this is the first study to look at this relationship in the highly politicized context of the COVID-19 vaccine. (Larson et al., 2018) We found that lower levels of trust in the medical profession increased the odds of being a refuser compared to a taker. However, our results demonstrate that lower levels of trust in the medical profession increased the odds of being a hesitater compared to a taker for Hispanic respondents, but not other racial/ethnic groups. These findings suggest that for hesitaters, views of the medical profession may be distinct from concerns regarding the COVID-19 vaccine, and vary by racial/ethnic group. This is an area for further research.

Higher levels of trust in one's own doctor were associated with significant and substantially greater odds of taking or seeking the COVID-19 vaccine. Our findings suggest that recommendations to get vaccinated from one's personal doctor may be persuasive to hesitaters or refusers if trust has been built, or already exists between patient and physician (and should those doctors concur with vaccination recommendations). A substantial literature suggests that trust in one's health care provider is mutable (Greene and Samuel-Jakubos, 2021; Zwingmann et al., 2017). However, reports from the Health Reform Tracking Survey during the same time period found that few unvaccinated adults had spoken to their physicians regarding the COVID-19 vaccine (Karpman and Zuckerman, 2021). Because vaccines had only received emergency authorization during the period of study, primary care physicians were largely not providers of the vaccine and may have missed the opportunity to communicate directly with their patients about it. To the degree physicians initiate these conversations with in a manner that builds trust with patients who are hesitant (or have them with patients whose trust they already have), they may have some success in persuading them to get vaccinated despite political ideology, given the high levels of trust in individual physicians reported in this sample. Still, pockets of resistance to the vaccine exist among physicians, and our sample does not allow us to understand respondent's own physician's views about the vaccine. Interestingly, our sensitivity analyses that limited the sample to those who had previously contracted COVID-19 showed the sample pattern, possibly suggesting that complacency, a determinant of vaccine hesitancy identified by the SAGE Working Group may also play a role.

The findings reported here are consistent with previous literature that has found higher odds of vaccine hesitancy among those of lower SES and among minority groups, effects that persist here even after controlling for trust in the medical profession, federal and state/local officials, and one's own doctor. Being a Black person increased the odds of both being in the hesitant or refuser group compared to takers, while being in the "other" race group decreased the odds for both. Consistent with other literature and media reports, having lower educational attainment, a lower income and being a Republican increased the odds of being either a hesitater or a refuser, compared to being a taker, all else equal. Baumgartner found that the relationship between political ideology and vaccine hesitancy was partially mediated by trust in the government medical experts, and similarly, we find a relationship between lower levels trust in the medical profession (a somewhat different construct), and trust in national and state/local officials and reluctance

to get a vaccine (Baumgaertner et al., 2018). Further, in this study, higher levels of trust in the medical profession decreased the odds of being a hesitater for Hispanic respondents compared to White respondents, but not for other racial/ethnic groups. These findings are consistent with other studies that have noted differences in trust in the health care system, the medical profession and governmental officials among some groups of Latinos (Wheldon et al., 2020). Yet given the extensive discussions regarding the role that medical mistrust may play in explaining lower rates of vaccine uptake some Black people, our finding that trust in the medical profession did not predict higher odds of hesitancy within this group is surprising. It may be that other factors, such as access, explain hesitancy within this population. Indeed, our findings that trust in national or state/local public health officials is not associated with trust in the medical profession suggest that these constructs may operate differently for different racial/ethnic groups. Future research with larger samples should examine the relationship between race/ethnicity, political ideology and trust in triple interactions predicting vaccine hesitancy.

Like all studies, this one has limitations. The data in this study are unweighted, so descriptive statistics do not approximate the population at large. However, the oversample of Black and Hispanic people allowed us to look more closely at factors affecting vaccine hesitancy within this group, these findings likely overestimate some factors associated with vaccine hesitancy in the population at large. To analyze hesitancy status, the dependent variable collapsed some levels of hesitancy (vaccinated and eager to be vaccinated, undecided and wait and see) and doing so may have obscured meaningful differences between combined groups. Finally, this is a cross-sectional study, and cannot disentangle the temporal relationships between trust in the medical profession, national, state/local leaders, and one's own doctor.

5. Conclusion

Trust in the medical profession and in public health professionals are important predictors of vaccine hesitancy. Physicians may be able to build on the trust their patients have in them to address vaccine concerns, and increase vaccination rates against COVID-19. However, to persuade those who are hesitant to get vaccinated, messengers other than one's doctors, federal and state/local public health officials are needed to communicate the benefits of the vaccine.

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Declaration of Competing Interest

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Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2022.107311.

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