Preventive Medicine Reports 38 (2024) 102626

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: www.elsevier.com/locate/pmedr

One year later: What role did trust in public officials and the medical profession play in decisions to get a booster and to overcome vaccine hesitancy?

Diana Silver [a,*], Yeerae Kim [b], Rachael Piltch-Loeb [b], David Abramson [b]

[a] Department of Public Health Policy and Management, NYU School of Global Public Health, United States
[b] Department of Social and Behavioral Sciences, NYU School of Global Public Health, United States

ARTICLE INFO

Keywords:
COVID-19 booster
Vaccine hesitancy
Trust
Physicians
Public health officials

ABSTRACT

Physicians may have an important role to play in promoting boosters as well as reducing COVID-19 vaccine hesitancy, but the relationship between hesitancy and trust in the medical profession and these behaviors has been underexplored. A representative online panel of 1,967 US adults that included oversamples of minoritized and rural populations were surveyed in April 2021 and June 2022 regarding their booster and vaccine status and intentions, their views of the medical profession, and their levels of trust in their own doctors, and national and state/local officials. Eighty percent of those vaccinated in 2021 had received a booster by 2022, while fewer than half of those initially reluctant to get a vaccine had gotten one by Wave 2 of the survey. Mean factor scores were calculated for response to a validated scale measuring trust in the medical profession. Linear and logistic regression models estimated the relationship between these factors scores and trust in other officials for those vaccinated as well initial hesitaters/refusers in Wave 1, controlling for population factors. Trust in one's own physician was associated with those vaccinated/eager to be vaccinated getting a booster, while trust in the medical profession was associated with getting a vaccine among those who had previously refused or were hesitant. Trust in other experts was not significantly associated with these behaviors, but wide confidence intervals suggest a need for future research. Innovative strategies, including mobilizing the medical community is needed to address reluctance, uncertainty, and distrust of therapeutic agents in pandemic response.

1. Introduction

By January 2022, 77 % of the U.S. adult population had received the full primary COVID-19 vaccination series, while 70 % of the vaccinated adult population had received a booster shot (about 48 % of the adult population overall).(Foundation, 2022) A substantive literature has emerged regarding vaccine hesitancy in the wake of the pandemic. Several systematic reviews and major studies have identified the role of misinformation in stoking fears of the vaccine, as well as the politicization of the decision to vaccinate, but less study of the decision to get a booster shot(Romate et al., 2022; Roy et al., 2022; Terry et al., 2022). In an online sample of adults (13 % of whom were not vaccinated), two months before boosters were made available, 39 % of adults indicated they did not intend to get one, with 55 % of those indicating they had little or no trust in vaccine information.(Yadete et al., 2021) Similarly, Bennett et al's study, conducted as boosters were becoming available, found that among vaccinated adults (25 years of age +), those who distrusted the U.S Centers for Disease Control and Prevention, the government and the health care system had nearly three times the odds of stating that they would not get a booster shot.[6] In an analysis of 37,000 tweets about booster shots, Uzair et al demonstrated that misinformation regarding the boosters, as well as expressions of distrust about the need for them, circulated widely in the six months preceding and including the final approval of them.(Uzair et al., 2022) And Lin et al's qualitative work concluded that the need for booster shots strengthened the distrust that those who were unvaccinated expressed regarding the efficacy of the vaccine and the role of government officials in approving it.(Lin et al., 2023).

Trust in government institutions, national experts, and the medical community have emerged as flashpoints in the politicized context of COVID-19. Adhikari's synthesis of the literature concluded that a large portion of the population chose to be vaccinated because they trusted

* Corresponding author at: Public Health Policy, NYU School of Global Public Health, 708 Broadway, NY, NY 10003, United States.
E-mail address: diana.silver@nyu.edu (D. Silver).

https://doi.org/10.1016/j.pmedr.2024.102626
Received 10 August 2023; Received in revised form 18 January 2024; Accepted 19 January 2024
Available online 20 January 2024

the institutions providing information about vaccines.(Adhikari et al., 2022) Yet data from the 2019 Health Information National Trends Survey from the National Cancer Institute provides greater insight into who the public trusts: 67.8 % of the adults surveyed indicated that they trusted information they received from physicians "a lot," but only 18.9 % indicated that they trusted health or medical information from government agencies "a lot," a decline from 25.6 % just two years earlier. (NCI, 0000) Notably, in a commentary in the New England Journal of Medicine in June 2021, Ratzan et al argued that while most people were receiving vaccines outside of their regular doctor's offices as a result of emergency public health dissemination strategies, primary care doctors, as trusted interlocutors, had a critical role to play in persuading those reluctant to be vaccinated or get a booster. Before the pandemic Platt found that trust in health care providers was higher than that in other "information brokers" such as public health officials or academic experts.(Ratzan et al., 2021; Platt et al., 2018).

Measuring such trust is complex: Ozawa & Sripad's systematic review of the measurement of health-related trust, conducted before the pandemic, identified 45 validated multi-item measures of health system-related trust.(Ozawa and Sripad, 2013) Examining the relationship between trust and COVID-19 vaccine hesitancy, Lamuda et al noted that trust in the medical profession and trust in one's own doctor were substantively different constructs, such that those who trusted their own doctor but not the medical profession had 20 % lower odds of stating they would seek a COVID-19 vaccine prior to its' authorization.(Lamuda et al., 2023) The authors confirmed that medical mistrust among minoritized survey respondents was associated with vaccine hesitancy, but their latent class analysis found medical mistrust was a complex construct with multiple sources, and noted that Black and Hispanic respondents were more likely to trust their own doctors but not the medical profession overall.

Much of the work on COVID-19 vaccination hesitancy and on booster acceptance has used cross-sectional data, and thus is unable (or subject to recall bias) to assess whether vaccine hesitancy resolved in favor or against getting the vaccine and the role that trust plays in changing vaccine status.(Bennett and Bloom, 2022; Motta, 2022; Ayyalasomayajula et al., 2023; Huang et al., 2023; Raman et al., 2022; Lee et al., 2022) Thus, whether initial expressions of hesitancy result in "delayed" vaccination or continued refusal is understudied, as is its relationship to getting boosted. Here, we make use of a unique panel dataset that includes two waves of data collected in April 2021 and June 2022 to explore the role that trust in the medical profession (measured using a validated scale), one's own doctor, and national, state and local officials plays in the decision among those initially vaccinated to seek a booster shot, and its relationship to the decision to vaccinate among those who refused or were hesitant to get vaccinated in 2021.

2. Data and 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 to both survey waves: April 8–22 2021 (n = 3,014) and June 20–24, 2022 (n = 2,003). The SSRS panel uses two sampling methods: 1) an Address-Based Sample (ABS) frame recruits nationally representative samples, and 2) the SSRS Omnibus survey, a multi-frame random digit dial sample of landlines and cellphones recruits harder-to-reach demographic groups. For this study, the SSRS Omnibus survey platform oversampled Blacks, Hispanics, and adults living in rural areas. The first wave occurred when vaccines had been approved for all US adults and investigated information sources, beliefs and experiences of COVID-19 and vaccination status. The second wave occurred when boosters were available to all adults. Only those responses that met quality control measures incorporated into the survey and had answered both waves were included.(Solutions, 2021) Our sample includes two groups based on Wave 1 responses: respondents who were categorized as vaccinated or eager to be vaccinated (n = 1,373) and respondents who were categorized as vaccine hesitaters or refusers (n = 594).(#####BLINDED for peer review, 2022) SSRS weighted the data by first applying a base weight to adjust for the sampling procedures, then weighted using raking for the distribution of sex by age and by race, age by education, race/ethnicity, and census region with benchmarks obtained from the 2020 Current Population Survey, and by population density, benchmarked to the 2020 Census Planning database (Full SSRS report on data collection, sampling and weighting available upon request from the authors). The final weighted sample included 1,215 respondents who were vaccinated/eager to vaccinate, and 731 hesitaters/refusers from Wave 1. The study was approved by the New York University Institutional Review Board (NYUIRB-FY2021-5251).

2.2. Outcome measures

Respondents who were fully vaccinated or were eager to get vaccinated in Wave 1 were asked in Wave 2 if they had received a booster shot of the COVID-19 vaccine. Respondents who answered *Yes* were categorized as "boosters".Those who answered that they planned to but hadn't, as well as those who answered that they hadn't and didn't plan to were categorized as "non-boosters". Hesitaters and refusers from Wave 1 were asked in Wave 2 if they were *1) fully vaccinated, 2) partially vaccinated or 3) unvaccinated* against COVID-19. If they answered *fully vaccinated*, then they were categorized as newly-vaccinated; those who answered either *partially vaccinated or unvaccinated* were categorized as non-vaccinated.

2.3. Independent variables

Trust in the medical profession: In Wave 2, 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], (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. This scale was constructed using psychometric analyses focused on feasibility factor structure, validity and reliability, and validated using two nationally representative samples(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 for this Wave 2 samples, and a one factor model was indicated for both. Confirmatory factor analysis (CFA) tested model fit using a structural equation model (SEM), and fit statistics including root mean squared error approximation (RMSEA), comparative fit index (CFI) and Tucker-Lewis index (TLI) calculated. 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. For those hesitant/refusing vaccination, factor loadings ranged from 0.473 to 0.84 while for those vaccinated/intending to vaccinate, factor loadings ranged from 0.45 to 0.81.

Trust in national officials, state or local officials, and one's own doctor: In Wave 1, 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 in this Wave 2 sample. Cut-off thresholds to create binary values for these were determined by assessing whether any cells contained less than 10 % of the sample and the log likelihood for the model.

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, or experienced financial hardship. Three questions assessed financial hardship by asking if respondents had lost income, job or trouble paying rent/housing/food/medical care/ other basic needs due to COVID-19. After determining that these were not statistically significant in the models, we employed a binary indicator that distinguished "any hardship" (those who answered yes to any of these three questions) from "no hardship" (answered no to all three questions).

2.5. Statistical analysis

Descriptive statistics for each group in the sample were calculated, and two sample tests of proportions were used to compare differences between respondents in Wave 1 and 2. Trust variables in national, state/ local or one's own doctor were transformed into a binary variable, high vs low trust. To determine the threshold for collapsing Likert scale values, we ran models with different thresholds for each variable, then compared their log likelihood, AIC and BIC for logistic regression model and R^2 values for linear regression. High trust in national experts and state/local public health officials was then coded as level 3–5, and high trust in one's own provider was coded as level 4 + 5. To test the role of independent variables (trust in the medical profession and the trust in public health officials) on decisions to be boosted or vaccinated, we built unadjusted and adjusted logistic regression models (adjusted for covariates including socio-demographics and COVID-19 exposure variables) that assessed the relationship between the independent variables and vaccination status by comparing boosters with non-boosters among those vaccinated, and comparing newly-vaccinated with unvaccinated among the initially refusing or hesitant, using an alpha level of 0.05. In supplemental analyses, 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 for each group. Missing values were omitted from the analyses, and predicted probabilities were calculated using average marginal effects, where the numerical derivative of a variable for each observation was calculated by using the other covariates as observed. We report predicted probabilities of variables that were statistically significant in the adjusted models. All models include sampling weights and analyses were performed using Stata/SE 15.1. (StataCorp, 2021).

3. Results

Table 1 presents descriptive statistics for those initially vaccinated or eager to be and those initially refusing or hesitant to be vaccinated, and Table S1 compares respondents in Waves 1 and 2. Among those vaccinated in 2021 (Column 1, n = 1373), the largest portion were between 30 and 49 years of age, followed by those 50–64. Those vaccinated were nearly split between males and females, 64 % were white, almost 55 % were employed and the largest group had a household income of $100,000+, followed by those making between $25,000-$49,999. Most lived in a metro area, and the largest group lived in the South, followed by the Western part of the U.S. Nearly 50 % had private insurance and almost half identified as Democrats. Most had not contracted COVID-19, and almost 40 % knew someone who had died of COVID-19, while the majority reported experiencing no financial hardships that resulted from pandemic measures. About 80 % reported getting a booster shot. Among hesitaters/refusers (Column 2, n = 546), about 40 % were between the

Table 1
Sample Descriptive Statistics.

	Eager to be vaccinated/ vaccinated in Wave 1 (weighted sample n = 1,215)[a] N (%)	Hesitant/Refused vaccination in Wave 1 (weighted sample n = 731)[a] N (%)
Sociodemographic factors		
Age group		
18–29	210(17.3)	168(23)
30–49	337.(27.8)	306(41.9)
50–64	310(25.5)	168(22.9)
65+	356(29.3)	79(10.9)
Gender		
Female	604(49.7)	344(47.1)
Male	599(49.3)	385(52.8)
Race/Ethnicity		
Non-Hispanic white	780(64.1)	440(60.3)
Non-Hispanic Black	124 (10.2)	101(13.8)
Hispanic	163(13.4)	145(19.9)
Other	137(11.2)	29(4)
Educational attainment		
Less than or graduated high school	342(28.1)	322(44.1)
Less than or graduated college	545(44.9)	345(47.2)
Post-graduate/professional	328(27)	63(8.7)
Employment status		
Unemployed	556(45.7)	276(37.7)
Employed	660(54.3)	455(62.3)
Household income		
<$25,000	166(13.7)	204(28)
$25,000- <$50,000	300(24.7)	227(31.1)
$50,000 - <$75,000	256(21.1)	118(16.1)
$75,000 - <$100,000	182(14.9)	82(11.2)
$100,000+	308(25.3)	98(13.5)
Religion		
Protestant	320(26.3)	248(33.9)
Evangelical	48(4)	60(8.2)
Catholic	258(21.3)	126(17.3)
Other	171(14.1)	100(13.6)
Nothing in particular/ Atheist/ Agnostic	414(34.1)	196(26.8)
Area of residence		
Rural	121(9.9)	152(20.8)
Metro	1089(89.6)	571(78.2)
Census region		
Northeast	240(19.7)	102(14)
North Central	264(21.7)	146(20)
South	410(33.7)	331(45.3)
West	302(24.8)	150(20.5)
Type of health insurance		
Private	605(49.7)	271(37.1)
Medicare	330(27.2)	95(13)
Medicaid	164(13.5)	197(27)
TRICARE/VA/Indian/Other	65(5.4)	53(7.3)
Uninsured	52(4.2)	114(15.6)
Parent		
No	979(80.6)	433(59.3)
Yes	236(19.4)	298(40.7)
Political party		
Republican	266(21.8)	271(37.1)
Democrats	504(41.5)	125(17.1)
Independent	389(32)	248(33.9)
Other	54(4.4)	85(11.7)
COVID-19 exposure		
Have you had COVID-19?		
No	709(58.4)	326(44.6)
Yes	421(34.6)	333(45.5)
Do you personally know anyone who died of COVID-19?		
No	725(59.6)	458(62.7)
Yes	450(37)	241(33)
Financial impact: lost income[b]		
No	1006(82.8)	577(79)
Yes	209(17.2)	153(21)
Financial impact: lost job		

(continued on next page)

Table 1 (*continued*)

	Eager to be vaccinated/ vaccinated in Wave 1 (weighted sample n = 1,215)[a] N (%)	Hesitant/Refused vaccination in Wave 1 (weighted sample n = 731)[a] N (%)
No	1144(94.1)	668(91.5)
Yes	72(5.9)	62(8.5)
Financial impact: trouble paying rent/basic needs		
No	1011(83.2)	531(72.7)
Yes	204(16.8)	199(27.3)
Trust in the medical profession		
Convenience and medical needs[c]		
1 Strongly disagree	167(13.8)	42(5.7)
2	398(32.8)	165(22.5)
3	554(45.6)	401(54.9)
4 Strongly Agree	96(7.9)	124(16.9)
Median	3	3
Mean	2.48	2.83
Thorough and careful		
1 Strongly disagree	16(1.3)	37(5)
2	162(13.3)	200(27.3)
3	794(65.3)	422(57.7)
4 Strongly agree	243(20)	72(9.9)
Median	3	3
Mean	3.04	2.73
Trust doctor's decisions		
1 Strongly disagree	17(1.4)	57(7.8)
2	166(13.7)	216(29.6)
3	739(60.8)	377(51.6)
4 Strongly agree	293(24.1)	80(11)
Median	3	3
Mean	3.08	2.66
Never Mislead		
1 Strongly disagree	10(4.9)	104(14.2)
2	295(24.3)	296(40.4)
3	572(47)	245(33.5)
4 Strongly agree	289(23.8)	86(11.8)
Median	3	2
Mean	2.9	2.43
All in all trust		
1 Strongly agree	16(1.3)	40(5.4)
2	66(5.4)	155(21.2)
3	671(55.2)	437(59.8)
4 Strongly disagree	462(38)	99(13.5)
Median	3	3
Mean	3.3	2.81
Trust level of information messengers		
National experts in public health		
1 Least amount of trust	36(2.9)	183(27.6)
2	69(5.4)	124(18.6)
3	167(13.1)	144(21.6)
4	342(26.8)	131(19.7)
5 Greatest trust	659(51.8)	82(12.4)
State/local public health officials		
1 Least amount of trust	39(3.1)	164(24.6)
2	69(5.4)	148(22.2)
3	269(21.1)	191(28.6)
4	534(42)	113(17)
5 Greatest trust	362(28.5)	50(7.5)
My doctor or healthcare provider		
1 Least amount of trust	5(0.4)	46(7)
2	11(0.9)	97(14.6)
3	127(10)	228(34.3)
4	471(37)	197(29.6)
5 Greatest trust	658(51.7)	97(14.5)
Vaccination Status		
Vaccinated/eager to be vaccinated and did not get booster	248(20.4)	NA
Vaccinated/eager to be vaccinated and got booster	967(79.6)	NA
Hesitant/Refused and did not get vaccinated	NA	413(56.6)
Hesitant/Refused and got vaccinated	NA	317(43.4)

Note: Categories may not add to 100, due to rounding. Sampling weights applied to unweighted sample of 1373 eager to be vaccinated/vaccinated, and 594 hesitant/refused vaccination in Wave 1.

[a] Vaccination status from Wave 1.

[b] Financial impact had three questions asking for a specific area of financial hardship: lost income, lost job, difficult paying for rent, and other necessities. After testing that including three separate variables were not statistically significant, these variables were recreated as binary variable (whether one had suffered any financial impacts in the specified areas due to pandemic) and used in the final analyses.

[c] Reverse coded for analysis.

ages of 30–49, more than half were men, 60 % were white, about 44 % had a high school education or less, while 47 % had some college. About 62 % were employed, more than 60 % had an income of less than $50,000 a year and 37 % had private health insurance. Thirty-seven percent were Republican, most were not parents, slightly more than half had had COVID-19, and a third knew someone who died from the virus. The majority of respondents reported no financial hardships from the pandemic. Fifty-seven percent of those unsure/refusing the vaccine in Wave 1 remained unvaccinated. Characteristics for the overall sample changed little between Wave 1 and 2, despite a decrease in sample size, with some exceptions. In general, a greater portion of respondents retained in Wave 2 were employed, had had COVID-19, and were Protestant. A smaller portion had incomes <$25,000, were rural residents, knew someone who died of COVID-19, or lost income or a job due to the pandemic. (Supplementary Table S1). These differences persisted when comparing those vaccinated between Wave 1 and 2, and a greater portion of the vaccinated who were retained lived in metro areas. When comparing the Wave 1 sample to those retained in Wave 2 among hesitaters/refusers, a larger portion in Wave 2 were employed, Protestant, had had COVID-19, and had not suffered financial hardship, but no other substantial differences were noted beyond those for the overall sample (Supplementary Table S1).

In supplemental analyses of those vaccinated, trust in the medical profession was associated significantly and positively with trust in one's own doctor. Higher levels of trust in state/local officials were significantly and positively associated with trust (compared to distrust) in national experts and one's own doctor, controlling for other covariates. In adjusted models, trust in one's own doctor was significantly and positively associated with trust (compared to distrust) in the medical profession, state/local officials and national experts. Similar results were found for those who had hesitated or refused vaccination in Wave 1, although trust in the medical profession was positively and significantly associated with trust in national public health experts (Supplementary Tables S2 and S3).

Table 2 presents results from unadjusted and adjusted logistic regression models reflecting vaccine adherence: comparing those who received a booster to those who didn't among those who were vaccinated (Models 1–2), and comparing those who got vaccinated to those who didn't among hesitaters (Models 3–4). Among those who had been vaccinated, higher levels of trust in the medical profession and trust in national experts were positively and significantly associated with getting a booster shot, compared to not (Model 1). When covariates were

Table 2
Results of unadjusted and adjusted logistic regression models estimating the odds of switching vaccine status and trust in the medical profession, national public health experts, state/local public health experts and one's own doctor among those vaccinated/eager to be vaccinated and those who were hesitaters/refusers at Wave 1, with 95 % CI.

	Odds of getting a booster		Odds of getting vaccinated	
	Model 1 (n = 1,215)	Model 2 (n = 1,065)	Model 3 (n = 731)	Model 4 (n = 610)
Trust level of experts				
Medical profession	**1.38 (1.08.,1.76)**	1.33 (1.00, 1.78)	**1.58* (1.14, 2.20)**	**1.68* (1.19, 2.38)**
National Experts				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	**1.88 (1.05, 3.37)**	1.42 (0.75, 2.66)	**2.28 (1.13, 4.56)**	1.10 (0.48, 2.53)
State/local experts				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	1.61 (0.91,2.86)	1.47 (0.81, 2.64)	1.21 (0.50, 2.90)	1.28 (0.55, 2.98)
One's own doctor				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	1.31 (0.72, 2.37)	**2.50 (1.20, 5.19)**	0.99 (0.57, 1.71)	1.27 (0.65, 2.47)
Sociodemographic characteristics				
Age group				
18–29	–	**0.28 (0.10, 0.78)**	–	**4.09 (1.06, 15.8)**
30–49	–	0.85 (0.29, 2.52)	–	1.47 (0.41, 5.30)
50–64	–	1.20 (0.49, 2.90)	–	1.32 (0.40, 4.41)
65+	*Reference*	*Reference*	*Reference*	*Reference*
Gender				
Female	*Reference*	*Reference*	*Reference*	*Reference*
Male	–	1.19 (0.73, 1.96)	–	1.07 (0.62, 1.85)
Race/Ethnicity				
Non-Hispanic White	*Reference*	*Reference*	*Reference*	*Reference*
Non-Hispanic Black	–	**0.44 (0.20, 0.95)**	–	1.55 (0.67, 3.55)
Hispanic	–	1.37 (0.57, 3.27)	–	1.54 (0.66, 3.59)
Other	–	**3.01 (1.15, 7.84)**	–	**5.21 (1.32, 20.57)**
Educational Attainment				
Less than/grad HS	–	0.50 (0.25, 1.03)	–	0.43 (0.18, 1.03)
Less than/ grad college	–	0.71 (0.40, 1.26)	–	**0.44 (0.20, 0.97)**
Post-grad/professional	*Reference*	*Reference*	*Reference*	*Reference*
Employment status				
Unemployed	–	1.34 (0.71, 2.53)	–	0.61 (0.30, 1.25)
Employed	*Reference*	*Reference*	*Reference*	*Reference*
Household income				
<$25,000	–	0.45 (0.17, 1.18)	–	0.97 (0.37, 2.55)
$25,000-$49,999	–	**0.38* (0.20, 0.74)**	–	0.63 (0.28, 1.41)
$50,0000-$74,999	–	0.74 (0.35, 1.56)	–	10.89 (0.40, 1.98)
$75,000-$100,000	–	0.54 (0.23, 1.26)	–	1.57 (0.62, 3.97)
$100,00+	*Reference*	*Reference*	*Reference*	*Reference*
Religion				
Protestant	*Reference*	*Reference*	*Reference*	*Reference*
Evangelical	–	0.67 (0.24, 1.91)	–	0.87 (0.32, 2.37)
Catholic	–	1.36 (0.65, 2.83)	–	**3.82* (1.59, 9.19)**
Other	–	1.11 (0.52, 2.37)	–	1.11 (0.45, 2.72)
Nothing/atheist/agnostic	–	0.76 (0.39, 1.48)	–	1.28 (0.62, 2.66)
Area of residence				
Rural	*Reference*	*Reference*	*Reference*	*Reference*
Metro	–	1.00 (0.52, 1.95)	–	1.30 (0.63, 2.64)
Census region				
Northeast	*Reference*	*Reference*	*Reference*	*Reference*
North Central	–	0.76 (0.35, 1.65)	–	0.66 (0.26, 1.63)
South	–	0.89 (0.44, 1.80)	–	0.47 (0.21, 1.03)
West	–	0.77 (0.36, 1.61)	–	**0.50 (0.20, 1.24)**
Type of health insurance				
Private	*Reference*	*Reference*	*Reference*	*Reference*
Medicare	–	1.23 (0.48, 3.14)	–	1.14 (0.39, 3.33)
Medicaid	–	0.57 (0.27, 1.20)	–	0.88 (0.40, 1.98)
Tricare/VA/Indian/Other	–	0.88 (0.35, 2.18)	–	0.69 (0.17, 2.78)
Uninsured	–	0.78 (0.20, 3.05)	–	1.28 (0.53, 3.09)
Parent				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	–	1.00 (0.50, 2.01)	–	0.55 (0.28, 1.11)
Political Party				
Democrats	*Reference*	*Reference*	*Reference*	*Reference*
Republican	–	**0.28* (0.14, 0.56)**	–	0.79 (0.31, 2.01)
Independent	–	**0.50 (0.27, 0.92)**	–	0.55 (0.23, 1.30)
Other	–	0.36 (0.12, 1.12)	–	0.34 (0.11, 1.10)
COVID-19 Exposure				

(*continued on next page*)

Table 2 (*continued*)

	Odds of getting a booster		Odds of getting vaccinated	
	Model 1 (n = 1,215)	Model 2 (n = 1,065)	Model 3 (n = 731)	Model 4 (n = 610)
Have you had COVID?	–		–	
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	–	0.61 (0.38, 1.00)	–	0.84 (0.49, 1.46)
Know anyone who died of COVID?				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	–	1.61 (0.96, 2.69)	–	1.05 (0.60, 1.86)
Severity of financial hardship due to COVID				
No	*Reference*	*Reference*	*Reference*	*Reference*
Yes	–	0.67 (0.39, 1.14)	–	1.59 (0.91, 2.80)

Bolded = p <.05.
Bolded*=-<0.01.
Results from logistic regression models with 95% confidence intervals estimating the relationship between independent variables for boosters vs non-boosters, vaccinated vs non-vaccinated (among hesitators/refusers), controlling for other factors.

added to the model, only trust in one's own doctor (AOR = 2.50, CI = 1.20–5.19) was associated with getting a booster shot (Model 2). Thus, the effect of going from a low to a high level of trust would increase the probability of getting a booster shot by 12.87 % ($p < 0.05$). Among those who were initially refusers or hesitaters, in adjusted models, the odds of getting vaccinated increases by 1.68 (CI = 1.19–2.38) times with a one unit increase in the factor score measuring trust in the medical profession (Model 4); such that one's probability of getting vaccinated would rise by 10.09 % ($p <.01$).

4. Discussion

This study finds that trust in one's own physician and the medical profession are associated with COVID-19 vaccine behaviors over time. Among those who were vaccinated or eager to be in 2021, trust in one's own doctor was associated with seeking a booster shot by 2022. In contrast, among those refusing or hesitant to get vaccinated in 2021, trust in the medical profession was associated with ultimately deciding to be vaccinated by 2022. These effects are meaningful, since predicted probabilities suggest that greater trust could increase vaccination and booster take-up by at least 10 % in these two groups.

Levels of trust varied considerably between these two groups. More than 79 % of our weighted sample who were vaccinated/eager to be vaccinated in Wave 1 reported receiving boosters in Wave 2, and about 88 % reporting high levels of trust in their own doctors, 70 % had high levels of trust in state/local officials. But among hesitators/refusers, levels of trust in leaders were far lower: about 26 % stated they had high levels of trust in state/local officials, and about 46 % reported high levels of trust in their own doctors, and about 25 % had high levels of trust in state/local officials. This pattern was the same for trust in national experts and the medical profession.

Our findings confirm previous work demonstrating the politicization of the vaccine decision-making: holding trust in officials and other factors constant, Republicans, Independents and others had far lesser odds of seeking booster shots or ultimately choosing to be vaccinated than Democrats(Grossman et al., 2020; James et al., 2022; Wallace et al., 2023). The costs of this mistrust have been high for both the public and for state/local officials: state and local employees in public health departments who had not signaled their intent to leave in 2017 had left their jobs in astonishing numbers by 2021.(Leider et al., 2023).

Previous studies have found that trust in one's own doctor was associated with higher levels of trust in the medical profession among the population overall, and this relationship was borne out in both groups here.(Adhikari et al., 2022; #####BLINDED for peer review, 2022) At the same time, in 2021, the Kaiser Family Foundation found that nearly 15 % of adults did not have a personal doctor, with higher percentages among minoritized populations.(Kaiser Family Foundation, 2021) In studies before the pandemic, scholars found a relationship between trust in one's own doctor and in the medical profession with vaccine behaviors but this is one of the first studies to examine these trust issues regarding booster take-up with panel data in the relationship in the highly politicized context of the COVID-19 vaccine.(Larson et al., 2018) Our work is consistent with a recent longitudinal study of older adults' COVID-19 booster uptake, trust in medicine was found to be one of the strongest predictors of uptake, while trust in government was not significant.(Viskupič and Wiltse, 2023) Our work is consistent with other studies that find that the decline in belief in science is associated with not seeking boosters, and breakthrough infections post-vaccination could muddle perceptions of booster effectiveness.(Barattucci et al., 2022; Juarez et al., 2022). Baumgartner found that the relationship between political ideology and vaccine hesitancy was partially mediated by trust in the government medical experts prior to the pandemic, and similarly, we find a relationship between higher trust in the medical profession and in national experts, and receiving a booster.(Baumgaertner et al., 2018) One early study regarding the pandemic, demonstrated that trust national experts, state/local officials and one's own doctor, as well as in the medical profession was associated with getting the vaccine, compared to those hesitating to get it. (#####BLINDED for peer review, 2022) Our study suggests views of the medical profession are associated with that overcoming hesitation to be vaccinated, or choosing to get a booster. Given the numerous public attacks on Dr. Fauci, arguably the best-known national leader regarding COVID-19, mistrust of his leadership by some may have seeped into estimation of the medical profession overall.(Suran, 2022) Additional strategies, such as community-level outreach may be needed to reach those who are reluctant to get a booster shot or to be vaccinated at all.

Our study has several limitations. First, questions regarding trust were not asked in wave 2 of the study and respondents' views of experts may have changed between survey waves. However, most of the misinformation regarding COVID-19 and the vaccine were already circulating in Wave 1, such that their impact on new decisions may be small; Lin's study found that booster-specific misinformation strengthened those who had refused the vaccine, while experiences with the vaccine itself (side effects, missing days from work) contributed to hesitancy in getting a vaccine among those vaccinated.(Lin et al., 2023) Second, changes in our panel due to attrition showed some significant differences in covariates between time periods. Still, these are relatively small, and the direction of the coefficients does not change when covariates are added to the models. Further, we did not ask those vaccinated if they had COVID-19 post-vaccination, so we are unable to assess the relationship between breakthrough infections and booster decision-making. Still, one study examining how breakthrough infections among family and friends contributed to booster uptake found little to no impact on attitudes towards boosters (Stevens et al., 2023). Last, wide confidence intervals caution against Type II errors.

5. Conclusion

Improving booster uptake may require greater mobilization of the primary care workforce, particularly if physicians have built trust with their patients. Broad engagement of the medical profession in communicating the benefits of vaccines will be needed in future pandemics.

The authors were supported by a grant from the National Science

Foundation grant #2049886. The sponsor had no role in the study design, collection, analysis or interpretation of data, nor did they assist in writing the report or in the decision to submit it for publication.

Financial disclosure

No financial disclosures were reported by the authors of this paper.

CRediT authorship contribution statement

Diana Silver: . **Yeerae Kim:** Writing – review & editing, Methodology, Formal analysis, Data curation. **Rachael Piltch-Loeb:** Writing – review & editing, Validation, Conceptualization. **David Abramson:** Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

The research presented in this paper is that of the authors and does not reflect the official policy of the NSF. Support for this work was provided by the National Science Foundation, grant # 2049886. DS conceived of the study, oversaw the analysis, and drafted the manuscript. YK conducted the analyses and edited the draft. RPL contributed to the conception of the study and edited the draft. DMA edited the draft. This work has not been published elsewhere. No financial disclosures were reported by the authors of this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2024.102626.

References

#####BLINDED for peer review, 2022.
Adhikari, B., Cheah, P.Y., von Seidlein, L., 2022. Trust is the common denominator for COVID-19 vaccine acceptance: a literature review. Vaccine X 12, 100123.
Ayyalasomayajula, S., Dhawan, A., Karattuthodi, M.S., Thorakkattil, S.A., Abdulsalim, S., Elnaem, M.H., Sridhar, S., Unnikrishnan, M.K., 2023. A systematic review on sociodemographic, financial and psychological factors associated with COVID-19 vaccine booster hesitancy among adult population. Vaccines 2023 (11), 623. https://doi.org/10.3390/vaccines11030623. DOI: 10.1002/14651858.CD015270.
Barattucci, M., Pagliaro, S., Ballone, C., Teresi, M., Consoli, C., Garofalo, A., De Giorgio, A., Ramaci, T., 2022. Trust in science as a possible mediator between different antecedents and COVID-19 booster vaccination intention: an integration of health belief model (HBM) and theory of planned behavior (TPB). Vaccines 10, 1099. https://doi.org/10.3390/vaccines10071099.
Baumgaertner, B., Carlisle, J.E., Justwan, F., 2018. The influence of political ideology and trust and willingness to vaccinate. PLoS One 13, e0191728.
Bennett NG, DE Bloom DE, M Ferranna (2022). Factors underlying COVID-19 vaccine and booster hesitancy and refusal, and incentivizing vaccine adoption. PLoS ONE 17 (9): e0274529. https://doi.org/10.1371/journal.pone.0274529.
Dugan, E., Trachtenberg, F., Hall, M.A., 2005. Development of abbreviated measures to assess patient trust in a physician, a health insurer, and the medical profession. BMC Health Serv. Res. 5, 64.
Kaiser Family Foundation COVID-19 Vaccine Monitor (January 28, 2022). Kff.org.
Grossman, G., Kim, S., Rexer, J.M., Thirumurthy, H., 2020. Political partisanship influences behavioral responses to governors' recommendations for COVID-19 prevention in the United States. PNAS 117 (39), 24144–24153.
Huang, M., He, R., Chen, Q., Song, J., Huang, H., Zheng, S., 2023. COVID-19 vaccine booster dose hesitancy among key groups: a cross-sectional study. Hum. Vaccin. Immunother. 19 (1), 2166323 https://doi.org/10.1080/21645515.2023.2166323.
James, S., Tervo, C., Skocpol, T., 2022. Institutional capacities, partisan divisions, and federal tensions in U.S. responses to the COVID-19 pandemic. the russell sage foundation. Journal of the Social Sciences 8 (8), 154–180. https://doi.org/10.7758/RSF.2022.8.8.08.
Juarez, R., Kang, Z., Okihiro, M., Garcia, B.K., Phankitnirundorn, K., Maunakea, A.K., 2022. Dynamics of trust and consumption of COVID-19 information implicate a mechanism for COVID-19 vaccine and booster uptake. Vaccines 10, 1435. https://doi.org/10.3390/vaccines10091435.
Kaiser Family Foundation, 2021. Adults Who Report Not Having a Personal Doctor/Health Care Provider by Race/Ethnicity. Accessed July 17, 2023. https://www.kff.org/other/state-indicator/percent-of-adults-reporting-not-having-a-personal-doctor-by-raceethnicity.
Lamuda, P.A., Azar, A., Taylor, B.G., Balawajder, E.F., Pollack, H.A., Schneider, J.A., 2023. Latent class analysis of medical mistrust and COVID-19 vaccine hesitancy among adults in the United States just prior to FDA emergency use authorization. Vaccine, pp. 2671–2679.
Larson, H.J., Clarke, R.M., Jarrett, C., Eckersberger, E., Levine, Z., Schulz, W.S., et al., 2018. Measuring trust in vaccination: a systematic review. Human Vaccine Immunotherapy. 14, 1599–1609. https://doi.org/10.1080/21645515.2018.1459252. Epub 2018 May 10.
Lee, R.C., Hu, H., Kawaguchi, E.S., Kim, A.E., Soto, D.W., Shanker, K., Klausner, J.D., Van Orman, S., Unger, J.B., 2022. COVID-19 booster vaccine attitudes and behaviors among university students and staff in the United States: The USC Trojan pandemic research Initiative. Prev. Med. Rep. 28, 101866 https://doi.org/10.1016/j.pmedr.2022.101866.
Leider, J.L., Castrucci, B.C., Robins, M., Bork, R.H., Fraser, M.R., Savoia, E., Piltch-Loeb, R., Koh, H., 2023. The exodus of state and local public health employees: separations started before and continued throughout COVID-19. Health Aff. 42 (3), 338–348. https://doi.org/10.1377/hlthaff.2022.01251.
Lin, C., Bier, B., Tu, R., Paat, J.J., Tu, P., 2023. Vaccinated yet booster-hesitant: perspectives from boosted, non-boosted, and unvaccinated individuals. Vaccines. 11, 550.
Motta, M., 2022. The correlates & public health consequences of prospective vaccine hesitancy among individuals who received COVID-19 vaccine boosters in the U.S. Vaccines 10, 1791. https://doi.org/10.3390/vaccines10111791.
National Cancer Institute, Health Information National Trends Survey (HINTS). https://hints.cancer.gov/.
Ozawa S, Sripad P. How do you measure trust in the health system? A systematic review of the literature. Social Scence and Medicine. 2013;91:10-14 PMID: 23849233 DOI: 10.1016/j.socscimed.2013.05.005.
Platt, J.E., Jacobson, P.D., Kardia, S.L.R., 2018. Public trust in health information sharing: a measure of system trust. Health Serv. Res. 53 (2), 824–845.
Raman, S., Kriner, D., Ziebarth, N., Simon, K., Kreps, S., 2022. COVID-19 booster uptake among US adults: assessing the impact of vaccine attributes, incentives, and context in a choice-based experiment. Soc Sci Med 310. https://doi.org/10.1016/j.socscimed.2022.115277.
Ratzan, S., Schneider, E.C., Hatch, H., Caccione, J., 2021. Missing the point- how primary care can overcome COVID-19 Vacinne "Hesitancy". N. Engl. J. Med. 384, e100.
Romate, J., Rajkumar, E., Gopi, A., Abraham, J., Rages, J., Lakshmi, R., Jesline, J., Bhogle, S., 2022. What Contributes to COVID-19 vaccine hesitancy? a systematic review of the psychological factors associated with COVID-19 vaccine hesitancy. Vaccines 10, 1777. https://doi.org/10.3390/vaccines10111777.
Roy, D.N., Biswas, M., Islam, E., Azam, M.S., 2022. Potential factors influencing COVID-19 vaccine acceptance and hesitancy: A systematic review. PLoS One 17 (3), e0265496.
Solutions SSR. 2021.
StataCorp. Stata statistical software: Release 17. 2021.
Stevens, C.W., Neely, S.R., Scacco, J.M., 2023. Breakthrough infections and acceptance of COVID-19 vaccine boosters: a survey analysis. PEC Innovation 2, 100167. https://doi.org/10.1016/j.pecinn.2023.100167. Epub 2023.
Suran, M., 2022. Dr Fauci and the art of science communication. J. Am. Med. Assoc. 328 (13), 1286–1287. https://doi.org/10.1001/jama.2022.16280.
Terry, E., Cartledge, S., Damery, S., Greenfield, S., 2022. Factors associated with COVID-19 vaccine intentions during the COVID-19 pandemic; a systematic review and meta-analysis of cross-sectional studies. BMC Public Health 22, 1667.
Uzair, S., Abd-alrazaq, A., Schneider, J., Househ, M., Shah, Z., 2022. Twitters' concerns and opinions about the COVID-19 booster shots: infoveillance study. J. Consumer Health Internet 26 (4), 337–356. https://doi.org/10.1080/15398285.2022.2106404.
Viskupič, Filip, and David L. Wiltse. (2023) "Trust in physicians predicts COVID-19 booster uptake among older adults: Evidence from a panel survey." Aging and Health Research. Mar;3(1):100127. doi: 10.1016/j.ahr.2023.100127. Epub 2023 Feb 12. PMID: 36817561; PMCID: PMC9922203.
Wallace, J., Goldsmith-Pinkham, P., Schwartz, J.L., 2023. Excess death rates for republican and democratic registered voters in florida and ohio during the COVID-19 Pandemic. JAMA Internal Med. 183 (9), 916–923. https://doi.org/10.1001/jamainternmed.2023.1154.
Yadete, T., Batra, K., Netski, D.M., Antonio, S., Patros, M.J., Bester, J.C., 2021. Assessing acceptability of COVID-19 vaccine booster dose among adult americans: a cross-sectional study. Vaccines. 9, 1424. https://doi.org/10.3390/vaccines9121424.