



## Racial/ethnic disparities in intent to obtain a COVID-19 vaccine: A nationally representative United States survey

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### ABSTRACT

Black, Latino, Pacific Islander, and American Indian/Alaska Native adults are more likely than White adults to experience SARS-CoV-2-related infections, hospitalizations, and mortality. We assessed intent to be vaccinated and concerns among 7 U.S. racial/ethnic groups (1,000 Black/African American, 500 American Indian/Alaska Native, 1,000 Asian, 1,000 Latino (500 English- and 500 Spanish-speaking), 500 Pacific Islander, 500 multiracial, and 1,000 White adults) in a cross-sectional online survey conducted December 2020–February 2021, weighted to be nationally representative within groups. Intent to be vaccinated was ascertained with: “If a COVID-19 vaccine becomes available, how likely are you to get vaccinated?” (not at all/slightly/moderately/very/extremely likely). Respondents identified which concerns would keep them from being vaccinated: cost, not knowing where, safety, effectiveness, side-effects, and other. Multinomial logistic regression models assessed associations of race/ethnicity with odds of being extremely/very/moderately, slightly likely to be vaccinated (ref = not at all), controlling for demographics and health. Overall, 30% were extremely likely, 22% not at all likely, and 48% unsure. Compared to White respondents, American Indian/Alaska Native (Adjusted Odds Ratio (AOR) = 0.66, 95% CI, 0.47–0.92) and Black/African American (AOR = 0.54, 95% CI, 0.41–0.72) respondents were less likely, and Asian (AOR = 2.21, 95% CI, 1.61–3.02) and Spanish-speaking Latino respondents (AOR = 3.74, 95% CI, 2.51–5.55) were more likely to report being extremely likely to be vaccinated. Side-effects (52%) and safety (45%) were overriding concerns. Intent and vaccination rates are changing rapidly; these results constitute a comprehensive baseline for ongoing vaccination efforts among U.S. racial and ethnic groups.

### 1. Introduction

American Indian/Alaska Native, Black/African American, and Latino adults are more likely than White adults to experience SARS-CoV-2 infections, COVID-19-related hospitalizations, and COVID-19 mortality (Mackey et al., 2021; Raine et al., 2020). Pacific Islander populations also experience higher COVID-19-related incidence (Raine et al., 2020; Hatcher et al., 2020) and mortality (Arrazola et al., 2020). Preventing

the disproportionate suffering of these populations due to COVID-19 will require widespread vaccination of individuals from these minority groups.

During 2020, in anticipation of vaccines becoming available, national surveys focused on intent to be vaccinated. Intent to be vaccinated (defined as absolutely certain or very likely to be vaccinated) increased from 39.4% to 49.1% overall from September to December 2020, although rates varied by race/ethnicity; Black/African American adults

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were less likely to report intent than White adults (Nguyen et al., 2021). Vaccine intent was low among Black/African American persons, in part due to mistrust of the medical establishment and racial injustice (Momplaisir et al., 2021). Immigrants feared that accessing public services, such as COVID-19 vaccines might jeopardize applications for legal status (Haq et al., 2020).

The COVID-19's Unequal Racial Burden (CURB) study is a nationally representative cross-sectional survey to determine the impact of the COVID-19 pandemic among U.S. adults from diverse racial/ethnic groups, including those disproportionately affected by COVID-19. CURB intentionally sampled American Indian/Alaska Native, Asian, Black/African American, Latino (Spanish- and English-speaking), Native Hawaiian/Pacific Islander, White, and multiracial adults to generate nationally representative estimates. The survey was launched prior to availability of COVID-19 vaccines and included questions about vaccine willingness and concerns. During the survey period (December 2020 through February 2021), two vaccines were approved for emergency use (Pfizer-BioNTech COVID-19 vaccine and Moderna COVID-19 vaccine). However, vaccine rollout was slow and only 5% of the U.S. population aged  $\geq 16$  years had received a COVID-19 vaccine during the survey period (Painter et al., 2021).

For this paper, we assess: 1) differences in intent to be vaccinated among these 7 racial/ethnic groups (and national origin and language subgroups) independent of socioeconomic status and health-related factors; 2) major concerns related to obtaining a COVID-19 vaccine within racial/ethnic groups; and 3) associations of concerns with intent to be vaccinated. Results could inform efforts to increase vaccination rates among racial/ethnic minority groups.

## 2. Methods

### 2.1. COVID-19's Unequal racial Burden (CURB) study design

The CURB survey was a cross-sectional online survey conducted by YouGov, a consumer research firm. YouGov conducted sampling, recruitment, and enrollment of respondents. The survey was conducted in the U.S. between December 8, 2020, and February 17, 2021.

### 2.2. CURB survey

The survey was first developed in English and then translated into Spanish by a certified translator. Final English and Spanish versions were produced through team reconciliation by four bilingual-bicultural researchers from varied Latino national origin groups.

### 2.3. Study population

YouGov uses a proprietary, opt-in survey panel comprising over 1.8 million U.S. residents. Panel members are recruited using multiple methods (e.g., Web advertising, email campaigns, partner-sponsored solicitations, and mail-to-Web recruitment) to help ensure panel diversity. YouGov panel members receive rewards to take individual surveys. The National Institutes of Health Office of IRB Operations determined that this study does not qualify as human subjects research because YouGov provided de-identified data.

To obtain nationally representative estimates, YouGov randomly matches eligible panel members with matching demographic characteristics (matched sample) to a theoretical cohort (target sample) identified by sampling nationally representative data. For the CURB study, the target sample of 5,500 was drawn from the 2018 American Community Survey (ACS) 1-year sample data, and included 1,000 Asian, 1,000 Black/African American, 1,000 Latino (500 Spanish- and 500 English-speaking, defined as preferred survey language), 1,000 White, 500 American Indian/Alaska Native, 500 Native Hawaiian/Pacific Islander, and 500 multiracial adults ( $\geq 18$  years old). YouGov panel members (matched sample) were then matched to the target sample

based on race/ethnicity, gender, age, education, and language preference (Latino sample) using a proximity matching method. YouGov invited these panel members to participate via email until quotas were met for each racial/ethnic/language group.

After survey completion, the matched sample was weighted using propensity scores. Briefly, within each racial/ethnic group (and language for Latino group), the matched and target sample were combined and multivariable logistic regression, adjusting for age, gender, years of education, and region, was used to estimate the probability for inclusion in the frame. Propensity scores were then grouped into deciles and post-stratified on gender, age, education, and region to produce a final weight for each stratified sample group. Weighted survey data with a matched sample allows national estimates within each racial/ethnic/language group.

## 2.4. Measures

### 2.4.1. Intent to get vaccinated

Our primary dependent variable was intent to obtain a COVID-19 vaccine. Respondents were asked "If a COVID-19 vaccine becomes available, how likely are you to get vaccinated?" (1 = not at all likely, 2 = slightly likely, 3 = moderately likely, 4 = very likely, 5 = extremely likely).

### 2.4.2. Concerns about getting a vaccine

Respondents were asked, "Would any of the following concerns keep you from getting the vaccine?" with the option to check all that apply from: concerns about the cost, not knowing where to get the vaccine, concerns about its safety, concerns about how effective it will be, concerns about side effects, other concerns (specify), and I have no concerns about getting the vaccine.

### 2.4.3. Self-identified race/ethnicity

To assess our primary independent variable, we asked: "Which one of the following would you say best represents your race/ethnicity?" with response options of Latino/a/x or Hispanic, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Pacific Islander, White, or multiracial. Those selecting multiracial were asked to check all that apply from the other groups. Those selecting Asian, Latino, or Native Hawaiian/Pacific Islander were asked to identify one relevant national origin group. Options for Asian respondents were Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, and other Asian. For Latino respondents, options were Mexican/Mexican American/Chicano, Puerto Rican, Cuban/Cuban American, Dominican Republic, Central American, South American, and another Hispanic, Latino, or Spanish origin. Native Hawaiian/Pacific Islander adults could select Native Hawaiian, Guamanian or Chamorro, Samoan, and Other Pacific Islander.

### 2.4.4. Demographic variables and covariates

We assessed age, gender, health insurance, immigration status, English proficiency, education, marital status, and family annual income. Respondents rated their physical health (poor/fair/good/very good/excellent). We assessed comorbidities associated with risk of serious COVID-19 (according to U.S. Centers for Disease Control and Prevention (CDC), December 2020) including cancer in the past year, chronic obstructive pulmonary disease, chronic kidney disease or on dialysis, Type 2 diabetes, heart conditions (e.g., heart failure, coronary artery disease, or cardiomyopathies), immunocompromised state from solid organ transplant, obesity, and sickle cell anemia.

## 2.5. Methods of analysis

Descriptive statistics characterized the sample overall; intent (likelihood) to be vaccinated overall and by racial/ethnic group; concerns about being vaccinated overall and by race/ethnicity; and concerns by intent to be vaccinated in the total sample.

Multinomial logistic regression models estimated the odds of being slightly/moderately/very likely/extremely likely, compared to not at all likely [reference], to receive a COVID-19 vaccine for each of the major racial/ethnic minority groups, compared to Whites. Adjusted models controlled for age group, gender, health insurance, comorbidities (any vs. none), fair/poor self-rated physical health, education, and family annual income. Additional models (unadjusted and adjusted) were estimated with Latino respondents stratified by language (English- and Spanish-speaking). Finally, we conducted a sensitivity analysis analyzing likelihood of vaccination as a 3-level variable (not at all [reference], unsure (slightly, moderately, very likely) or extremely likely, adjusting for covariates.

Verbatim responses from respondents selecting “other concerns” (that would keep them from getting a COVID-19 vaccine) were coded independently by two coders to identify salient themes, define themes, and select illustrative quotes. The coders then met until reaching consensus.

Analyses were conducted using SAS version 9.4 (SAS Inc., Cary, NC) and were weighted to obtain national estimates (except for qualitative coding of open-ended responses).

### 3. Results

#### 3.1. Sample characteristics

By design, the sample consisted of 5,500 participants: 500 American Indian/Alaska Native (9%), 1,000 Asian (18%), 1,000 Black/African American (18%), 1,000 Latino (18%) (half in English and half in Spanish), 500 Native Hawaiian/Pacific Islander (9%), 1,000 White (18%), and 500 multiracial individuals (9%) (Supplement Table 1).

Respondents’ mean (SD) age was 43.9 years (17.0) (range 18 to 92 years). Men and women were equally represented.

Twenty-one percent was uninsured and 36% had public insurance only. Foreign-born residents comprised 22% and 5% was undocumented. Over 40% had ≤ high school education, 54% was not married/partnered, and 23% reported a family annual income of <\$20,000. Twenty-seven percent rated their physical health as fair/poor. About 31% reported at least one comorbidity.

#### 3.2. Intent to be vaccinated

Responses to this question had a U-shaped distribution, with the largest percentages at each pole: 30% were extremely likely and 22% were not at all likely (Table 1). The three middle categories, representing individuals who were unsure, made up 48% of respondents.

There was considerable variation across race/ethnicity in intent to be vaccinated. The U-shaped distribution was observed in all except Asian and Latino groups. The percent responding not at all likely to be vaccinated was highest among Black/African American respondents (32%) followed by American Indian/Alaska Native respondents (29%). Asian respondents had the lowest percent answering not at all likely (11%). At the other extreme, the percent responding extremely likely to be vaccinated was highest among Asian (39%), White (37%), and Spanish-speaking Latino respondents (33%). Those with the lowest percent reporting extremely likely were Black/African American (20%) and American Indian/Alaska Native (25%) respondents.

There were some differences by national origin and language. Among Asian respondents, 22% of Japanese origin persons reported being not at all likely to be vaccinated compared to 11% of Asians overall. Also, 47% of Asian Indian respondents reported being extremely

**Table 1**

Intent to obtain a COVID-19 vaccine in 5,500 respondents, by race/ethnicity, U.S. online survey, December 8, 2020 - February 17, 2021.<sup>1</sup>

	Overall	“If a COVID-19 vaccine becomes available, how likely are you to get vaccinated?”										
		Not at all		Slightly		Moderately		Very		Extremely		
Total, N (%)	5,500	(100.0)	1,210	(22.0)	866	(15.7)	868	(15.8)	902	(16.4)	1,653	(30.1)
<b>Race/ethnicity, n (%)</b>												
American Indian/Alaska Native	500	(9.1)	145	(28.9)	93	(18.7)	92	(18.4)	44	(8.8)	126	(25.2)
Asian	1,000	(18.2)	111	(11.1)	138	(13.8)	175	(17.5)	183	(18.3)	392	(39.2)
Asian Indian	175	(3.2)	11	(6.5)	25	(14.5)	29	(16.8)	27	(15.6)	82	(46.6)
Chinese	274	(5.0)	20	(7.5)	35	(12.6)	56	(20.5)	63	(22.9)	100	(36.5)
Filipino	161	(2.9)	19	(12.0)	22	(13.6)	30	(18.5)	26	(16.2)	64	(39.7)
Japanese	132	(2.4)	29	(22.3)	24	(18.3)	9	(6.4)	20	(15.5)	50	(37.5)
Other Asian <sup>2</sup>	258	(4.7)	30	(11.7)	32	(12.5)	52	(20.0)	47	(18.1)	97	(37.7)
Black/African American	1,000	(18.2)	323	(32.3)	188	(18.8)	155	(15.5)	138	(13.8)	196	(19.6)
Latino	1,000	(18.2)	187	(18.7)	150	(15.0)	169	(16.9)	191	(19.1)	304	(30.4)
English-speaking	496	(49.6)	118	(23.7)	75	(15.2)	90	(18.2)	74	(14.9)	139	(28.0)
Spanish-speaking	504	(50.4)	69	(13.7)	75	(14.8)	78	(15.5)	117	(23.2)	165	(32.7)
<b>National origin</b>												
Mexican/Mexican-American/Chicano	528	(9.6)	77	(14.6)	85	(16.1)	93	(17.6)	108	(20.5)	165	(31.2)
Puerto Rican	115	(2.1)	21	(18.6)	20	(17.1)	17	(14.5)	18	(15.5)	39	(34.3)
Cuban/Dominican	85	(1.5)	20	(23.9)	10	(11.7)	15	(17.5)	12	(14.4)	27	(32.4)
Central American	80	(1.4)	18	(22.9)	9	(11.7)	14	(17.1)	17	(21.7)	21	(26.6)
South American	99	(1.8)	13	(13.1)	11	(11.4)	14	(14.6)	21	(21.3)	39	(39.5)
Other Latino	94	(1.7)	37	(38.9)	15	(16.1)	16	(16.9)	15	(15.5)	12	(12.7)
Native Hawaiian/Pacific Islander	500	(9.1)	115	(23.1)	77	(15.4)	91	(18.2)	80	(16.0)	136	(27.3)
Native Hawaiian	274	(5.0)	64	(23.5)	33	(12.2)	49	(17.7)	43	(15.6)	85	(31.0)
Pacific Islander <sup>3</sup>	226	(4.1)	51	(22.6)	44	(19.3)	43	(18.8)	37	(16.6)	51	(22.7)
White	1,000	(18.2)	209	(20.9)	123	(12.3)	122	(12.2)	182	(18.2)	365	(36.5)
Multiracial <sup>4</sup>	500	(9.1)	121	(24.1)	96	(19.2)	65	(13.0)	85	(17.0)	133	(26.6)
American Indian/Alaska Native	139	(28.1)	50	(35.7)	43	(31.2)	11	(7.9)	13	(9.7)	22	(15.5)
Asian	150	(30.2)	12	(8.0)	15	(10.2)	22	(14.4)	37	(24.7)	64	(42.7)
Black/African American	197	(39.7)	56	(28.1)	57	(28.7)	28	(14.1)	26	(13.3)	31	(15.8)
Latino	122	(24.6)	27	(21.9)	24	(19.3)	14	(11.8)	29	(23.7)	28	(23.3)
Native Hawaiian/Pacific Islander	27	(5.5)	9	(31.9)	2	(8.1)	4	(15.4)	4	(13.3)	9	(31.2)
White	408	(82.2)	94	(23.0)	74	(18.1)	55	(13.5)	74	(18.1)	112	(27.4)

<sup>1</sup> Weighted to be nationally representative within each major racial/ethnic group (and language for Latinos).

<sup>2</sup> Other Asian includes Korean and Vietnamese respondents in addition to self-reported “other” (due to small sample sizes).

<sup>3</sup> Other Native Hawaiian/Pacific Islander includes Guamanian or Chamorro and Samoan respondents in addition to self-reported “other” (due to small sample sizes).

<sup>4</sup> Multiracial participants were able to select all major racial/ethnic groups that apply.

likely to be vaccinated compared to 39% of Asian respondents overall. Compared to English-speaking Latino respondents, a lower percent of Spanish-speaking Latinos responded as not at all likely to be vaccinated (14% versus 24%) and a higher percent responded as extremely likely to be vaccinated (33% versus 28%). English-speaking Latino respondents were less likely (28%) than White respondents (37%) to report being extremely likely to get vaccinated. A higher percent of Native Hawaiian respondents was extremely likely to get vaccinated (31%) than Pacific Islanders (23%).

### 3.3. Multivariable models

Adjusting for covariates, notable differences by race/ethnicity in intent to be vaccinated were observed (Table 2). Compared to White respondents, American Indian/Alaska Native (AOR = 0.66, 95% CI, 0.47–0.92) and Black/African American (AOR = 0.54, 95% CI, 0.41–0.72) respondents were significantly less likely to report being extremely likely to be vaccinated. Conversely, compared to White respondents, the odds of being extremely likely to be vaccinated were significantly higher among Asian (AOR = 2.21, 95% CI, 1.61–3.02) and Spanish-speaking Latino respondents (AOR = 3.74, 95% CI, 2.51–5.55). Similarly, compared to White respondents, Asian and Spanish-speaking Latino respondents were more than twice as likely to report being moderately or slightly likely to be vaccinated. English-speaking Latino and Native Hawaiian/Pacific Islander persons were similar to White persons on degree of intent across all categories.

Similar results were seen when likelihood was modeled as a 3-level variable (not at all [ref], slightly/moderately/very or extremely), Supplement Table 2, except that multiracial respondents were significantly less likely to report being extremely likely to be vaccinated than White respondents.

### 3.4. Concerns about being vaccinated

Overall, the most important concerns regarding vaccination were side-effects (52%), safety (45%), and effectiveness (34%) (Table 3). Of much less concern were vaccination cost (17%) and not knowing where to get the vaccine (10%). About 27% reported having no concerns regarding vaccination.

Side-effects was of great concern in all groups (45%–62%) and highest in multiracial (62%) and Black/African American (57%) respondents. Safety was of concern in all groups (33%–55%) and highest in American Indian/Alaska Native (55%), Black/African American (54%), and multiracial (53%) respondents, and lowest in Latino respondents (33%). Spanish-speaking Latino respondents were less concerned than

their English-speaking counterparts about safety (23% versus 44%) and side-effects (45% versus 51%). The percent reporting no concerns was highest among White (35%), Asian (29%), and Latino (28%) respondents. Native Hawaiian respondents had fewer concerns than Pacific Islander respondents (31% versus 21% had no concerns). Not knowing where to get the vaccine was of low concern in all groups (4%–15%).

Three major categories of write-in responses to other concerns (N = 277) were identified: mistrust (43%), safety (31%), and miscellaneous (26%), disaggregated into 14 salient themes (Supplement Table 3). Mistrust comprised four themes: mistrust of government/corporations/medical care (16%), mistrust of vaccine contents (14%), mistrust of vaccine development (9%), and beliefs that the vaccine is a government conspiracy (4%). Safety concerns included safety of COVID-19 vaccines (11%), if have allergies (9%), if have health conditions (9%), and if pregnant or breastfeeding (2%). Miscellaneous concerns included access/availability (8%) and do not need a vaccine (6%); being anti-vax, effectiveness, religious concerns, and fear of needles were all < 5%.

### 3.5. Association of concerns with intent

For those reporting not at all likely to be vaccinated, the most important concerns were side-effects (69%), safety (65%), and effectiveness (46%) (Table 4). Of least concern to those reporting not at all likely was cost (9%) and not knowing where to get vaccinated (4%); only 13% reported no concerns. Among those reporting being extremely likely to be vaccinated, side-effects were a concern for only 25%; 56% reported no concerns.

Overall, as intent to be vaccinated increased, side-effects, safety, and effectiveness were of decreasing importance, especially among the extremely likely group (Fig. 1). In contrast, not knowing where to get a vaccine was of increasing importance as intent to be vaccinated increased.

## 4. Discussion

In the nationally representative CURB survey, we assessed intent to be vaccinated among a large, diverse sample of American Indian/Alaska Native, Asian, Black/African American, Latino (Spanish- and English-speaking), Native Hawaiian/Pacific Islander, White, and multiracial U. S. adults. The survey was conducted just as COVID-19 vaccines were being approved for emergency use and provides a nuanced baseline for subsequent vaccination uptake efforts. Just under half of the U.S. population is to some extent unsure of their intent. American Indian/Alaska Native and Black/African American were significantly less likely than

**Table 2**

Adjusted odds of being slightly, moderately, very, or extremely likely to be vaccinated, compared to not at all likely, in 5,500 respondents, by race/ethnicity and language (for Latinos only), online survey, December 8, 2020 - February 17, 2021.<sup>1</sup>

	Slightly		Moderately		Very		Extremely	
	AOR	(95% CI) <sup>2</sup>	AOR	(95% CI) <sup>2</sup>	AOR	(95% CI) <sup>2</sup>	AOR	(95% CI) <sup>2</sup>
American Indian/Alaska Native	1.24	(0.85, 1.82)	1.06	(0.72, 1.56)	0.46	(0.30, 0.72)	0.66	(0.47, 0.92)
Asian	2.33	(1.59, 3.41)	2.79	(1.93, 4.03)	2.07	(1.45, 2.95)	2.21	(1.61, 3.02)
Black/African American	1.16	(0.84, 1.61)	0.91	(0.65, 1.26)	0.74	(0.54, 1.02)	0.54	(0.41, 0.72)
Latino	1.59	(1.11, 2.28)	1.64	(1.15, 2.33)	1.68	(1.20, 2.35)	1.71	(1.27, 2.30)
English-speaking <sup>3</sup>	1.19	(0.80, 1.78)	1.35	(0.91, 1.98)	1.00	(0.68, 1.47)	0.91	(0.65, 1.27)
Spanish-speaking <sup>3</sup>	2.32	(1.46, 3.68)	2.16	(1.36, 3.42)	3.65	(2.37, 5.61)	3.74	(2.51, 5.55)
Native Hawaiian/Pacific Islander	1.46	(0.97, 2.19)	1.28	(0.86, 1.92)	1.17	(0.79, 1.73)	0.99	(0.70, 1.40)
White	1.00	(ref)	1.00	(ref)	1.00	(ref)	1.00	(ref)
Multiracial	1.40	(0.94, 2.08)	0.83	(0.54, 1.27)	0.95	(0.64, 1.40)	0.72	(0.50, 1.01)

<sup>1</sup> Weighted to be nationally representative within each major racial/ethnic group (and language for Latinos).

<sup>2</sup> Adjusted for age, gender, health insurance, presence of any comorbidity (cancer, COPD, chronic kidney disease, diabetes, heart conditions, immunocompromised from transplant, obesity, sickle cell anemia), poor self-rated physical health, education, and family annual income; individuals who identified as non-binary or transgender were dropped from analysis due to small cell sizes.

<sup>3</sup> A second model stratifying Latinos by language preference was run separately; results for other racial/ethnic groups did not meaningfully change in the adjusted model (results for other racial/ethnic groups are from model with overall Latino group).



**Table 3**  
Concerns about vaccination in 5,500 respondents stratified by race/ethnicity, U.S. online survey, December 8, 2020 - February 17, 2021.<sup>1</sup>

	Concerns about... <sup>2</sup>													
	Cost		Not knowing where to get it		Safety		Effectiveness		Side-effects		Other		No concerns	
Total, n (%)	912	(16.6)	567	(10.3)	2,475	(45.0)	1,881	(34.2)	2,847	(51.8)	292	(5.3)	1,478	(26.9)
<b>Race/ethnicity, n (%)</b>														
American Indian/Alaska Native	79	(15.9)	62	(12.3)	273	(54.6)	177	(35.5)	268	(53.6)	46	(9.2)	113	(22.5)
Asian	160	(16.0)	115	(11.5)	417	(41.7)	334	(33.4)	505	(50.5)	26	(2.6)	287	(28.7)
Asian Indian	24	(13.5)	18	(10.5)	64	(36.5)	53	(30.3)	73	(41.9)	5	(2.7)	54	(30.7)
Chinese	51	(18.5)	38	(14.0)	114	(41.7)	97	(35.5)	141	(51.6)	6	(2.2)	71	(26.0)
Filipino	23	(14.4)	18	(10.9)	71	(44.0)	54	(33.5)	80	(50.0)	4	(2.6)	46	(28.8)
Japanese	21	(16.0)	8	(6.1)	58	(43.6)	43	(32.6)	76	(57.6)	4	(3.1)	38	(29.0)
Other Asian <sup>3</sup>	41	(16.0)	33	(12.7)	111	(42.9)	87	(33.7)	134	(51.7)	7	(2.7)	78	(30.2)
Black/African American	143	(14.3)	65	(6.5)	540	(54.0)	387	(38.7)	570	(57.0)	34	(3.4)	223	(22.3)
Latino	196	(19.6)	111	(11.1)	334	(33.4)	331	(33.1)	481	(48.1)	36	(3.6)	277	(27.7)
<b>Language preference</b>														
English	91	(18.4)	48	(9.8)	216	(43.6)	168	(33.9)	255	(51.4)	23	(4.7)	142	(28.7)
Spanish	104	(20.7)	63	(12.4)	118	(23.3)	163	(32.3)	226	(44.9)	13	(2.5)	135	(26.8)
<b>National origin</b>														
Mexican/ Mexican-American/ Chicano	113	(21.5)	68	(12.9)	166	(31.5)	188	(35.6)	255	(48.4)	17	(3.3)	144	(27.3)
Puerto Rican	12	(10.8)	10	(8.6)	45	(38.7)	34	(29.3)	56	(49.0)	3	(2.5)	38	(32.9)
Cuban or Dominican	7	(8.7)	3	(3.7)	33	(39.4)	22	(25.9)	49	(58.2)	4	(4.6)	22	(26.5)
Central American	22	(28.1)	11	(13.4)	28	(35.5)	28	(34.9)	36	(45.8)	3	(3.8)	22	(27.1)
South American	19	(18.7)	9	(9.2)	28	(28.6)	34	(34.8)	44	(44.1)	0	(0.0)	34	(34.5)
Other Latino	21	(22.8)	10	(10.5)	33	(35.2)	25	(26.4)	40	(42.5)	9	(9.5)	17	(18.4)
Hawaiian/ Pacific Islander	110	(22.0)	71	(14.3)	227	(45.4)	190	(38.0)	251	(50.4)	29	(5.7)	132	(26.4)
Native Hawaiian	53	(19.5)	37	(13.6)	125	(45.5)	93	(34.0)	133	(48.5)	14	(5.3)	85	(31.1)
Pacific Islander <sup>4</sup>	56	(25.0)	34	(15.1)	102	(45.3)	96	(42.8)	119	(52.6)	14	(6.3)	47	(20.7)
White	140	(14.0)	73	(7.3)	419	(41.9)	265	(26.5)	461	(46.1)	61	(6.1)	350	(35.0)
Multiracial	84	(16.8)	70	(14.0)	265	(52.9)	197	(39.5)	310	(62.0)	59	(11.9)	96	(19.2)

<sup>1</sup> Weighted to be nationally representative within each major racial/ethnic group (and language for Latinos).

<sup>2</sup> Respondents were able to check all that apply.

<sup>3</sup> Other Asian includes Korean and Vietnamese respondents in addition to self-reported ‘other’ (due to small sample sizes).

<sup>4</sup> Other Native Hawaiian/Pacific Islander includes Guamanian or Chamorro and Samoan respondents in addition to self-reported ‘other’ (due to small sample sizes).

**Table 4**  
Concerns about vaccination in 5,500 respondents, stratified by intent to be vaccinated, U.S. online survey, December 8, 2020 - February 17, 2021.<sup>1</sup>

	“If a COVID-19 vaccine becomes available, how likely are you to get vaccinated?”											
	Overall	Not at all		Slightly		Moderately		Very		Extremely		
Total, N (%)	5,500	1,210	(22.0)	866	(15.7)	868	(15.8)	902	(16.4)	1,653	(30.1)	
<b>Concerns about<sup>2</sup>..., n (%)</b>												
Cost	912	(16.6)	106	(8.7)	160	(18.5)	178	(20.5)	226	(25.1)	242	(14.6)
Not knowing where to get it	567	(10.3)	50	(4.2)	73	(8.5)	92	(10.6)	122	(13.5)	229	(13.9)
Safety	2,475	(45.0)	785	(64.8)	572	(66.1)	485	(55.8)	376	(41.6)	257	(15.6)
How effective it will be	1,881	(34.2)	555	(45.9)	387	(44.7)	367	(42.3)	309	(34.2)	263	(15.9)
Side-effects	2,847	(51.8)	835	(69.0)	603	(69.6)	504	(58.0)	477	(52.8)	429	(26.0)
Other	292	(5.3)	150	(12.4)	39	(4.5)	34	(3.9)	33	(3.7)	36	(2.2)
<b>I have no concerns, n (%)</b>	1,478	(26.9)	157	(13.0)	78	(9.0)	115	(13.2)	200	(22.1)	928	(56.2)

<sup>1</sup> Weighted to be nationally representative within each major racial/ethnic group (and language for Latinos).

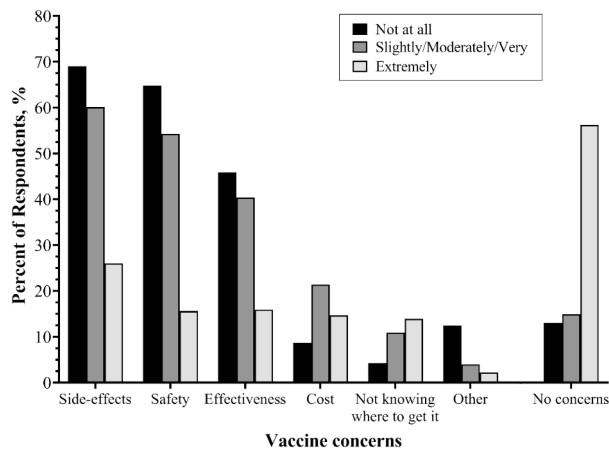
<sup>2</sup> Participants were able to select multiple concerns.

White respondents to intend to be vaccinated, whereas Asian and Spanish-speaking Latino respondents were significantly more likely to intend to be vaccinated, controlling for demographics and health factors.

Our sample was unique due to its representation of diverse populations, including a substantial proportion with limited health

insurance and lower levels of education and income. Our results therefore provide a detailed understanding of intent to be vaccinated and related concerns for the most at-risk groups in the U.S.

Our study is one of few including a representative sample of American Indian/Alaska Native adults, who have experienced more than twice the incidence rates and four times the mortality rates of White



**Fig. 1.** Percent of respondents' concerns about vaccination (n = 5,500), organized by the overall prevalence of each concern and stratified by vaccination intent (not at all, slightly/moderately/very, extremely), U.S. online survey, December 8, 2020 - February 17, 2021. Responses were weighted to be nationally representative within each racial/ethnic group.

adults due to COVID-19 (Hill and Artiga, 2021; Williamson et al., 2021). Our findings that they had a lower likelihood of intent to be vaccinated early in the vaccine approval timeline are especially important given recent data on vaccination rates. As of October 8, 2021, the CDC COVID tracker (Centers for Disease Control and Prevention, 2020) reported that vaccination rates for this group are the highest of all other racial/ethnic groups in the U.S., including Whites, despite challenges associated with remoteness of some communities, initial skepticism, distrust, and limited resources (Hill and Artiga, 2021; Gregory, 2021). Mobilization of tribal communities, decentralized tribal control, and infusion of cultural values in vaccination campaigns may explain the higher vaccination rates of this group and serve as a public health model (Gregory, 2021).

Due to stratified sampling of English and Spanish-speaking Latino adults, we were able to discern differences in intent and concerns by language. Our findings that Spanish-speaking Latino respondents were almost four times as likely to intend to be vaccinated as White respondents, and that side-effects and safety were of greater concern to English- than Spanish-speaking Latino persons are unique. Other studies have found that Latino adults are less willing, however, those studies did not distinguish language and samples were not nationally representative (Grumbach et al., 2021; Doherty et al., 2021). Our results suggest that addressing concerns may be more important to English-speaking Latino persons, and facilitating access may increase adoption of vaccines among Spanish-speaking Latino persons who are more willing.

Overall, concerns over side-effects and the safety of COVID-19 vaccines were reported by about half of respondents, and concerns about effectiveness by about one third. Concern about side-effects was high overall and especially in the multiracial group. Concerns over safety varied the most, ranging from a low of 33% in Latino respondents to a high of 55% in American Indian/Alaska Native and 54% in Black/African American respondents. White and Asian groups had the greatest proportion of those indicating they had no concerns, consistent with the finding that these groups were among the most willing to be vaccinated. Qualitative findings about concerns indicate that mistrust was by far the most important concern, followed by safety.

We found that Native Hawaiian respondents were more willing to be vaccinated and had fewer concerns than Pacific Islander respondents. Disaggregated data indicate that mortality rates for certain Pacific Islander groups (i.e., Samoan, Tongan and Chamorro/Guamanian) are higher than for the Native Hawaiian population (Ponce et al., 2021; Hawai'i State Department of Health, 2021). Although we did not sample these subpopulations to be nationally representative, our results fill an

information gap. Higher mortality rates and greater concerns among Pacific Islanders warrant targeted efforts to increase COVID-19 vaccine coverage in these groups.

Safety and side effects were cross-cutting concerns at the start of vaccine approval processes and need to be addressed among all groups, but were of elevated concern among Black/African American, American Indian/Alaska Native, and multiracial groups. The heightened concerns of these groups that have experienced a legacy of structural racism in the U.S. that persists today (Bleich et al., 2019; Findling et al., 2019; Parker et al., 2015), points to the importance of equitable non-discriminatory vaccine promotion and access. Cost was of greater concern among Latino (regardless of language) and Native Hawaiian/Pacific Islander persons than the other groups even though the vaccine is free. These two groups experience higher uninsured rates than White persons and greater socioeconomic disparities (Chu and Sommers, 2021; Artiga et al., 2021), thus, campaigns stressing that vaccines are provided at no cost are especially important.

Vaccination rates have increased over time. Recent data indicate that the proportion of U.S. adults who have received at least 1 dose (as of September/October 2021) ranges from 72% to 82% (CDC reports ages 12 and older) (Centers for Disease Control and Prevention, 2020; Hamel et al., 2021; Survey, 2021), with Asian, American Indian/Alaska Native and Latino persons reporting the highest rates, depending on the source. In the scientific literature, recent estimates for adults who have received at least one dose range from 64% for Black to 86% for Asian persons (May 2021) (Nguyen et al., 2021). One study examining adults ages 18–39 (March–May 2021) reported vaccination rates ranging from 25% among Black persons to 39% among those classified as from all other races (Baack et al., 2021). Longitudinal studies of vaccination intent and behaviors could provide valuable data on the timing, correlates of, and potential reasons for shifts (or stability) in intent and behaviors across and within subpopulations.

#### 4.0.1. Study limitations and strengths

Our use of an online panel survey may have underrepresented the most vulnerable segments of the U.S. population that have no internet access. We did not administer the survey in any Asian or Pacific Island languages. We did not measure political beliefs which are an important determinant of vaccine intent and a potential confounder. We asked about intent to be vaccinated which may not correlate highly with future vaccination behavior. Detailed information related to access (e.g., time constraints, convenience of scheduling and vaccination) that might affect intent to be vaccinated was not assessed, given that COVID-19 vaccines were not available at the time of survey initiation. Unequal access due to structural factors and racism could differentially affect vaccine intent among racial/ethnic groups (Corbie-Smith, 2021). Finally, Spanish-speaking Latino respondents were identified based on a 1-item measure of language preference, a relatively crude measure of language acculturation.

Strengths include the nationally representative results obtained for all major racial/ethnic groups (and by language for Latinos) in the U.S. Disaggregated data within race/ethnic groups has been very limited. Information on intent by specific subpopulations can help inform community-level public health responses.

## 5. Conclusion

Current vaccination rates suggest that a substantial proportion of adults in all groups have now been vaccinated. However, vaccination efforts must continue due to emerging variants, waning immunity among the vaccinated, the need for booster shots, and persistent segments of the population that do not intend to be vaccinated (associated with partisanship, lower educational attainment, and lack of health insurance (Hamel et al., 2021)). Promotion of COVID-19 vaccination needs to be tailored to the social context of communities using

approaches based on data, cultural and social factors, and barriers to obtaining vaccination (Chou and Budenz, 2020; Pogue et al., 2020). Efforts to vaccinate the American public will need to harness community networks to effectively reach community members. Such networks can effectively increase trust in vaccine effectiveness and safety, address vaccine misconceptions, and utilize proven strategies to reduce logistical barriers (Bibbins-Domingo, 2020).

Access and equity issues are as important as public trust in vaccines. Initially, neighborhoods with high vaccination rates had a greater share of White and Asian people and a lower share of Black and Latino people (Sacarny and Daw, 2021), reinforcing that prioritization of high-risk racial/ethnic groups is needed to ensure equitable access (Wrigley-Field et al., 2021). Equity in vaccination rates is critical to ensure that COVID-19 health disparities are reduced. For racial/ethnic minority groups, continued disparities in vaccination rates could reinforce long-standing experiences and feelings of racial discrimination (Brunson and Schoch-Spana, 2020). We have witnessed the devastating impact of COVID-19, and the striking disparities by race/ethnicity in incidence, hospitalization, and death rates. We must continue to act.

## 6. Disclaimer

The opinions expressed in this article are the authors' and do not reflect the views of the National Institutes of Health, the Department of Health and Human Services, or the United States government.

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## CRedit authorship contribution statement

**Anna María Nápoles:** Conceptualization, Methodology, Resources, Formal analysis, Writing – original draft, Writing – review & editing, Supervision, Project administration, Funding acquisition. **Anita L. Stewart:** Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing, Project administration. **Paula D. Strassle:** Methodology, Software, Formal analysis, Data curation, Visualization, Writing – review & editing, Project administration. **Stephanie Quintero:** Resources, Writing – review & editing, Project administration. **Jackie Bonilla:** Resources, Writing – review & editing, Project administration. **Alia Alhoms:** Resources, Writing – review & editing, Project administration. **Veronica Santana-Ufret:** Resources, Writing – review & editing, Project administration. **Ana I. Maldonado:** Resources, Writing – review & editing, Project administration. **Eliseo J. Pérez-Stable:** Methodology, Writing – review & editing, 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.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2021.101653>.

## References

- Mackey, K., Ayers, C.K., Kondo, K.K., Saha, S., Advani, S.M., Young, S., Spencer, H., Rusek, M., Anderson, J., Veazie, S., Smith, M., Kansagara, D., 2021. Racial and ethnic disparities in COVID-19-related infections, hospitalizations, and deaths: A systematic review. *Ann. Intern. Med.* 174 (3), 362–373. <https://doi.org/10.7326/M20-6306>.
- Raine, S., Liu, A., Mintz, J., Wahood, W., Huntley, K., Haffizulla, F., 2020. Racial and ethnic disparities in COVID-19 Outcomes: Social determination of health. *Int. J. Environ. Res. Public Health* 17 (21), 8115. <https://doi.org/10.3390/ijerph17218115>.
- Hatcher, S.M., Agnew-Brune, C., Anderson, M., Zambrano, L.D., Rose, C.E., Jim, M.A., Baugher, A., Liu, G.S., Patel, S.V., Evans, M.E., Pindyck, T., Dubray, C.L., Rainey, J. J., Chen, J., Sadowski, C., Winglee, K., Penman-Aguilar, A., Dixit, A., Claw, E., Parshall, C., Provost, E., Ayala, A., Gonzalez, G., Ritchey, J., Davis, J., Warren-Mears, V., Joshi, S., Weiser, T., Echo-Hawk, A., Dominguez, A., Poel, A., Duke, C., Ransby, I., Apostolou, A., McCollum, J., 2020. COVID-19 among American Indian and Alaska Native persons - 23 states, January 31–July 3, 2020. *MMWR Morb. Mortal. Wkly Rep.* 69 (34), 1166–1169. <https://doi.org/10.15585/mmwr.mm6934e1>.
- Arrazola, J., Masiello, M.M., Joshi, S., Dominguez, A.E., Poel, A., Wilkie, C.M., Bressler, J.M., McLaughlin, J., Kraszewski, J., Komatsu, K.K., Peterson Pompa, X., Jespersen, M., Richardson, G., Lehnertz, N., LeMaster, P., Rust, B., Keyser Metobo, A., Doman, B., Casey, D., Kumar, J., Rowell, A.L., Miller, T.K., Mannell, M., Naqvi, O., Wendelboe, A.M., Leman, R., Clayton, J.L., Barbeau, B., Rice, S.K., Warren-Mears, V., Echo-Hawk, A., Apostolou, A., Landen, M., 2020. COVID-19 Mortality among American Indian and Alaska Native Persons - 14 states, January–June 2020. *MMWR Morb. Mortal. Wkly Rep.* 69 (49), 1853–1856. <https://doi.org/10.15585/mmwr.mm6949a3>.
- Nguyen, K.H., Srivastava, A., Razzaghi, H., Williams, W., Lindley, M.C., Jorgensen, C., Abad, N., Singleton, J.A., 2021. COVID-19 Vaccination Intent, Perceptions, and Reasons for Not Vaccinating Among Groups Prioritized for Early Vaccination — United States, September and December 2020. *MMWR Morb. Mortal. Wkly Rep.* 70 (6), 217–222. <https://doi.org/10.15585/mmwr.mm7006e3>.
- Momplaisir, F., Haynes, N., Nkwihoreze, H., Nelson, M., Werner, R.M., Jemmott, J., 2021. Understanding drivers of COVID-19 vaccine hesitancy Among Blacks. *Clin. Infect. Dis.* <https://doi.org/10.1093/cid/ciab102>.
- Haq, C., Hostetter, I., Zavala, L., Mayorga, J., 2020. Immigrant health and changes to the public-charge rule: Family physicians' response. *Ann. Fam. Med.* 18 (5), 458–460. <https://doi.org/10.1370/afm.2572>.
- Painter, E.M., Ussery, E.N., Patel, A., Hughes, M.M., Zell, E.R., Moulia, D.L., Scharf, L.G., Lynch, M., Ritchey, M.D., Toblin, R.L., Murthy, B.P., Harris, L.Q., Wasley, A., Rose, D.A., Cohn, A., Messonnier, N.E., 2021. Demographic characteristics of persons vaccinated during the first month of the COVID-19 vaccination program - United States, December 14, 2020–January 14, 2021. *MMWR Morb. Mortal. Wkly Rep.* 70 (5), 174–177. <https://doi.org/10.15585/mmwr.mm7005e1>.
- Hill, L., Artiga, S., 2021. COVID-19 vaccination among American Indian and Alaska Native people. Kaiser Family Foundation Racial Equity and Health Policy Issue Brief. Kaiser Family Foundation. <https://www.kff.org/racial-equity-and-health-policy/issue-brief/covid-19-vaccination-american-indian-alaska-native-people/#> (accessed 25 April 2021).
- Williamson, L.L., Harwell, T.S., Koch, T.M., et al., 2021. COVID-19 Incidence and Mortality Among American Indian/Alaska Native and White Persons - Montana, March 13–November 30, 2020. *MMWR Morb. Mortal. Wkly. Rep.* 70(14), 510–513. (In eng). DOI: 10.15585/mmwr.mm7014a2.
- Centers for Disease Control and Prevention. COVID Data Tracker, Percent of people receiving COVID-19 vaccine by race/ethnicity and date reported to CDC, United States, December 14, 2020 - October 03, 2021 Centers for Disease Control and Prevention. (<https://covid.cdc.gov/covid-data-tracker/#vaccination-demographics-trends>).
- Gregory, N., 2021. COVID-19 vaccines in tribal communities save lives, preserve culture. *Am. J. Health Syst. Pharm.* 78 (10), 835–839. <https://doi.org/10.1093/ajhp/zxab105>.
- Grumbach, K., Judson, T., Desai, M., Jain, V., Lindan, C., Doernberg, S.B., Holubar, M., 2021. Association of race/ethnicity with likelihood of COVID-19 vaccine uptake among health workers and the general population in the San Francisco Bay Area. *JAMA Intern. Med.* 181 (7), 1008. <https://doi.org/10.1001/jamainternmed.2021.1445>.
- Doherty IA, Pilkington W, Brown L, et al. COVID-19 vaccine hesitancy in underserved communities of North Carolina. medRxiv preprint. Cold Spring Harbor Laboratory; 2021. DOI 10.1101/2021.02.21.21252163. <https://www.medrxiv.org/content/10.1101/2021.02.21.21252163v1.full.pdf+html> (accessed 16 October 2021).
- Ponce, N.A., Shikhada, R., Tulua, A., 2021. Disaggregating California's COVID-19 data for Native Hawaiians and Pacific Islanders and Asians. UCLA Center for Health Policy Research, Los Angeles, CA <https://healthpolicy.ucla.edu/publications/Documents/PDF/2021/COVID-19-Data-NHPI-Asians-factsheet-may2021.pdf> (accessed 03 October 2021).
- Hawai'i State Department of Health. COVID-19 in Hawai'i: Addressing health equity in diverse populations. Honolulu, Hawai'i: Disease Outbreak Control Division: Special Report, Hawai'i State Department of Health, 2021. <https://hawaiicovid19.com/wp-content/uploads/2021/03/COVID-19-Race-Ethnicity-Equity-Report.pdf> (accessed 16 October 2021).
- Bleich, Sara N., Findling, Mary G., Casey, Logan S., Blendon, Robert J., Benson, John M., SteelFisher, Gillian K., Sayde, Justin M., Miller, Carolyn, 2019. Discrimination in the United States: Experiences of Black Americans. *Health Serv. Res.* 54 (S2), 1399–1408. <https://doi.org/10.1111/hesr.v54.s210.1111/1475-6773.13220>.

- Findling, Mary G., Casey, Logan S., Fryberg, Stephanie A., Hafner, Steven, Blendon, Robert J., Benson, John M., Sayde, Justin M., Miller, Carolyn, 2019. Discrimination in the United States: Experiences of Native Americans. *Health Serv. Res.* 54 (S2), 1431–1441. <https://doi.org/10.1111/hesr.v54.s210.1111/1475-6773.13224>.
- Parker K, Horowitz JM, Morin R, Lopez HL. Multiracial in America: Chapter 4: The Multiracial experience. Washington, D.C.: Pew Research Center, June 11, 2015 2015. <https://www.pewresearch.org/social-trends/2015/06/11/chapter-4-the-multiracial-experience/> (accessed 09 October 2021).
- Chu RC, Sommers BD. Health insurance coverage changes since implementation of the Affordable Care Act: Asian Americans and Pacific Islanders (Issue Brief No. HP-2021-11). Washington, D.C.: Office of the Assistant Secretary for Planning and Evaluation, U.S. Department of Health and Human Services, May 24, 2021 2021. <https://aspe.hhs.gov/sites/default/files/private/pdf/265581/aspe-uninsured-trends-aapi-ib.pdf> (accessed 09 October 2021).
- Artiga S, Tolbert J, Orgera K. Hispanic people are facing widening gaps in health coverage. San Francisco, CA 2021. <https://www.kff.org/policy-watch/hispanic-people-facing-widening-gaps-health-coverage/> (accessed 06 November 2020).
- Hamel L, Lopes L, Sparks G, et al. KFF COVID-19 vaccine monitor: September 2021. Henry J. Kaiser Family Foundation. September 28, 2021. <https://www.kff.org/coronavirus-covid-19/poll-finding/kff-covid-19-vaccine-monitor-september-2021/> (accessed 08 October 2021).
- Household Pulse Survey COVID-19 Vaccination Tracker. 9/27/2021 <https://www.census.gov/library/visualizations/interactive/household-pulse-survey-covid-19-vaccination-tracker.html> (accessed 08 October 2021).
- Nguyen, K.H., Nguyen, K., Corlin, L., Allen, J.D., Chung, M., 2021. Changes in COVID-19 vaccination receipt and intention to vaccinate by socioeconomic characteristics and geographic area, United States, January 6 - March 29, 2021. *Ann. Med.* 53 (1), 1419–1428. <https://doi.org/10.1080/07853890.2021.1957998>.
- Baack, Brittney N., Abad, Neetu, Yankey, David, Kahn, Katherine E., Razzaghi, Hilda, Brookmeyer, Kathryn, Kolis, Jessica, Wilhelm, Elisabeth, Nguyen, Kimberly H., Singleton, James A., 2021. COVID-19 vaccination coverage and intent among adults Aged 18–39 Years - United States, March–May 2021. *MMWR Morb. Mortal. Wkly Rep.* 70 (25), 928–933. <https://doi.org/10.15585/mmwr.mm7025e2>.
- Corbie-Smith, Giselle, 2021. Vaccine hesitancy is a scapegoat for structural racism. *JAMA Health Forum* 2 (3), e210434. <https://doi.org/10.1001/jamahealthforum.2021.0434>.
- Chou, W.S., Budenz, A., 2020. Considering emotion in COVID-19 vaccine communication: Addressing vaccine hesitancy and fostering vaccine confidence. *Health Commun.* 35 (14), 1718–1722. <https://doi.org/10.1080/10410236.2020.1838096>.
- Pogue, Kendall, Jensen, Jamie L., Stancil, Carter K., Ferguson, Daniel G., Hughes, Savannah J., Mello, Emily J., Burgess, Ryan, Berges, Bradford K., Quaye, Abraham, Poole, Brian D., 2020. Influences on attitudes regarding potential COVID-19 vaccination in the United States. *Vaccines* 8 (4), 582. <https://doi.org/10.3390/vaccines8040582>.
- Bibbins-Domingo, K., 2020. This time must be different: Disparities during the COVID-19 pandemic. *Ann. Intern. Med.* 173 (3), 233–234. <https://doi.org/10.7326/m20-2247>.
- Sacarny, Adam, Daw, Jamie R., 2021. Inequities in COVID-19 vaccination rates in the 9 largest US cities. *JAMA Health Forum* 2 (9), e212415. <https://doi.org/10.1001/jamahealthforum.2021.2415>.
- Wrigley-Field, Elizabeth, Kiang, Mathew V., Riley, Alicia R., Barbieri, Magali, Chen, Yea-Hung, Duchowny, Kate A., Matthay, Ellicott C., Van Riper, David, Jegathesan, Kirrthana, Bibbins-Domingo, Kirsten, Leider, Jonathon P., 2021. Geographically targeted COVID-19 vaccination is more equitable and averts more deaths than age-based thresholds alone. *Sci. Adv.* 7 (40) <https://doi.org/10.1126/sciadv.abj2099>.
- Brunson, Emily K., Schoch-Spana, Monica, 2020. A social and behavioral research agenda to facilitate COVID-19 vaccine uptake in the United States. *Health Security* 18 (4), 338–344. <https://doi.org/10.1089/hs.2020.0106>.