

ORIGINAL ARTICLE

Associations of Racism and COVID-19 Vaccination Intention among Asian Americans and Other Ethnic Groups in the United States

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Objectives: The COVID-19 pandemic, vaccine hesitancy, and vaccine distribution are intimately linked to race and ethnicity. The study investigates COVID-19 vaccination intention and related predictors including demographic, medical and mental health, and racism-related experiences in a diverse US sample with a focus on Asian Americans.

Methods: The study sample consisted of 1,469 adults in the United States. Participants completed an electronic survey that queried demographic variables, medical history and health behaviors, mental health status, COVID-19 vaccination intention, and three racism-related measures (racial ethnic discrimination, cultural racism, and anticipatory racism-related stress scales)

Results: Bivariate and multivariate analyses showed that vaccination intention differed by demographic characteristics including gender, race/ethnicity, education, income, and age as well as physical and medical conditions. Study participants who reported greater experiences with cultural racism and racism anticipatory-related stress expressed higher vaccination intention while racial discrimination predicted lower intention for COVID-19 vaccination.

Conclusion: We found racism-related experience can influence vaccination intention, albeit in a complex way. This work contributes to understanding the complicated relationships between racial discrimination and COVID-19 vaccination intention. There is a critical need to develop and implement evidence-based intervention strategies to improve COVID-19 vaccine uptake to achieve herd immunity against COVID-19 and community protection.

Key Words: Asian Americans ■ health disparities ■ racial discrimination ■ vaccine acceptance

The medical, social, and economic burdens from severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) have been massive worldwide, and the COVID-19 pandemic has, as of early 2021, claimed almost 3 million lives with nearly 130 million confirmed cases worldwide.¹ Returning to normalcy can occur if there is high uptake of the COVID-19 vaccine among the overall population; therefore, understanding the drivers of vaccine acceptance and hesitance is crucial to curbing the pandemic. As of April 29, 2021, 30% of the US population (over 99 million) was fully vaccinated either by Johnson & Johnson's single-dose vaccine or the two-dose series made by Pfizer-BioNTech and Moderna.² The COVID-19 pandemic

has disproportionately affected racial and ethnic minorities who are at particularly increased risk of contracting COVID-19 and suffering from its complications and death.³⁻⁶

Moreover, reaching high vaccination rates in communities will be key for achieving broader population immunity. Recent studies investigating factors associated with vaccination intentions have focused on demographic and geographic locations where males, older adults, individuals with a college and/or graduate degree, and those identifying as democrats reported higher acceptance of the COVID-19 vaccine.⁷ Geographic differences were found in that residents of region 2 (New Jersey, New York, Puerto Rico, and the Virgin Islands),

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For Sources of Funding, see page 10.

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POPULAR SCIENTIFIC SUMMARY

- Understanding determinants of vaccine uptake including intention is critical to achieving higher COVID-19 vaccination. The current concern about the COVID-19 vaccine uptake and hesitancy can be rooted in a deeper problem, structural racism.
- Asian Americans faced a surge of anti-Asian hate crimes and incidents, however, have not been well represented in COVID-19 vaccine studies.
- The current study revealed that racism-related experience can influence vaccination intention, albeit in a complex way. For all racial/ethnic groups, higher racism anticipatory stress predicted higher vaccination intent.
- For Asian Americans, there were two ways racism influences vaccination intention. First, direct experiences of racial discrimination and/or racism acts (e.g., harassment and mistreatment) decrease the vaccination intention. Nevertheless, cultural racism (e.g., seeing themselves poorly portrayed in media, social media, and public officials) predicts higher vaccination intention.

and five (Illinois, Indiana, Minnesota, Ohio, and Wisconsin) and rural dwellers reported lower COVID-19 vaccine acceptance.^{7,8} Other researchers have also examined the psychosocial factors related to vaccine uptake. Using constructs of the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB) as predictors of COVID-19 vaccination intent, Guidry et al. found higher subjective norms, perceived susceptibility to COVID-19, perceived benefits of the vaccine and self-efficacy for getting vaccine as well as low barriers were all significantly associated with higher COVID-vaccination intention.⁹

Understanding determinants of vaccine uptake including intention is critical to achieving higher COVID-19 vaccination. The current concern about the COVID-19 vaccine uptake and hesitancy can be rooted in a deeper problem, structural racism.¹⁰ Societal structures, policies, and practices are consistent predictors of a cycle of unequal access to care, unequal access to educational and employment opportunities, and disproportionate exposure to health risks and other health disparities exacerbated in the COVID-19 pandemic.¹¹ The current study draws on the theoretical underpinning of the Harrell Model that posits physical, psychological, social, functional, and spiritual consequences of discrimination.¹² According to Harrell, racism impacts health directly and indirectly; in particular, it can contribute to negative health outcomes indirectly by shaping the health-related behavior of oppressed groups.¹³ While the negative health impact of discrimination on Asian Americans has been documented in the literature,^{14,15} the impact of COVID-19-related racial discrimination on COVID-19 vaccine intention has not been examined. Structural racism and

interpersonal discrimination have led to mistrust of and disengagement from the healthcare system among racial and ethnic minority groups.¹⁶ It is hypothesized that these factors can have an impact on COVID-19 related behaviors among minorities and, in the case of vaccine uptake, can either suppress or encourage vaccine uptake.

Most of the research investigating COVID-19 vaccine intention and uptake has focused on African Americans and Latinos^{17,18}; less is known about how racism and discrimination influence COVID-19 vaccination intent among Asian Americans. Gee calls for more research on racism, at both structural and interpersonal levels, to better understand the various ways that racism causes and contributes to illness.¹⁹ Asian Americans comprise 6.6% of the US population and are a diverse group representing over 20 countries in East and Southeast Asia and the Indian subcontinent.²⁰ Recently, Asian Americans faced a surge of anti-Asian hate crimes and incidents have not been well represented in other COVID-19 vaccine studies. Therefore, there is a need to examine the role of racism/discrimination experiences in influencing COVID-19 vaccination intention amongst Asian Americans.

The purpose of this study was to investigate COVID-19 vaccination intention and related predictors including demographic, medical and mental health, and racism-related experiences and effects. We were particularly interested in how these factors may operate among Asian Americans. As a result, we oversampled Asian Americans. As a result, the study has the potential to strengthen the existing literature by providing additional empirical evidence on racism and its associations with COVID-19 vaccine intention.

METHODS

Sample

Based on the total population of adults in the US ($N = \sim 330$ million), with a 95% confidence level and a 3% margin of error, a minimum of 1,068 participants were needed for the study. Due to the focus on Asian Americans, we oversampled this group of participants to reach at least 50% of the overall sample to allow precision of estimates in this group and to allow between-group comparisons. Using Cohen's $d = 0.20$, $\alpha = 0.05$, power = 0.95, it was estimated that at least 651 Asian Americans were needed for detecting a significant difference in a given dependent variable compared with other racial/ethnic groups combined. The sample consisted of 1,479 US adults from diverse backgrounds drawn from the Dynata Simplify panel that comprises over 2.5 million US residents. Dynata randomly sampled their panel and sent invitations to potential participants. A rigorous verification process was deployed that included digital fingerprinting, spot checking via third-party verification to prove identity; in addition, Dynata set up a

system underwent screening participant's eligibility before taking the survey. To ensure reliability and accuracy of data, participants that provided illogical responses or did not spend sufficient time answering survey questions were removed. Upon completion of the survey, Dynata provided a small monetary remuneration to participants.

Data were collected using an electronic questionnaire via Qualtrics in December 2020 to January 2021. Eligible participants were individuals 18 years of age or older who could read English and had access to the internet via computer or smartphone to complete online surveys. The study protocol and procedures were approved by the Institutional Review Board at the first author's institution.

Measures

Demographic variables included age, gender, race, ethnicity, education, income, and health insurance status. The survey also assessed participants' medical history by asking if she/he ever had ever been diagnosed with (1) cancer, (2) diabetes or high blood sugar, (3) high blood pressure or hypertension, or (4) heart conditions such as heart attack, angina, or congestive heart failure. Mental health was assessed with the four-item Patient Health Questionnaire-4 (PHQ-4): Anxiety and Depression²¹ that asked, how often have you been bothered by any of the following problems?: (1) little interest or pleasure in doing things, (2) feeling down, depressed, or hopeless, (3) feeling nervous, anxious, or on edge, and (4) not being able to stop or control worrying; all of which were answered with a 1–4 scale, with 4 being 'not at all' and 1 being 'nearly every day'. Moreover, participants were asked about health behaviors including current cigarette, E-cigarette, alcohol, and marijuana use.

Intention to get a COVID-19 vaccine was measured by the item: 'If a vaccine becomes available for COVID-19, would you get it?' with responses ranging from '5 = definitely yes' to '1 = definitely no' on a 5-point Likert scale. Following previous studies^{22,23} measuring behavioral intention of health-related behavior, we assessed intention as a continuous variable as it indicates how strong a person feels to perform a given behavior (a Likert scale). Therefore, a higher score indicated stronger vaccine intention.

The racism study tool consists of three scales that were designed to assess direct experiences (Racial-Ethnic Discrimination Scale), responses (Anticipatory Race-Related Stress Scale), as well as perceptions (Cultural Racism against Asians Scale) to racism and discrimination (Appendix A). The 13-item Racial-Ethnic Discrimination Scale assessed racial discrimination and unfair treatment that occurred in different settings (e.g. restaurant, at work, etc.); the scale items were adapted from William's Major Experiences of Discrimination (MED)²⁴ and Fisher Adolescent Discrimination Distress

Index (ADDI).²⁵ Sample items included 'Were you threatened or harassed because of your race/ethnicity?' from MED and 'Were you treated unfairly because of your race/ethnicity?' from ADDI. The original Cronbach's alpha for the ADDI was 0.77–86²⁶, and the alpha of 13-item scale in our study was 0.98. The second subscale is the four-item Anticipatory Racism-Related Stress Scale that assessed a participant's psychological responses or behavioral reactions in anticipation of an impending race-related event. Adapted from Utsey's Prolonged Activation and Anticipatory Race-Related Stress Scale (PARS),²⁷ a sample item included, 'I try to avoid certain places (e.g. stores, parks) because I might be teased or harassed because of my race'. The Cronbach's alpha for the original scale was 0.77, and alpha was 0.95 in our study. The third scale, Cultural Racism against Asians, focused on negative portrayals of Asian Americans. Four scale items were adapted from the Index of Race-Related Stress (IRRS)-Brief Version²⁸; a sample item included, 'I have seen the media make Asians look bad (e.g., dirty, suspicious, or rude)'. The Cronbach's alpha of cultural racism in the original IRRS scale was 0.69 and 0.92 in our study. Krieger et al.²⁹ validated that experiences of discrimination were significantly associated with psychological distress and also associated with cigarette smoking between Blacks and Latinos.

Items from three racism scales were rated by all study participants to report the frequency of encountering various types of discrimination with responses ranging from '1 = less than once a year' to '6 = almost every day'. Three scaled scores (for Racial-Ethnic Discrimination, Anticipatory Racism-Related Stress, Cultural Racism) were formed by averaging the corresponding items in each of the scales.

Data analysis

Data were analyzed using R version 4.0.3 (R Core Team, 2020). Descriptive statistics were computed to characterize the sample and variable distributions. Moreover, bivariate associations were computed between sample characteristics and vaccine intention. Finally, to examine the unique association of each of the study variables and COVID-19 vaccination intent, a multiple linear regression was conducted. We further investigated if the effects of racial discrimination and racism anticipatory stress on vaccine intention differed by racial/ethnic groups by entering interaction terms (racial discrimination*racial/ethnic groups and racism anticipatory stress*racial/ethnic groups) into the multiple regression model. It is important to note that although the cultural racism scale was completed by all participants, this scale captured direct experiences by Asian Americans and only vicarious experiences by other groups. Therefore, the cultural racism scale was entered in a multivariate regression analysis using the Asian subsample to

examine its impact on COVID-19 vaccination intent for this group. Statistical significance was established at an alpha of $P < 0.05$.

We analyzed the outcome (COVID-19 vaccination intention) with a regression approach (parametric statistic) as the evidence suggests that most parametric statistics are robust, and applying them to Likert scale variables will not cause issues with the estimates and standard errors.^{30,31} Furthermore, most readers can more readily interpret parametric statistics compared to nonparametric statistics.

RESULTS

Demographics and COVID-19 vaccination intention

A total of 1,479 individuals were in this national sample; the majority of the participants were females (58.6%), aged between 18 and 50 (69.9%) years, who had health insurance (86%), and were born in the United States (74.1%). With the oversampling strategy for Asian Americans, 63.74% of participants identified as Asian alone or in combination with Others. Other racial/ethnicity groups were White (17.61%), Black (10.44%), Hispanic or Hispanic in combination with Others (7.10%), and Others (1.11%). Among Asian Americans, they identified themselves as Chinese (26.62%), Filipino (13.57%), Indian (4.59%), Japanese (18.79%), Korean (11.38%), Vietnamese (12.21%), Other Asian (1.77%), and Asian Mixed (11.06%). For marital status, the largest percentage of participants reported themselves as single and never married (43.5%) followed by married (41.1%), divorced (6.6%), living as married (4.6%), widowed (3.0%), and separated (1.2%). The demographic information above, along with income and education distributions, can be found in Table 1. Table 2 provided similar demographic information with Asian American subgroup.

Table 3 shows descriptive statistics for continuous variables (i.e., physical health, mental health, alcohol use, and racism scales). Of the 1,404 participants who answered the vaccination intention item, 8.4% responded 'definitely not' to if they will get the COVID-19 vaccine when it becomes available, 6.1% as 'probably not', 17.1% as 'not sure', 25.5% as 'probably yes', and 42.9% as 'definitely yes'.

Demographics and vaccination intention

Bivariate analyses (Table 1) and multivariate analysis (Table 3) consistently showed that the vaccination intention differed by demographic characteristics including gender, race/ethnicity, education, and income. Specifically, multivariate analysis showed that females (compared with males), Asians (compared with White, Black, and Hispanic/

Hispanic Mixed Americans), individuals with college or higher degrees (compared with high school or some college), and income groups of \$50,000 and higher (compared with those who in the income group of less than \$35,000), and older respondents reported statistically higher intention. Although married individuals expressed a significantly higher intention for a COVID-19 vaccine compared with non-married individuals (i.e., single, divorced, separated, widowed) at the bivariate level (Table 1), no significant difference by marital status was found between the groups at the multivariate level (Table 3) after controlling for other variables.

Health coverage, medical status, and vaccination intention

Bivariate and multivariate analyses showed that those who had health insurance (compared with those with no medical insurance) and more physical health issues (i.e. diabetes, hypertension, heart conditions, lung conditions, arthritis/rheumatism) expressed a significantly higher intention for a COVID-19 vaccine (Tables 3 and 4). Although more mental health issues (i.e. anxiety, depression) were found to relate to less vaccination intention at the bivariate level (Table 4), the association did not hold up at the multivariate level (Table 3).

Racism and vaccination intention

Our final objective was to include all demographic and medical variables as covariates and test the main effects of racism anticipatory stress and racial discrimination on COVID-19 vaccination intention, as well as the interaction effects of these racism scales with race/ethnicity groups. We first used a geographic information system (GIS) to generate a map to show racism scores, vaccine hesitancy among study samples (Fig. 1).

Multivariate analyses indicated that individuals who reported more racism anticipatory stress expressed a significantly higher vaccination intention (Table 3). There was no interaction of racism anticipatory stress by race/ethnicity [$F(4,1,191) = 1.865, P = 0.114$] on vaccination intention. For racial discrimination, multivariate analyses (Table 3) indicated that individuals who reported more racial discrimination expressed significantly lower intention for a COVID-19 vaccine although it was not significant at the bivariate level (Table 3). This inconsistency shows a suppression effect that is common in multiple regression analyses,³² whereas the multivariate model presents a 'cleaner' picture of the association between racial discrimination and vaccination intention in examining interaction effect between racial discrimination and vaccination intention with adjusted residuals when other predictors were considered simultaneously, compared with a bivariate model. In this case, the

Table 1. Participant Characteristics (Categorical/Rank Order Variables) and Bivariate Associations with COVID-19 Vaccination Intent.

Characteristics	<i>N</i>	<i>N</i> for t-test/ ANOVA	Mean for vaccine intent	<i>SD</i>	Statistics (<i>t/F</i>) ^a	<i>p</i>	Effect size (<i>d/R</i> ²) ^a
Gender					-5.10	<0.001	-0.276
Male	612	590	3.74	1.30			
Female	867	814	4.08	1.17			
Race/Ethnicity					12.138	<0.001	0.034
White	253	237	3.79	1.43			
Black	150	142	3.41	1.48			
Asian Americans	916	873	4.05	1.11			
Hispanic/Hispanic	102	98	3.53	1.39			
Other	16	15	3.40	1.29			
Age					21.634	<0.001	0.044
18 to 30	559	534	3.62	1.29			
31 to 50	475	447	3.86	1.30			
51 to 64	199	194	4.07	1.19			
65 or above	246	229	4.38	0.97			
Marital Status					-5.448	<0.001	-0.292
Married/living as married	674	641	4.08	1.31			
Others	805	763	3.72	1.17			
Education					36.629	<0.001	0.050
High school or less	238	227	3.35	1.35			
Some college	335	317	3.71	1.35			
College graduate or higher	903	860	4.09	1.14			
Income					24.369	<0.001	0.065
\$0 to \$34,999	425	396	3.41	1.35			
\$35,000 to \$49,999	162	154	3.81	1.22			
\$50,000 to \$74,999	257	245	3.94	1.23			
\$75,000 to \$99,999	232	221	4.22	1.04			
\$100,000 or more	397	388	4.17	1.17			
Born in the US					1.681	0.093	0.102
Yes	1096	1037	3.85	1.29			
No	383	367	3.98	1.18			
Health Insurance					-9.207	<0.001	-0.703
Yes	1270	1204	4.01	1.20			
No	206	200	3.15	1.34			
Cigarette Use					-1.752	0.080	-0.105
Yes	402	386	3.979	1.29			
No	1062	1015	3.847	1.27			
E-Cigarette Use					0.003	0.998	.0002
Yes	365	350	3.883	1.27			
No	1099	1052	3.883	1.26			
Marijuana Use					-0.680	0.497	-0.0383
Yes	497	481	3.915	1.22			
No	953	913	3.866	1.28			

Note: ^aFor categorical predictors with two classes, *t* statistics were reported with Cohen's *d* as effect sizes. For categorical predictors with three classes or more, *F* statistics were reported with *R*² as effect sizes. Some participants did not respond to all the items; the *N* for each analysis was different due to missing data.

Table 2. Participant Characteristics (Categorical/Rank Order Variables) and Bivariate Associations with COVID-19 Vaccination Intent for Asian American Subgroup.

Characteristics	N	N for t-test/ ANOVA	Mean for vaccine intent	SD	Statistics (t/F) ^a	p	Effect size (d/R ²) ^a
Gender					-4.47	<0.001	-0.31
Male	359	349	4.26	1.00			
Female	557	524	3.91	1.16			
Age					20.20	<0.001	0.06
18 to 30	347	335	3.76	1.18			
31 to 50	283	263	4.07	1.10			
51 to 64	131	128	4.28	1.06			
65 or above	155	147	4.47	0.81			
Marital Status					-4.66	<0.001	-0.317
Married/living as married	413	390	4.24	1.01			
Others	503	483	3.89	1.17			
Education					12.4	<0.001	0.03
High school or less	103	98	3.57	1.24			
Some college	637	607	4.15	1.06			
College graduate or higher	176	168	3.96	1.17			
Income					12.4	<0.001	0.05
\$0 to \$34,999	214	194	3.60	1.19			
\$35,000 to \$49,999	103	101	3.97	1.10			
\$50,000 to \$74,999	167	158	4.11	1.06			
\$75,000 to \$99,999	158	152	4.32	0.93			
\$100,000 or more	274	268	4.22	1.10			
Born in the US					-0.68	0.50	-0.05
Yes	565	537	4.07	1.09			
No	351	336	4.02	1.15			
Health Insurance					7.81	<0.001	0.80
Yes	803	763	4.16	1.06			
No	113	110	3.30	1.22			
Cigarette Use					-1.53	0.13	-0.13
Yes	171	164	4.17	1.01			
No	739	707	4.02	1.14			
E-Cigarette Use					1.32	0.19	0.12
Yes	157	151	3.94	1.16			
No	753	721	4.07	1.11			
Marijuana Use					0.256	0.80	0.02
Yes	237	232	4.03	1.07			
No	667	638	4.06	1.13			

Note: ^aFor categorical predictors with two classes, *t* statistics were reported with Cohen's *d* as effect sizes. For categorical predictors with three classes or more, *F* statistics were reported with *R*² as effect sizes. Some participants did not respond to all the items; the *N* for each analysis was different due to missing data.

interaction effect of racial discrimination by race/ethnicity was significant [$F(4,1,191) = 2.702, p = 0.029$]. The simple slope analysis (Fig. 2) shows different patterns of associations among racial/ethnic groups; in particular, for Asian individuals, racial discrimination was significantly associated with lower vaccination intention; however, such association was not significant for other racial/ethnicity groups.

Finally, a separate multivariate model was performed to determine whether cultural racism against Asians predicts vaccination intention among the Asian American subsample. With all demographic and medical variables controlled as covariates, results indicated that experience of cultural racism against Asians was predictive of higher vaccination intention ($B = 0.088, SE = 0.031, P = 0.005$) among the Asian sample.

DISCUSSION

Despite a trend of decreasing COVID-19 vaccine hesitancy, it still poses a major public health challenge. As a result, it is critical to understand the COVID-19 vaccine hesitancy

to provide a scientific foundation for developing evidence-based interventions and messaging to best address concerns and educate individuals, especially vulnerable groups. In this study, we provided a profile of demographic

Table 3. Multiple regression analysis of predictors of COVID-19 vaccination intention (N = 1,221).

Predictors (categorical/rank order variables) ^a	B ^b	SE	p(B)	b
Intercept	2.253	0.200	<0.001	–
Gender				
Female	–		–	
Male	0.223	0.071	0.002	0.177
Race/ethnicity				
Asian Americans	–	–	–	–
White	-0.271	0.103	0.008	-0.214
Black	-0.527	0.126	< 0.001	-0.417
Hispanic/Hispanic mixed	-0.446	0.155	0.004	-0.353
Other	-0.623	0.328	0.058	-0.493
Age				
18 to 30	–	–	–	–
31 to 50	-0.025	0.091	0.781	-0.020
51 to 64	0.150	0.123	0.222	0.119
65 or above	0.417	0.127	0.001	0.330
Marital status				
Others	–	–	–	–
Married/living as married	0.067	0.077	0.386	0.053
Education				
High school or less	–	–	–	–
Some college	0.194	0.110	0.079	0.154
College graduate or higher	0.321	0.104	0.003	0.254
Income				
Less than \$35,000	–	–	–	–
\$35,000 to \$49,999	0.171	0.118	0.150	0.135
\$50,000 to \$74,999	0.392	0.107	< 0.001	0.311
\$75,000 to \$99,999	0.465	0.115	< 0.001	0.369
\$100,000 or more	0.309	0.106	0.003	0.245
Born in the United States				
No	–	–	–	–
Yes	0.0190	0.083	0.819	0.015
Medical insurance				
No	–	–	–	–
Yes	0.455	0.102	< 0.001	0.360
Cigarette use				
No	–	–	–	–
Yes	-0.084	0.096	0.378	-0.067
E-Cigarette use				
No	–	–	–	–
Yes	0.021	0.102	0.837	0.017
Marijuana use				
No	–	–	–	–

(Continued)

Table 3. (Continued) Multiple regression analysis of predictors of COVID-19 vaccination intention (N = 1,221).

Predictors (categorical/rank order variables) ^a	B ^b	SE	p(B)	b
Predictors (continuous variables)	B	SE	p(B)	
Yes	0.042	0.089	0.640	0.033
Physical health issues	0.099	0.035	0.005	0.087
Mental health issues	-0.009	0.048	0.845	-0.006
Alcohol use (days/week in the past month)	0.006	0.019	0.745	0.010
Racial ethnic discrimination	-0.117	0.050	0.018	-0.094
Anticipatory racism-related stress	0.019	0.034	< 0.001	0.129

Note: Due to missing data, N = 1,221 was used for the regression model.

^a For the current overall model, multiple R-squared = 0.175, adjusted R-squared = 0.158, F(25,1,195) = 10.15, P < 0.001. F tests for the multicategory predictors were race/ethnicity, F(4,1,195) = 6.490, P < 0.001; age, F(3,1,195) = 5.074, P < 0.001; education, F(2,1,195) = 4.847, P = 0.005, income, F(4,1,195) = 5.350, P < 0.001.

^b B = unstandardized regression coefficients, SE = standard errors, p(B) = P-values, b = standardized regression coefficients.

Table 4. Bivariate associations of participant characteristics (continuous variables) and COVID-19 vaccination intent.

Characteristics	N for bivariate r	p	r ^b	M ^b	SD ^b	Effect size (R ²)
Physical health issues	1,404	<0.001	0.105	0.76	1.18	0.011
Mental health Issues	1,391	0.002	-0.085	1.81	0.89	0.007
Alcohol use (days/week in the past month)	1,275	0.646	0.0129	2.79	1.93	0.000
Racial-ethnic discrimination	1,404	0.683	-0.011	1.66	1.15	0.000
Anticipatory racism-related stress	1,404	0.010	0.069	2.12	1.45	0.005
Cultural racism ^a	873	0.094	0.057	4.05	1.11	0.003

Note: Some participants did not respond to all the items; the N for each analysis was different due to missing data.

^a Cultural racism pertained to only Asian/Asian Mixed individuals.

^b r = bivariate Pearson correlation, M = Mean (Arithmetic average), SD = standard deviation.

and medical factors and racism-related experiences associated with COVID-19 vaccine hesitancy. For demographic factors, individuals who were males, younger age, unmarried, education less than a college graduate, lower income <\$50,000, and non-insured had lower intentions. Next, for medical factors, individuals with fewer chronic conditions reported lower intentions.

Our work contributes to the body of literature that seeks to understand the complicated relationships between racial discrimination and COVID-19 vaccination intention. The study results showed different effects of racism scales. For all racial/ethnic groups, higher racism anticipatory stress predicted higher vaccination intent. When stressors are appraised and counter balanced by coping resources individuals may activate coping resources to mitigate discrimination^{33,34}, in this case, getting protection with COVID-19 vaccination.

For Asian Americans, there were two ways racism influences vaccination intention. First, racial discrimination predicts lower vaccination intention. During the COVID-19 pandemic, constant news updates and politicization of the pandemic may have heightened negative emotional responses in the form of myriad emotions such as fear/anxiety^{35,36}, which are also coupled with racism-related

experiences. Direct experiences of racial discrimination and/or racism acts (e.g. harassment and mistreatment) can be overwhelming to the point to increase the sense of hopelessness and avoidance coping^{37,38} and therefore, decrease the vaccination intention. These study results also show cultural racism predicts higher vaccination intention. The effect of direct racial discrimination experiences can be especially salient for Asian Americans as the racism acts against this group are pervasive during the COVID-19 pandemic. In contrast, Asian Americans who see themselves poorly portrayed in media, social media and public officials (measured by cultural racism) may have participated in 'protective' behaviors such as being careful about the way they talk or look and avoiding going to places that posed dangers (measured by anticipatory racism-related stress), and they may perceive that one of best protections is through getting vaccinated. Furthermore, it is possible that Asian Americans who perceive negative media stereotypes and take public health proactive actions (e.g., getting COVID-19 vaccines, wearing masks) can 'counteract' the negative image of Asians being portrayed on the news or social media. Our study findings suggest that racism-related perceptions (i.e., cultural racism among Asian Americans) and

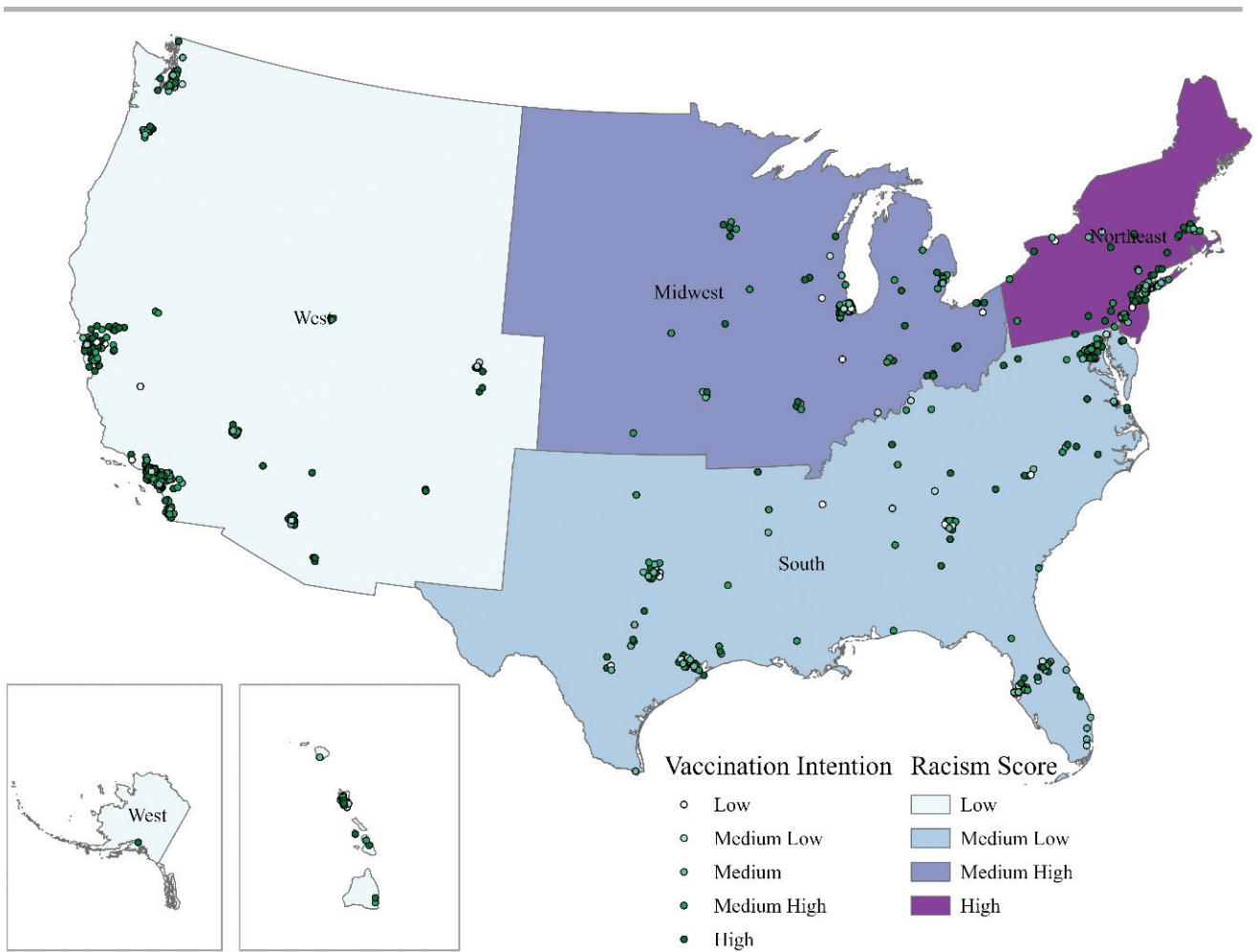
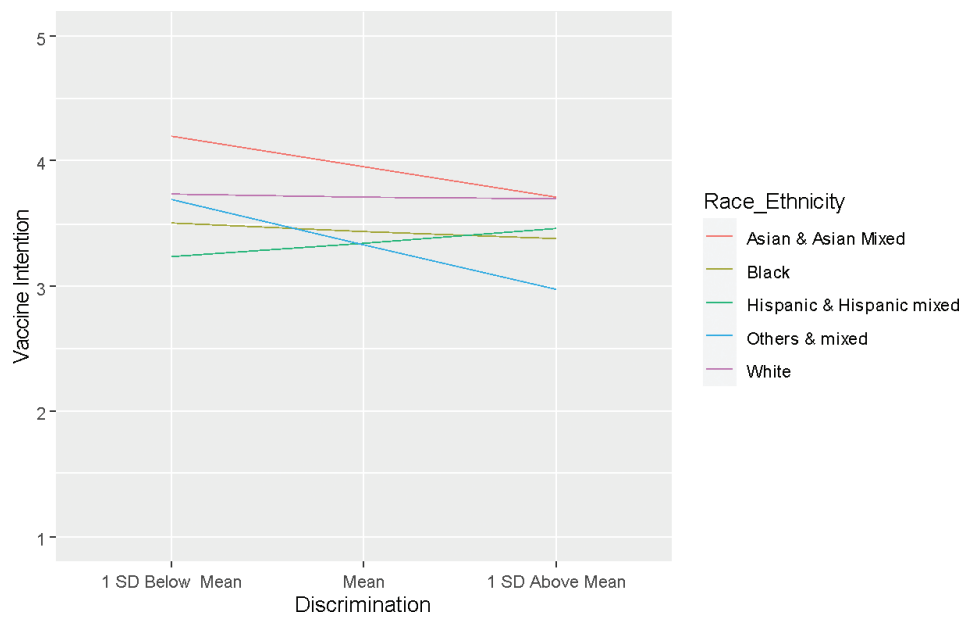


Figure 1. Racism and COVID-19 vaccination intention with geographic distributions of study participants.



*Simple slope analyses showed the effects of racial discrimination experiences on vaccination intention each racial/ethnic group were Asian and Asian Mixed ($B = -0.213$, $SE = 0.059$, $P < 0.001$), Black ($B = -0.056$, $SE = 0.099$, $P = 0.568$), Hispanic and Hispanic Mixed ($B = 0.092$, $SE = 0.111$, $P = 0.407$), Others and Others Mixed ($B = -0.308$, $SE = 0.347$, $P = 0.5375$), White ($B = -0.015$, $SE = 0.084$, $P = 0.858$).

Figure 2. Interaction of racial discrimination experience and race/ethnicity on vaccination intention.^a

responses (i.e., anticipatory racism-related stress for all racial/ethnic groups) could trigger coping behaviors that include an increased intention for COVID-19 vaccine uptake. It is important to continue examining ways for building resiliency in the context of racism, white supremacy, oppression among Asian Americans, and other racial minority populations in the areas of public health education, research, and interventions.

In April 2021, the Centers for Disease Control and Prevention (CDC) declared racism as a serious threat to public health; as a result, CDC plans to take a variety of steps to tackle racism in public health. Perceived discrimination in health care is an issue that deserves more attention from researchers, providers, insurers, and policymakers. Future studies are warranted to investigate how multiple aspects of racism relate to each other and combine, additively and interactively, as well as their associations with physical and psychosocial risks to affect health behaviors and outcomes.

The limitations of this study must be noted. First, the cross-sectional study design precluded causal inferences between demographics, racism, and COVID-19 vaccination intention. Second, self-reported measures of discrimination face several limitations, including (1) response biases (e.g., overreporting or understating experiences with discrimination) and (2) social desirability bias as participants may respond to questions in a manner that is viewed favorably by others or may avoid reporting racism because they are challenged by others to prove that discrimination exists.³⁹ Moreover, there are other characteristics that were associated with perceived racism and discrimination yet not assessed in the current study. Specifically, it may be informative to examine how indicators of structural racism, including hate crimes and disparate health care access and quality, may influence both predictors and outcome variables.^{40,41} Finally, study results are limited with a threat to the external validity because the study sample was not representative of all Asian Americans and Americans with other races/ethnicities and included those with access to online surveys, which limits the generalizability of study findings.

The study findings showed different effects of racism on COVID-19 vaccination intention, whereas cultural racism against Asian Americans increased vaccination intention while the direct experience of racial discrimination decreased intention. As a result, coping mechanisms and behavioral reactions among Asian Americans when faced with racism may be different from other groups and differ by the types of racism experiences. The information gathered in this line of research provides a deeper understanding and advances the science for effective interventions that reduce and ultimately eliminate the pathogenic effects of racism on health.

As noted by Chen and colleagues,¹⁵ the rise of racism/discrimination against Asian Americans due to COVID-19

has revealed this group's tenuous position in a large system of privilege and oppression that presents in both challenges and opportunities for efforts to mitigate health disparities. There is an urgent need to achieve herd immunity against COVID-19 and community protection; policy makers and stakeholders will need to develop and implement evidence-based intervention strategies to improve COVID-19 vaccine uptake and stop the transmission.

ARTICLE INFORMATION

Received August 5, 2021; Accepted January 16, 2022.

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Acknowledgments

The researchers thank study participants who contributed to this study and staff members at the Center for Health Disparities Innovation and Studies, Dr. Xining Yang for his expertise in GIS mapping, Dr. Alice Jo Rainville, Aleezay Kahn, and Vedhika Raghunathan who assisted in editing the manuscript and Ahmad Zalt who assisted in data management.

Conflicts of interest and funding

The authors have no conflicts of interest to declare that are relevant to the content of this article. The study was supported funded by the CDC-Racial Ethnic Approaches toward Community Health (REACH)- Grant# NU58DP006590.

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Appendix A

Measurement of three dimensions of racism experiences and firearm-related behaviors and intention.

Racism: Direct experience, cultural racism and response	
Since the COVID-19 pandemic started in Mar. 2020, how often have the following ever happened to you?	Response options: 1 = Less than once a year 2 = A few times a year 3 = At least once a month 4 = A few times a month 5 = At least once a week 6 = Almost everyday
Direct experience: Racial discrimination Nine items from Racial-Ethnic Discrimination Scale (Sladek et al. 2020) and 4 items from Major Experiences of Discrimination (William ²⁴) Cronbach's alpha: 0.98	1. Were you called insulting names because of your race/ethnicity?
	2. Were you treated unfairly because of your race/ethnicity?
	3. Were you hassled by the police because of your race/ethnicity?
	4. Were you threatened because of your race/ethnicity?
	5. Did people act like they were suspicious of you because of your race/ethnicity?
	6. Were you evaluated differently in school/at work than you deserved because of your race/ethnicity?
	7. Did other people exclude you from their activities because of your race/ethnicity?
	8. Did you get poor service at a restaurant or fast-food place because of your race/ethnicity?
	9. Did people assume your English was poor because of your race/ethnicity?
	10. Were you threatened or harassed because of your race/ethnicity?
	11. Were you denied housing because of your race/ethnicity?
	12. Were you hassled by law enforcement, including police and TSA because of your race/ethnicity?
	13. Were denied/fired from a job because of your race/ethnicity?
Perceptions of culture racism Index of Race-Related Stress (IRRS)-Brief Version (Utsey et al. ²⁷) Cronbach's alpha-0.92	1. I have seen the media make Asians look bad (e.g. dirty, suspicious, or rude)
	2. I have seen videos online (e.g. YouTube, Instagram) that portrays Asians in a negative way.
	3. I have seen leaders (e.g. US president), celebrities, or other prominent figures talk negatively about Asian people
	4. I have seen Asian ethnic groups (e.g. Japanese, Hmong) portrayed negatively in history textbooks, documentaries, or in class
Responses to Racism: Anticipatory Racism-Related Stress Prolonged Activation and Anticipatory Race-Related Stress Scale (PARS) (Utsey ²⁷) Cronbach's alpha-0.95	1. I have been worried about the kinds of problems I will likely experience because of my race
	2. I feel like have to be very careful about how I talk or look to avoid being teased or harassed because of my race/ethnicity
	3. I try to avoid certain places (e.g. stores, parks) because I might be teased or harassed because of my race
	4. I carefully observe people around me because I am worried about being teased, harassed, or attacked because of my race
COVID vaccine intention	
If COVID-19 vaccine becomes available to you, would you get it?	Response options: 1 = Definitely no, 2 = Probably No 3 = Not sure 4 = Probably yes 5 = Definitely yes