Accepted Manuscript
Version of record at: https://doi.org/10.1093/abm/kaab091

Psychosocial Determinants of COVID-19 Vaccination Intention Among White, Black, and Hispanic Adults in the US

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Abstract

Background COVID-19 vaccine uptake is an urgent public health priority.

Purpose To identify psychosocial determinants (attitudes, normative pressure, and perceived behavioral control) of COVID-19 vaccination intentions for U.S. White, Black, and Hispanic adults, and how COVID-19 misperceptions, beliefs about the value of science, and perceived media bias relate to these determinants.

Methods Longitudinal online survey using two national samples (18–49 years old/50 years and older), each stratified by racial/ethnic group (n = 3,190). Data were collected in October/November 2020 and were weighted by race group to be representative.

Results Path analyses showed that more positive attitudes about getting vaccinated predict intention across age and racial/ethnic groups, but normative pressure is relevant among older adults only. Belief in the value of science was positively associated with most determinants across all groups, however the association of COVID-19 misperceptions and perceived media bias with the determinants varied by age group.

Conclusions Messages that emphasize attitudes toward vaccination can be targeted to all age and racial/ethnic groups, and positive attitudes are universally related to a belief in the value of science. The varying role of normative pressure poses messages design challenges to increase vaccination acceptance.

Keywords Health behavior · COVID-19 vaccine · Misinformation · Reasoned action · Intention

Introduction

The rapid development of effective COVID-19 vaccines is scientifically unprecedented, but their success in preventing new infections and hospitalizations is dependent on vaccination uptake. Vaccination hesitancy, however, is a barrier to widespread public acceptance, especially in light of the "infodemic" of misinformation and skepticism toward the scientific community [1]. According to a November 2020 national survey [2], about 39% of Americans reported they would not get the vaccine if it were available and of Black respondents, who are disproportionately affected by COVID-19 [3], 57% reported they would not get the vaccine. Lower vaccination acceptance among Blacks compared with Whites is consistent with additional studies that have examined COVID-19 vaccine receptivity; acceptance among Hispanic communities, who are also at increased risk for COVID-19 infection, is less clear in comparison (i.e., studies have reported the same, lower, and higher acceptance rates compared with Whites) [4, 5]. Early data on COVID-19 vaccination rates indicate that White adults are getting vaccinated at rates 2.3 and 2.6 times higher than Black and Hispanics [6]. Despite low intention to vaccinate, Black and Hispanic Americans actually experience higher rates of COVID-19 infections, hospitalizations, and deaths [3], due primarily to structural determinants and racism that increase their vulnerability [7]. Addressing vaccination hesitancy is a priority because vaccinations will eventually supplant mask wearing and social distancing as the primary means of prevention. Although structural barriers may be determinative, individual decision making is also a key component of vaccination uptake.

Social and behavioral sciences can inform understanding of decision making related to vaccine uptake [8, 9]. Health behavior theories offer a systematic approach to identify determinants of vaccination that can become targeted points of intervention. Studies early in the pandemic recognize sociodemographic characteristics [10–13] and sociocultural factors like conspiracy theory beliefs [14] and political affiliation [13], as correlates of intention to get a COVID-19 vaccination [10–12]. However, in a systematic review of over 100 studies on vaccination intention and receptivity, only one applied a behavioral theory (i.e., Health Belief Model) in its analysis [4, 15].

Theoretically driven analyses of vaccination intention *among racially and ethnically diverse groups* in the USA are needed to understand COVID-19 vaccination uptake and to develop evidence-based messaging to encourage it. The Reasoned Action Approach (RAA) [16] is a widely tested behavioral theory in psychology, advertising/marketing, public health, communication, and business, often used for health messaging design [17, 18]. The focus of the RAA is one's intention to perform a specific behavior, the "target behavior." Intention is a function of one's favorability toward performing the behavior (i.e., attitudes), perceptions about what others think and do about performing the behavior (i.e., normative pressure), and beliefs about one's own ability to perform the behavior (i.e., perceived control). Each of these constructs is determined by a corresponding set of salient underlying beliefs. Precursor variables, which may include demographic characteristics, exposure to health information, and personality traits, affect intention, and ultimately behavior, through the mediating factors of attitudes, normative pressure, and perceived control [19]. Numerous meta-analyses on RAA constructs demonstrate the utility of the theory in understanding and predicting a range of health-related behaviors [20–22].

Reported racial differences in COVID-19 vaccination intentions suggest that psychosocial determinants among groups vary. Research shows that Black Americans report less favorable beliefs about a COVID-19 vaccine which predicts lower intention to vaccinate compared with non-Black Americans [23]. One explanation for differences in vaccination hesitancy may be exposure to misinformation in the media environment; there is evidence to indicate that Hispanic and Black Americans have higher levels of COVID-19 misinformation compared with Whites [24]. Black adults are also more likely to share COVID-19-related content on social media [25], where it is often difficult to distinguish between legitimate and questionable information sources. According to the World Health Organization, the dissemination and amplification of inaccurate information through mass media and digital technologies leads to "poor observance of public health measures" and undermines efforts to control the pandemic [1]. Thus, vaccination intention is lower among those exposed to misinformation and older adults are particularly susceptible to believing misinformation [26, 27]. Additionally, lower trust in science and in the media are also related to misperceptions that stem from misinformation exposure [28] and may independently interfere with the acceptance of effective vaccination policies. Any and all of these information-based constructs could be related to attitude, norms, or perceived control. For example, misinformation is known to be driven by social and identity-related factors [29] and perceived media bias is commonly explored as an outcome of group identity factors related that would implicate social norms [30]. In addition, studies have also shown that exposure to vaccine misinformation is related to less positive attitudes about vaccination [31, 32].

This study uses the RAA to identify psychosocial determinants that predict intention to receive a COVID-19 vaccination. Data from a national sample with strata of Black, White, and Hispanic U.S. adults were collected using a two-wave online survey in fall 2020. For each race group we (a) identify relevant cognitive and normative determinants (i.e., attitudes, normative pressure, and perceived control) that predict intention to get a COVID-19 vaccine; (b) examine whether these determinants mediate the relationship between intention and three information-related precursors: misperceptions (i.e., agreement with misinformation), perceived value of science, and perception of COVID-19-related media bias; and (c) assess whether these relationships vary across race and ethnic groups. Through these analyses, the theory is used as a tool to identify the factors that are most predictive of behavior. The goal of this research is therefore to assess what the empirical reality of these relationships is within these distinct populations.

Methods

Sample

Data were collected as part of a larger study to examine the effects of the COVID-19 information environment on COVID-19 prevention behaviors and on willingness to participate in scientific research. Because research participant diversity is a priority of the NIH, the study was designed to compare expectancies, barriers, and facilitators of participation across racial groups. A quota sampling design was employed to ensure statistical power for group comparisons. Two waves of data were collected by SSRS, a survey research firm, from October 20 through November 2, 2020 (Time 1/T1), and 4 weeks later from November 26 through December 4, 2020, for Time 2 (T2). Although the primary study focuses on adults ages 50 years and older, a smaller sample of 18–49-year-old adults was added to enable comparisons across age groups.

A third-party volunteer web panel was utilized to reach respondents. Panelists were invited by email to participate in an online survey. Respondents were rescreened to ensure they met qualification criteria. Quotas for each race group (n = 756 for 50+ years; n = 300 for 18–49 years) were employed to reach similar numbers of respondents by race and ethnicity. At Time 1 the sample included 3,418 respondents: 2,284 adults ages 50 and older (White, non-Hispanic n = 758; Black non-Hispanic n = 755; Hispanic n = 771) and 906 adults ages 18–49 years (White, non-Hispanic n = 298; Black non-Hispanic n = 301; Hispanic n = 307). The online survey took approximately 36 min to complete. Follow-up unweighted retention rates for Time 2 the under age 50 group were 47% for White, 49% for Black, and 46% for Hispanic respondents. For the over age 50 group rates were 62% for White, 50% for Black, and 51% for Hispanic.

Table 1 shows that at T1 groups were well-distributed across national regions and the average age of each group was consistent with the quota sampling design at baseline. White respondents had the highest education level of the groups and were evenly distributed between sex groups. However, sex was not part of the quota design, and both Black and Hispanic samples included greater proportions of female respondents compared with males than the White sample.

The sample was weighted by matching self-reported demographics to population parameters. The parameters used in the poststratification of the respondents aged 18–49 were (18–34, 35–49), sex (M, F), education level attained (High School Grad or Less, Some College/ Associate's degree, Bachelor's degree or higher), and census region (Northeast, Midwest, South, West). The same parameters were used in the poststratification of the respondents aged 50 or over, except for age (50–64, 65+). Demographic benchmarks were obtained from the 2018 American Community Survey (ACS). Data are weighted here within race and ethnicity unless noted (White, non-Hispanic; Black, non-Hispanic; Hispanic; Other, non-Hispanic) to achieve nationally representative groups *within each race group*. See Table 1 for description of the sample characteristics (unweighted).

Measures

Intention

For *intention*, the item was "How likely are you to get the coronavirus (COVID-19) vaccine as soon as it becomes available?" coded from −3 to +3, from extremely unlikely to extremely likely.

Attitudes

The semantic differential *attitude* items were "Bad-Good," "Unpleasant-Pleasant," "Foolish-Wise," "Unnecessary-Necessary," "Harmful-Beneficial," "Risky-Safe," "Not Protective-Protective," and "Ineffective-Effective," measured on a 7-point scale and coded from −3 to + 3. The scales had alphas of .97 for the over 50 sample and .94

Table 1 Demographic characteristics by age groups and race/ethnicity (unweighted)

Sample characteristics	Sample ages 18–49			Sample ages 50+		
	White	Black	Hispanic	White	Black	Hispanic
n	298	301	307	758	755	771
	%	%	%	%	%	%
Region						
Northeast	22.3	11.5	15.2	18.8	113.5	14.6
Midwest	34.7	19.5	9.8	22.5	22.3	9.5
South	37.3	59.3	41.8	37.4	52.5	44.8
West	15.6	9.8	33.3	21.3	11.7	31.1
Education						
Some high school	0.7	0.7	4.2	0.3	1.6	1.8
High school	14.5	13.1	18.0	10.7	13.4	13.0
Some college	25.7	38.4	31.4	28.5	41.7	36.1
College degree or more	59.1	47.8	46.4	60.5	43.3	49.0
Male	48.0	28.6	33.2	54.2	27.8	41.0
Age (years)	39.3	36.7	36.0	68.1	63.1	61.6
Household income	5.8 (100,000–150,000)	4.7 (70,000–100,000)	4.9 (70,000–100,000)	5.9 (70,000–100,000)	5.0 (70,000–100,000)	5.7 (70,000–100,000)

For income, entries are mean and (modal income) category for each group.

for the under 50 sample. Higher values on this scale represent positive appraisals of the vaccination behavior.

Normative pressure

The *injunctive norm* item was: "Do most people who are important to you think you should or should not get the coronavirus (COVID-19) vaccine when it becomes available?" coded −3 ("Should Not") and +3 ("Should"). The *descriptive norm* item was "Will people like you get the coronavirus (COVID-19) vaccine when it becomes available?" coded −3 ("Will not") to +3 ("Will"). The items were averaged together to create the measure of normative pressure (in the over 50 sample their correlation was 0.70 and in the under 50 sample, 0.76).

Perceived control (autonomy and self-efficacy)

The *autonomy* measure was "It is completely up to me whether I get the coronavirus (COVID-19) vaccine when it becomes available" and the *self-efficacy* measure was "If I really wanted to, I am certain that I could get the coronavirus (COVID-19) vaccine when it becomes available." Both items were measured on a 7-point scale from strongly disagree to strongly agree and subsequently coded −3 to +3. These items were not combined into a single measure of perceived control because in the over 50 group they were correlated $r = .28$ and in the under 50 group at $r = .37$.

Perceived COVID-19 media bias

Perceived COVID-19 media bias was measured by three items [33], each on 5-point scale from strongly disagree to strongly agree and coded from −2 to 2: "Media have exaggerated the risk posed by coronavirus (COVID-19)," "Media provide information to avoid outbreaks and health problems caused by coronavirus (COVID-19)" (reversed), and "One cannot trust what one hears in the media about coronavirus (COVID-19)." The polychoric alpha [34, 35] for the over 50 sample was 0.82 but 0.53 for the under 50 sample because of the poor performance of the second item for this group.

Value of science

Value of science was based on an average five items [36] on a 7-point scale from strongly disagree to strongly agree (coded −3 to 3): "Science provides us with a better understanding of the universe than does religion," "The scientific method is the only reliable path to knowledge," "The only real kind of knowledge we can have is scientific knowledge," "Science is the most valuable part of human culture," and "Science is the most efficient means of attaining truth." The alpha was .87 for the over 50 sample and .90 for the under 50 sample.

COVID-19 misperceptions

COVID-19 misperceptions were measured using an index based on six misinformation items. The items assessed agreement with each false belief using a 7-point scale from strongly disagree to strongly agree (coded −3 to +3). The items were: "Coronavirus (COVID-19) has affected most countries more negatively than the United States," "The coronavirus (COVID-19) is a hoax," "The coronavirus (COVID-19) vaccine will be used to implant people with microchips," "The coronavirus (COVID-19) pandemic is mostly over in the United States," "The flu is more lethal than coronavirus (COVID-19)," and "Herd immunity is the best strategy for managing the coronavirus (COVID-19) in the US." A positive score on the index indicates agreement with the misinformation. They were generated based on most common misperception discussed on the fact checking sites factcheck.com and snopes.com.

Statistical Analysis

Analyses were conducted separately by age and racial/ethnic group because of the sample design. The precursor and RAA mediating constructs were measured at T1 and the intention measure was from T2. Multiple group path analysis with full information maximum likelihood (FIML) was used to estimate the extent to which the attitudes, normative pressure, and perceived control constructs mediated the relationships between the precursor variables (perceived media bias, value of science, media bias) and intention to get the COVID-19 vaccination. FIML uses all available data without the limiting biases of listwise deletion [37, 38]. Data were weighted to each racial/ethnic group and unstandardized regression coefficients are reported. Wald tests were used to test for statistically significant differences across groups. All analyses were performed with STATA.

Results

Descriptive statistics for the RAA mediators and precursors by racial/ethnic group are shown in Table 2. In both age groups, means of the RAA constructs for White and Hispanic adults are more similar compared with those of Black respondents. For example, in the over age 50+ group, Black respondents reported lower intention to get the vaccine [M (SE) = 0.16 (.11)] compared with White [M (SE) = 0.91 (.13)] and Hispanic [M (SE) = 0.74 (.12)] respondents, and in the 18–49-year-old group, Black respondents have a negative mean intention (on a scale from −3 to 3; M (SE) = −0.05 (.26)]), indicating it is unlikely that they would receive the vaccine. Normative

Accepted Manuscript
Version of record at: https://doi.org/10.1093/abm/kaab091

Table 2 Weighted means and standard errors for behavioral determinants of intention and information-related precursor measures

	Sample ages 18–49				Sample ages 50+		
	White *M* (SE)	Black *M* (SE)	Hispanic *M* (SE)		White *M* (SE)	Black *M* (SE)	Hispanic *M* (SE)
n	298	301	307	*n*	758	755	771
Behavioral determinants				Behavioral determinants			
Attitude[a,c]	0.62 (.13)	0.28 (.11)	0.63 (.12)	Attitude[a,c]	1.16 (.08)	0.66 (.07)	1.02 (.07)
Normative pressure[a]	0.38 (.15)	−0.15 (.13)	0.23 (.16)	Normative Pressure[a,c]	0.89 (.09)	0.07 (.09)	0.80 (.08)
Autonomy[d]	1.22 (.12)	1.34 (.12)	1.21 (.13)	Autonomy[a]	1.93 (.07)	1.74 (.07)	1.74 (.07)
Self-efficacy[a]	0.63 (.13)	0.25 (.13)	0.49 (.14)	Self-efficacy[a,c]	1.07 (.08)	0.44 (.09)	0.94 (.08)
Intention to get the COVID-19 vaccine	0.26 (.23)	−0.05 (.26)	0.32 (.24)	Intention to get the COVID-19 vaccine	0.91 (.13)	0.16 (.11)	0.73 (.12)
Information-related precursors				Information-related precursors			
Value of science[a]	0.70 (.10)	0.36 (.11)	0.43 (.13)	Value of science[c]	0.29 (.07)	0.26 (.06)	0.45 (.06)
Misperceptions[a,b]	−0.58 (.11)	−0.96 (.11)	−0.94 (.10)	Misperceptions[a,c]	−1.16 (.06)	−1.77 (.05)	−1.48 (.05)
Perceived media bias[d]	−0.10 (.07)	−0.27 (.06)	−0.27 (.06)	Perceived media bias[a,c]	−0.27 (.05)	−0.87 (.04)	−0.37 (.05)

[a]Significant difference between White and Black.
[b]Significant difference between White and Hispanic.
[c]Significant difference between Black and Hispanic.
[d]No significant differences between groups.

pressure is also negative among younger Black respondents [*M* (SE) = −0.14 (.13)], suggesting social disapproval of getting vaccinated. Respondents' autonomy (i.e., feeling like it is in one's control) for getting the vaccination is the high across all age and racial/ethnic groups.

The results of the path analyses are shown in Tables 3 and 4. The findings are presented in two tables for clarity, but the precursors, mediators, and intention were all run simultaneously in age-specific models.

What Behavioral Determinants Are Relevant in Predicting Intention to Get the COVID-19 Vaccine for Each Race and Ethnic Group and Are There Differences Across Groups?

Among respondents at least 50 years old, intention to get the COVID-19 vaccine among Black respondents was predicted by favorable attitudes [*b* = 0.43 (.10)], increased normative pressure [*b* = 0.28 (.08)], and higher self-efficacy [*b* = 0.12 (.06)]. Among older White respondents, attitudes [*b* = 0.64 (.10)] and normative pressure [*b* = 0.33 (.09)] positively predicted intention to get the vaccine, while autonomy negatively predicted intention [*b* = −0.13 (.06)], indicating that the more individuals felt it was up to them, the lower their intentions to get the vaccine. The effect of self-efficacy on intention was not statistically significant for older White or Hispanic respondents. Among older Hispanics, only attitudes [*b* = 0.58 (.10)] and normative pressure [*b* = 0.30 (.07)] predicted intention. The coefficients across these groups were statistically equivalent.

In the 18–49-year-old group, favorable attitudes were associated with intention for White [*b* = 0.66 (.16)] and Black [*b* = 0.86 (.14)] respondents and the effect of attitude was significantly different between Black and Hispanics [*b* = 0.32 (.19), *p* = .084]. Normative pressure, autonomy, and self-efficacy were not significantly related to intention within any of the groups among 18–49-year-old adults.

What Is the Relationship Between Each of the Information-Related Precursors and the RAA Mediators of Intention and Are There Differences Across Race and Ethnic Groups?

For older adults, *placing a higher value in science* was associated with more favorable attitudes toward vaccination for each racial/ethnic group [W: *b* = 0.17 (.06); B: *b* = 0.21 (.05); H: *b* = 0.26 (.05)] and correlated with increased normative pressure for Black [*b* = 0.22 (.07)] and Hispanic [*b* = 0.32 (.06)] respondents, which were statistically different from one another. *Misperceptions* were negatively associated with attitudes about getting the vaccine for White [*b* = −0.35 (.11)] and Black [*b* = −0.22 (.09)] respondents and negatively associated with normative pressure among Whites [*b* = −0.38 (.11)]. *Media bias* was significantly related to determinants in only two instances. It was negatively associated with attitudes among White [*b* = −0.20 (.10)] and with self-efficacy among Black [*b* = −0.29 (.12)] respondents.

Value of science was positively associated with attitudes, normative pressure, autonomy, and self-efficacy for each racial/ethnic group among 18–49-year-old adults, with one exception: for Black respondents, value of science was not associated with autonomy. The relationship between value of science was statistically stronger among White respondents [*b*= 0.46 (.08)] compared with Black respondents [*b*= 0.19 (.09)]. *COVID-19 misperceptions* were only related to increased normative pressure among Whites [*b*= 0.21 (.09)] respondents.

Table 3 Regression results for behavioral determinants predicting vaccination intention by age group and race/ethnicity

Behavioral determinants	Sample ages 18–49			Behavioral determinants	Sample ages 50+		
	White *b* (SE)	Black *b* (SE)	Hispanic *b* (SE)		White *b* (SE)	Black *b* (SE)	Hispanic *b* (SE)
n	298	301	307	*n*	758	755	771
Attitude[b]	**0.66 (.16)**	**0.86 (.14)**	0.32 (.19)	Attitude[c]	**0.64 (.10)**	**0.43 (.10)**	**0.58 (.10)**
Normative pressure[c]	0.26 (.17)	−0.08 (.15)	0.29 (.16)	Normative pressure[c]	**0.33 (.09)**	**0.28 (.08)**	**0.30 (.07)**
Autonomy[a]	−0.23 (.14)	0.23 (.12)	−0.10 (.17)	Autonomy[c]	**−0.13 (.06)**	−0.05 (.06)	−0.09 (.06)
Self-efficacy[c]	0.25 (.16)	0.14 (.12)	0.11 (.20)	Self-efficacy[c]	0.05 (.06)	**0.12 (.06)**	0.09 (.06)
R^2	0.56	0.46	0.29	R^2	0.57	0.48	0.56

Bolded values are statistically significant from zero at .05 level or less.

[a]Significant difference between White and Black.

[b]Significant difference between Black and Hispanic.

[c]No significant differences between groups.

Accepted Manuscript
Version of record at: https://doi.org/10.1093/abm/kaab091

Table 4 Regression results predicting behavioral determinants of vaccination intention by age group and race/ethnicity

Precursors	Sample ages 18–49			Precursors	Sample Ages 50+		
	White *b* (SE)	Black *b* (SE)	Hispanic *b* (SE)		White *b* (SE)	Black *b* (SE)	Hispanic *b* (SE)
n	298	301	307	*n*	758	755	771
Value of science on…				Value of science on…			
Attitude[d]	**0.31 (.07)**	**0.22 (.07)**	**0.25 (.09)**	Attitude[d]	**0.16 (.05)**	**0.20 (.05)**	**0.24 (.05)**
Normative pressure[d]	**0.44 (.08)**	**0.19 (.10)**	**0.23 (.11)**	Normative pressure[b]	0.11 (.06)	**0.20 (.06)**	**0.31 (.06)**
Autonomy[d]	**0.20 (.08)**	−0.00 (.08)	**0.25 (.10)**	Autonomy[d]	−0.04 (.05)	0.00 (.05)	0.03 (.05)
Self-efficacy[d]	**0.35 (.08)**	**0.32 (.08)**	**0.22 (.11)**	Self-efficacy[d]	0.04 (.06)	0.06 (.06)	0.11 (.06)
COVID-19 misperceptions on…				COVID-19 misperceptions on…			
Attitude[d]	−0.10 (.08)	−0.11 (.08)	−0.12 (.10)	Attitude[b]	**−0.34 (.11)**	−0.17 (.09)	−0.01 (.08)
Normative pressure[d]	0.13 (.09)	0.01 (.12)	0.03 (.11)	Normative pressure[d]	**−0.37 (.10)**	−0.13 (.11)	−0.10 (.10)
Autonomy[d]	−0.01 (.09)	0.03 (.10)	0.08 (.10)	Autonomy[d]	−0.10 (.09)	−0.14 (.10)	−0.02 (.08)
Self-efficacy[a]	−0.12 (.25)	0.18 (.09)	0.03 (.11)	Self-efficacy[d]	−0.10 (.10)	−0.07 (.10)	0.04 (.09)
Perceived media bias on…				Perceived media bias on…			
Attitude[d]	**−0.53 (.16)**	−0.21 (.13)	−0.27 (.17)	Attitude[d]	**−0.22 (.10)**	−0.11 (.10)	−0.20 (.08)
Normative pressure[d]	**−0.60 (.18)**	−0.27 (.15)	**−0.45 (.22)**	Normative pressure[d]	−0.16 (.10)	−0.13 (.12)	−0.18 (.10)
Autonomy[d]	0.06 (.24)	−0.26 (.17)	−0.01 (.16)	Autonomy[d]	0.08 (.09)	−0.18 (.11)	−0.01 (.08)
Self-efficacy[d]	0.04 (.21)	−0.27 (.14)	−0.08 (.20)	Self-efficacy[c]	−0.07 (.09)	**−0.27 (.12)**	0.04 (.11)

Precursor effects adjusted for respondent's family income, education, gender, and age. Bolded values are statistically significant from zero at .05 level or less.

[a]Significant difference between White and Black.

[b]Significant difference between White and Hispanic.

[c]Significant difference between Black and Hispanic.

[d]No significant differences between groups.

On the other hand, *perceived media bias* was negatively related to normative pressure [*b* = −0.63 (.21)] among White as well as attitudes [*b* = −0.58 (.18)], and normative pressure among Hispanic respondents [*b* = −0.45 (.22)] respondents.

Discussion

Increasing vaccination rates for the most vulnerable to COVID-19 is a public health priority. Behavioral theories like the RAA provide a structure for identifying factors associated with individuals' decision making pertaining to getting vaccinated against COVID-19 infection. Using a diverse national sample, we demonstrated that patterns of relevant behavioral determinants of intention to be vaccinated vary less across race and ethnic groups than age groups, and that information-related variables like value of science, misperceptions, and media bias affect some of these vaccine intention determinants. Implications for messaging and intervention development are discussed below.

Across nearly all race and ethnic groups and ages, positive attitudes about getting a COVID-19 vaccine predicted vaccination intention. Attitudes reflect underlying expectancies about consequences that might result from getting vaccinated, such as preventing infection or protecting others. Although this analysis does not identify the specific behavioral beliefs salient to these groups, focusing on positive outcomes gained or negative outcomes avoided due to vaccination, is a promising strategy for public health messaging through media or interpersonal sources like medical providers. Among older adults, the findings suggest that normative pressure—knowing that others like them are receiving the vaccine—may be an effective point of intervention. When confronted with differential expectancies, programs or messages tailoring to appropriate participant groups is recommended [39].

Normative pressure and intention were much lower among Black adults of all ages than it was when compared with White and Hispanic respondents. As vaccine availability increases and it becomes less difficult to schedule appointments and dealing with other barriers, it may be that normative pressure will increase as more people get vaccinated. However, it is likely that low normative pressure is due in part to institutional mistrust and structural racism [40], which are difficult factors to remedy on a timeline that reflects the urgency of the COVID-19 pandemic. Vaccine hesitancy among members of the Black community is related in part to "historical mistreatment" and other factors like an accelerated vaccine timeline and the government's pandemic response [41]. Markedly different experiences within the health care system between Black and White Americans also inform the extent to which Black adults believe information about positive outcomes associated with COVID-19 (i.e., attitudes), however improving transparency of the scientific process involved in vaccine development and approval [42].

Influencing norms and attitudes and increasing intention *specific to the behavior of getting vaccinated against COVID-19* offers pathways to improving vaccination rates. Unfortunately, none of the constructs were related to intention among 18–49-year-old Hispanic adults and only attitudes predicted intention for younger White and Black respondents. The relationship between attitudes and intention was much stronger among younger Black respondents than among older one. The difference between the age groups indicate that age-specific strategies may be needed to encourage vaccination and the distinct underlying beliefs driving attitudes may not overlap between younger and older adults.

Because decisions about getting vaccinated are being made in the context of the COVID-19 "infodemic," it is not surprising that beliefs associated with how individuals obtain and interpret information from the media are contributors to the formation of attitudes, normative pressure, and perceived control about getting vaccinated. Our findings indicate that attitudes toward perceived media bias, value of science, and beliefs in misinformation each play a role in shaping key determinants. Beliefs in the value of science, for instance, emerged as a precursor that was universally consequential to positive attitudes and normative pressure among all ages, and to autonomy and self-efficacy among 18–49-year-old adults. Given that trust in science has diminished precipitously among political conservatives over the last 40 years, this finding has important implications for public policy and the rhetorical cues provided by conservative political leaders [43].

COVID-19 misinformation, in contrast, was negatively related to attitudes for Black older adults and both attitudes and normative pressure for White older adults. This is consistent with research that demonstrates older adults are more susceptible to misinformation [26] It may be that older adults are less savvy at recognizing questionable information [44], are more likely to forget the message source over time [45] and fail to seek out multiple sources [46].

Limitations

The data were collected at the end of October 2020 before any vaccine received emergency use authorization from the FDA. It is possible the relationships identified here may have changed and continue to change as the vaccine rollout progresses, as more of the population becomes vaccinated, and as COVID-19 infections, hospitalizations, and deaths decline accordingly. Given the design of the original study, it was not possible to combine the age groups in a way that would allow the resulting race and ethnic groups to be nationally representative, therefore the age groups needed to be analyzed separately. Although reliability on the media bias scale was lower than what is considered acceptable in the under 50 age group, we chose to include it so we could report on the same model in both age groups. Poor reliability in either dependent or predictor variables attenuates regression coefficients. However, note that 18–49-year-old Hispanics have the only significant effect of media bias across the six groups. This is exactly the opposite effect one would expect if this association were attenuated. Additionally, although the groups are weighted to be nationally representative, the respondents were recruited from an opt-in panel and Black and Hispanic males are underrepresented, therefore generalizability may be limited.

Public Health Implications

Findings from this study have practical and theoretical implications. First, we provide an evidence base for the health messaging and intervention designed to promote vaccinations. Messaging grounded in tailored theory is more effective [47] especially when the target audience matches the sample population [39]. Initiatives to reduce exposure to and beliefs in misinformation, and to bolster beliefs in the value of scientific inquiry, require more sustained, deliberate efforts. It is uncommon for theories to be tested in national samples of diverse racial and ethnic groups in ways that allow for direct comparison of effects. This study demonstrates the utility of the RAA in predicting the same behavior in various age and racial/ethnic groups. In this instance, there were some important differences across race groups among the precursor effects, but fewer differences in the behavioral determinants that predicted intention. Although these findings provide an evidence based for group-specific vaccination messaging, it is important to note, however, that contextual factors like geographic residence and social support systems may moderate the relationship between vaccination intention and behavior.

Funding

This paper was made possible by Grant No. 3R01AG063954-02S1 from the National Institute on Aging (NIA). Its contents are solely

the responsibility of the authors and do not necessarily represent the official views of the NIA.

Compliance with Ethical Standards

Authors' Statement of Conflict of Interest and Adherence to Ethical Standards Authors Amy Bleakley, Michael Hennessy, Erin Maloney, Danna Young, John Crowley, Kami Silk, and Jessica B. Langbaum declare that they have no conflict of interest.

Authors' Contributions All authors made substantial contributions to conception and design and acquisition of data, and approved the final version for publication. Amy Bleakley drafted the manuscript and analyzed the data; Michael Hennessy analyzed the data assisted with revisions, and Erin Maloney interpreted and assisted with revisions. All authors made substantial contributions to conception and design and acquisition of data, assisted with revisions, and approved the final version for publication. Amy Bleakley drafted the manuscript and analyzed the data; Michael Hennessy analyzed the data, and Erin Maloney interpreted and assisted with revisions.

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