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COVID-19 Vaccine Hesitancy: Disadvantaged Groups' Experience with Perceived Barriers, Cues to Action, and Attitudes

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Abstract

Purpose: Drawing from the Health Belief Model, we explored how disadvantaged groups in the U.S., including Black, Hispanic, less educated and wealthy individuals, experienced perceived barriers and cues to action in the context of the COVID-19 vaccination.

Design: A cross-sectional survey administered in March 2021.

Setting: USA

Subjects: A national sample of U.S. residents (n = 795) recruited from Prolific.

Measures: Perceived barriers (clinical, access, trust, religion/spiritual), cues to action (authorities, social circles), attitudes toward COVID-19 vaccination.

Analysis: Factor analysis and Structural Equation Model (SEM) were performed in STATA 16.

Results: Black and less educated individuals experienced higher clinical barriers (CI [.012, .33]; CI [.027, .10]), trust barriers (CI [.49, .92]; CI [.057, .16]), and religious/spiritual barriers (CI [.28, .66]; CI [.026, .11]). Hispanics experienced lower levels of clinical barriers (CI [-.42, .0001]). Clinical, trust, and religious/spiritual barriers were negatively related to attitudes toward vaccination (CI [-.45, −.15]; CI [-.79, −.51]; CI [-.43, −.13]). Black and less educated individuals experienced fewer cues to action by authority (CI [-.47, −.083]; CI [-.093, −.002]) and social ties (CI [-.75, −.33]; CI [-.18, −.080]). Lower-income individuals experienced fewer cues to action by social ties (CI [-.097, −.032]). Cues from social ties were positively associated with vaccination attitudes (CI [.065, .26]).

Conclusion: Communication should be personalized to address perceived barriers disadvantaged groups differentially experience and use sources who exert influences on these groups.

Keywords

underserved populations, disadvantaged groups, health disparities, COVID-19 vaccine hesitancy, vaccine promotion, HBM, barriers, cues to action

Introduction and Purpose

The COVID-19 pandemic brought catastrophic global human, economic, and social consequences. Vaccines remain one of the best ways to defeat COVID-19. However, to be successful, hundreds of millions of Americans should fully be vaccinated.[1] The U.S. still lags in this regard and leads the world in vaccine opposition and hesitancy.[2] For example, as of January 2022, COVID-19 cases and hospitalizations were the highest. Only around 64% are fully vaccinated, and only around half of those eligible have received a booster dose.[3] In addition, data show disparities in the vaccination rates in traditionally disadvantaged populations - across racial and ethnic minority groups (predominantly Black and Hispanic[4]) and lower education and income groups.[5,6] In this study, we defined socially disadvantaged groups as Black, Hispanic, and people of lower education and lower household income.

Effects continue to be felt disproportionally.[7] It is thus critical to identify the factors associated with attitudes toward

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COVID-19 vaccines for these most affected and disadvantaged groups. Vaccine refusal and hesitancy especially among the disadvantaged groups, were related to distrust (in the vaccine, vaccine developers, government, etc.), mis/disinformation (primarily about the vaccine's side effects), and political differences.[2,8] Consequently, we need to better understand how to change vaccine attitudes racial/ethnic minority and lower socioeconomic status groups hold.

Literature Review

The present study draws from the Health Belief Model (HBM) to address this critical issue. HBM is one of the widely adopted and tested frameworks for explaining and predicting attitudes toward health choices and designing health interventions.[9,10] The model's fundamental variables are perceptions of severity, susceptibility, barriers, benefits, self-efficacy, and cues to action.[11] HBM is widely used in the vaccination context, including COVID-19.[8,12,13] In this context, the model focuses on perceived severity and susceptibility of the disease the vaccine would prevent, perceived benefits and barriers of the vaccine, cues to action, and self-efficacy for accepting/refusing the vaccine.

Barriers and Cues to Action

Perceived barriers are among the most powerful predictors of health behaviors.[14] While studies on HBM tend to treat barriers as a single variable, this conceptual approach may miss important facets social groups uniquely experience. Recent studies have shown the impact of different obstacles to COVID-19 vaccination, such as access, perceived clinical elements, trust, and a lack of information for decision-making.[9,13] Further, not all barriers may be equally influential or relevant to attitudes toward the COVID-19 vaccine, with access and trust as salient barriers to vaccination for disadvantaged groups.[15] Our study fills this gap by examining potential dimensions of perceived barriers to COVID-19 vaccination with a focus on disadvantaged groups (ethnic/racial minorities, low income, low education). Specifically, based on existing literature, we propose four dimensions of perceived barriers: *perceived clinical barriers;*[12] *perceived access barriers;*[12] *trust barriers* (newly developed); and *religious/spiritual barriers* (newly developed).

Cues to action, another significant HBM predictor of health behaviors, refers to health messaging from different sources, including authority sources[12] and personally connected sources.[16] Despite its theoretical importance, this construct has been understudied relative to other HBM factors,[17] particularly as connected to disadvantaged groups' experiences. It is plausible that they respond to messages from different sets of actors. Based on existing literature,[12,16] we differentiate cues to action into *authority/officials* (eg, health departments, mayors, the President of the U.S., governor, CDC) and *social ties* (eg, employer/boss, spiritual advisor, doctor/nurse, family members, friends, colleagues) dimensions. We thus posit the following research questions and hypotheses:

RQ1: How do disadvantaged groups experience different types of barriers to COVID-19 vaccination?

RQ2: How do disadvantaged groups experience different types of cues to action for taking COVID-19 vaccines?

H1: Different types of perceived barriers are negatively associated with attitudes toward taking COVID-19 vaccines.

H2: Different types of cues to action are positively associated with attitudes toward taking COVID-19 vaccines.

Methods

Data Collection

The study was conducted after IRB approval. A national sample of 795 U.S. participants was recruited through Prolific, an online sample vendor, in early March 2021. Prolific is one of the existing professional survey platforms used by academic researchers (Palan and Schitter, 2018; Pedersen and Favero, 2020). We recruited participants from Prolific's online panel who volunteered to participate in research projects in exchange for incentives. Black and Hispanic participants were selected using stratified sampling based on the U.S. Census. Excluding participants who failed attention checks, a total of 741 participants were included in the final data set. Table 1 provides demographic profiles of the sample.

Measures

All questions included in the survey were randomized to minimize order effects.

Disadvantaged groups. In this study, we defined socially disadvantaged groups as Blacks, Hispanics, and people of lower education and lower household income. Blacks and Hispanics were coded as dummy variables. Education was measured on an eight-point scale (1 = *less than high school*, 8 = *Doctorate or equivalent*) and then reversed coded so that larger values indicated lower education. Household income was measured on a ten-point scale (1 = *under $10,000*, 10 = *$200,000 or more*) and then reversed coded.

Severity of COVID-19. Four items by Coe et al[12] were used to measure perceived severity of COVID-19 (eg, "If I get COVID-19, I will get sick." 1 = *strongly disagree* to 5 = *strongly agree*). The average of the four items was 3.33 (SD = .84, α = .70).

Susceptibility of COVID-19. Four items, adapted from Coe et al.[12] and Myers and Goodwin[18] were used to measure perceived susceptibility of COVID-19 (eg, "I am at risk for getting COVID-19." 1 = *strongly disagree* to 5 = *strongly agree*). The average of the four items was 3.40 (SD = 1.01, α = .84).

Self-efficacy. Two items adapted from Guidry et al.[9] were used to measure self-efficacy of getting COVID-19 vaccines ("For

Table 1. Demographics of Participants.

Demographics	Category	N = 741, %
Age	20-35	30.5
	36-55	35.2
	56-90	34.3
Gender	Male	47.4
	Female	51.2
Ethnicity (multiple selections are possible)	White, non-hispanic or latino	77.1
	Black or african american	13.1
	Hispanic or latino	7.4
	Asian	7.5
	Native american or alaskan native	2.0
	Others	0.9
Education	Less than high school	0.8
	High school	12.4
	Some college, or community college	21.9
	Two-year associate degree	10
	Four-year bachelor degree	32.7
	Master's degree	17.1
	Medical degree: MD	0.7
	Doctoral or equivalent	4.5
Household income	Under $10,000	12.7
	$10,000 to $14,999	7.6
	$15,000 to $24,999	9.7
	$25,000 to $34,999	10.7
	$35,000 to $49,999	13.9
	$50,000 to $74,999	19.9
	$75,000 to $99,999	11.8
	$100,000 to $124,999	7.0
	$125,000 to $199,999	4.6
	$200,000 or more	2.2
Gotten the COVID vaccine	Yes	20.6
	No	79.4
Party affiliation	Strong republican	7.3
	Moderate republican	7.6
	Weak republican	5.0
	Independent	24.8
	Weak democrat	10.3
	Moderate democrat	16.9
	Strong democrat	28.2

me to have the COVID-19 vaccine would be..." 1= *very difficult, 5 = very easy*). The average was 3.34 (SD = 1.12, Pearson's correlation = .50).

Attitudes toward the COVID-19 Vaccine. Six items from Myers and Goodwin[18] were used to measure attitudes toward getting COVID-19 vaccines. On a six-point semantic differential scale, participants were asked, "If I were to get the COVID-19 vaccine, it would be..." (1) *Foolish – Wise*, (2) *worthless – valuable*, (3) *harmful – beneficial*, (4) *unsatisfactory – satisfactory*, (5) *bad – good*, (6) *negative – positive*. The average of the items was 5.06 (SD = 1.42, α = .99). Table 2 contains a complete list of items.

Scale Development for Barrier and Cues to Action

We developed a scale of barriers based on existing literature on barriers to getting vaccines.[9,12,19,20] The first dimension of the scale was related to *clinical barriers* leading to vaccine hesitancy.[12] Five items were developed (eg, "I will get sick from the COVID-19 vaccine"). *Access barriers*, the second dimension, refers to the perceived access people have to the COVID19 vaccine.[12,21] Four items were developed (eg, "There is a shortage of the COVID-19 vaccine"). Another dimension was *information barriers*[22] – degrees of access to accurate and trustworthy information about the COVID-19 vaccines (eg, "I don't know where I can get accurate information about the COVID-19 vaccines"). This dimension was later removed from the scale as factor analysis results indicated it overlapped with the trust barrier. The third dimension was *trust barriers*[23,24] – how much people trust COVID-19 vaccines and vaccine-connected organizations (eg, "I don't trust the government agencies that approved the COVID-19 vaccines"). The last dimension measured *religious barriers*[9,23,25,26] – the extent to which

Table 2. Barriers and Cue to Actions Scales and Corresponding Items with Descriptive Statistics, N = 741.

Construct	Items	Mean (SD)
Clinical barrier	(CB1) I will have side effects from the COVID-19 vaccine	3.14 (1.13)
	(CB2) I will get sick from the COVID-19 vaccine	2.24 (1.15)
	(CB3) I will die from the COVID-19 vaccine *	1.41 (.77)
	(CB4) the COVID-19 vaccine will be painful	2.17 (1.09)
	(CB5) the COVID-19 vaccine is NOT an effective way to protect against COVID-19 *	1.64 (1.08)
Access barrier	(AB1) I don't know how to get a hold of the COVID-19 vaccine	2.29 (1.33)
	(AB2) it is inconvenient to get the COVID-19 vaccine	2.40 (1.32)
	(AB3) there is a shortage of the COVID-19 vaccine	3.43 (1.19)
	(AB4) the clinics/venues that provide the COVID-19 vaccine are too far away	1.96 (1.11)
Information barrier*	(IB1) I don't have enough information to decide whether to take the COVID-19 vaccine or not *	1.80 (1.21)
	(IB2) I am confused by the information about the COVID-19 vaccines *	1.85 (1.70)
	(IB3) I don't know where I can get accurate information about the COVID-19 vaccines *	1.79 (1.14)
	(IB4) I don't know where I can get trustworthy information about the COVID-19 vaccines *	1.89 (1.22)
Trust barrier	(TB1) I don't trust vaccines in general*	1.73 (1.18)
	(TB2) I don't trust the medical professionals who recommend the COVID-19 vaccines	1.78 (1.18)
	(TB3) I don't trust the scientists who recommend the COVID-19 vaccines	1.78 (1.19)
	(TB4) I don't trust the government agencies that approved the COVID-19 vaccines	2.20 (1.38)
	(TB5) I don't trust the pharmaceutical companies pfizer and moderna that manufacture the COVID-19 vaccines	2.19 (1.32)
	(TB6) I don't trust media that recommend the COVID-19 vaccines	2.26 (1.43)
Religious barrier	(RB1) as long as I am faithful to my god and/or my religion, I am protected from COVID-19, therefore I do not need the COVID-19 vaccine	1.33 (.79)
	(RB2) the COVID-19 vaccines' ingredients are banned by my religion therefore I cannot get the COVID-19 vaccine	1.22 (.66)
	(RB3) it is better to use spiritual/holy preventive measures (eg, holy water, holy oil, cross, holy amulets, etc.) to prevent getting sick from COVID-19 than to get the COVID-19 vaccine	1.29 (.71)
	(RB4) it is better to use natural preventive methods (eg, essential oils, other natural drinks, tonics etc.) to prevent getting infected with COVID-19 than getting the vaccine	1.56 (1.04)
	(RB5) it is better to get sick of COVID-19 and for your body to fight it off, building natural immunity than getting the vaccine	1.75 (1.20)
Cue to action by authority	(CAA1) my local health department recommended us to get the COVID-19 vaccine	4.25 (1.08)
	(CAA2) the mayor in my city recommended us to get the COVID-19 vaccine	3.73 (1.22)
	(CAA3) the president of the U.S. recommended us to get the COVID-19 vaccine	4.60 (.83)
	(CAA4) my governor recommended us to get the COVID-19 vaccine	4.19 (1.10)
	(CAA5) the CDC recommended us to get the COVID-19 vaccine	4.64 (.74)
Cue to action by social circles	(CASC1) the organization/boss I work for recommended us to get the COVID-19 vaccine	3.29 (1.33)
	(CASC2) my doctor recommended me to get the COVID-19 vaccine	3.57 (1.42)
	(CASC3) my nurse recommended me to get the COVID-19 vaccine	3.29 (1.34)
	(CASC4) my spiritual advisor (such as pastor/priest/rabi/imam) recommended me to get the COVID-19 vaccine	2.52 (1.14)
	(CASC5) my family members recommended me to get the COVID-19 vaccine	3.73 (1.43)
	(CASC6) my friends recommended me to get the COVID-19 vaccine	3.62 (1.40)
	(CASC7) my colleagues recommended me to get the COVID-19 vaccine	3.34 (1.37)

Note. All above items used 5-point scale, 1=strongly disagree, 2=somewhat disagree, 3=Neither agree nor disagree, 4=somewhat agree, 5=strongly agree. Items marked by * were removed from the final measures, based on the results of factor analysis.

religious/spiritual beliefs serve as barriers (eg, "As long as I am faithful to my God and/or my religion, I am protected from COVID-19, therefore I do not need the COVID-19 vaccine").

A cue-to-action scale was developed based on research that emphasizes cues to action by authorities[12] and social circles.[16] Five items were developed for cues to action by authority (eg, "The President of the U.S. recommended us to get the COVID-19 vaccine") and six by social circles (eg, "My family members recommended me to get the COVID-19 vaccine").

Statistical Analysis Plan

We performed factor analysis to confirm the scales of barriers and cues to action. We first split the data (N = 741) into two separate samples (n_1= 371 and n_2 = 370) as a cross-validation strategy.[27] Then we conducted exploratory factor analysis

(EFA) using the first sample. Maximum likelihood factoring with an Oblimin rotation was used to examine item loadings. Based on the EFA results, we performed confirmatory factor analysis (CFA) on the second sample. We inspected modification indices and correlated errors for item correlations when a model fit was not satisfactory for the measurement model. We then estimated a structural equation model (SEM) to test the hypotheses and research questions. Both factor analysis and SEM were performed in STATA 16.

Results

Factor Analysis

We started with EFA with the first sample (n_1= 371). For the barrier scale, eigenvalues and the scree-plot indicated the retention of four factors, which is different from the original proposal of five factors. Upon reviewing the item loadings, we found that the four items used to represent information barriers cross-loaded on the trust barrier factor. Underlying trust issues may have caused a perceived lack of vaccine information and trustworthy information.[28] Based on the statistical results and existing literature, we thus decided to remove the information barrier items (see Supplemental Table 1).

Next, to determine which items to retain for each factor in the four-factor scale, we first considered items with a strong loading and then cross-loadings. One negative-wording item was removed due to cross-loading (ie, "CB5: The COVID-19 vaccine is NOT an effective way to protect against COVID-19"). Another item about the clinical side-effect of COVID-19 vaccines ("CB3: I will die from the COVID-19 vaccine") was also removed because of weak loading (<.30) and cross-loading. Lastly, one item with a weak loading (<.30) on the trust barrier factor was removed ("TB1: I don't trust vaccines in general"). With the items selected for each factor, we preformed CFA on the second data set (n_2 = 370). Upon inspecting the modification indices, we allowed four correlated errors, doing so significantly improved the model fit: Chi-square = 216.07 (84), RMSEA = .059, CFI = .967, TLI = .958. Please see Table 3 for the CFA factor loadings.

EFA was performed for the 12 items of the cue-to-action scale with the first data set (n_1 = 371). Both eigenvalues and the scree-plot indicated the retention of two factors, consistent with the literature on the cues to action by authority and social circles[12,16] (also see Supplemental Table 2). Then we performed CFA on the second data set (n_2 = 370). Based on the modification indices, we allowed three correlated errors. The model fit improved after these parameters were added: Chi-

Table 3. CFA Factor Loadings of the Four-Factor Barrier Scale, n_2 = 370.

	Standardized Factor Loading			
Items	Clinical Barrier	Access Barrier	Trust Barrier	Religious Barrier
CB1	.44			
CB2	.65			
CB4	.72			
AB1		.57		
AB2		.84		
AB3		.60		
AB4		.69		
TB2			.89	
TB3			.92	
TB4			.89	
TB5			.85	
TB6			.84	
RB1				.59
RB2				.62
RB3				.58
RB4				.82
RB5				.82
Goodness of fit index				
Chi^2	216.07 (94)			
RMSEA	.059			
CFI	.967			
TLI	.958			

Note. Correlations among the four factors are included in the model. Based on the modification indices, we allowed four correlation paths between items: TB2 and TB3, TB4 and TB5, TB4 and TB6, RB1 and RB3. Model fit if not allowing correlation between items: *Chi*^{2} = 467.61 (98), *RMSEA*= .101, *CFI*= .900 *TLI*= .877. Cronbach's alpha of clinical barrier is .70, access barrier is .70, trust barrier is .94, religious barrier .84.

Table 4. CFA Factor Loadings of the Two-Factor Cue to Action Scale, n_2 = 370.

	Standardized Factor Loading	
Items	Cue to Action by Authority	Cue to Action by Social Ties
CAA1	.77	
CAA2	.56	
CAA3	.72	
CAA4	.59	
CAA5	.68	
CASC1		.73
CASC2		.78
CASC3		.78
CASC4		.66
CASC5		.68
CASC6		.76
CASC7		.84
Goodness of fit index		
Chi^2	130.46 (50)	
RMSEA	.066	
CFI	.964	
TLI	.953	

Note. Correlations among the four factors are included in the model. Based on the modification indices, we allowed three correlation paths between items: CAA2 and CAA4, CASC2 and CASC3, CASC5 and CASC7. Model fit if not allowing correlation between items: *Chi*^{2} = 257.98 (53), *RMSEA*= .102, *CFI*= .909 *TLI*= .887.
Cronbach's alpha of cue to action by authority is .79, cue to action by social ties is .90.

square = 130.46 (50), RMSEA = .066, CFI = .96, TLI = .95. Please see Table 4 for the CFA factor loadings.

SEM Results

A full structural equation model (SEM) was fitted using the maximum likelihood estimator (ML). SEM is a multivariate statistical analysis technique that is used to analyze structural relationships between variables. The RMSEA statistics showed a close fit of the proposed model to the observed data covariance matrix (RMSEA: .049, 95% CI = .046, .051). The CFI (=.936) and TLI (=.928) values also indicated that the proposed model fit the data acceptably. We also controlled for the relationship between access barriers and self-efficacy, as access to vaccines is associated with self-efficacy to vaccination.[29] Table 5 contains the unstandardized (B) and standardized (β) coefficients from the full structural model.

Regarding RQ1, results showed that Blacks and participants of lower education experienced a higher level of clinical barriers than other participants (B = .17, $P < .05$, CI [.012, .33] and B = .066, $P < .001$, CI [.027, .10], respectively). Hispanics, however, reported a lower level of clinical barriers (B= −.21, $P = .05$, CI [-.42, .0001]). Being Black or Hispanic and education and income were not related to access barriers. In terms of trust barriers, Blacks and people of lower education had a higher level of trust barriers (B = .70, $P < .001$, CI [.49, .92] and B = .11, $P < .001$, CI [.057, .16], respectively). For religious and spiritual barriers, Blacks and people of lower education had a higher level of religious barriers (B = .47, $P < .001$, CI [.28, .66] and B = .070, $P < .01$, CI [.026, .11], respectively).

Concerning RQ2, results showed that Blacks and people of lower education reported a lower level of *cues to action by authority* (B = −.28, $P < .01$, CI [-.47, −.083] and B =-.048, $P < .05$, CI [-.093, −.002], respectively). Blacks, people of lower education, and people of lower income reported a lower level of *cues to action by social ties* (B = −.54, $P < .001$, CI [-.75, −.33], B = −.13, $P < .001$, CI [-.18, −.080], and B = −.065, $P < .001$, CI [-.097, −.032], respectively).

H1 was partially supported. Results showed that clinical barriers, trust barriers, and religious/spiritual barriers were negatively associated with attitudes toward COVID-19 vaccines (B = −.29, $P < .001$, CI [.45, −.15], B = −.65, $P < .001$, CI [-.79, −.51], and B = −.28, $P < .001$, CI [-.43, −.13], respectively). However, access barriers did not have any significant association with attitudes toward COVID-19 vaccines. H2 was also only partially supported. Results showed that only cues to action by social ties were positively associated with attitudes toward COVID-19 vaccines (B = .16, $P < .01$, CI [.065,.26]). Cues to action by authority did not have any significant association with attitudes toward COVID-19 vaccines. Figure 1 shows the results of the SEM model.

Table 5. Unstandardized (B) and standardized (β) effects of variables in the full structural model.

Outcome	Predictor	*B* (95% CI)	*β* (95% CI)
Clinical barrier	Black*	.17 (.012, .33)	.087 (.007, .17)
	Hispanic*	−.21 (−.42, .0001)	−.081 (−.16, −.0001)
	Lower education**	.065 (.027, .10)	.15 (.065, .24)
	Lower income	−.019 (−.044, .0057)	−.070 (−.16, .02)
	Age**	−.005 (−.0085, −.0013)	−.12 (−.20, −.033)
	Gender***	.22 (.11, .32)	.17 (.087, .25)
	Party affiliation***	−.09 (−.12 −.06)	−.26 (−.34, −.18)
Access barrier	Black	−.029 (−.19, .14)	−.02 (−.10, .070)
	Hispanic	.0058 (−.22, .21)	.002 (−.089, .084)
	Lower education	−.0067 (−.046, .032)	−.016 (−.11, .078)
	Lower income	−.018 (−.044, .0078)	−.068 (−.16, .028)
	Age*	.0043 (.0004,.0008)	.10 .014, .19)
	Gender*	−.11 (−.22, −.0055)	−.092 (−.18, −.0055)
	Party affiliation**	.047 (.01695, .077)	.14 (.050, .22)
Trust barrier	Black***	.70 (.49, .92)	.23 (.16, .29)
	Hispanic	−.060 (−.34, .21)	−.015 (−.083, .054)
	Lower education***	.11 (.057, .16)	.16 (.084, .23)
	Lower income	−.0047 (−.038, .029)	−.011 (−.086, .065)
	Age	−.0004 (−.005, .004)	−.006 (−.076, .064)
	Gender**	.20 (.06, .34)	.098 (.03, .16)
	Party affiliation***	−.21 (−.27, −.19)	−.40 (−.46, −.34)
Religious barrier	Black***	.47 (.28, .66)	.19 (.11, .26)
	Hispanic	−.20 (−.45, .040)	−.062 (−.14, .012)
	Lower education**	.070 (.026, .11)	.13 (.048, .21)
	Lower income	−.026 (−.055, .003)	−.074 (−.16, .0082)
	Age	−.001 (−.0050, .0030)	−.027 (−.10, 05)
	Gender	.044 (−.076, .16)	.027 (−.005, .10)
	Party affiliation***	−.15 (−.18, −.11)	−.32 (−.39, −.25)
Cue to action by authority	Black**	−.28 (−.47, −.083)	−.12 (−.19, −.04)
	Hispanic	.054 (−.19, .30)	.017 (−.063, .097)
	Lower education*	−.048 (−.093, −.002)	−.092 (−.18, −.005)
	Lower income	−.019 (−.049, .01)	−.057 (−.15, .03)
	Age**	.0056 (.0014, .0099)	.11 (.027, .19)
	Gender	−.078 (−.20, .045)	−.050 (−.13, .029)
	Party affiliation***	.089 (.054, .12)	.21 (.13, .29)
Cue to action by social circles	Black***	−.54 (−.75, −.33)	−.19 (−.26, −.12)
	Hispanic	−.051 (−.32, .21)	−.014 (−.086, .058)
	Lower education***	−.13 (−.18, −.080)	−.21 (−.28, −.13)
	Lower income***	−.065 (−.097, −.032)	−.16 (−.24, −.082)
	Age	−.0024 (−.007, .0021)	−.039 (−.11, .035)
	Gender**	−.18 (−.32, −.052)	−.099 (−.17, −.029)
	Party affiliation***	.13 (.088, .16)	.25 (.18, .32)
Self-efficacy	Access barrier***	1 (1,1)	.58 (.51, .65)
Attitude toward COVID vaccines	Clinical barrier***	−.29 (−.45, −.15)	−.16 (−.23, −.080)
	Access barrier	−.11 (−.25, .036)	−.055 (−.13, .018)
	Trust barrier***	−.65 (−.79, −.51)	−.54 (−.65, −.43)
	Religious barrier***	−.28 (−.43, −.13)	−.18 (−.28, .087)
	Cue to action authority	.043 (−.068, .15)	.027 (−.043, .097)
	Cue to action social circles**	.16 (.065, .26)	.12 (.049, .20)
	Severity	.002 (−.072, .075)	.001 (−.046, .049)
	Susceptibility***	.17 (.11, .24)	.14 (.088, .18)
	Self-efficacy	.042 (−.022, .11)	.036 (−.019, .092)

Note. N = *741*, with 8 missing data. * means statistically significant predictors: ***P < .001. **P < .01. *P < .05.

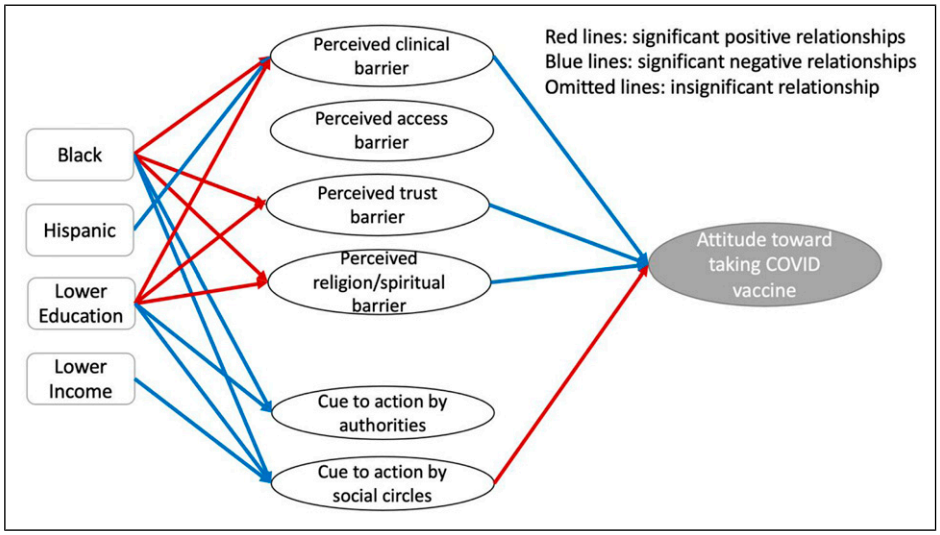

Figure 1. Results of the SEM model of COVID-19 Vaccine and Health Disparities: Barriers and Cue to Action. *Note*: N = *741*, with 8 missing data. Blue paths indicate significant negative relationships, whereas red paths indicate significant positive relationships. Insignificant paths are not included for brevity. Correlation paths among the four barriers variables, correlation paths between the two cue to action variables, and the control variables: gender, age, party affiliation, perceived severity of COVID-19, perceived susceptibility of COVID-19, and self-efficacy are included in the full SEM model but not shown here for brevity.

Discussion

This study examined socially disadvantaged groups' experience with barriers to COVID-19 vaccination and cues to action. While supporting the HBM framework through a newly developed scale of barriers and cues to action, our study uncovered theoretically and practically meaningful results. Disadvantaged groups experienced higher clinical, trust, and religious/spiritual barriers, which led to a more negative attitude toward COVID-19 vaccines. Perceived access barriers did not play a role in this process, while only cues from social ties, not authorities, were positively associated with COVID-19 vaccine attitudes. Our study extended the HBM by showing that some perceived barriers and cues to action are stronger than others in their influences on COVID-19 vaccine attitudes.

Perceived Barriers

Disadvantaged groups differentially experienced barriers to COVID-19 vaccination. Concerningly, Blacks and individuals with lower education experienced higher clinical, trust, and religious/spiritual barriers, echoing other national studies.[9,13] Specifically, these groups were more likely to believe that the vaccine was detrimental to their health, had severe side effects, and would make them sick. Some of these misconceptions might result from misinformation and anti-vaccine messages widely disseminated via social media and unfortunately reiterated by some opinion leaders.[30] Blacks and people of lower education also had a higher level of mistrust in actors connected to the vaccines, including the government, pharmaceutical companies, and media. Past and accumulative negative/traumatic experiences[8,31] can explain such mistrust, especially for people of color. For example, the Tuskegee Study and other mistreatment examples are often cited as reasons for vaccine hesitancy/refusal.[32] Moreover, these groups are more likely to believe that they should not vaccinate because vaccines go against their religion or because religious or spiritual/natural preventive measures and cures are considered better. For example, White evangelicals and Black protestants are less likely to get vaccinated, with some calling the vaccine "the mark of the beast."[33] Others believe natural alternatives offer better protection or cures.[34]

Some findings, however, offer a silver lining. Hispanics, unlike Black individuals, did not experience religious barriers, probably because the Pope and Catholic leaders from early on promoted the COVID-19 vaccine.[35] We did not find a significant association between the four disadvantaged groups and access barriers. Thus, access barriers did not seem to be a key obstacle for disadvantaged groups in our study, even in the early stage of COVID-19 vaccination. This offers some optimistic news as access has been a concern in other vaccines in the past.[36]

Clinical, trust, and religious/spiritual barriers had a significant relationship with attitudes toward COVID-19 vaccines. Even though we conducted the study early in March, access barriers were not a significant predictor of attitudes. These results have important theoretical and practical implications. On a theoretical side, the results confirmed the utility of the multidimensional conceptual approach to perceived barriers. This approach helps clarify a unique set of factors that disadvantaged groups experience when forming vaccine attitudes. On a practical side, the results point to the

need for more targeted and personalized communication messages to achieve better persuasive effects for these disadvantaged groups. Health officials and communicators need to better focus on and address these perceived barriers (clinical, trust, religion/spiritual), especially as current data suggest that the increasing peak in cases is especially connected with the unvaccinated group. For example, messaging could address the vaccine's safety, include trust-building elements, and connect the vaccine to the religious and moral duty.[8]

Cues to Action

Black and less educated people experienced a lower level of cues to action by both authority and social ties. The result suggests that while these individuals were not exposed to pro-vaccine cues to action from authorities (eg, the president, local government), their social ties (eg, friends, family members) who can personally reach out to them did not encourage vaccination. There is thus a critical need to examine how authority cues to action can break through and how to engage people who can personally influence those around them within these social groups. Our results show that cues to action from social ties may be more influential in affecting attitudes toward COVID-19 vaccination.

We also found that only cues to action by social ties were significantly associated with vaccine attitudes. This result is not fully surprising. Research has shown that social norms or friends/families exert a greater influence on one's vaccination decisions than authoritative figures.[37] It is also possible that misinformation about government, companies, and authority figures involved in vaccine development and dissemination contributed to the null finding for cues to action by authority (eg, intense disinformation campaigns against Dr Fauci). Therefore, researchers must differentiate the two types of cues to action and their differential impact. This study showed that, from a practical perspective, vaccine promotion efforts must focus on engaging ordinary people in one's social ties because social ties are more influential than authoritative figures in promoting COVID-19 vaccination. Consequently, future messaging for COVID-19 vaccine interventions should include more people "just like them" instead of traditional sources such as governors and mayors. For example, messaging and campaigns on social media could encourage people who have been vaccinated to post about their experience so that others can see cues to action from their social ties. Thus, health professionals should engage the sources for cues to action that can have the most significant impact rather than the ones that might have traditionally worked.

The study had some limitations. The cross-sectional survey does not prove causality. Longitudinal studies are needed to draw a causal conclusion regarding how different barriers and cues to action experienced by disadvantaged groups may influence their subsequent attitudes toward COVID-19 vaccination. The national sample of participants was recruited from an online panel, which may not represent the U.S population. Moreover, the study did not include any measures related to emotions or past negative/traumatic experiences of vaccines or healthcare services, which might also affect perceived trust or clinical barriers. We identified several facts of barriers and cues to action based on existing research, but there may be other equally important dimensions. We do not have a cognitive interview from the individuals in these disadvantaged groups, to establish face validity. Finally, while HBM is a useful framework in vaccination research, it also has some limitations, such as not including past vaccination behavior[38] or cognitive or emotional predictors.[39] Nevertheless, our study serves as an essential first step toward developing effective intervention strategies to target different barriers and cues to action to increase COVID-19 vaccination. Future research should build on our study to design personalized or tailored messages to promote COVID-19 vaccination for disadvantaged groups.

So What?

What is already known on this topic?

Research has been done to better understand individuals' barriers and cues to actions in the context of vaccines, including the COVID-19 vaccine.

What does this article add?

This study develops and tests multidimensional barriers and cues to action in the context of COVID-19 vaccination. Furthermore, it is one of few quantitative studies to, more comprehensively, identify specific barriers and cues to actions experienced by disadvantaged groups toward COVID-19 vaccination.

What are the implications for health promotion practice or research?

Trust, clinical, religious/spiritual barriers, and cues to action by social ties are stronger than the others in their influences on COVID-19 vaccine attitudes among disadvantaged groups. Therefore, health professionals need to better target and personalize the messages to these disadvantaged groups, focusing on their perceived barriers and engaging the sources for cues to action that can have the most significant impact.

Author Contributions

IC and SX equally contributed to the design of the work, data analysis and interpretation, drafting and revising the manuscript, and approved this version for submission. MY contributed to data analysis and interpretation, drafting and revising the manuscript and approved this version for submission.

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Supplemental Material

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