

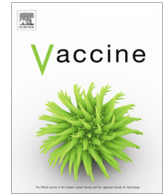


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The role of trust in COVID-19 vaccine hesitancy and acceptance among Black and White Americans [☆]

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ABSTRACT

Mass vaccination has been identified as the easiest way to combat the deadly spread of the coronavirus (COVID-19) disease, yet many Americans are still hesitant to be vaccinated. To understand motivations behind why someone is vaccine hesitant, we conceptualized a theoretical model in which demographic variables are positively associated with four types of trust (i.e., trust in institutions, physicians, non-discrimination, and social media). These trust variables, in turn, are positively associated with the outcome variable of vaccine acceptance. A multi-group structural equation modeling analysis of survey data from 1008 U.S. adults suggested that trust in institutions and physicians were important for both White and Black Americans in whether they were vaccine accepting or hesitant, while trust in non-discrimination was important for Black Americans and trust in social media was important for White Americans. Implications of the findings and how they can inform future vaccine campaigns are discussed.

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1. Introduction

On February 22, 2022, the United States had 78.4 million cases of severe acute respiratory syndrome coronavirus 2 (SARSCoV-2 - the virus that causes COVID-19). Tragically 934,000 Americans have died from COVID-19 and those numbers continue to grow. Mitigation efforts, such as masking, washing hands, and social distancing, are scientifically proven ways to stop the spread of COVID-19, but the single most effective method to stop the spread of this virus continues to be vaccination [1].

To stop more Americans from dying or being hospitalized from COVID, health officials are frantically trying to encourage more Americans to get vaccinated and boosted [2]. Hindering these efforts are widespread myths, misconceptions, and conspiracy theories

being proliferated across traditional and social media sources among anti-vaccination groups [3]. This spread of misinformation, coupled with rapidly changing information from trusted sources, like the Centers for Disease Control (CDC) and the World Health Organization (WHO), have left many people unsure if they should get vaccinated.

People who are apprehensive about whether to vaccinate have become known as the vaccine hesitant. The vaccine hesitant are not those on one side of the continuum who are rushed out to get vaccinated as soon as they could, and they are not those on the other end who outright refuse to get vaccinated. The vaccine hesitant fall somewhere in the middle and are still waiting to make their vaccination decision and in some cases whether to get a booster. Full vaccination rates across the entire US are currently at 65 % (with an even lower 43 % of that group who have received boosters). Getting this vaccine hesitant group to get fully vaccinated and boosted is becoming more and more important so the US stop the virus from killing more Americans [4]. Convincing the vaccine hesitant to become vaccine accepting represents a pivotal moment in the fight against COVID-19. The longer the virus is allowed to spread and potentially mutate the more chances there are to have a strain that is resistant to the current vaccines.

This study employs an integrative framework that looks at the multi-faceted nature of vaccine hesitancy (VH) and how trust plays an important role in VH. By examining how trust in institutions, physicians, social media, and trust you won't be discriminated

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against by the medical community affect VH, public health officials will have a better overview of how to effectively tailor health messages to meet different race groups where they are and increase vaccination rates.

2. Vaccine hesitancy

Anti-vaccination movements and vaccine hesitancy are not new. An early example can be found in the late 18th century after the smallpox vaccine was introduced [5]. Fear and mistrust of this medical advancement were widely found throughout England and America. Groups formed to protest mandatory vaccination laws citing concerns about personal freedoms and political or religious objections to the vaccine [6]. Doctors were talking about the scientific breakthrough this vaccine brought about and urging parents to get their children vaccinated. Due in part to these conflicting views other groups of people became hesitant and the vaccine roll-out was slowed down. Today you'll again find groups of Americans making very similar arguments for why people shouldn't receive the COVID-19 vaccines and a group of vaccine hesitant individuals.

Vaccine hesitancy is a major issue throughout the world today and it continues to harm efforts to curb viruses. In 2019 WHO placed vaccine hesitancy as one of the top 10 threats to global health since despite being a cost-effective and safe way to avoid disease more and more individuals are unsure about getting vaccines. Vaccine hesitancy has been defined by the WHO as the "delay in acceptance or refusal of vaccination despite availability of vaccination services. Vaccine hesitancy is complex and context specific, varying across time, place and vaccines. It is influenced by factors such as complacency, convenience, and confidence" [7, p. 4163].

2.1. Reasons for vaccine hesitancy

The reasons for VH vary from person to person. The 3 Cs of vaccine hesitancy, according to a WHO working group, are: confidence, complacency, and convenience [7]. These 3 Cs represent key groupings of reasons why people are hesitant and provide an easy way to summarize common concerns, with the full understanding that one C can certainly moderate or mediate the effect of another C [7].

Confidence is where the biggest issues surrounding refusal and hesitancy reside. Confidence involves trust in the vaccine itself, or in the effectiveness of the vaccine [7]. Primary confidence reasons for not getting the vaccine are not trusting the speed at which the vaccine was created, not trusting the government's support of the vaccine, and the fact that previously the vaccine wasn't FDA approved (approval came in late August 2021 after emergency use authorization for adults in December 2020).

Complacency involves a low awareness about the risks of being unvaccinated and getting the virus, one's self-efficacy regarding getting vaccinated, as well as a lack of understanding why increasing vaccination rates is an important step in the fight against COVID-19 [7]. There is a lot of erroneous information about how most people easily recover after having the virus leading to some becoming complacent about the need to vaccinate.

Convenience is availability and accessibility to vaccines. Concerns about how to make a vaccine appointment, get to the appointment, if there is a cost for the vaccine, if a person could get the time off work or afford to take the time off are all related to convenience. The degree to which vaccination services are provided in a cultural context and within one's comfort level are also related to convenience and have been shown to affect one's decision to vaccinate [7].

2.2. Focus on race

Different cultural contexts relating to hesitancy demonstrate how one's race and ethnicity can intersect with their level of VH. Racial and ethnic minoritized groups, like Black and Hispanic Americans, have traditionally been more hesitant to get any vaccines and this tempered approach continues with COVID-19 vaccines [8,9]. Since COVID-19 has been found to disproportionately and negatively affect minoritized groups, this issue of increased hesitancy among these groups becomes more dire [10]. Tragically Black Americans are more likely to be diagnosed with COVID-19, more likely to be hospitalized after diagnosis, and 2–3 times more likely to die from COVID-19 than White Americans [11–13]. This disproportionate effect COVID-19 has on Black Americans makes vaccine acceptance for the Black community a crucial focus for public health.

This disparity in how Black Americans are affected by the pandemic can be traced to a greater prevalence of comorbidities like heart disease, high blood pressure, obesity, and diabetes [11]. Experts in health disparities and social determinants of health have connected the higher prevalence of these comorbidities in the Black community not only to lifestyle choices, but also to decades of structural and systematic racism leading to things like unstable housing, lower-wage employment, lower levels of education, and poverty [12,14]. Another outcome of this long-standing racism is a level of medical mistrust that is prevalent in the Black community.

Medical mistrust is a level of suspicion of healthcare systems, healthcare providers, and the public health functions of the government [8,12,15,16]. This mistrust is a cultural barrier as trust in the medical community is often lower in minoritized communities due to historical atrocities, like the often-cited Tuskegee Syphilis Study and the unconscionable and forced sterilization of Puerto Rican and Native American women [15,17]. These iniquitous transgressions hinder ethical medical treatment from reaching these communities. In the case of COVID-19 vaccines the question becomes how important is trust in dispelling vaccine hesitancy?

2.3. Trust

Within health research, trust is a vital concept that has been conceptualized in many ways. In a systematic review of over 19,000 articles on vaccines and trust, Larson et al. (2018) define trust as "a relationship that exists between individuals, as well as between individuals and a system, in which one party accepts a vulnerable position, assuming the best interests and competence of the other, in exchange for a reduction in decision complexity" [18, p. 1599]. This definition highlights trust as complex and based on a relationship between an individual and another person, system, or institution. There is an inherent assumption the person with more control has a level of expertise and the best interest at heart for the vulnerable person [18].

Studies on trust and healthcare have consistently concluded systematic racism and resulting medical mistrust are far more prevalent for Black Americans than White Americans [19,20]. Disturbingly, this mistrust often results in poor health outcomes for Black Americans and underutilization of health services [16,21]. This medical mistrust also extends to vaccines in general with Black Americans by and large being more vaccine hesitant than White Americans [22].

Many studies on trust and vaccines failed to use validated multi-item measures of trust and commonly only used a single item. Given the complexity of trust and the intersectionality of how different types of trust can affect one's level of VH, we believe multiple measures of trust would yield a better picture of how trust and VH are intertwined [18]. Thus, we hypothesize a theoret-

ical model, in which demographic variables (including age, gender, education, income, political party, community, and religion) are independent variables, conceptualized to be positively associated with four types of trust (including trust in institutions, in physicians, in non-discrimination, and in social media). These trust variables, in turn, are conceptualized to be positively associated with the outcome variable vaccine acceptance, which has three dimensions: confidence, compliance, and convenience. In other words, the four trust variables are conceptualized as mediators between demographic variables and vaccine acceptance. In addition to the indirect relationships, we also hypothesize direct positive relationships between the demographic variables and vaccine acceptance since demographic variables have been found to be directly related to vaccine acceptance. Furthermore, given the discrepancy of levels of trust and vaccine acceptance between White and Black people, we compare the model between the two race groups to investigate if race moderates the conceptual model.

3. Material and methods

Survey participants were recruited from Lucid, a research technology (ResTech) platform providing programmatic access to first-party data. Previous research has shown Lucid samples outperform convenience samples by closely matching samples to benchmarks like U.S. Census data [23]. Quota sampling for this study sought to match 2019 U.S. Census data targets on age, gender, income level, and educational attainment while oversampling Black Americans so there would be roughly equal groups for comparison.

3.1. Procedure

After confirming their eligibility and consenting to participate, individuals completed an online survey asking about their media behaviors, demographics, level of trust, and vaccine acceptance in July 2021. 1,094 U.S. adults completed the survey. Excluded from the study were 69 participants who reported their race as neither White nor Black and 17 who did not answer the income question. The final sample size was 1,008, including 498 Black participants and 510 White participants.

3.2. Measures

Demographic variables. Age was measured by an open-ended question. Gender was recoded as a dichotomous variable, with 0 = male, 1 = non-male. Education was measured as the highest degree or level of school the participant had completed. Income was measured as annual household income. Political party was measured by the question “generally speaking, which political party do you identify with the most,” with five answer options including republican, democrat, independent, none, and other; the data were recoded as 0 = non-Democrat, 1 = Democrat. Community was measured by the question “which of the following best describes the place where you now live,” with four answer options that were recoded as 0 = rural area, a small city or town, and 1 = suburb near a large city or large city. Religion was measured by the question “What is your present religion, if any,” with 13 options; the data were recoded as 0 = non-Christian, and 1 = Christian.

Trust variables. Institutional trust was a scale built from five measured items [24]: trust in official government websites, in President Biden, in the CDC, in state, county, or city health departments, and in the WHO as sources to provide accurate COVID-19 information (1 = never, 5 = always, $\alpha = 0.89$ for Black, $\alpha = 0.90$ for White). Trust in physicians was measured using a previously established 4-item scale (e.g., “I trust my doctor’s opinions about

my health”) [25], with 1 = strongly disagree, 7 = strongly agree, ($\alpha = 0.89$ for Black, $\alpha = 0.93$ for White). Trust in nondiscrimination was a three-item scale (e.g., “In most hospitals people of different ethnic groups receive the same type of assistance”), with 1 = strongly agree, and 7 = strongly disagree [16]. The data were recoded, so a bigger number indicated a higher level of trust in non-discrimination ($\alpha = 0.86$ for Black, $\alpha = 0.85$ for White). Trust in social media was measured by two items: trust in Twitter and in Facebook to provide accurate COVID-19 information (1 = never, 5 = always), which were significantly correlated ($r = 0.47$ for Black, $r = 0.58$ for White).

Vaccine acceptance was a latent variable, which had three indicators: complacency, confidence, and convenience adapted from a previous scale [26]. Complacency was measured by two items, “how necessary I think the COVID-19 vaccine is” and “how important I think the COVID-19 vaccine is”; that were significantly correlated ($r = 0.82$ for Black, $r = 0.93$ for White). Confidence was measured by three items, including “the level of trust I have in the COVID-19 vaccine,” “how safe I think the COVID-19 vaccine is,” and “how effective I think the COVID-19 vaccine is” and was reliable ($\alpha = 0.93$ for Black, $\alpha = 0.97$ for White). Convenience was measured by a single item “how convenient I think the COVID-19 vaccine is.” All the vaccine acceptance items were measured on a 0–100 scale, with 0 = no agreement at all, and 100 = full agreement.

3.3. Statistical analysis

To test the hypothesized model, we built a multigroup model using maximum likelihood Structural Equation Modeling (SEM), with the two groups being Black and White. In the model, the seven demographic variables (i.e., age, gender, education, income, political party, community, and religion) were exogenous variables, predicting the four trust variables (i.e., trust in institutions, trust in physicians, trust in non-discrimination, and trust in social media) and the final outcome variable vaccine acceptance at the same time. The four trust variables were mediators, predicted by the demographic variables and predicting the outcome variable vaccine acceptance. The error variables for the four trust variables were allowed to covary because they were all about trust, so the residuals should covary. Vaccine acceptance was the outcome endogenous variable. The demographic variables and the trust variables were all observed variables, while vaccine acceptance was a latent variable, with three indicators: complacency (necessary + important), confidence (level of trust, safe, effective), and convenience. We also conducted a bootstrap analysis (number of bootstrap samples = 2,000) and used the 95 % bias-corrected confidence intervals to test the significance of the relationships. Furthermore, we ran model comparison between the two race groups to test whether race moderated the model.

4. Results

Descriptive statistics for each group were reported in Table 1. As indicated in Table 1, Black participants reported significantly lower levels of trust in physicians and in non-discrimination, and in the three indicators of vaccine acceptance than their White counterparts.

The SEM model fit the data well, with $\chi^2 = 56.66$, $df = 44$, $\chi^2/df = 1.29$, $p = .10$, goodness-of-fit index (GFI) = 0.992, comparative fit index (CFI) = 0.997, and root mean square error of approximation (RMSEA) = 0.017. Path relationships between variables were reported as follows.

Table 1
Descriptive Statistics for the variables in the model.

Variable	Frequency (%) – Black	Frequency (%) – White
Gender (Non-Male)	284 (57 %)	298 (58.4 %)
Education (Bachelor or higher)*	154 (30.9 %)	210 (41.2 %)
Income (50 K or higher)**	211 (42.4 %)	256 (50.2 %)
Party (Democrat)***	327 (65.7 %)	201 (39.4 %)
Community (Suburb/city)***	370 (74.3 %)	323 (63.3 %)
Religion (Christian)	308 (61.8 %)	308 (60.4 %)
	Mean (SD) – Black	Mean (SD) –White
Age***	36.99 (14.60)	43.97(16.43)
Trust in institutions	3.36 (1.04)	3.24 (1.11)
Trust in physicians**	5.31 (1.27)	5.58 (1.25)
Trust in non-discrimination***	4.11 (1.70)	4.95 (1.51)
Trust in social media***	2.76 (1.16)	2.41 (1.23)
Confidence**	57.73 (29.54)	63.67 (33.22)
Complacency*	62.84 (30.72)	66.92 (34.28)
Convenience***	61.5 (32.32)	69.34 (32.5)

* p <.05;

** p <.01;

*** p <.001.

4.1. Direct relationships for the Black group

For the direct relationships between demographic variables and the trust variables among the Black group, the following significant paths were identified. Trust in institution was positively predicted by age ($\beta = 0.10$, $p = .02$), political party ($\beta = 0.20$, $p <.001$), and religion ($\beta = 0.17$, $p <.001$) but negatively predicted by gender ($\beta = -0.11$, $p = .01$). Trust in physician was positively predicted by political party ($\beta = 0.09$, $p = .045$) and religion ($\beta = 0.18$, $p <.001$). Trust in non-discrimination was negatively predicted by age ($\beta = -0.24$, $p <.001$) and gender ($\beta = -0.16$, $p <.001$). Trust in social media was negatively predicted by age ($\beta = -0.27$, $p <.001$), gender ($\beta = -0.10$, $p = .02$) but positively predicted by income ($\beta = 0.10$, $p = .048$) and political party ($\beta = 0.12$, $p = .009$).

For the direct relationships between the trust variables and vaccine acceptance variable among the Black group, three significant paths were identified. Trust in institutions ($\beta = 0.35$, $p <.001$), trust in physicians ($\beta = 0.12$, $p = .007$), and trust in non-discrimination ($\beta = 0.10$, $p = .02$) significantly predicted vaccine acceptance. Trust in social media, however, was not associated with vaccine acceptance ($\beta = -0.002$, $p = .96$).

For the direct relationship between demographic variables and the vaccine acceptance variable among the Black group, age ($\beta = 0.26$, $p <.001$) was the only significant predictor of vaccine acceptance. See Table 2 and Fig. 1 for significant direct paths for the Black group.

4.2. Indirect relationships for the Black group

For the Black group, the standardized indirect effects of gender (effect = -0.06 , $p = .005$), political party (effect = 0.08 , $p = .001$), and religion (effect = 0.09 , $p = .001$) on vaccine acceptance were significant. In contrast, the standardized indirect effects of age (effect = 0.02 , $p = .39$), education (effect = 0.00 , $p = .75$), income (effect = 0.02 , $p = .29$), and community (effect = -0.00 , $p = .92$) on vaccine acceptance were not significant.

4.3. Direct relationships for the White group

For the direct relationship between demographic variables and the trust variables among the White group, the following significant paths were identified. Trust in institution was positively predicted by gender ($\beta = 0.09$, $p = .03$), education ($\beta = 0.12$, $p = .009$), income ($\beta = 0.11$, $p = .02$), and political party ($\beta = 0.42$, $p <.001$). Trust in physician was positively predicted by

Table 2
Standardized path coefficients for the Black and White group.

Path	Black	White
Path between demographic variables and trust variables		
Age → Trust in institution	0.10*	-0.04
Gender → Trust in institution	-0.11*	0.09*
Education → Trust in institution	0.02	0.12**
Income → Trust in institution	0.04	0.11*
Party → Trust in institution	0.20***	0.42***
Religion → Trust in institution	0.17***	-0.004
Age → Trust in physician	0.07	0.15**
Party → Trust in physician	0.09*	0.12**
Religion → Trust in physician	0.18***	0.06
Age → Trust in non-discrimination	-0.24***	0.10*
Gender → Trust in non-discrimination	-0.16***	-0.17***
Education → Trust in non-discrimination	-0.003	0.13*
Income → Trust in non-discrimination	0.01	0.11*
Religion → Trust in non-discrimination	0.07	0.11*
Age → Trust in social media	-0.27***	-0.29***
Gender → Trust in social media	-0.10*	-0.12**
Education → Trust in social media	0.01	0.13**
Income → Trust in social media	0.10*	0.04
Party → Trust in social media	0.12**	0.22***
Community → Trust in social media	0.07	0.10*
Path between trust variables and vaccine acceptance		
Trust in institution → Vaccine acceptance	0.35***	0.39***
Trust in physician → Vaccine acceptance	0.12**	0.11**
Trust in non-discrimination → Vaccine acceptance	0.10*	0.03
Trust in social media → Vaccine acceptance	-0.002	-0.15***
Path between demographic variables and vaccine acceptance		
Age → Vaccine acceptance	0.26***	0.17***
Education → Vaccine acceptance	0.01	0.14***
Income → Vaccine acceptance	0.04	0.10*
Party → Vaccine acceptance	0.06	0.16***
Community → Vaccine acceptance	-0.01	0.12***

Only paths significant for at least one race group were included in the table.

Gender = being non-male.

Party = being Democrat.

Community = living in a suburb near a large city or a large city.

Religion = being Christian.

* p <.05,

** p <.01,

*** p <.001.

age ($\beta = .15$, $p = .001$) and political party ($\beta = 0.12$, $p = .008$). Trust in nondiscrimination was positively predicted by age ($\beta = 0.10$, $p = .03$), education ($\beta = 0.13$, $p = .01$), income ($\beta = 0.11$, $p = .04$) and religion ($\beta = 0.11$, $p = .016$) but negatively predicted by gender ($\beta = -0.17$, $p <.001$). Trust in social media was positively predicted by political party ($\beta = 0.22$, $p <.001$) and community

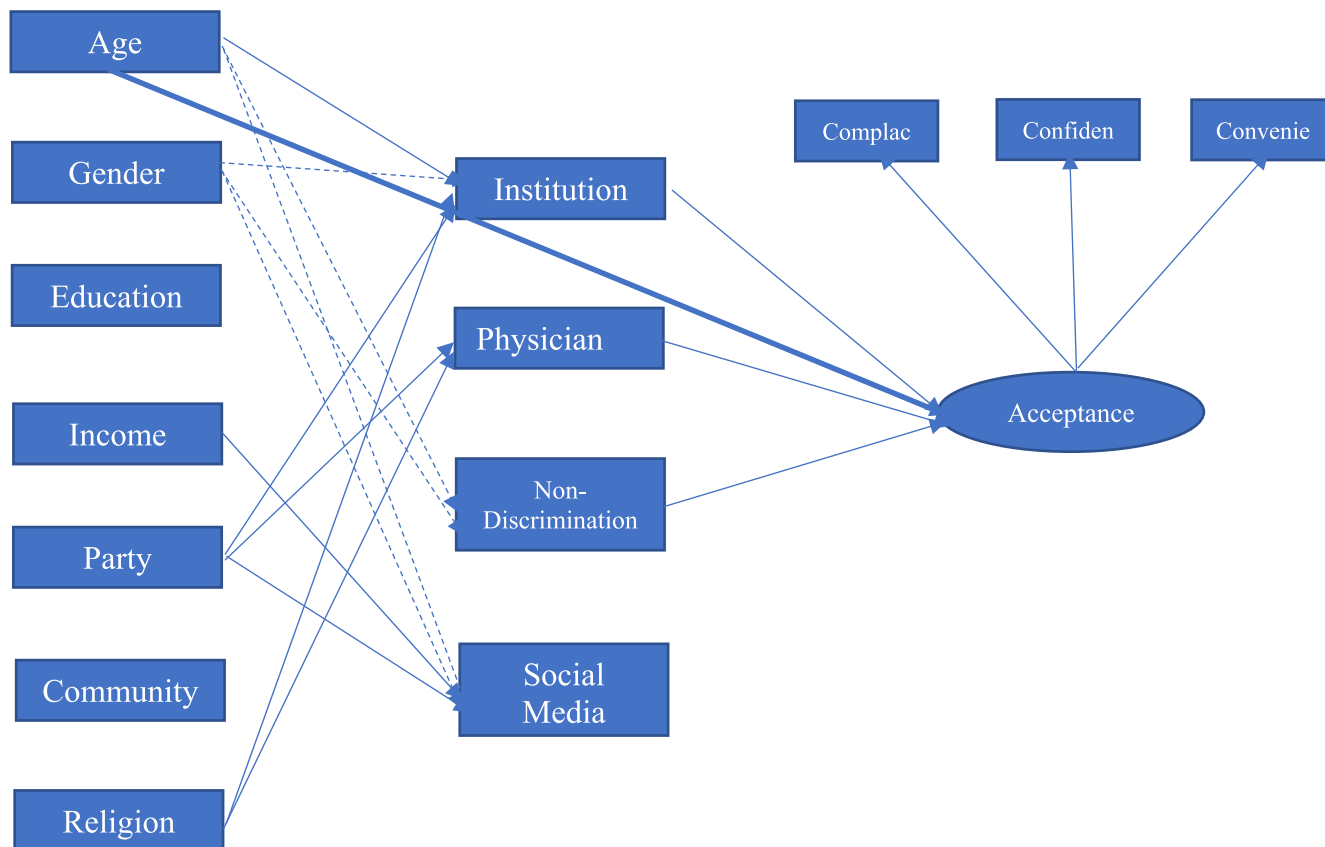


Fig. 1. Significant paths for the Black group.

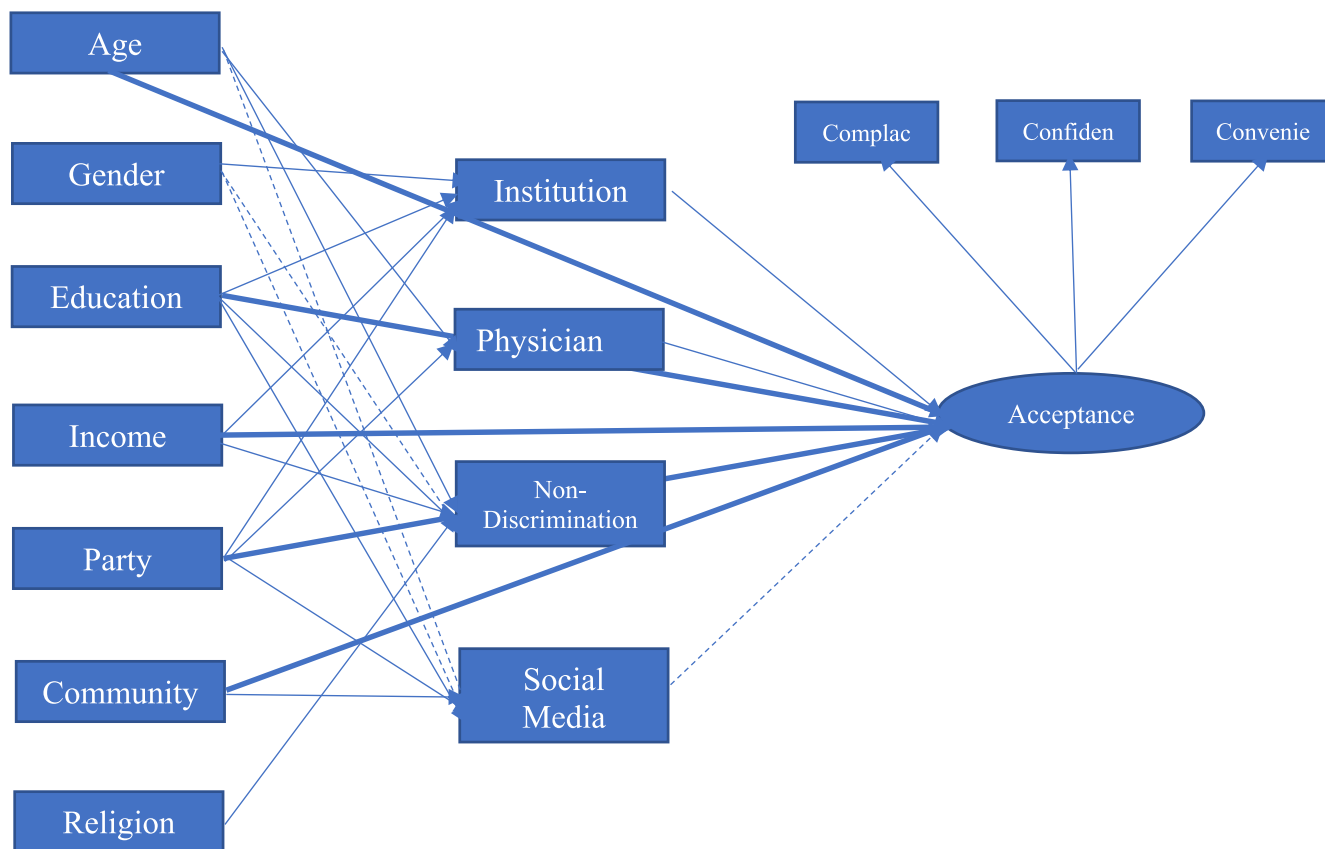


Fig. 2. Significant paths for the White group.

($\beta = 0.10$, $p = .02$) but negatively predicted by age ($\beta = -0.29$, $p < .001$) and gender ($\beta = -0.12$, $p = .005$).

For the direct relationships between the trust variables and vaccine acceptance variable among the White group, trust in institutions ($\beta = 0.39$, $p < .001$) and trust in physicians ($\beta = 0.11$, $p = .005$) were positive predictors of vaccine acceptance. Meanwhile, trust in social media ($\beta = -0.15$, $p < .001$) was negatively associated with vaccine acceptance, whereas trust in non-discrimination was not associated with vaccine acceptance ($\beta = 0.03$, $p = .49$).

For the direct relationship between demographic variables and the vaccine acceptance variable among the White group, age ($\beta = 0.17$, $p < .001$), education ($\beta = 0.14$, $p < .001$), income ($\beta = 0.10$, $p = .019$), political party ($\beta = 0.16$, $p < .001$) and community ($\beta = 0.12$, $p < .001$) were positive predictors of vaccine acceptance. On the contrary, gender ($\beta = -0.07$, $p = .08$) and religion ($\beta = -0.04$, $p = .27$) were not associated with vaccine acceptance. See Table 2 and Fig. 2 for significant direct paths for the White group.

4.4. Indirect relationships for the White group

For the White group, the standardized indirect effects of age (effect = 0.05, $p = .036$), gender (effect = 0.04, $p = .035$), income (effect = 0.05, $p = .037$), and political party (effect = 0.14, $p = .001$) on vaccine acceptance were significant. In contrast, the standardized indirect effects of education (effect = 0.04, $p = .06$), community (effect = -0.02, $p = .30$), and religion (effect = -0.004, $p = .80$) on vaccine acceptance were not significant.

4.5. Moderation

To test whether race was a moderator of the hypothesized model, we ran a constrained model in which equal weights on the paths were posed between the two race groups. Model fit indices for the constrained model were as follows: $\chi^2 = 190.73$, $df = 83$, $\chi^2/df = 2.3$, $p < .001$, GFI = 0.97, CFI = 0.98, RMSEA = 0.04. The numbers indicated the constrained model did not fit the data as well as the unconstrained one. Furthermore, model comparison results suggested assuming the unconstrained model to be correct, the equal-weight model differed significantly from the unconstrained one, with $\chi^2 = 134.07$, $df = 39$, $p < .001$. Thus, race, as hypothesized, moderated the hypothesized model, with the model for the Black group differing significantly from the model for the White group.

5. Discussion

We found trust is overwhelmingly important when it comes to overcoming vaccine hesitancy and moving people toward vaccine acceptance (VA). Different trust factors are not only directly related to vaccine acceptance, but they also mediate the effects of demographic variables on VA. When examining the relationship between the trust variables and VA, we found trust in one's physician is important for both racial groups. This is a valuable finding because it underscores the importance health care providers have in affecting vaccine decisions. Additional research should focus on how to best craft these provider and patient conversations, so hesitant patients feel supported, and have their concerns addressed.

The more people trust their doctors, the more likely they are to get vaccinated. To improve trust in physicians, physicians need to focus on improving the overall patient-provider relationship, respecting patients, and providing better health system guidelines [27]. To increase vaccination rates recent research has advocated for things like interactive educational interventions and culturally sensitive information [28]. Because our study also indicated Black respondents had significantly lower levels of trust in physicians,

providers should take into consideration their patients' cultural backgrounds to improve a patient's healthcare experience and eventually increase trust in physicians and in the medical system. Not using terms like "herd immunity," which has connections to eugenic racism, can go a long way towards understanding the enduring power of language and why using terms that are culturally appropriate for the audience you are trying to reach is not only appropriate, but necessary [29].

For both groups, overall trust in institutions is vital for moving individuals from vaccine hesitant to vaccine accepting. This aligns with previous research from around the world that has shown trust in the government and local government agencies is closely aligned with acceptance and hesitancy [30,31]. The question then becomes, how do you increase trust for these groups? For Black Americans agencies must operate with a "trustworthiness before trust" approach to alleviate and offset the structural racism experienced from these institutions and the resulting deep-seated mistrust Black Americans now have [32]. Further research could focus on how to rebuild trust between institutions and the public.

To improve overall trust in institutions, communication efforts should take into consideration demographic characteristics. Our results indicated while being Democrat is positively associated with institutional trust for both race groups, gender is related to institutional trust in different ways for the two groups. For the Black group, being female is negatively associated with institutional trust, whereas for the White group, being female is positively associated. Furthermore, education and income are positively associated with institutional trust for the White group, while age and religion are positively associated for the Black group. This means education and campaign initiatives should target those with less education and income in the White group and those who are younger and non-Christian in the Black group.

Underscoring the significance of discrimination and trust, Black respondents had a significantly lower level of trust in nondiscrimination than White participants. Trust in nondiscrimination from healthcare providers was significantly related to vaccine acceptance for the Black respondents only. This means Black respondents become more vaccine accepting the less they felt their healthcare providers would discriminate against them. This supports prior research that found feeling discriminated against breeds medical mistrust and is not surprising given the disproportionate levels of systematic racism and discrimination affecting Black respondents [37]. Ensuring Black Americans don't feel their lives are devalued and the medical professionals caring for them truly have their best interests at heart should not be viewed as an easy gap to fill. However, doing so is important not only for increasing vaccine acceptance, but also for eliminating the many health disparities experienced by the Black community.

Differing from the nondiscrimination findings, trust in social media is negatively associated with vaccine acceptance for White respondents only. This finding supports research that found anti-vaccination misinformation rampant on social media channels and this misinformation resulted in lower vaccine acceptance [33]. Further research should examine whether this means there is a path forward for developing and disseminating valid information aimed at persuading White Americans to become vaccinated or whether the dearth of accurate and verifiable information on social media has rendered this channel ineffective for these purposes. If the channel is still found to be functional, public health experts should focus on amplifying the voices of trusted experts, using language easily understood by lay audiences, and being honest about what is known or unknown at that point in time [34].

For Black respondents age was the only demographic variable positively associated with vaccine acceptance showing older respondents tended to be more accepting than younger respondents. Other studies have also found COVID-19 vaccine hesitancy

to be higher among younger Black participants [35,36]. More research examining the specific reasons younger Black Americans are vaccine hesitant is needed so public health experts can determine if there is something unknown causing the hesitancy or if it is related to a lack of trust overall in institutions, medical professionals, and concerns about potential medical discrimination. If the latter is the case, partnering with local community leaders who are trusted, like clergy members or those the youth are exposed to daily, like social media influencers, should be explored [28,37]. Another area for further research would be to examine how intersectionality plays a role in the way people view vaccines. Examining the ways social identities (e.g., race, gender, sexual orientation, political affiliation) intersect with one another and how they in turn affect one's perception of vaccines and their level of acceptance could provide a more comprehensive understanding of vaccine hesitancy.

Age, education, income, political party (i.e., self-identifying as a Democrat), and community (i.e., living in a suburb near a large city or living in a large city) are all positively associated with vaccine acceptance in White participants. This finding mirrors previous research that those who live in rural areas, are Republican, have lower levels of education and income, and are younger tend to be more vaccine hesitant or resistant [38,39].

Collectively these results indicate the two race groups are very different in terms of what does or does not affect one's level of vaccine acceptance. Our SEM model differs significantly between the two groups demonstrating what works for one group may not work for the other group meaning tailored and targeted messages are needed to impact both groups. For Black respondents, trust in nondiscrimination is very important and this is predicted by being young and being male. For the White respondents, trust in social media is important, as it is negatively associated with vaccine acceptance. Trust in social media is predicted by being young, being male, having a higher level of education, and being a Democrat. Overall demographic variables seem to be more important for the White Americans than for the Black Americans in terms of direct effects.

5.1. Strengths and limitations

Admittedly this study does have some limitations. The data is cross-sectional and does not allow us to see how things are changing over time. This lack of ability to see how one's level of VH can change over time is restrictive since the situation with the pandemic and vaccines are changing rapidly and it is possible people's levels of hesitancy are more transient as well. Another limitation is our study only investigated four types of trust in the study. Future studies should incorporate other types of trust (e.g., trust in the pharmaceutical industry) as mediators that might affect vaccine acceptance.

These known limitations are counterbalanced by a large and diverse population mirroring the current US Census data while oversampling Black Americans and providing a direct comparison of Black and White Americans. While it is common knowledge there is structural and societal racism there is not as much knowledge about how this directly impacts vaccine hesitancy.

As more of the US population becomes vaccinated it is essential for public health officials to ensure more Black Americans become vaccinated. Reducing disparities in knowledge through transparency and accurate communication on vaccines in an era of misinformation is not easy to deliver, but it is imperative [40]. It is also important to examine the underlying causes for why Black Americans are disproportionately and negatively affected by this pandemic. Data from 29 states demonstrated the extent of known racial disparities connected to COVID-19 and these findings accentuate the need for a focus on eliminating structural racism to combat COVID-19 in the Black community [41]. Health researchers

truly need to meet people where they are when looking to increase vaccine acceptance among Black Americans. One of the keys to this will be targeting specific groups and providing tailored information that is not only culturally competent and focused on plain language over overly complicated scientific jargon, but also delivered by trusted sources [42].

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Declaration of Competing Interest

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

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