**Hope as a predictor for COVID-19 vaccine uptake in the US: a cross-sectional survey of 11,955 adults**

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Abstract

Widespread vaccine uptake is critical for ending the COVID-19 pandemic. As public health officials focus on overcoming vaccine hesitancy, simultaneously boosting hope may be equally important in the US. We analyzed data from an online cross-sectional survey. Participants were 11,955 US adults (ages 18-83) of various ethnicities, living in urban and rural settings. Of these, 71.3% had at least some college education. Mean age was 32.3 years and 72.4% reported being vaccinated against COVID-19. Main measures were COVID-19 self-reported vaccination status (vaccine uptake), vaccine hesitancy (WHO SAGE Vaccine Hesitancy Scale), and hope (Adult Hope Scale). The US grand mean hope score fell within the low-hope range. COVID-19 vaccination status was positively associated with hope, even after adjusting for vaccine hesitancy, gender, age, ethnicity, income, and urban vs. rural residence. The strong relationship between hope and vaccine uptake persisted across US populations at risk for low vaccine uptake. Our mediation analysis revealed that, for every unit increase in hope, the probability of being vaccinated went up by 5 percentage points. Of this association, 52% was not mediated by vaccine hesitancy, but rather through a direct pathway from hope to vaccine uptake. Mediation analyses of US populations at risk of low vaccine uptake revealed similar findings. Hope may play an important role in vaccine uptake by reducing vaccine hesitancy and by directly enhancing vaccine uptake. Especially in populations at risk of low vaccine uptake, vaccine interventions that boost hope may augment public health efforts to increase US vaccination rates.

Keywords: hope, vaccine hesitancy, vaccine uptake, public health, COVID-19

Introduction:

More than a year has passed since the first vaccines for COVID-19 were approved, yet less than 70% of adults in the United States are fully vaccinated and less than 50% have received a booster shot1. Failure to achieve herd immunity (75–85% of the population vaccinated) raises the risk of new variants emerging and new surges of infection and disease.2

In parallel, researchers have documented both a growing “crisis of despair” that pre-dates the pandemic3 as well as a series of “cascading collective traumas” compounding a general deficit of hope in the US.4 Could this deficit of hope be impeding vaccine uptake and fueling vaccine hesitancy in the US?

Hope has been defined as a cognitive state that results from both an individual’s sense of agency and their perception of available pathways towards achieving their goals.5 Furthermore, individual differences in hope can be measured using validated tools that demonstrate internal consistency and test-retest reliability.5 Others research suggests that hope is a flexible state – one that can be influences by external

While no large-scale studies to date have documented the relationship between hope, vaccine hesitancy and vaccine uptake in the US, an exploratory study conducted in Israel investigated the emotional drivers of vaccine uptake and identified hope as the only factor associated with willingness to be vaccinated.6

Hope has been defined as a cognitive counterpart of planning – a critical component of initiative-taking and an emotion that boosts cognitive resolve, even in the face of uncertainty.7

Especially for US populations at risk of low vaccine uptake (including Black Americans, those living in rural areas, low-income and low-education groups)8 vaccine hesitancy may not be the main barrier to uptake – nor the easiest to overcome.9,10 Black Americans, for example, may have legitimate cause for vaccine-related uncertainty, given the history of unethical research involving communities of color in the US.2,9 For Americans with low incomes or no college education, low levels of hope may thwart messages from the public health community that may be too narrowly focused on reducing vaccine hesitancy.3,11

Sociodemographic differences in vaccine uptake have aggravated existing disparities in COVID-19 morbidity and mortality.10,12 This translates into a pressing need for studies exploring both the factors that contribute to vaccine hesitancy as well as those that may influence vaccine uptake directly, across all demographic groups.

Specifically, the public health community may underestimate the importance of harnessing emotions - especially positive emotions, like hope, in the decision-making processes that lead to vaccine uptake.11 Here, we explore the direct and indirect relationships between hope, vaccine hesitancy and vaccine uptake, in a large sample of US adults.

Methods:

Study setting and participants: Data for this cross-sectional survey was collected online via the web survey platform Gorilla ([www.gorilla.sc](http://www.gorilla.sc)). Eligible participants (adult volunteers aged 18 years and older living in the US), were recruited and consented via the Prolific Academic Research Platform (ProA: <https://www.prolific.co/>). Our survey was nested within a randomized controlled trial, described elsewhere.13

Variables: Participants responded to the 14-item WHO SAGE Vaccine Hesitancy Scale,14 and the 8-item Adult Hope Scale.15 We calculated scores for the former by aggregating the 14 vaccine hesitancy items on a scale of 1-5, with lower scores corresponding to greater vaccine hesitancy. We present these scores as “vaccine confidence” (ie: the complement of vaccine hesitancy). We calculated participants’ hope levels by aggregating the 8 Adult Hope Scale items on a scale of 1-4.15,16 Participants self-reported sociodemographic data, (including ethnicity, income, rural or urban residence and education), as well as vaccination status - an approach supported by the documented high validity of self-reported vaccination status.17

Analysis: We used regression analyses to assess the effect of hope on vaccine confidence, hope on vaccine uptake and vaccine confidence on vaccine uptake. To determine the mediation effect of hope on vaccine uptake by vaccine confidence, we added vaccine confidence as a predictor to the regression model of vaccine uptake on hope. We used binary logit regression for models with vaccine uptake as the outcome and linear regression for those with hope and vaccine confidence as the outcome. We express these results respectively as odds ratios and regression coefficients, with 95% confidence intervals, after adjustment for covariates (income <50k, Black ethnicity, rural residence, and no college education). All analysis were performed in R (R Core Team, 2018). We performed our mediation analysis and generated the plot using the *“Mediation”* package in R.18

Ethics: We obtained ethics approval from the Stanford University IRB on January 12th, 2021, protocol #59503.

Results:

Of 12,000 adults who consented to participate, 11,955 completed all parts of the surveys. Mean age was 32.3 years (SD 10.1), 10.4% identified as Black American, 46.0% male, 71.3% had at least some college education and 23.5% lived in a rural area. Overall, 72.4% reported being vaccinated against COVID-19.

The grand mean hope score was 43.63 (SD 5.6), which falls within the “low-hope” range, as defined by Snyder et al. 2002.16 The mean vaccine confidence score was 54.9 (SD 9.4). Figure 1 illustrates deviations from the grand mean hope score by demographic group and vaccination status.

Fig. 1 Deviations from the US grand mean hope score by demographic group and vaccination status

Chart, box and whisker chart

Description automatically generated\*Note: Due to our large sample size, error bars are so small that they overlap with hope level markers.

Regression analyses revealed that hope was significantly positively associated with vaccine uptake (Beta coefficient: 0.18, 95%CI - 0.12 to 0.23). As anticipated, vaccine confidence was significantly positively associated with vaccine uptake (0.17, 95%CI - 0.16 to 0.17). Surprisingly, we observed a strong independent association between hope and vaccine uptake (0.12, 95%CI - 0.05 to 0.19), even after adjustment for vaccine confidence. Table 1 presents the regression analyses of hope on vaccine confidence and vaccine uptake by demographic group.

Table 1 Regression analyses of hope on vaccine confidence and vaccine uptake

|  |  |  |
| --- | --- | --- |
|  | Regression coefficients for hope on vaccine uptake | Regression coefficients for hope on vaccine uptake with vaccine confidence in the model |
| All participants | 0.18\*\*\* [0.12,0.23] | 0.12\*\*\* [0.05,0.19] |
| Black participants | 0.34\*\*\* [0.19,0.49] | 0.31\*\*\* [0.14,0.48] |
| Low-income participants | 0.15\*\*\* [0.07,0.23] | 0.17\*\*\* [0.07,0.27] |
| Rural participants | 0.21\*\*\* [0.10,0.32] | 0.16\* [0.03,0.30] |
| Low-education participants | 0.22\*\*\* [0.12,0.31] | 0.23\*\*\* [0.12,0.35] |

\*\*\*p<0.001 \*\*p<0.01 \*p<0.05

Our mediation analysis revealed that for every point increase in mean hope score, prevalence of vaccine uptake went up by 5.4 points across all participants. Of this, 2.8 points (52% of the total effect) was attributable to the direct pathway between hope and vaccine uptake. Figure 2 shows the mediation analysis model of hope with vaccine confidence and vaccine uptake.

Figure 2. Mediation analysis model and interpretation models

Diagram

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Discussion:

This study is the first of its kind attempting to quantify the association between hope, vaccine hesitancy and vaccine uptake in the US. We observed significant associations between hope, vaccine hesitancy and vaccine uptake, as well as a generally low grand mean hope score across all US participants. This finding contrasts with the medium-range grand mean hope scores observed across a similar number of adult participants (N=12,000) in China who were involved in the parallel sister trial ([DRKS #00023650](https://www.drks.de/drks_web/navigate.do?navigationId=trial.HTML&TRIAL_ID=DRKS00023650)), conducted at the same time (F. Yu, personal communication, December 2021).

Low hope has been highlighted as a serious problem in the US, pre-dating the pandemic. Researchers have suggested that the current crisis of despair could be fueling nativist politics, vulnerability to misinformation and skepticism about science.3 In the context of a documented US crisis of despair,3 and a series of cascading collective traumas (an economic recession, race-driven social unrest and weather-related disasters)4 these observations support our hypothesis that low hope could be a significant impediment to universal vaccine uptake in the US.

Contrary to our initial expectation – that the relationship between hope and vaccine uptake would be almost entirely mediated by vaccine hesitancy – we found that more than half of this relationship resulted from a direct pathway between hope and vaccine uptake. As a cognitive counterpart to planning, researchers suggest that hopefulness can liberate us from beliefs that reduce our confidence in the world around us, threatening to leave us in a state of “numbed inaction”.7 The direct pathway between hope and vaccine uptake observed in this study aligns with calls for additional research on the emotional drivers of vaccine uptake11 as well as the potential for integrating these drivers into innovative, globally scalable, public health messages.19 We need more nuanced public health messages.20 This could include messages that lie at the intersection of health communication and entertainment, that harness narratives to activate positive emotions like hope, and may prove to be powerful tools for promoting vaccine uptake.11,21-23

Limitations of this study include a study population that was more educated, and slightly younger than the general US population, likely because this was an online survey. The comparatively lower mean hope score we observed in less educated participants could suggest that hope in the general US population may be even lower than documented here. Secondly, we did not measure other factors associated with vaccine uptake, including political affiliations, religious beliefs or trust in science, although the relationship between hope and trust has been documented.24 Finally, while we assume the direction of causality from hope to vaccine uptake, it may be the reverse (i.e. vaccine uptake driving hope). This seems less plausible given the observed association between hope and reduced vaccine hesitancy, a well-documented precursor for vaccine uptake.14

The strong association between hope and vaccine uptake, observed in this study suggests that foundational public policy efforts to boost hope and address the crisis of despair in the US, could yield powerful, concurrent improvements in vaccine uptake. Additionally, the documented interconnections between hope and trust24 and between trust in science and vaccine confidence25 suggest that boosting all of these could work synergistically in favor of improved vaccine uptake. Hope has already been identified as an important therapeutic target in other health fields that, when boosted, can influence patient outcomes.26 Especially for populations at risk of low vaccine uptake, broadening the focus of our vaccine promotion efforts – beyond standard informational messages aimed at reducing vaccine hesitancy – may yield more equitable and effective interventions. Such efforts would contribute to a win-win situation for the US and the world as we work together to end the COVID-19 pandemic.

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