

# How vaccine hesitant are you? A third of Americans aren't fully protected against COVID-19

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Credit: Cottonbro/Pexels

In May 2021, U.S. President Joe Biden announced his goal as getting at least 70% of Americans partially vaccinated against COVID-19 by July of that year. However, government records indicate that as late as September 2022, more than 31% of Americans were still not fully vaccinated. It has been shown this was not due to supply constraints, but rather, due to vaccine hesitancy among certain segments of the

population.

Why were so many Americans hesitant about the COVID vaccine? This is what researchers at USC Viterbi School of Engineering set out to answer. Mayank Kejriwal, Research Lead at the USC Information Sciences Institute (ISI) and a Research Assistant Professor in the Daniel J. Epstein Department of Industrial and Systems Engineering, along with Ph.D. student Ke Shen analyzed socio-demographic variables in their paper, "Using Conditional Inference To Quantify Interaction Effects of Socio-Demographic Covariates of Us COVID-19 Vaccine Hesitancy," which was recently published in *PLOS Global Public Health*.

With this research, they hope to lay the groundwork for future pandemic preparedness with regard to vaccine hesitancy.

Kejriwal conducted a retrospective analysis on data from a COVID-19 cross-sectional Gallup survey that was administered to a representative sample of U.S.-based respondents. It was an [online survey](#) that began in March 2020, and included daily random samples of U.S. adults.

"We wanted to see whether we could predict, based on socio-demographic variables, what specific groups might be more vaccine hesitant than others," said Kejriwal. He explained, "If we can predict that, then you could target the communication. You might know that these are the communities where we need more vaccine awareness, for example.

Using the responses of 16,322 respondents, he analyzed the relative effects of different categories of [demographic variables](#) on vaccine hesitancy. These variables were: annual household income, race/ethnicity, [political party](#), employment status, gender, education, and "trust in the Trump administration."

For this final variable, the 2020 Gallup question asked: "Please think about the recent impact of the coronavirus (COVID-19) on your life when responding to the following and indicate your level of agreement or disagreement: I have confidence in the leadership of President Donald Trump to successfully manage emerging health challenges." Responses to this question were recorded on a five-point scale, from strongly disagree (1) to strongly agree (5). Those who responded greater than 3 were identified as individuals who had trust in the Trump administration

## **How (and by how much) do these variables affect vaccine acceptance?**

Kejriwal had two goals in mind for the [survey data](#): 1) find the associations between the variables and vaccine acceptance; and 2) quantify and visualize the interactions between those variables and vaccine acceptance.

Using univariate regression—a model that looks to find the relationship between one variable and a target variable (vaccine acceptance in this case)—Kejriwal analyzed the Gallup data to find and measure the associations

Additionally, Kejriwal used [machine learning](#) and deep statistical analysis to take the variables and the associations between them and vaccine hesitancy and organize them into a conditional inference tree. This tree is a way to quantify and visualize the relative importance of the variables, and also show the effects between the variables

The tree shows, for example, a male non-Black Democrat who did not trust the Trump administration had high vaccine acceptance. Whereas a female under age 57 who trusted the Trump administration had very low vaccine acceptance. Both of these might seem intuitive, but with the

conditional inference tree, the degree of vaccine acceptance and the relationship between the variables is quantified and visualized.

And the thought is that, with this level of precision, communications strategies could be more targeted and effective. Kejriwal found clear patterns between [vaccine](#) acceptance among different socio-demographic groups in the U.S. and hopes that his methods can be used to predict [vaccine hesitancy](#) if we ever face another pandemic.

**More information:** Ke Shen et al, Using conditional inference to quantify interaction effects of socio-demographic covariates of US COVID-19 vaccine hesitancy, *PLOS Global Public Health* (2023). [DOI: 10.1371/journal.pgph.0001151](https://doi.org/10.1371/journal.pgph.0001151)

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