



Short communication

## Age and partisan self-identification predict uptake of additional COVID-19 booster doses: Evidence from a longitudinal study

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## ABSTRACT

COVID-19 continues to threaten public health and authorities recommend that people receive additional doses of booster vaccines. We conducted a longitudinal study to investigate the correlates of uptake of additional COVID-19 booster doses among that population that already received a booster dose. In February 2023, we completed a panel study of 208 adults in the U.S. state of South Dakota who indicated receiving a booster dose in a similar survey conducted in May 2022. We measured COVID-19 vaccination status, trust in government, interpersonal trust, age, gender, education, income, and partisan self-identification. We examined the effect of change in these values of the two trust variables over time. We found statistically significant associations between age, partisan self-identification, and the uptake of additional booster doses. Neither of the time-variant trust variables were statistically significant. Our results showed the presence of differences in vaccination behavior even among the people who are fully vaccinated and boosted.

### 1. Introduction

Despite the announcement by the U.S. Department of Health and Human Services to close the public health emergency on May 11, 2023, COVID-19 continues to pose a threat to public health. Thus, vaccination will remain a part of federal policy in the future. It is well established that vaccines effectively provide protection and slow the spread of the virus causing COVID-19. However, vaccine effectiveness wanes over time, and the Centers for Disease Control and Prevention (CDC) recommends that people who are fully vaccinated receive additional booster doses regularly.

Vaccine boosters became widely available to the public in September 2021, and updated (bivalent) boosters became available to people 12 years and older in September 2022. Scientists showed that updated boosters provide effective protection against infection (Bobrovitz et al., 2023; Link-Gelles et al., 2022). However, the uptake of boosters is lower than vaccination. As of March 2023, 79% of American adults completed the primary vaccination series, whereas only about 20% of all adults had received the updated (bivalent) booster (CDC, 2020). Booster hesitancy was recorded in all segments of society, including among nurses (Viskupić and Wiltse, 2022).

The lower booster uptake rate was consistent with the decrease in compliance with other measures aimed at slowing the spread of the

virus, such as compliance with lockdowns (Bodas et al., 2022). The World Health Organization (WHO) considers a drop in willingness to follow protective behaviors a threat to successful COVID-19 pandemic protection and prevention (World Health Organization. Regional Office for Europe, 2020).

Scholars have started investigating the correlates of lower booster uptake (Agaku et al., 2022; Bennett et al., 2022; Williams et al., 2022). Scientific studies showed that variables such as age, trust in government, and partisan self-identification, among others, correlated with booster uptake (Rzymiski et al., 2021; Yoshida et al., 2022; Viskupić and Wiltse, 2023; Folcarelli et al., 2022). This study examined the predictors of receiving additional booster doses among those who received at least one booster dose. We made several contributions to the scholarship. First, we used original data from a longitudinal survey examining people's COVID-19 vaccination status. Most studies examining correlates of booster uptake used data from cross-sectional surveys (Agaku et al., 2022; Bennett et al., 2022; Rzymiski et al., 2021). We used panel data to determine whether people received an additional booster dose. We built upon the longitudinal studies that tracked booster uptake among the fully vaccinated population (Viskupić and Wiltse, 2023).

Second, we used booster uptake as the dependent variable as opposed to booster vaccination intentions. Vaccination intentions and behaviors do not always correlate (Ye et al., 2021) and using actual

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booster uptake provided a more accurate measure.

## 2. Methods

### 2.1. Data

Our data came from an original longitudinal survey. The first survey wave was fielded from May 2 to 15, 2022 in the U.S. state of South Dakota. We used registration-based sampling to recruit participants (Barber et al., 2014). We randomly selected 21,000 registered voters in the state who were mailed an invitation to participate in an online survey on the *QuestionPro* platform. No reminders were sent in the first wave. Respondents who opted into the panel by providing their email addresses received an invitation email on February 16, 2023 for a short follow-up survey. The follow-up survey was open between February 16–26, 2023, e-mail reminders were sent on February 21 and 24 to those who had not completed it.

Participants did not receive any compensation for the completion of either wave. Both survey waves were conducted by the authors under the auspices and approval of the Institutional Review Board (IRB) of South Dakota State University. Prior to entering the survey, respondents read a consent statement explaining their rights as participants, our data handling policy, and contact information for the investigators and the university's IRB officer.

### 2.2. Measures

Both surveys included questions about COVID-19 vaccination status, trust in government, and interpersonal trust. The original survey collected data on age, gender, education, income, and partisan self-identification. The full text of each survey question is presented in the appendix.

We constructed an indicator to capture whether a person who was fully vaccinated and boosted received an additional booster dose. The indicator was constructed from questions measuring COVID-19 vaccination status that were included in both surveys. Those fully vaccinated and boosted participants who received an additional booster dose were coded as "1," while those fully vaccinated and boosted participants whose vaccination status remained unchanged were coded as "0." Those participants who hadn't receive a booster at the time of the first survey were excluded from the analysis.

We also modeled the effects of any possible changes in trust in government and interpersonal trust ( $t_2 - t_1$ ). In line with extant studies (Viskupić and Wiltse, 2023), we suspected that some individual-level changes in levels of trust were likely to occur between survey waves, given the politicization of COVID-19 mitigation measures. Those with favorable attitudes toward mitigation efforts may have seen their trust in government reinforced during the response, whereas those opposed to mitigation measures may have seen their trust in government undermined. Positive scores indicate an increase of trust for that individual between the two waves, whereas a negative score would indicate a decrease in trust. Positive changes in either attitude could make people more inclined towards additional booster vaccinations. The wording of all questions used in this study was consistent with extant research (Viskupić and Wiltse, 2022; Viskupić and Wiltse, 2023).

### 2.3. Analysis

A logistic regression was estimated where receiving multiple booster shots was the dependent variable. The two time-variant variables measuring change in the levels of trust in government and interpersonal trust were independent variables of central interest. We also controlled for all other variables discussed above, which is in line with recently published studies (Rzymiski et al., 2021; Yoshida et al., 2022; Viskupić and Wiltse, 2023; Folcarelli et al., 2022). We plotted predicted probabilities to help interpret statistically significant variables. All analysis

was conducted in Stata 17 (StataCorp., 2021).

## 3. Results

We received 1,199 responses in the first survey, yielding a response rate of 5.5%; on par with other surveys using registration based sampling (Viskupić and Wiltse, 2023). Of those respondents, 833 opted in the panel, and 292 respondents completed it; we retained 210 that indicated in the first survey that they were fully vaccinated and received a booster.

We included an attention check question in the second wave of the survey. Six respondents failed the test (2.9%). Upon analysis, there were no appreciable differences between statistical models where those failures were included or excluded. As such, we reported results with those failing respondents included.

Of our final sample, 157 received an additional booster dose, and 51 did not (with 2 missing). The average age of participants was 60.7 years, 48% were male, and 52% were female. Overall, 49% registered differences between waves on trust in government, whereas 48% changed scores on interpersonal trust. The descriptive statistics of all variables (Table S1) are available in the Appendix.

Table 1 displayed the results of the logistic regressions and two-tailed significance. Partisan self-identification ( $\beta = -0.249$ ,  $p = 0.008$ ) and age ( $\beta = 0.036$ ,  $p = 0.004$ ) correlated strongly with the probability of getting multiple boosters. Neither of the time-variant trust variables were statistically significant, nor were any of the specified control variables.

Overall goodness of fit, as assessed by McFadden's r-square statistic of 0.1012 and a Hosmer-Lemeshow p-value of 0.1221, suggested a soundly specified model. Variance inflation factors (VIFs) were low (mean of 1.15), thus detecting no significant levels of multicollinearity.

Fig. 1 presented the predicted probabilities of respondents receiving multiple boosters plotted against partisan self-identification at four specified ages (20, 40, 60, and 80), with all other variables held at their means. A 20-year-old respondent had a probability of 0.458 of receiving multiple boosters, whereas an 80-year-old respondent had a 0.881 probability. Partisanship also had a strong effect, with strong Democrats having a 0.871 probability of multiple boosters and strong Republicans having a probability of 0.603.

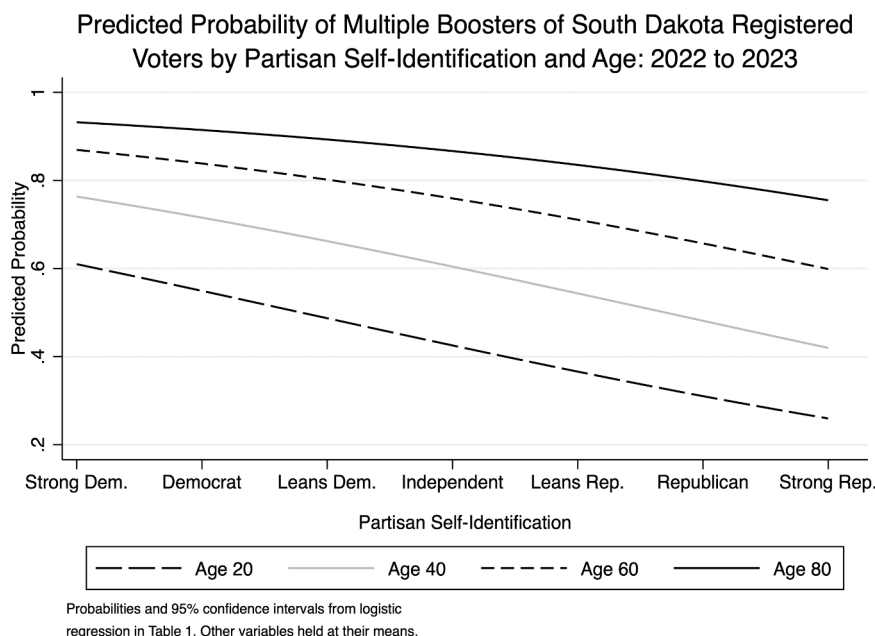
## 4. Discussion

We found that older adults and those who identify as Democrats were more likely to receive an additional booster. These results comport with existing scholarship. Scholars linked age to initial COVID-19 vaccine

**Table 1**

Correlates of receiving multiple COVID-19 booster vaccinations among South Dakota registered voters, multivariate logistic regression: 2022 to 2023.

Trust in Government	0.089 (0.213)
Interpersonal Trust	0.023 (0.223)
Partisan identification (7 point)	-0.249** (0.094)
Age	0.036** (0.012)
Male	-0.108 (0.384)
Education	0.247 (0.144)
Income	-0.015 (0.130)
Constant	-1.093 (0.991)
Pseudo R-Square	0.101
Number of Cases	189
p t <0.01 two-tailed* *	
Cell entries are logistic coefficients, with standard errors in parentheses.	



**Fig. 1.** Predicted probability of multiple boosters of South Dakota registered voters by partisan self-identification and age: 2022 to 2023.

uptake, with older adults being more likely to receive the initial vaccination than younger adults (Trent et al., 2022; Corcoran et al., 2021). One determinant of this difference was the presence of greater risk for older adults from the virus. Those in the 65–74 years cohort were 4.9 times more likely to be hospitalized and have a 60 times greater chance of death after being infected with COVID-19 compared to the 18–29 years olds (CDC., 2020). Moreover, older adults likely felt greater urgency to receive additional booster doses as vaccines offer effective protection only for a limited time. Our finding is consistent with similar studies conducted in the United States (Agaku et al., 2022; Viskupić and Wiltse, 2023), Italy (Folcarelli et al., 2022), and Poland (Rzymiski et al., 2021).

The finding that self-identified Democrats were more likely to receive an additional booster dose was likewise consistent with the extant literature. Given the politicization of the COVID-19 vaccination, scholars consistently reported a gap in vaccine attitudes and vaccine uptake between Democrats and Republicans (Callaghan et al., 2021). Our findings underscored the continued effect of political identities on COVID-19 vaccination uptake. Even though COVID-19 vaccines were no longer novel and people had experience with receiving multiple doses, vaccination remained a deeply political issue, a finding consistent with similar studies (Bennett et al., 2022).

Regarding the time-variant trust variables, our results indicated that the observed changes in trust levels did not affect the probability of receiving multiple boosters. This finding suggested that the role of trust in determining vaccination behavior was most profound in the initial decisions to get vaccinated and boosted, and not in the decision to get boosted regularly thereafter.

Besides members of the scholarly community, our findings might be of interest to public health officials and healthcare providers. When the public health emergency was first declared, vaccination attitudes in the United States quickly divided along partisan lines. Our findings suggested that this polarization did not disappear, but remained a powerful driver of behavior, even among the already vaccinated and boosted. In the case that COVID-19 boosters will be administered annually, like the influenza vaccine, we expect to see the same partisan tinge in coming years. Public health officials and healthcare providers are considered trustworthy sources of information about vaccines (Folcarelli et al.,

2022). In order to maintain this status, they would be well advised to be mindful of the continued polarization of COVID-19 vaccines.

#### 4.1. Limitations

We note the limitations of our study that readers should consider when interpreting the results. The survey was conducted in South Dakota, a rural state with a relatively ethnically homogenous population. The political leadership of the state has been strongly opposed to some COVID-19 mitigation measures, such as lockdowns and mandatory vaccination. Our findings therefore might not apply to other states and scholars might wish to conduct similar studies using nationally representative samples.

In the first wave, we recruited participants from a list of registered voters in South Dakota. Older adults are more likely to be registered to vote and respond to survey invitations, leading to a slight oversampling of older adults in both survey waves, a common imbalance in similar studies using registration based sampling (Viskupić and Wiltse, 2023). Due to a larger-than-average number of older adults in our sample, the reported values for the uptake multiple doses of boosters were likely greater than in the general population. Nevertheless, as the main objective of this study was to analyze the factors predicting the uptake of additional booster doses among those people who received a booster dose, this imbalance was unlikely to bias the results.

Finally, as with most surveys, our measures were self-reported. Some people might have exaggerated the number of vaccine doses they received due to social desirability bias. However, given the strength and acceptance of anti-COVID-19 vaccine sentiment among some portions of the sampling frame, the presence of such bias was unlikely.

## 5. Conclusions

Using data from a longitudinal survey, we examined whether those who were fully vaccinated and boosted received an additional booster dose. We found that older adults and those who identify as Democrats are more likely to receive multiple booster doses. Our results showed that COVID-19 vaccination continues to be a divisive topic in our society, and that difference exists even among those who are fully

vaccinated and boosted. In the future, we plan to conduct another survey wave to track the uptake of additional booster doses.

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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.

### Data availability

Data will be made available on request.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2023.102407>.

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