








## Using the theory of planned behavior to assess willingness and attitudes towards COVID-19 vaccination among a predominantly white U.S. college sample

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### ABSTRACT

**Objective:** Through the lens of behavioral models such as the Theory of Planned Behavior (TPB) and the Health Belief Model, the present study (1) investigated U.S. university students' willingness to receive the COVID-19 vaccine and (2) examined predictors (e.g. demographics, past vaccine experience, TPB constructs) of vaccine willingness.

**Method:** University students ( $n = 170$ ) completed a survey assessing demographics, health behaviors, attitudes, perceived severity/susceptibility, norms, and vaccine intentions related to the COVID-19 pandemic. Data were collected from April 2020 through July 2020.

**Results:** Overall, 56.5% of participants indicated that they would be willing to receive the COVID-19 vaccine once it is available, 39.4% were unsure of whether they would receive the vaccine, and 4.1% indicated they would not receive the vaccine. Multinomial logistic regression indicated that greater adherence to CDC guidelines ( $p = .030$ ) and greater perceived pro-vaccine norms ( $p < .001$ ) predicted greater vaccine willingness.

**Conclusions:** Results from this study are consistent with previous literature on vaccine hesitancy, whereby normative beliefs and adherence to CDC guidelines were found to be determinants of vaccine willingness. To reduce transmission of the COVID-19 pandemic, interventions aimed at promoting positive attitudes towards vaccination should aim to incorporate these observed determinants.

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Vaccine willingness; vaccine norms; vaccine attitudes; COVID-19; university students

Among individuals infected with COVID-19, increased risk of hospitalization, and long-term symptoms such as chronic fatigue and possible damage to the lungs and heart, and increased risk of mortality have been observed. Vaccination has been shown to improve health outcomes, particularly for more severe COVID-19-related illnesses (Birhane et al.,

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2021). The COVID-19 vaccine provides communities a means of mitigating the spread of the COVID-19 virus in a way that reinforces non-maleficence. A recent population-representative study conducted showed that those who received the COVID-19 vaccine did not have worse quality of life than those not receiving COVID-19 vaccine (Polack et al., 2020), particularly when any potential risk of vaccine-related adverse events is compared with the risk of harm due to rates of morbidity and mortality attributed to the COVID-19 virus ('U.S. COVID-19 vaccine tracker', 2022). Widespread vaccination is conceptualized as a vital step towards achieving normalcy, and the distribution of several effective vaccines is supporting this goal (Yasmin et al., 2021). However, there have been challenges achieving widespread vaccination over the course of the pandemic, with the current vaccination rate in the U.S. at 67.6% (Kukreti et al., 2022). Current COVID-19 vaccine acceptance rates in the U.S. range from 12% among historically vaccine hesitant populations such as the Orthodox Jewish to 91.4% (Qiao et al., 2021) in the U.S. general population samples, and average vaccine willingness across the general population worldwide being calculated at 60.1% (Byrne et al., 2012).

College students in particular may have lower risk perception about contracting COVID-19 and experiencing serious illness (Ramsey & Marczyński, 2011). Understanding determinants of vaccine willingness among young adults, such as college students, is necessary for encouraging the buy-in from students needed to increase vaccine rates and slow the spread of COVID-19. Though research that addresses COVID-related attitudes among college students is still on-going, variability of intentions to vaccinate has been observed during the 2009 H1N1 pandemic when student intentions to receive the H1N1 vaccine varied between 15.8% (Myers & Goodwin, 2011) to 91.5% of students (Fan et al., 2021). Such rates reflect current trends in vaccine willingness among college students (Qiao et al., 2021). As intentions to vaccinate may vary, it is essential to identify predictors of and barriers to vaccination. Thus, the purpose of this study is to identify possible predictors of intention to vaccinate among a college student population.

Research has investigated vaccination willingness and engagement as determinants of intention to vaccinate during previous pandemics. Further, vaccine acceptance associated with both the seasonal influenza and H1N1 vaccines have provided insight to the public's attitudes towards vaccination. Specifically, vaccinating for seasonal influenza is a regularly occurring healthcare decision, and past flu vaccination has been a dependable predictor of vaccination (Huang et al., 2021). International studies investigating college students' attitudes towards the COVID-19 vaccine found that intention to receive the COVID-19 vaccine was predicted by past seasonal flu vaccination (Catalano et al., 2017; Colbourn, 2017). Nevertheless, only approximately 46% of college students report receiving the annual influenza vaccination with knowledge about this seasonal vaccine, financial access to the vaccine, and the endorsement of family and healthcare professionals being identified as important determinants of receiving the seasonal influenza vaccine (Chen et al., 2019). Thus, past seasonal flu vaccination has been a consistent predictor of future vaccine willingness among college students.

Theories of health behavior may help explain mechanisms of vaccine hesitancy or willingness. Specifically, the Theory of Planned Behavior (TPB) is commonly used to conceptualize the uptake of health behaviors, such as vaccination (Ajzen, 1991; Donadiki et al., 2014; Fall et al., 2018). The TPB model addresses predictors of intention to perform a

health behavior, as intentions are considered the primary predictors of behavior (Yahaghi et al., 2021). The TPB model constructs such as positive attitudes towards vaccines, perceptions of how others view vaccines (subjective norms), perceptions of how difficult a behavior is to complete (perceived behavioral control), and confidence in being able to perform the behavior (self-efficacy) are significant predictors of intention to vaccinate (Huang et al., 2021; Ullah et al., 2021). For example, a sample of Iranian and Pakistani adults reported perceived susceptibility to COVID-19 infection was a significant predictor of intention to vaccinate for COVID-19 (Guidry et al., 2021; Husain et al., 2021). In addition, there are mixed findings regarding the role of subjective norms in predicting vaccine intentions. Though subjective norms was not seen as a significant predictor of COVID-19 vaccine intentions in a sample of Chinese university students (Colbourn, 2017), positive subjective norms were predictive of intention to vaccinate among adults in the U.S. and India (Rubin, 2021; Schmid et al., 2017). Despite the effectiveness of these health behavior constructs on vaccine uptake, the path from vaccination intentions to receiving a vaccine is not always linear. For example, among a sample of Taiwanese university students, self-efficacy and knowledge of infection risk regarding the COVID-19 vaccine were associated with vaccine intentions (Catalano et al., 2017). Barriers that occur after the stated behavioral intention but before the performance of the health behavior may play a significant role in lowering vaccine intention over time.

Though the COVID-19 vaccine is a significant tool to lessen transmission of the virus and prevent serious illness and hospitalization (Thunstrom et al., 2020), there are many barriers that impact vaccination intentions and uptake. General vaccine hesitancy, particularly lack of confidence in vaccines and concerns regarding efficacy and safety of vaccines, have been observed as significant predictors for not intending to receive the COVID-19 vaccine (Kotecha et al., 2022; Ling et al., 2019; Rad et al., 2022; Williams et al., 2020). Concerns about adverse events, low perception of risk towards others, and low perceived severity of the illness are often cited as barriers to vaccination (Hamilton et al., 2015; Williams et al., 2020), though there is early evidence that educational interventions may lessen some of these barriers (Callaghan, 2020). Political orientation may also impact vaccine beliefs. Political arguments made regarding vaccines highlight that trust in science and scientists may be higher among liberals compared to conservatives, as exhibited by increased vaccine hesitancy among Republican politicians (Allington et al., 2021; Hamilton et al., 2015). These barriers echo common topics supported by the anti-vaccine community, which include reliance on anecdotal evidence (Hoffman et al., 2019), spreading pseudoscience regarding vaccines (Landowska et al., 2017), and stoking conspiracy theories regarding potential cover-ups by the government and medical community (Allington et al., 2021). Exposure to this pseudoscientific information is particularly worrying for college student populations, as college students are reported to find most of their vaccine-related information over the Internet where these vaccine-hesitant communities are common (Jiménez-García et al., 2010).

Gender, though well-researched, has mixed results as a determinant of vaccine uptake. Women participants were found to be more hesitant of the influenza vaccine in both English and Spanish samples (Applewhite et al., 2020; Latkin et al., 2021). Lower influenza vaccine uptake was found among women as well, with gender disparities in

medical care being cited as a reason for these possible gender differences (Kini et al., 2021). COVID-19 vaccine hesitancy is also observed at higher rates among women (Henry, 2008). In addition, most studies do not examine gender as a determinant in isolation, which may strengthen or weaken attitudes towards vaccination. Age, political orientation, and race are also prevalent individual-level determinants of vaccine willingness and uptake, which often intersect and exacerbate existing vaccine attitudes (de Perio et al., 2012; Henry, 2008; Latkin et al., 2021).

### **Current study**

The present study examined predictors of vaccine willingness among students in a northeastern university in the U.S. using TPB. Our first aim was to investigate the relationship between COVID-19 vaccine attitudes and intention to vaccinate. We hypothesized that perceived risk for oneself and others, accurate beliefs about COVID-19, and high levels of perceived behavioral control towards receiving the vaccine would be associated with intention to vaccinate. Our second aim was to explore which demographic and experiential predictors (gender, race, essential worker status, political orientation, experience with vaccination, etc.) may be related to vaccine intention. We hypothesized that prior influenza vaccination, liberal political orientation, and greater adherence to CDC guidelines would be associated with higher intentions to vaccinate.

## **Method**

### **Participants and procedure**

Participants were 170 (81.2% female) undergraduate and graduate students at a mid-sized New England university aged 18 to 30 years ( $M = 21.81$ ,  $SD = 3.04$ ) who participated in a larger study about health behaviors surrounding COVID-19. Participants included 19 freshmen, 19 sophomores, 43 juniors, 56 seniors, and 33 graduate students. Participants were 81.2% ( $n = 138$ ) White, 8.2% ( $n = 14$ ) Asian, 7.1% ( $n = 12$ ) as mixed-race, and 3.5% ( $n = 6$ ) as Black. Twelve participants identified as Hispanic or Latino (7.1%). A previous COVID-19 diagnosis was reported by three individuals. There were 30 participants who identified themselves as high-risk for contracting COVID-19, and 73 participants reported living with someone who was high-risk. Though this sample is a relatively homogenous student sample, it provides a snapshot of the within-group attitudes of this population. Rather than focusing on generalizability to the population at large, this study seeks to describe attitudes within a specific subgroup in the population (Chen et al., 2010). Additional demographic, health, and work characteristics of participants are shown in Table 1.

Participants were recruited through various listservs at the participating university. Individuals were eligible to participate in the study if they were at least 18 years old and enrolled as a student. Eligible participants provided informed consent through the online survey link, and were given the choice to exit the survey or to complete a 15-minute questionnaire that included questions about risk perception, adherence to CDC COVID-19 prevention guidelines, attitudes surrounding vaccines, and vaccine

**Table 1.** Descriptive summary of determinants of vaccine intentions.

Characteristic	Vaccine intention, <i>n</i> (%)			Total <i>N</i> = 170
	Yes <i>N</i> = 96 (56.4%)	No <i>N</i> = 7 (4.1%)	Unsure <i>N</i> = 67 (39.4%)	
<b>Gender</b>				
Male	17 (53.1)	3 (9.4)	12 (37.5)	32
Female	79 (57.2)	4 (2.9)	55 (39.9)	138
<b>Sexuality</b>				
Straight	77 (55.4)	7 (5.0)	55 (39.6)	139
Gay/Lesbian	5 (71.4)	0	2 (28.6)	7
Bisexual	12 (63.2)	0	7 (36.8)	19
Other	2 (40)	0	3 (60)	5
<b>Race</b>				
White	78 (56.5)	7 (5.1)	53 (38.4)	138
Black/AA	1 (16.7)	0	5 (83.3)	6
Asian	9 (64.3)	0	5 (35.7)	14
Mixed	8 (66.7)	0	4 (33.3)	12
<b>Ethnicity</b>				
Hispanic or Latino	3 (25)	2 (16.7)	7 (58.3)	12
Not Hispanic or Latino	93 (58.9)	5 (3.2)	60 (38)	158
<b>Class Standing</b>				
College freshman	11 (57.9)	1 (5.3)	7 (36.8)	19
College sophomore	10 (52.6)	0	9 (47.4)	19
College junior	25 (58.1)	3 (7.0)	15 (34.9)	43
College senior	35 (62.5)	3 (5.4)	18 (32.1)	56
Graduate student	15 (45.5)	0	18 (54.5)	33
<b>Political Ideology</b>				
Very liberal	11 (68.8)	0	5 (31.3)	16
Liberal	43 (61.4)	1 (1.4)	26 (37.1)	70
Moderate	37 (55.2)	1 (1.5)	29 (43.3)	67
Conservative	5 (31.3)	5 (31.3)	6 (37.5)	16
<b>Relationship Status</b>				
Single/Never Married	79 (57.7)	6 (4.4)	52 (38.0)	137
Married	2 (25.0)	1 (12.5)	5 (62.5)	8
Living w/ Partner	15 (60.0)	0	10 (40.0)	25
<b>Compliance with CDC Guidelines</b>				
Not at all compliant	0	0	1 (100.0)	1
Somewhat Compliant	5 (50.0)	0	5 (50.0)	10
Mostly Compliant	37 (54.4)	3 (4.4)	28 (41.2)	68
Very Compliant	54 (59.3)	4 (4.4)	33 (36.3)	91
<b>Living w/ Essential Worker</b>				
Yes	57 (58.2)	3 (3.1)	38 (38.8)	98
No	39 (54.2)	4 (5.6)	29 (40.3)	72
<b>Essential Worker</b>				
No	73 (60.8)	6 (5.0)	41 (34.2)	120
Yes, but I can work from home	4 (40)	0	6 (60.0)	10
Yes, and I have to report to my place of employment	19 (47.5)	1 (2.5)	20 (50.0)	40
<b>High Risk</b>				
Yes	17 (56.7)	2 (6.7)	11 (36.7)	30
No	79 (56.4)	5 (3.6)	56 (40.0)	140
<b>Living w/ High Risk</b>				
Yes	40 (54.8)	3 (4.1)	30 (41.1)	73
No	56 (57.7)	4 (4.1)	37 (38.1)	97
<b>Employment Change</b>				
No Change	26 (50.0)	3 (5.8)	23 (44.2)	52
Change	70 (59.3)	4 (3.4)	44 (37.3)	118
<b>Health Insurance</b>				
Yes	94 (57.3)	6 (3.7)	64 (39.0)	164
No	2 (33.3)	1 (16.7)	3 (50)	6
<b>Flu Shot</b>				
Yes	74 (64.3)	1 (0.9)	40 (34.8)	115

(Continued)

**Table 1.** Continued.

Characteristic	Vaccine intention, <i>n</i> (%)			Total <i>N</i> = 170
	Yes <i>N</i> = 96 (56.4%)	No <i>N</i> = 7 (4.1%)	Unsure <i>N</i> = 67 (39.4%)	
No	22 (40.0)	6 (10.9)	27 (49.1)	55
<b>Reasons for Not Intending</b>				
<b>I don't think I'll need the vaccine</b>				
Disagree	86 (71.7)	1 (0.8)	33 (27.5)	120
Unsure	4	1	25	30
Agree	4	5	7	16
<b>I don't think the vaccine will keep me from getting COVID-19</b>				
Disagree	77	1	29	107
Unsure	11	0	27	38
Agree	6	6	9	21
<b>The vaccine won't be safe</b>				
Disagree	79	0	26	105
Unsure	12	2	25	39
Agree	3	5	13	21
<b>I won't have time to get the test</b>				
Disagree	86	5	47	138
Unsure	6	1	12	19
Agree	2	1	6	9
<b>It will cost too much to get the test</b>				
Disagree	62	3	26	91
Unsure	19	2	25	46
Agree	11	2	14	27
<b>I have already had COVID-19</b>				
Disagree	78	7	53	138
Unsure	10	0	7	17
Agree	6	0	5	11
<b>The vaccine could make me sick</b>				
Disagree	65	2	19	86
Unsure	19	2	32	53
Agree	10	3	13	26
<b>Vaccine Attitude Subscales</b>	<b>Vaccine Intention, Mean (SD)</b>			
Beliefs	28.11 (3.8)	23.57 (4.3)	26.23 (3.9)	
Norms	35.41 (8.4)	17.17 (11.3)	27.11 (6.2)	
Perceived Behavioral Control	22.22 (4.2)	22.29 (3.3)	20.46 (4.0)	

intention. Data were collected from April 2020 to July 2020. Participants were entered into a raffle to win one of ten \$25 gift cards. The study followed APA ethical guidelines and was approved by the university's institutional review board (Approval Number 1596574-1).

## Measures

### Vaccine intention

Vaccine intention was measured with the question 'Will you receive the COVID-19 vaccine once it is available?' Participants selected one response: 'Yes,' 'No,' or 'Unsure.'

### COVID-19 vaccine attitudes

COVID-19 vaccine attitudes were measured using a 23-item measure, including four subscales (Lin et al., 2022). These included (1) reasons for not intending to get vaccinated, (e.g. 'I don't think I'll need the vaccine'), (2) beliefs (e.g. 'I don't think the

vaccine will keep me from getting COVID-19'), (3) norms (e.g. 'A majority of my coworkers plan to get the vaccine once it is available'), and (4) perceived behavioral control (e.g. 'I am confident I will be able to get the vaccine if I wanted'). Participants rated each statement on a 7-point Likert-type scale ranging from 1 = *Strongly Disagree* to 7 = *Strongly Agree*. Three sets of subscale scores (for beliefs, norms, and perceived behavioral control) were obtained by summing up item responses within each subscale, with higher scores indicating stronger attitudes. The 'reasons for not intending to get vaccinated' questions were excluded from subscale score analyses due to the nature of these items, which addressed COVID-specific reasons for intention to vaccinate rather than TPB-based determinants of vaccine intention. Internal consistency were  $\alpha_{\text{beliefs}} = 0.550$ ,  $\alpha_{\text{norms}} = 0.883$ , and  $\alpha_{\text{perceived behavioral control}} = 0.494$  in the present study.

### *Political ideology*

Political ideology was measured with the question 'How would you describe your political ideology?' Response options were: 'Very liberal,' 'Liberal,' 'Moderate,' 'Conservative,' and 'Very Conservative.'

### *Compliance with CDC guidelines*

CDC guidelines recommended twelve specific hygienic behaviors to prevent the spread of transmission of COVID-19 (e.g. 'Wash my hands often for at least 20 s'). Participants rated each guideline on a 10-point Likert-type scale ranging from 1 = *Not at All* to 10 = *Constantly/All The Time* to report on how often they followed these guidelines within the past two months. The scores for each behavior were summed, with higher scores indicating greater compliance.

### *Demographic measures*

Participants were asked a variety of demographic questions including personal demographics (e.g. age, racial background, ethnicity), history of a 2019 or 2020 flu shot, diagnosis of COVID-19, if they were an essential worker, whether they were living with essential workers, health insurance status, whether they were a member of a high-risk population, whether they were living with people deemed high risk, and whether they experienced a change in employment. Response options for these demographic items can be found in [Table 1](#).

### *Data analysis*

Data analyses were conducted using IBM SPSS version 26. We first examined data for normality and missingness. The  $n = 11$  (6.5%) cases with partially missing responses on the COVID-19 vaccine attitude scale were deleted listwise. For the two aims of the present study, we conducted logistic regressions to examine TPB-based vaccine attitude constructs, demographic variables, and experiential factors as predictors of vaccine intention (Yes/Unsure). Because there were too few individuals who responded that they would not receive the vaccine ( $n = 7$ ), they were excluded from the logistic regressions due to complete or quasi-complete separation issues. Power analysis using G\*Power 3.1 suggests that a sample size of 160 would allow us to detect a small-sized effect for each predictor variable (Odds Ratio = 1.51) with 80% power and a significance level of



0.05, assuming 50% of participants intend to receive the COVID-19 vaccine once it is available. Therefore, the logistic regression analysis in this study was adequately powered (Kumar et al., 2021). The traditional .05 threshold of statistical significance was employed for all tests.

## Ethics statement

The study was conducted in accordance with the Declaration of Helsinki and was approved by an Institutional Review Board/Ethics committee. See details under Methods. The study received an exemption from an Institutional Review Board/Ethics committee; See details under Methods.

## Results

### *Descriptive statistics about vaccine intentions*

Overall, 56.4% of the participants indicated that they would be willing to receive the COVID-19 vaccine once it is available, and 39.4% said that they were unsure whether or not they would receive the vaccine. Only 4.1% of the participants indicated they would not receive the vaccine. Main reasons cited by respondents for not intending to receive the COVID-19 vaccine are shown in Table 1. Of the participants who would not receive the COVID-19 vaccine, the reason 'I don't think the vaccine will keep me from getting COVID-19' had the strongest endorsement compared to any other response. Participants who were unsure about receiving the vaccine were mostly concerned about the efficacy, safety, expense, and necessity of the COVID-19 vaccine.

### *Aim 1: TPB-based vaccine attitude constructs as predictors of vaccine intentions*

A logistic regression was conducted to predict vaccine intention (Yes/Unsure) from three subscales, beliefs, norms, and perceived behavioral control. The descriptive summary of three subscales in two groups is shown in Table 1. Results of the logistic regression showed that only the norms subscale was a significant predictor for vaccine intention [ $p < .001$ ] among all three TPB-based constructs. As shown in Table 2, the score of the norms subscale was a significant predictor when comparing the individuals who would receive the vaccine with the group who were unsure about receiving the vaccine (OR = .83, 95% CI [.76, .90]), meaning participants who feel more external pressure from others to receive the vaccine are more likely to be willing to receive the vaccine rather than feeling unsure.

### *Aim 2: demographic and experiential factors related to vaccine intention*

The results of the logistic regression analyses with TPB-based constructs and demographic/experiential characteristics as predictors and vaccine intention as the outcome variable showed that besides the norms subscale, female gender [ $\chi^2 (1, N = 153) = 4.42, p = .036$ ], compliance with CDC guidelines [ $\chi^2 (1, N = 153) = 6.33, p = .012$ ], and history of a 2019 or 2020 flu shot [ $\chi^2 (1, N = 153) = 7.73, p = .005$ ] were significantly



**Table 2.** Logistic regression with TPB-based constructs and demographic/experiential factors as predictors for vaccine intention – (yes vs unsure).

Predictors	Odds ratio	95% Confidence Interval	
		Lower bound	Upper bound
<b>Vaccine intention (Yes (N = 91) vs. unsure (N = 62); Ref = Yes)</b>			
<b>Intercept</b>			
<b>Beliefs</b>	1.06	0.91	1.22
<b>Norms</b>	0.83***	0.76	0.90
<b>Perceived Behavioral Control</b>	0.98	0.86	1.11
<b>Age</b>	0.95	0.70	1.28
<b>Compliance with CDC guidelines</b>	0.94*	0.90	0.99
<b>Change of Employment (Ref = No)</b>			
Yes	0.34	0.11	1.01
<b>Class Standing (Ref = College freshman)</b>			
College sophomore	5.93	0.64	55.14
College junior	3.04	0.44	21.15
College senior	1.39	0.17	11.51
Graduate student	8.05	0.44	148.53
<b>Gender (Ref = Male)</b>			
Female	5.58*	1.12	27.75
<b>Relationship Status (Ref = Single/Never Married)</b>			
Married	1.54	0.08	28.02
Living w/ Partner	0.37	0.09	1.48
<b>Political Ideology (Ref = Very liberal)</b>			
Liberal	1.78	0.37	8.54
Moderate	2.67	0.51	14.02
Conservative	1.49	0.13	16.90
<b>Ethnicity (Ref = Hispanic or Latino)</b>			
Not Hispanic or Latino	0.25	0.02	3.08
<b>Race (Ref = White)</b>			
Black/AA	2.35	0.11	50.10
Asian	2.09	0.27	16.43
Mixed	1.28	0.21	7.68
<b>Essential Worker (Ref = No)</b>			
Yes, but I can work from home	1.47	0.22	9.86
Yes, and I have to report to my place of employment	1.83	0.55	6.05
<b>Living w/ Essential Worker (Ref = Yes)</b>			
No	1.35	0.48	3.80
<b>Health Insurance (Ref = Yes)</b>			
No	0.94	0.03	33.52
<b>History of a 2019/2020 flu shot (Ref = Yes)</b>			
No	4.70**	1.58	13.97
<b>High Risk (Ref = Yes)</b>			
No	0.64	0.16	2.63
<b>Living w/ High Risk (Ref = Yes)</b>			
No	0.81	0.30	2.16

Note: Ref = reference category; \*\*\* indicates significant at the level of 0.001, \*\* indicates significant at the level of 0.01, \* indicates significant at the level of 0.05.

associated with vaccination intention. Notably, nearly 10% of participants identifying as straight reported that they would refuse the vaccine, though the group of those who would refuse to receive the vaccine was not large enough to be included in the logistic regression.

As shown in Table 2, gender was a significant predictor ( $OR = 5.58$ , 95% CI [1.12, 27.75],  $p = .036$ ), indicating that female participants were more likely to respond 'unsure' rather than 'yes', than male participants. Compliance with CDC guidelines was also a significant predictor of membership in the group who were unsure about receiving the vaccine rather than the reference group who responded 'Yes',  $OR = .94$ ,

95% CI [.90, .99]. The odds ratio of .94 indicates that if all other predictors were held constant, for a one-unit increase in compliance with CDC guidelines, we expect to see about 6% decrease in the odds of feeling unsure about receiving the COVID-19 vaccine compared to being willing to receive the vaccine. In addition, the results indicate that history of a 2019 or 2020 flu shot was a significant predictor ( $OR = 4.70$ , 95% CI [1.58, 13.97]), with participants who reported not having received the 2019 or 2020 flu shot being 4.7 times more likely to feel unsure about the vaccine compared to participants who received the flu shot. Contrary our initial hypotheses, political affiliation was not shown significantly associated with intention to vaccination.

## Discussion

The purpose of this study was to explore how attitudes toward the COVID-19 vaccine and demographic/experiential factors predicted willingness to receive the COVID-19 vaccine among U.S. university students. Understanding predictors of vaccination in this population can increase vaccination rates and mitigate the spread of COVID-19 not only among college students, but also in communities where students dwell. We hypothesized that personal characteristics may be related to vaccination intention, with prior flu vaccination, political orientation, and adherence to CDC guidelines thought to be important predictors. Consistent with this hypothesis, we observed that adherence to CDC guidelines and past flu shot were significant predictors of willingness to vaccinate. In addition, a TPB-based predictor, norms, was associated with intention to vaccinate. Contrary to our hypothesis, political orientation did not predict vaccine willingness, whereas gender emerged as a significant predictor.

The first aim of our study was to examine how vaccine attitudes and other predictors of vaccination impact intention to vaccinate. Perceived behavioral control and accurate beliefs regarding risks were not associated with intention to vaccinate against COVID-19, though higher perceived norms regarding vaccination predicted increased vaccine intentions. External pressure to receive the vaccine from those within the student's social network is associated with higher intention to receive the vaccine. Though largely incongruent with our hypotheses, results were in-line with literature regarding theory-based determinants of intention to vaccinate. A study of vaccine intentions among undergraduate students conducted later in the pandemic (November 2020) found that higher perceived norms were associated with higher perceived importance of receiving the COVID-19 vaccination, and thus higher intentions to vaccinate (Graupensperger et al., 2021). Endorsement of the COVID-19 vaccine in the campus community and other norms-based messaging may be an effective strategy in increasing intention to vaccinate as well as vaccination rates across college campuses.

The second aim of this study concerns whether other factors related to vaccination are predictive of vaccine intentions. This study strongly supports past health behavior, namely prior flu vaccine and adherence to CDC guidelines, as predictors of current intention to vaccinate. Previous research (Chen et al., 2019; Colbourn, 2017; Huang et al., 2021) suggests that past experiences with performing congruent health behaviors may lead to adaptive coping appraisal and increased self-efficacy in preventing infection or spread of the COVID-19 virus (Catalano et al., 2017). Gender was another factor found to be predictive of willingness to vaccinated for COVID-19, with female

participants being less sure about their intention to receive the vaccine than male participants who were more likely to intend to vaccinate for COVID-19. Though the relationship between gender and vaccine willingness was unsurprising due to gender being a well-researched determinant of vaccination, it was not initially hypothesized that gender would be a significant predictor of willingness to vaccinate due to mixed findings in research (de Perio et al., 2012; Williams et al., 2020).

Incongruent with our hypotheses, political orientation was not associated with likelihood of endorsing TPB-related constructs associated with intention to vaccinate. This result is inconsistent with extensive literature exploring vaccine hesitancy and political orientation. Inaccurate beliefs regarding vaccines and lack of trust in scientific authority have been found to be increasingly prevalent among individuals who identify as politically conservative, and these beliefs may be driving both general and COVID-19 vaccine hesitancy (Head et al., 2020; Hoffman et al., 2019; Sarathchandra et al., 2018). Despite this discrepancy, findings suggest that education level may have a larger influence over intention to vaccinate than political orientation (Kumar et al., 2016; Rosenfeld et al., 2020; van Holm et al., 2020).

Clinical implications for our study suggest that college health professionals could utilize flu shot data to estimate their student population compliance with COVID-19 vaccination recommendations, as students in this study who reported receiving the annual flu vaccine had an increased likelihood of intending to get a COVID-19 vaccine. Past vaccination may be indicative of experiential self-efficacy, while following CDC guidelines may be indicative of perceived severity and susceptibility to the virus among students. Strong public health messaging, along with fostering the safety and confidence in the vaccine, may be needed to boost perceived behavioral control in college-aged populations. This will be valuable information for college administrators' plans for post-pandemic restoration and recovery. As the association between norms and past experiences with vaccines is similar finding to the H1N1 vaccine, health care professionals should monitor and attempt to increase vaccination rates among college students. College students were also concerned about the financial and safety consequences of a COVID-19 vaccine, which implies that health professionals should emphasize messages of safety and cost-effectiveness of COVID-19 vaccinations when working with this population. And if possible, student health care plans should cover the cost of COVID-related vaccinations. Future research should conduct a cost-benefit analysis of COVID-19 vaccines.

The present study has limitations. First, this study was a cross-sectional design, which does not allow for longitudinal analyses throughout the pandemic. Second, our sample consisted of primarily White, female, non-Hispanic college students, limiting generalizability to other demographic groups. Though this is a concern for this study, this data provides valuable insight into vaccine attitudes among the largest demographic group at the participating university. However, given racial/ethnicity health disparities, in general and during the pandemic, more research in this area is critically needed. Third, participants were asked to report their adherence to CDC recommendations for an initial set of CDC recommendations that recommended masks not be worn by the general public. Fourth, data were self-reported and may have been influenced by social desirability even though measures were collected confidentially and anonymously. Fifth, the scale describing Perceived Behavioral Control in the COVID-19 Vaccine Intentions measure was less internally consistent than would typically be desirable, and these

results should be interpreted with caution. Further research on the impacts of Perceived Behavioral Control on intentions to vaccinate for COVID-19 is warranted. Fourth, we did not collect data related to potential vaccine misinformation, which has been widespread since the release of the current COVID-19 vaccine options.

Strengths of the present study were that vaccine beliefs were investigated early in the pandemic. Further, vaccine willingness related to behaviors and political ideology, so these data represent initial vaccine attitudes prior to the availability of COVID-19 vaccines. Our findings compliment a body of research on vaccine hesitancy surrounding the COVID-19 pandemic. Additionally, our findings extend research regarding political ideology and COVID-19 (Rosenfeld et al., 2020; van Holm et al., 2020). Finally, due to data collection for this study taking place in the early stages of the pandemic, measures used were not as robust or established as hoped, as the TPB-based measure was adapted from a measure used to measure intention of vaccinating for H1N1. Other potential validated instruments have been developed over the course of the pandemic to more accurately assess the mechanism of COVID-19 vaccine uptake intention (Chen et al., 2021; Chen et al., 2022).

## Conclusions

As COVID-19 continues to spread across the U.S., efforts to increase vaccination rates among younger populations, particularly university students, have become more urgent. As many U.S. universities prepare to reopen with various guidelines for mitigating the spread of COVID-19, understanding what drives students' decisions to vaccinate can be used to further inform these efforts. This study sought to shed insight on predictors of vaccine willingness among this population, and observed that a variety of experiential, demographic, and behavioral predictors contributed to intention to vaccinate. Our findings suggest that interventions targeted toward college students should focus on norms and increasing experiential self-efficacy related to vaccination. Given the limitations in our sample, future research should focus on increasing the representativeness of the sample, as well as incorporating longitudinal results spanning the course of the pandemic.

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