



Hesitant but vaccinated: assessing COVID-19 vaccine hesitancy among the recently vaccinated

Don E. Willis¹ · James P. Selig² · Jennifer A. Andersen¹ · Spencer Hall³ · Emily Hallgren¹ · Mark Williams² · Keneshia Bryant-Moore² · Pearl A. McElfish¹

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Abstract We administered a survey during the fifteen-minute wait time after the COVID-19 vaccine was given (N = 1475) to examine attitudes towards COVID-19 vaccines among adults who were vaccinated in Arkansas between April 22nd and July 6th, 2021. We found 60% of those who had just been vaccinated reported some level of hesitancy, including 10% who reported being “very hesitant.” Hesitancy was not evenly distributed across sociodemographic groups (age, sex, race/ethnicity, and education) and was associated with whether a non-English language is spoken in the home, health care coverage, and flu vaccination over the past five years in bivariate analysis. Generalized ordered logistic regression results reveal associations between the log-ordered odds of COVID-19 vaccine hesitancy and age, sex, race/ethnicity, health care coverage, health literacy, and flu vaccination over the past five years. Surprisingly, a prior COVID-19 diagnosis was not significantly associated with COVID-19 vaccine hesitancy. These results can inform health care and communication strategies. Further attention to “hesitant adopters” can provide insights into the process of overcoming vaccine hesitancy that are critical to vaccine uptake.

Keywords COVID-19 · Vaccine hesitancy · Vaccination

✉ Pearl A. McElfish
pamelfish@uams.edu

¹ College of Medicine, University of Arkansas for Medical Sciences Northwest, Fayetteville, AR, USA

² Fay W. Boozman College of Public Health, University of Arkansas for Medical Sciences, Little Rock, AR, USA

³ Office of Community Health and Research, University of Arkansas for Medical Sciences Northwest, Fayetteville, AR, USA

Introduction

Vaccine hesitancy was designated as one of the top ten threats to global health by the World Health Organization (WHO) in 2019 (WHO, 2019a). The urgency of understanding and addressing vaccine hesitancy has been amplified by the COVID-19 pandemic which has led to the largest overall decline in United States (US) life expectancy in more than seven decades (Arias et al., 2021). Minority populations have reported greater hesitancy to get the COVID-19 vaccine, with some communities of color being half as likely to be vaccinated as Whites (Khubchandani et al., 2021; Malik et al., 2020; Nguyen et al., 2021; Niño et al., 2021; Willis et al., 2021), but these gaps have narrowed over time (Daly & Robinson, 2021; Hamel et al., 2021). Vaccine attitudes are often perceived as being on a continuum ranging from complete refusal to active demand (Dubé et al., 2013). However, research defining hesitancy as a behavior, or both an attitude and behavior, faces the problem of conflating issues such as access with the attitude of hesitancy (Quinn et al., 2019). If someone reports being unvaccinated, it may or may not actually reflect their level of vaccine hesitancy (Dubé et al., 2013).

Emerging evidence suggests those who express hesitancy, or an intention to not receive the COVID-19 vaccine, may still get vaccinated. For example, one study shows nearly a quarter of individuals interviewed in January 2021 who reported they would definitely not get the COVID-19 vaccine or would only get it if required have now received at least one dose (Kirzinger et al., 2021). Yet, little is known regarding hesitancy among those who choose to be vaccinated. Two qualitative studies conducted prior to the emergence of COVID-19 focused on hesitancy among parents who accepted a vaccine for their children (Enkel et al., 2018; Walker et al., 2020). One study focused on Australian

parents making decisions about flu and measles-mumps-rubella vaccinations for their children (Enkel et al., 2018), and the other focused on human papillomavirus vaccination for young adult children (Walker et al., 2020). Both studies demonstrate that hesitancy may co-occur with adherence (Enkel et al., 2018; Walker et al., 2020). However, many questions remain about “hesitant adopters.”

Most research on vaccine hesitancy has overlooked those who have been vaccinated, in part because of inconsistency in the operationalization of vaccine hesitancy (Dubé et al., 2013). A review as recent as 2015 found there was no established definition of vaccine hesitancy (MacDonald, 2015). Consistent with the Increasing Vaccination Model (Brewer et al., 2017; WHO, 2019b; WHO EURO, 2011), we view vaccine hesitancy as an attitude or motivational state (Brewer et al., 2017), whereas vaccination is a behavior which may or may not correspond with reported attitudes towards vaccination. Therefore, the behavior of being vaccinated is distinct but not mutually exclusive from the attitude of vaccine hesitancy (Dubé et al., 2013). Further examination of “hesitant adopters”—individuals who are hesitant but vaccinated—can provide insights into the process of overcoming hesitancy to receive a vaccination, which is critical to vaccine uptake.

Rather than assuming those who receive a COVID-19 vaccine are not hesitant, we asked the following questions: (1) How prevalent is hesitancy towards the COVID-19 vaccine among those who have recently been vaccinated? (2) How does this COVID-19 vaccine hesitancy among the recently vaccinated vary across sociodemographic groups? (3) How does this COVID-19 vaccine hesitancy among the recently vaccinated relate to other factors such as prior diagnosis of COVID-19, health care coverage, health literacy, and flu vaccination behavior over the past five years?

We examined these questions in the context of a state which has COVID-19 vaccination rates substantially lower than the national average. As of August 24th 2021, only 39% of the total population of Arkansas was fully vaccinated, compared to 52% of the US population (HHS & CDC, 2021). States with low vaccination rates have experienced a disproportionate burden of COVID-19 hospitalizations and deaths, especially since the emergence of the Delta variant (Leatherby & Walker, 2021a, b). Thus, understanding COVID-19 vaccine hesitancy in states such as Arkansas is particularly pressing.

Methods

Respondents were recruited at more than 30 vaccination sites across the state of Arkansas where the COVID-19 vaccine was given. Vaccination sites include drive-through clinic locations and vaccination events in the community and at faith-based organizations. Respondents had to be 18 years

of age or older, be recently vaccinated, and speak or read English, Spanish, or Marshallese to be included in the study.

The consent and survey were administered during the fifteen-minute wait time after the COVID-19 vaccine was given using REDCap (Harris et al., 2009). Participants were seated after receiving their vaccination, provided information about the survey, and invited to participate. The study included an incentive of entry into a raffle for a \$100 Walmart gift card. The consent information and survey were available in English, Spanish, and Marshallese. Respondents could document consent and complete the survey on their smartphone by scanning a QR code or utilizing a sterilized iPad provided by study staff. Respondents could also complete the study with assistance of a bilingual staff member asking them the questions verbally. Respondents had the ability to refuse (as indicated by skipping or selecting “prefer not to answer”) questions. Data were collected between April 22nd and July 6th, 2021. The study was approved by the University of Arkansas for Medical Sciences Institutional Review Board (IRB #262645).

Measures

The survey included sociodemographic questions, as well as questions to assess COVID-19 vaccine hesitancy, prior COVID-19 diagnosis, health care coverage, health literacy, and past history of flu vaccinations.

COVID-19 vaccine hesitancy

To measure the dependent variable of COVID-19 vaccine hesitancy, we modified an existing single-item measure of vaccine hesitancy to specifically capture attitudes about the COVID-19 vaccine. The original question asked, “Overall, how hesitant are you about getting vaccinations?” (Quinn et al., 2017, 2019). We modified this to ask respondents to think specifically about how hesitant they were to receive the COVID-19 vaccine. Respondents were asked, “Thinking specifically about the COVID-19 vaccine, how hesitant were you about getting vaccinated?” Response options included the following: “not at all hesitant,” “a little hesitant,” “somewhat hesitant,” and “very hesitant.”

Sociodemographics

Sociodemographic information, including age, sex, race, education, marital status, and whether non-English languages were spoken in the home, was collected. Sociodemographic information other than age was assessed using standard questions from the Behavioral Risk Factor Survey (CDC, 2020). Age was measured using a question from the General Social Survey as a continuous variable calculated from reported date of birth or respondents’ best

estimates of their age (Smith et al., 2019). Sex was measured as a categorical variable of either female or male with the option to self-describe—responses from non-binary respondents were too few to include in the analysis. Respondents were asked to identify their race and could select all that apply from a list of valid responses: American Indian or Alaska Native (AIAN), Asian, Black/African American, Native Hawaiian or Pacific Islander (NHPI), White, or Other. These responses were combined with a response to a question about ethnicity to indicate whether each individual was non-Hispanic Black/African American, non-Hispanic NHPI, non-Hispanic White, non-Hispanic Multiracial or other racial group, or Hispanic or Latino. Responses from AIAN, Asian, and multiracial respondents were too few to keep these categories separate from others in analyses, so they were combined. Although combining these groups is problematic, we decided this option was preferable to excluding them from the analysis. To assess educational attainment, respondents selected the closest fit from an ordinal set of responses. Possible responses included “never attended or only kindergarten,” “grades 1 through 8,” “grades 9 through 11,” “grade 12 or GED,” “some college or technical school,” or “college 4 years or more.” There were few respondents who selected options below “less than a high school,” and these responses were combined into a single “less than high school” category. Respondents were presented a question about relationship status. For analysis, responses were coded into married and non-married respondents. Non-married respondents include any respondent who provided a valid response other than “married.” Respondents were asked if they spoke a language other than English at home, with possible responses of “yes” and “no” (American Community Survey, 2019).

Prior COVID-19 diagnosis

To assess whether individuals had been diagnosed with COVID-19 prior to their vaccination, respondents were asked, “Has a doctor or another health care professional diagnosed you with the coronavirus (COVID-19)?” Possible responses included “yes” or “no.”

Health care coverage

To assess health care coverage, we used a standard measure from the Behavioral Risk Factor Surveillance Survey (CDC, 2020). Respondents were asked, “Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as

Medicare, or Indian Health Service?” Possible responses included “yes” or “no.”

Health literacy

A single-item screener of health literacy was used. Health literacy screeners have been validated among low-income and Spanish-speaking patients (Chew et al., 2008; Hadden et al., 2019; Ylitalo et al., 2018), and evidence suggests that a single item is effective at detecting limited to marginal health literacy with reasonable specificity (Wallace et al., 2006). This question asked respondents, “How confident are you filling out medical forms by yourself?” Possible responses included “extremely,” “quite a bit,” “somewhat,” “a little bit,” or “not at all.”

Flu vaccine behavior

An existing measure of flu vaccination behavior was used to provide insight into whether individuals typically received a flu shot over the past five years (Quinn et al., 2017). The question asked respondents, “How often in the past 5 years have you gotten a seasonal flu vaccine?” Possible responses included “every year,” “most years but not all,” “once or twice,” and “never.”

Statistical analyses

We present descriptive statistics for all variables in the study. Spearman correlations and Kruskal Wallis H tests were performed to assess bivariate relationships with COVID-19 vaccine hesitancy. Due to the ordinal nature of the dependent variable, a generalized ordered logistic regression with partial proportional odds (Williams, 2006) was used to analyze multivariable relationships with COVID-19 vaccine hesitancy. We made the decision to use a partial proportional odds model following a Brant test which revealed that age, health care coverage, and health literacy violated the proportional odds assumption in an ordered logistic regression. The generalized ordered logistic regression allowed us to relax the proportional odds assumption for age, health care coverage, and health literacy, while maintaining it for other variables (Williams, 2006). All tests were two-tailed, with a standard significance level of $p < 0.05$. Statistical analysis was performed on Stata SE/15.1.

Results

Our analytical sample includes 1475 respondents. Among these respondents, 91% answered every item in the survey. In Table 1, we present the descriptive statistics of this sample ($N = 1475$). The average respondent was 38 years old,

Table 1 Descriptives of recently vaccinated Arkansans

	Frequency	% or \bar{x}	S.D	Range
Age	1475	38.18	13.44	18–94
Sex	1463			0–1
Female	838	57		
Male	625	43		
Race/Ethnicity	1457			1–5
NH Black/African American	72	5		
NH Native Hawaiian or Pacific Islander	170	12		
NH White	612	42		
Hispanic/Latinx	496	34		
NH Multiracial and Other Racial Groups	107	7		
Education	1428			1–4
Less than high school	227	16		
High school	359	25		
Some college	338	24		
Four-year degree	504	35		
Marital Status	1432			0–1
Married	709	50		
Not married	723	50		
Non-English Language in Home	1465			0–1
Yes	605	41		
No	860	59		
Prior COVID-19 Diagnosis	1452			0–1
Yes	300	21		
No	1152	79		
Health Care Coverage	1379			0–1
Yes	969	70		
No	410	30		
Health Literacy (medical forms)	1441			0–4
Not at all	30	2		
A little bit	59	4		
Somewhat	125	9		
Quite a bit	337	23		
Extremely	890	62		
Flu Vaccination (past 5 years)	1439			0–3
Never	366	25		
Once or twice	338	24		
Most years but not all	314	22		
Every year	421	29		
COVID-19 Vaccine Hesitancy	1459			0–3
Not at all hesitant	587	40		
A little hesitant	451	31		
Somewhat hesitant	271	19		
Very hesitant	150	10		

NH = non-Hispanic

and approximately half were female (57%). The sample was racially and linguistically diverse with less than half of the population identifying as White (42%) and slightly over half speaking only English in the home (59%). Twenty-nine

percent received their flu vaccinations every year over the past five years. Approximately one in five (21%) reported they had been diagnosed with COVID-19. Although 40% reported themselves to be “not at all hesitant” about getting

the COVID-19 vaccine, the remaining 60% reported some level of hesitancy: 31% were “a little hesitant,” 19% were “somewhat hesitant,” and 10% were “very hesitant.”

In Table 2, we present the bivariate analysis between COVID-19 vaccine hesitancy and all independent variables. Spearman correlation analysis demonstrated

age was negatively associated with COVID-19 vaccine hesitancy ($r_s(1452) = -0.064$; $p = 0.015$). Kruskal Wallis H tests demonstrated there was a difference in vaccine hesitancy by sex ($\chi^2(1) = 5.94$; $p < 0.015$), race ($\chi^2(4) = 37.44$; $p < 0.001$), education ($\chi^2(3) = 10.83$; $p = 0.013$), whether a language other than English was

Table 2 Bivariate relationships with hesitancy among the recently vaccinated

	Not at all Freq(row%)	A little Freq(row%)	Somewhat Freq(row%)	Very Freq(row%)	p-value
^aAge (mean)	40	37	37	39	.015
Sex					.015
Female	302(37)	273(33)	157(19)	91(11)	
Male	275(44)	174(28)	114(18)	58(9)	
Race/Ethnicity					.000
NH Black/African American	17(24)	16(22)	19(26)	20(28)	
NH Native Hawaiian or Pacific Islander	94(57)	35(21)	27(16)	10(6)	
NH White	230(38)	199(33)	116(19)	64(11)	
Hispanic/Latinx	202(42)	160(33)	77(16)	47(10)	
NH Multiracial and Other Racial Groups	39(37)	37(35)	24(23)	5(5)	
Education					.013
Less than high school	111(49)	67(30)	28(12)	19(8)	
High school	139(39)	110(31)	66(19)	37(11)	
Some college	135(40)	96(29)	64(19)	40(12)	
Four-year degree	184(37)	167(33)	103(21)	48(10)	
Marital Status					.105
Married	297(43)	213(31)	120(17)	67(10)	
Not married	276(38)	229(32)	139(19)	75(10)	
Prior COVID-19 Diagnosis					.915
Yes	121(40)	90(30)	56(19)	32(11)	
No	457(40)	354(31)	209(18)	116(10)	
Non-English Language in Home					.001
Yes	266(45)	177(30)	106(18)	45(8)	
No	317(37)	270(32)	162(19)	103(12)	
Health Care Coverage					.016
Yes	366(38)	309(32)	190(20)	96(10)	
No	190(47)	109(27)	59(15)	46(11)	
Health Literacy (medical forms)					.122
Not at all	8(27)	16(53)	2(7)	4(13)	
A little bit	24(41)	20(34)	7(12)	8(14)	
Somewhat	41(33)	36(29)	35(28)	13(10)	
Quite a bit	136(41)	119(36)	57(17)	19(6)	
Extremely	363(41)	251(28)	167(19)	101(12)	
Flu Vaccination (past 5 years)					.000
Never	140(39)	90(25)	76(21)	55(15)	
Once or twice	111(33)	115(35)	69(21)	38(11)	
Most years but not all	116(37)	116(37)	58(15)	31(7)	
Every year	211(50)	116(28)	61(15)	31(7)	

^aSpearman correlation test was used for association between age and COVID-19 vaccine hesitancy

Percentages may not sum to 100 due to rounding

NH = non-Hispanic

spoken in the home ($\chi^2(1) = 10.56; p = 0.001$), health care coverage ($\chi^2(1) = 5.82; p = 0.016$), and flu vaccination behavior over the past five years ($\chi^2(1) = 28.06; p < 0.001$). Reports of being “not at all” hesitant were most prevalent among men, NHPIs, and those with less than a high school degree, who speak a language other than English in the home, who do not have health care coverage, and who report flu vaccination every year in the past five years. Black/African American respondents had the lowest percentage (24%) of reporting they were “not at all” hesitant to receive the vaccine and the highest percentage (28%)

of reporting they were very hesitant. Marital status, prior COVID-19 diagnosis, and health literacy were not associated with COVID-19 vaccine hesitancy.

In Table 3, we present the ordered log-odds regression coefficients from a generalized ordered logistic regression using a partial proportional odds model. These coefficients indicate the increase or decrease in log-odds of reporting a higher level of vaccine hesitancy. The ordered log-odds of vaccine hesitancy were associated with age, sex, race, health care coverage, health literacy, and flu vaccination behaviors over the past five years. As age increased, respondents were

Table 3 Generalized ordered logistic regression of hesitancy among recently vaccinated

	Coef	S.E	p-value	95% Conf	Interval
^aAge					
Not at all hesitant	-.012	.005	.011	-.022	-.003
A little hesitant	-.000	-.020	.982	-.010	.010
Somewhat hesitant	.015	.007	.043	.000	.029
Sex (Ref: Male)					
Female	.377	.110	.001	.162	.593
Race/Ethnicity (Ref: White)					
NH Black/African American	.956	.246	.000	.475	1.437
NH Native Hawaiian or Pacific Islander	-.970	.274	.000	-1.508	-.432
Hispanic/Latinx	-.200	.197	.309	-.586	.186
NH Multiracial and Other Racial Groups	-.092	.222	.680	-.527	.344
Education (Ref: Four-year degree)					
Less than high school	-.186	.211	.377	-.599	.227
High school	.192	.155	.215	-.111	.495
Some college	.064	.142	.653	-.214	.341
Marital Status (Ref: Not married)					
Married	-.009	.115	.939	-.234	.216
Prior COVID-19 Diagnosis					
Yes	.194	.135	.151	-.071	.459
Non-English Language in Home					
Yes	-.046	.165	.780	-.369	.277
^aHealth Care Coverage (Ref: No coverage)					
Not at all hesitant	.291	.145	.044	.007	.574
A little hesitant	.049	.158	.757	-.261	.359
Somewhat hesitant	-.476	.216	.027	-.899	-.053
^aHealth Literacy (medical forms)					
Not at all hesitant	-.226	.071	.002	-.365	-.086
A little hesitant	-.063	.076	.401	-.211	.085
Somewhat hesitant	-.013	.110	.908	-.228	.202
Flu Vaccination (past 5 years)					
Flu vaccination over past 5 years	-.226	.048	.000	-.320	-.132
Constant (Not at all hesitant)	1.637	.361	.000	.930	2.344
Constant (A little hesitant)	-.603	.373	.105	-1.334	.127
Constant (Somewhat hesitant)	-2.272	.506	.000	-3.263	-1.281
Pseudo r-squared	.038	Number of obs		1237	
Chi-square	118.98	Prob > chi2		.000	

^a Nonparallel lines specified

NH = non-Hispanic

less likely to report some level of hesitancy compared to no hesitancy ($\beta = -0.012$; 95% CI $[-0.022, -0.003]$); however, as age increased, people were more likely to report being very hesitant rather than somewhat hesitant ($\beta = 0.015$; 95% CI $[0.000, 0.029]$). Women were more likely to report higher levels of vaccine hesitancy compared to men ($\beta = 0.377$; 95% CI $[0.162, 0.593]$). Black/African American respondents were more likely to report higher levels of hesitancy ($\beta = 0.956$; 95% CI $[0.475, 1.437]$), and NHPI respondents were less likely to report a higher level of hesitancy ($\beta = -0.970$; 95% CI $[-1.508, -0.432]$) compared to White respondents.

Respondents who had health care coverage were more likely to report some level of hesitancy ($\beta = 0.291$; 95% CI $[0.007, 0.574]$); however, respondents with health care coverage were less likely to report being very hesitant compared to somewhat hesitant ($\beta = -0.476$; 95% CI $[-0.899, -0.053]$). Health literacy was associated with vaccine hesitancy; as health literacy increased, respondents were less likely to report some level of hesitancy ($\beta = -0.226$; 95% CI $[-0.365, -0.086]$). As the number of years respondents reported receiving a flu vaccination increased, the less likely they were to report higher levels of hesitancy ($\beta = -0.226$; 95% CI $[-0.320, -0.132]$). Education, marital status, prior COVID-19 diagnosis, and speaking a non-English language in the home were not significantly associated with COVID-19 vaccine hesitancy.

Discussion

We found hesitancy towards the COVID-19 vaccine was prevalent among recently vaccinated Arkansans. Surprisingly, 60% of recently vaccinated individuals showed some level of hesitancy towards the COVID-19 vaccination. Among these “hesitant adopters,” the majority were “a little hesitant” (31%) or “somewhat hesitant” (19%); however, 10% said they were “very hesitant.” The co-occurrence of vaccine hesitancy and the behavior of vaccination suggests that hesitant individuals can overcome their hesitancy enough to receive the vaccine.

Hesitancy varied by race/ethnicity. Black/African American respondents were significantly more hesitant than White respondents or any other racial/ethnic group, with 76% of Black/African American respondents who had recently received a COVID-19 vaccination reporting some level of hesitancy and 28% reporting they were “very hesitant” even after getting the COVID-19 vaccination. This finding is encouraging given prior studies have documented that Black/African American individuals report significantly more hesitancy compared to other racial/ethnic groups (Latkin et al., 2021; Malik et al., 2020; Willis et al., 2021). Historical and ongoing racism has undermined the

trustworthiness of medical institutions (Warren et al., 2020; H. A. Washington, 2006; J. Washington, 2020), which continues to feed into vaccine hesitancy among Black/African American individuals (Savoia et al., 2021). However, past studies have conflated the attitude of hesitancy with the behaviors of receiving or not receiving a vaccine (Quinn et al., 2019). It is important to continue to address vaccine hesitancy; however, our study suggests many Black/African American respondents may choose to get vaccinated despite feeling hesitant.

Interestingly, NHPI respondents reported less hesitancy compared to White respondents. This could be because a large portion of NHPI individuals who are hesitant are not getting vaccinated, or it could be due to intensive, culturally appropriate COVID-19 vaccine outreach and education efforts implemented in Arkansas, which may have reduced hesitancy (McElfish et al., 2021a, 2021b). What is known about hesitancy among NHPIs has been somewhat inconsistent. For example, research on NHPIs tends to aggregate them with Asian Americans (Chang et al., 2020). Studies combining these groups report they have low levels of vaccine hesitancy (Niño et al., 2021); however, studies which distinguish them reveal NHPIs have much higher COVID-19 vaccine hesitancy compared to Asian Americans (Ta Park et al., 2021).

Although a higher proportion of Hispanic/Latinx respondents reported no hesitancy at all compared to Whites, the association was not significant when adjusting for other factors. Similar to NHPIs, research on vaccine hesitancy among Hispanics/Latinx has been mixed. Some research has documented no significant differences in COVID-19 vaccine hesitancy between Hispanic/Latinx individuals and White individuals (Willis et al., 2021), while other studies found that Hispanic/Latinx individuals report significantly higher vaccine hesitancy (Nguyen et al., 2021) or lower probability of intention to vaccinate (Latkin et al., 2021; Niño et al., 2021).

Females reported greater hesitancy compared to males after having received a COVID-19 vaccine, even after adjusting for other independent variables. This finding is consistent with prior research assessing differences in vaccine hesitancy between men and women in the general population (Latkin et al., 2021). The present study documents there are still differences in hesitancy even among men and women who have decided to be vaccinated. Calarco and Anderson (2021) attribute gendered differences in opposition to new public health initiatives like vaccination to the gendered pressures mothers experience. These gendered pressures result in mothers supporting initiatives they control and perceive to be useful but opposing measures like vaccination which they perceive to be an uncontrollable risk (Calarco & Anderson, 2021).

Hesitancy towards the COVID-19 vaccine was associated with whether a non-English language is spoken in the home, health care coverage, and flu vaccination behaviors over the past five years. Although health literacy was not associated with hesitancy in bivariate analysis, it was significant when adjusting for other independent variables—the opposite was true for non-English languages spoken in the home, which was not significant in the regression analysis. Reviews of vaccine hesitancy in general have noted the importance of factors such as access to health care and potential language barriers and health literacy in communicating information about the vaccine (MacDonald, 2015). We were surprised to find having been diagnosed with COVID-19 prior to vaccination was not associated with hesitancy towards receiving the vaccine given some of the misinformation about vaccines has focused on whether those with prior infection should receive the COVID-19 vaccine (Mandavilli, 2020). The majority of research on COVID-19 vaccine hesitancy has not assessed differences across languages spoken in the household, prior COVID-19 diagnosis, or health care coverage, particularly among those who have recently been vaccinated.

These findings have implications for messaging within vaccine clinics and outreach programs. The prevalence of hesitancy among those being vaccinated suggests health care providers should be considerate of hesitation as they answer patient questions. Assuming those who choose to be vaccinated are fully confident in their decision is a lost opportunity to ease any concerns, answer questions, and help encourage them to return for their second dose (if needed). Findings suggest hesitancy towards vaccination should not be conflated with vaccine refusal, just as vaccine compliance should not be conflated with a lack of hesitancy (Bedford et al., 2018). Assuming the unvaccinated are hesitant dismisses issues of access and convenience, while assuming the vaccinated are not hesitant dismisses any ongoing concerns people may have leading up to and after vaccination (Quinn et al., 2019). Vaccine attitudes and behaviors are not static (Enkel et al., 2018), and they do not always relate to one another in ways we might expect (Brewer et al., 2017). These points are foundational for any attempts at shifting vaccine attitudes or behaviors. Further examination of “hesitant adopters” is necessary to provide insights into the *process* of overcoming vaccine hesitancy which is critical to identifying points of intervention. Although hesitancy often differs from one vaccine to another, investigating this group further may also allow for a better understanding of what it means to *become* vaccinated despite vaccine hesitancy.

Strengths and limitations

This study does have limitations. The data are cross-sectional; thus, the results cannot establish causality. Moreover, the sample was not randomly selected and only included

vaccination sites in Arkansas and may not be generalizable to all recently vaccinated individuals. We encourage others to investigate this topic in other locations and contexts. Finally, we relied on self-reported measures for variables such as health literacy and prior diagnosis of COVID-19, and our measure of health literacy relied on a single-item. Future research aimed at understanding the effectiveness of vaccination interventions will require longitudinal designs and the inclusion of both vaccinated and unvaccinated individuals. Although we find that individuals may be hesitant even as they are being vaccinated, future research should explore questions related to the presence of hesitancy at multiple time points after vaccination to better understand the durability or fluctuation of these attitudes.

A major strength of this study is it addresses questions related to COVID-19 vaccine hesitancy among the recently vaccinated, a group which has been overlooked in the literature on vaccine hesitancy in part due to inconsistencies in conceptualization and operationalization of hesitancy. This is the first study to examine hesitancy among a sample of recently vaccinated individuals, providing novel insights into the prevalence and variation of hesitancy among hesitant adopters. The study utilized a large and diverse sample. Moreover, the study was conducted in a context where vaccination rates have been lagging behind national averages and where understanding COVID-19 vaccine uptake and hesitancy towards the COVID-19 vaccine is urgent.

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Declarations

Conflict of interest The authors have no conflicts of interest to declare.

Human and animal participants All procedures followed were in accordance with ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000.

Informed consent Informed consent was obtained from all individual participants included in the study.

Ethical approval All study procedures were approved by the University of Arkansas for Medical Sciences Institutional Review Board (IRB #262645).

Consent to participate All relevant ethical regulations have been followed and participants have completed informed consent.

Consent for publication Not applicable.

Availability of data and material The deidentified data underlying the results presented in this study may be made available upon request from the corresponding author Dr. Pearl A. McElfish, at pamelfish@uams.edu. The data are not publicly available in accordance with funding requirements and participant privacy.

Code availability Statistical analysis was performed on Stata SE/15.1.

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