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Sociodemographic Determinants of COVID-19 Vaccine Hesitancy, Fear of Infection, and Protection Self-Efficacy

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Abstract

Objectives: Arkansas COVID-19 vaccine uptake has been lower than the national average. This study examined associations between sociodemographic factors and COVID-19 vaccine hesitancy, fear of infection, and protection self-efficacy. **Methods:** Adults either residing, having employment, or receiving health care in Arkansas (n = 754) participated in an online survey between October 30, 2020 and January 16, 2021. Participants were recruited in both rural and urban areas from 6 Arkansas primary care clinics. Survey questions addressed sociodemographic factors, COVID-19 infection fear, protection self-efficacy, and COVID-19 vaccine attitudes. Bivariate and multivariable logistic regression models were used to assess associations between dependent variables and respondents' sociodemographic characteristics, COVID-19 infection fear, and COVID-19 protection self-efficacy. **Results:** About 38% of participants reported COVID-19 vaccine hesitancy. Age, sex, race, and education were significantly associated with COVID-19 and general vaccine attitudes. Odds of COVID-19 vaccine hesitancy decreased as age increased (OR = 0.98; $P < .01$). Women had higher odds of COVID-19 vaccine hesitancy than men (OR = 1.52; $P < .05$). Respondents with a high school diploma and below and respondents with some college or a technical degree had greater odds of COVID-19 vaccine hesitancy (OR = 2.58; $P < .001$; and OR = 1.97; $P < .01$, respectively) compared to respondents with a 4-year college degree. Black/African American respondents had greater odds of COVID-19 vaccine hesitancy compared to White respondents (OR = 3.08; $P < .001$). No significant difference was observed among rural and urban respondents regarding COVID-19 vaccine hesitancy; however, respondents in rural areas were more likely to report low general vaccine trust compared to those in urban areas (OR = 1.87; $P < .01$). Respondents reporting no fear (OR = 5.51; $P < .001$) and very little fear (OR = 1.95; $P < .05$) of COVID-19 had greater odds of COVID-19 vaccine hesitancy compared to respondents who feared COVID-19 infection to a great extent. **Conclusions:** COVID-19 vaccine hesitancy and general trust in vaccines differ significantly among age, sex, race, and education. These trust and hesitancy patterns are challenges for achieving population immunity and follow similar patterns of vulnerability to COVID-19. Vaccination programs and interventions must consider these differences in COVID-19 vaccine hesitancy and general vaccine trust to alleviate COVID-19 disparities. Findings make a significant contribution in evaluating vaccine hesitancy among a large, diverse sample from a rural state.

Keywords

COVID-19, vaccine hesitancy, sociodemographic factors, fear, self-efficacy

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Introduction

The coronavirus (COVID-19) infection was the third leading cause of death in the United States (US) in 2020,[1] and it surpassed the daily mortality rates for heart disease and cancer during the spring of 2020.[2] Attaining population immunity through vaccinations is a well-established approach adopted to address infectious outbreaks.[3] It has been

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estimated that population immunity can be achieved by immunizing approximately 75% to 90% of the population.[4] However, surveys conducted before the COVID-19 vaccine was available document that a large proportion of the global population are hesitant toward COVID-19 immunization.[5] The highest COVID-19 vaccine acceptance rates among adults in the general public were found in Ecuador (97.0%), Malaysia (94.3%), Indonesia (93.3%), and China (91.3%), and the lowest rates were found in Kuwait (23.6%), Jordan (28.4%), Italy (53.7), Russia (54.9%), Poland (56.3%), US (56.9%), and France (58.9%).[5] Attitudes toward vaccination are generally viewed as existing on a continuum ranging from active demand to complete refusal.[6] Populations of racial and ethnic minorities have been differentially affected by COVID-19.[7] Variable uptake of vaccines might further worsen the health disparities gap hindering the public health efforts to allocate resources and vaccines appropriately.

Arkansas is a diverse and rural state with 43.84% of the population living in a rural area[8] and 28.00% of the population reporting a race or ethnicity other than non-Hispanic white.[9] In an effort to assure access to all populations, COVID-19 vaccines (Pfizer, Moderna, and Johnson & Johnson) have been made widely and freely available in almost all parts of the US, including Arkansas, to all persons who meet age requirements, regardless of insurance status and coverage.[10,11] Nevertheless, Arkansas COVID-19 vaccine coverage has been lower than the 2021 US national average.[12,13] As of July 2021, the proportion of fully vaccinated individuals in the US was 49.10%, with 57.40% having received at least 1 dose of the vaccine. Conversely, only 35.20% were found to be fully vaccinated in Arkansas, with 43.50% having received at least 1 dose of the vaccine.[14-16] Therefore, an online survey approach was used to examine the association between selected sociodemographic factors and COVID-19 vaccine hesitancy among Arkansans. Furthermore, the study examined how fear of COVID-19 infection and self-efficacy to protect against COVID-19 influenced COVID-19 vaccine hesitancy.

Methods

Participants were recruited from 6 primary care clinics located throughout rural and urban areas in Arkansas between October 30, 2020 and January 16, 2021. Eligibility criteria included being an adult aged 18 years or older and either residing, having employment, or receiving health care in the state of Arkansas. A recruitment email that included the purpose of the study, the participation eligibility criteria, and the link to voluntarily participate in the survey was sent to 6092 potential respondents. About 876 responses were completed. Out of those, 809 met the eligibility criteria. The final dataset consisted of 754 responses after excluding 21 responses with no data beyond demographic information and 34 duplicate responses.

Before starting the online survey, the potential participants reviewed the study description and consent information. Research Electronic Data Capture (REDCap), a widely used web-based software for capturing survey data, was used to document the written consent and collect responses.[17,18] A $20.00 gift card was provided as an incentive to participate in the study. Identifying information was deleted from the downloaded data before conducting the analysis. The Institutional Review Board at the University of Arkansas for Medical Sciences (IRB#261226) approved the study.

The survey included questions about sociodemographic information, vaccine attitudes, and items related to COVID-19. *Sociodemographic* measures included age, sex, race, and ethnicity, income, education, and urban/rural area as determined by the U.S. Department of Agriculture (USDA) Rural-Urban Commuting Area (RUCA) Codes matched with zip codes. Two key vaccine attitude questions were asked: (1) general vaccine trust and (2) COVID-19 vaccine hesitancy. *General vaccine trust* was assessed by asking, "Overall how much do you trust vaccines?" Respondents could answer with "not at all," "very little," "somewhat," "to a great extent," and "completely." Those who answered "to a great extent" or "completely" were coded as 1 to indicate a high level of trust. The other responses were coded as 0 to indicate lower levels of trust. *COVID-19 vaccine hesitancy* was measured by asking, "If a vaccine for COVID-19 were available today, what is the likelihood that you would get vaccinated?" Those who selected "don't know/not sure," "unlikely," or "very unlikely" were coded as 1 to indicate hesitancy toward a COVID-19 vaccine. Those who responded that they were "likely" or "very likely" were coded as 0 to indicate they were not hesitant.

Respondents were asked to respond to the statement "I know how to protect myself from COVID-19" to assess *COVID-19 self-efficacy*. Possible responses included, "not sure at all," "maybe/not sure," and "yes, completely sure." Responses were coded as 1 to indicate uncertainty and 0 to indicate that the respondent was completely sure. *Fear of COVID-19 infection* was measured by asking respondents to rate their concern about being infected with COVID-19. Respondents could answer by indicating they were concerned "to a great extent," "somewhat," "very little," or "not at all." These responses were coded from 1 to 4, with higher numbers indicating less fear or more complacency regarding COVID-19 infection.

We tested associations between sociodemographic characteristics, rural/urban residence, fear of COVID-19 infection, and self-efficacy in protecting against COVID-19 with COVID-19 vaccine hesitancy and general trust in vaccines using bivariate analyses (*t*-tests and chi-square tests) and multivariable logistic regressions. We ran these tests separately for each dependent variable (COVID-19 vaccine hesitancy and general trust in vaccines). Descriptive and

Table 1. Descriptive Statistics for Phase 2 Sample of Arkansas Adults.

	Frequency	% or $\bar{x}$	SD	Range
Age	754	47.38	16.31	18.20-90.60
Sex	752			0-1
Women	531	70.42		
Men	221	29.31		
Race/ethnicity	747			1-4
Black/African American	128	17.14		
White	526	70.41		
Other race or multiracial	61	8.17		
Hispanic/Latinx	32	4.28		
Income	620			1-4
<$25K	281	45.32		
$25K < $50K	133	21.45		
$50K < $75K	72	11.61		
>$75K	134	21.61		
Education	748			1-3
High school or less	212	28.34		
Some college	265	35.43		
Four-year college degree	271	36.23		
Residence	522			0-1
Rural	142	27.20		
Urban	380	72.80		
COVID-19 attitudes/feelings				
COVID-19 self-efficacy	717			0-1
Maybe/not sure	373	35.15		
Completely sure	709	64.85		
Fear of COVID-19 infection	637			1-4
Great extent	194	30.46		
Somewhat	290	45.53		
Very little	106	16.64		
Not at all	47	7.38		
Vaccine confidence				
General vaccine trust	694			0-1
Low trust	302	43.52		
High trust	392	56.48		
Vaccine hesitancy				
COVID-19 vaccine hesitancy	694			0-1
Hesitant	279	38.75		
Not hesitant	441	61.25		

bivariate analyses were conducted using Stata/SE 15.1.[19] Mplus 7.3[20] was used for full-information maximum likelihood (FIML) logistic regression analyses.

Results

Table 1 depicts descriptive statistics for sociodemographics and the independent and dependent variables. The sample is over-representative of women for the state of Arkansas; however, the proportion of those with a 4-year college degree (36.23%) is similar to that of the state population (32.10%).[21] Non-Hispanic white respondents accounted for 70% of the sample, and non-Hispanic black residents accounted for 17%. Over a quarter (27%) of respondents reported a zip code that is considered to be a rural resident by the RUCA codes.

Table 2 depicts bivariate analyses between independent variables and COVID-19 vaccine hesitancy and trust in vaccines in general. There was statistically significant variation in COVID-19 vaccine hesitancy based on age ($t(718)=5.77$; $P<.001$), sex ($\chi^2(1)=9.88$, $P<.01$), race/ethnicity ($\chi^2(3)=45.16$, $P<.001$), income ($\chi^2(3)=18.86$, $P<.001$), education ($\chi^2(2)=42.36$, $P<.001$), and fear of infection ($\chi^2(3)=22.96$, $P<.001$). The average age for

Table 2. Prevalence of COVID-19 Vaccine Hesitancy and General Vaccine Trust among Arkansas Adults.

	COVID-19 vaccine hesitancy		General vaccine trust	
	Hesitant % (n) or $\bar{x}$	*t*-Test or χ^2 *P*-value	Low trust % (n) or $\bar{x}$	*t*-Test or χ^2 *P*-value
Age	43.09	$P<.001$	44.41	$P<.001$
Sex		$P<.01$		$P<.01$
Women	42.41 (215)		47.33 (230)	
Men	29.86 (63)		34.47 (71)	
Race/ethnicity		$P<.001$		$P<.001$
Black/African American	63.03 (75)		71.56 (78)	
White	31.24 (159)		36.14 (180)	
Other race or multiracial	46.43 (26)		53.70 (29)	
Hispanic/Latinx	51.72 (15)		46.15 (12)	
Income		$P<.001$		$P<.001$
<$25K	45.32 (126)		49.81 (132)	
$25K < $50K	34.09 (45)		44.70 (59)	
$50K < $75K	30.56 (22)		34.29 (24)	
>$75K	24.63 (33)		27.07 (36)	
Education		$P<.001$		$P<.001$
High school or less	51.01 (101)		64.48 (118)	
Some college	44.31 (113)		50.61 (125)	
Four-year college degree	23.28 (61)		21.92 (57)	
Residence		.98		.13
Rural	34.51 (49)		45.19 (61)	
Urban	34.66 (131)		37.77 (139)	
COVID-19 attitudes/feelings				
COVID-19 self-efficacy		.109		
Maybe/not sure	42.40 (106)			
Completely sure	36.29 (168)			
Fear of COVID-19 infection		$P<.001$		
Great extent	34.38 (66)			
Somewhat	32.41 (94)			
Very little	39.42 (41)			
Not at all	68.09 (32)			

respondents reporting they were likely or very likely to get the COVID-19 vaccine (50.16) was 7 years higher than the average for those who reported hesitancy (43.09). COVID-19 vaccine hesitancy was higher among women (42.41%) than men (29.86%). COVID-19 vaccine hesitancy was highest among Black/African American respondents (63.03%), followed by Hispanic/Latinx respondents (51.72%), and non-Hispanic other race and multiracial individuals (46.43%)—it was lowest among non-Hispanic White respondents (31.24%). COVID-19 vaccine hesitancy was highest for those in the lowest income category (45.32%) and steadily declined as income category increased, with the highest income group reporting the lowest hesitancy (24.63%). Respondents with a high school degree or less reported the highest prevalence of COVID-19 vaccine hesitancy (51.01%) across education categories, followed by those with a technical degree or some college (44.31%), and those with a 4-year college degree (23.28%), who reported the lowest prevalence of hesitancy. Respondents who did not fear infection of COVID-19 at all had the highest prevalence of COVID-19 vaccine hesitancy (68.09%). There was no significant difference in COVID-19 vaccine hesitancy by residence or COVID-19 self-efficacy.

There was statistically significant variation in general vaccine trust based on age ($t(692)=-4.51$; $P<.001$), sex ($\chi^2(1)=9.73$, $P<.01$), race/ethnicity ($\chi^2(3)=48.24$, $P<.001$), income ($\chi^2(3)=20.93$, $P<.001$), and education ($\chi^2(2)=87.11$, $P<.001$). The average age of those with high trust (50) was over 5 years older than the average age of those with low trust (44). Men had a lower prevalence of low trust (34.47%) than women (47.33%). Non-Hispanic White respondents had the lowest prevalence of low trust (36.14%), followed by Hispanic/Latinx respondents (46.15%), other

Table 3. FIML Logistic Regression of COVID-19 Vaccine Hesitancy (N = 754).

	B	S.E.	OR	*P*-value	Sig
Age	−0.02	0.01	0.98	.002	**
Sex					
Women	0.42	0.20	1.52	.033	*
Men	—	—	—	—	
Race					
Black/African American	1.13	0.24	3.08	.000	***
White	—	—	—	—	
Other race or multiracial	0.57	0.31	1.77	.065	
Hispanic/Latinx	0.78	0.42	2.19	.059	
Income					
<$25K	0.30	0.27	1.35	.272	
$25K < $50K	0.16	0.30	1.18	.587	
$50K < $75K	0.44	0.35	1.55	.209	
>$75K	—	—	—	—	
Education					
High school or less	0.95	0.23	2.58	.000	***
Some college	0.68	0.22	1.97	.002	**
Four-year college degree	—	—	—	—	
Residence					
Rural	0.21	0.24	1.23	.388	
Urban	—	—	—	—	
Fear of COVID-19 infection					
Great extent	—	—	—	—	
Somewhat	0.30	0.22	1.35	.169	
Very little	0.67	0.28	1.95	.019	*
Not at all	1.71	0.39	5.51	.000	***
COVID-19 self-efficacy					
Maybe/not sure	0.28	0.18	1.32	.645	
Completely sure	—	—	—	—	
Constant	−1.53	0.45	0.22	.001	**

*$P < .05$. **$P < .01$. ***$P < .001$.

Table 4. FIML Logistic Regression of Low Trust in Vaccines in General (N = 754).

	B	S.E.	OR	*P*-value	Sig
Age	−0.01	0.01	0.99	.016	*
Sex					
Women	0.32	0.20	1.37	.104	
Men	—	—	—	—	
Race					
Black/African American	1.19	0.25	3.29	.000	***
White	—	—	—	—	
Other race or multiracial	0.68	0.32	1.97	.033	*
Hispanic/Latinx	0.09	0.45	1.10	.836	
Income					
<$25K	0.24	0.27	1.27	.380	
$25K < $50K	0.56	0.29	1.75	.058	
$50K < $75K	0.45	0.35	1.56	.204	
>$75K	—	—	—	—	
Education					
High school or less	1.86	0.24	6.43	.000	***
Some college	1.15	0.22	3.15	.000	***
Four-year college degree	—	—	—	—	
Residence					
Rural	0.63	0.24	1.87	.010	**
Urban	—	—	—	—	
Constant	−1.49	0.41	0.23	.000	***

*$P < .05$. **$P < .01$. ***$P < .001$.

racial or multiracial group respondents (53.70%), and Black/African American respondents, who reported the highest prevalence of low trust (71.56%). Low trust was most prevalent among those in lower income categories and those with lower educational attainment.

Table 3 depicts the FIML logistic regression results for vaccine hesitancy specific to the COVID-19 vaccine. The odds of reporting COVID-19 vaccine hesitancy were significantly associated with age, sex, race/ethnicity, education, and fear of infection. The odds of COVID-19 vaccine hesitancy decreased as age increased (OR = 0.98; $P < .01$). The odds of COVID-19 vaccine hesitancy for women were 1.52 greater than that of men ($P < .05$). Black/African American respondents had 3.08 times greater odds of vaccine hesitancy compared to White respondents ($P < .001$). Those with a high school diploma or less education had 2.58 greater odds of COVID-19 vaccine hesitancy than those with a 4-year college degree ($P < .001$), and those with some college or a technical degree had 1.97 times the odds of vaccine hesitancy compared to those with a 4-year college degree ($P < .01$). Those who reported very little fear of COVID-19 infection had odds of COVID-19 vaccine hesitancy 1.95 times greater than those who feared it to a great extent ($P < .05$). Those who felt no fear at all of COVID-19 infection had 5.51 greater odds of COVID-19 vaccine hesitancy compared to those who feared COVID-19 infection to a great extent ($P < .001$).

Table 4 depicts the FIML logistic regression results for low trust in vaccines in general. The odds of reporting low trust in vaccines in general were significantly associated with age, race/ethnicity, education, residence, fear of infection, and COVID-19 self-efficacy. The odds of low trust in vaccines decreased as age increased (OR = 0.99; $P < .05$). Black/African American respondents were 3.29 times more likely to report low trust in vaccines compared to White respondents ($P < .001$). Respondents who reported multiple races or a race/ethnicity other than Black/African American, White, or Hispanic or Latino, were 1.97 times more likely to report low trust in vaccines compared to White respondents ($P < .05$). Those with a high school diploma or less education were 6.43 times more likely to report low trust in vaccines than those with a 4-year college degree ($P < .001$), and those with some college or a technical degree were 3.15 times more likely to report low trust

in vaccines compared to those with a 4-year college degree ($P < .001$). Respondents living in a rural area were 1.87 times more likely to report low trust in vaccines compared to those living in an urban area ($P < .01$).

Discussion

This study examined the factors associated with vaccine hesitancy in Arkansas, a rural state with a high proportion of people at-risk for severe COVID-19 if infected. Up to 38.75% of Arkansans demonstrated COVID-19 vaccine hesitancy, compared to the national estimate of vaccine hesitancy closest to the time period (January 2021) of this study (21.60%).[13] Our results reflect a higher proportion of vaccine hesitant people as compared to the other prior recent studies documenting vaccine hesitancy; however, comparisons of hesitancy across studies are challenging due to inconsistent measurement.

We found that hesitancy toward COVID-19 vaccines and trust in vaccines in general vary significantly across sociodemographic groups. COVID-19 and general vaccine attitudes were significantly associated with age, sex, race, and education, with younger respondents and those with lower education and incomes reporting greater hesitancy. These findings were consistent with several other studies that found those who did not intend to be vaccinated were much less likely to be female and much more likely to be Black/African American compared to White.[22,23] Consistent with prior studies, Black/African American were 3 times as likely to report COVID-19 vaccine hesitancy.[24,25] These findings were concerning because people with lower incomes and/or lower education levels and communities of color experienced greater COVID-19 disparities in infection, hospitalization, and death.[7] The higher odds COVID-19 vaccine hesitancy among these populations could worsen COVID-19 disparities.

Contemporary literature shows that few studies examined vaccine hesitancy among rural population in the US. Surprisingly, our findings indicated that residing in either a rural or urban area was not associated with COVID-19 hesitancy. This finding was in contrast with prior studies which have shown greater COVID-19 hesitancy among those living in a more ruralized area.[26,27] However, we did find differences in general vaccine confidence, with rural area residents reporting significantly less trust in vaccines in general compared to those living in urban areas. To our knowledge, this is the first study to document a difference in general vaccine confidence among rural and urban respondents.

Respondents who had less fear of infection by COVID-19 were more likely to report hesitancy toward the COVID-19 vaccination. Respondents who reported they did not fear contracting COVID-19 infection had 5 times greater odds of vaccine hesitancy compared to respondents who feared infection to a great extent. This finding was consistent with general vaccine hesitancy studies[28] and is among the first studies to document fear as a predictor of COVID-19 vaccine hesitancy.

Limitations

This study does have some limitations. Because the data are cross-sectional, we were unable to determine causality or assess trends in COVID-19 vaccine hesitancy across time. The study recruited participants who were patients at 6 clinics and may not represent the responses of participants without a primary care provider or who do not have e-mail addresses. Despite the limitations, this study makes a significant contribution in evaluating vaccine hesitancy among a large and diverse sample from a rural state.

Conclusions

Hesitancy toward the COVID-19 vaccine and general trust in vaccines differ significantly among age, sex, race, and education, with younger respondents and those with lower education and incomes reporting greater hesitancy. These patterns of hesitancy and trust are worrisome because they are a challenge for achieving population immunity and because they follow similar patterns of vulnerability to COVID-19 itself. Vaccination programs and interventions which do not consider these differences in COVID-19 vaccine hesitancy and general vaccine trust may exacerbate rather than alleviate existing COVID-19 disparities.

Declaration of Conflicting Interests

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Ethical Approval

The Institutional Review Board at the University of Arkansas for Medical Sciences (IRB#261226) approved the study.

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