COVID-19 Vaccine Attitudes and Barriers among Unvaccinated Residents in Rural Northern/Central Illinois

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Background: Rural communities have lower COVID-19 vaccine uptake and poorer health outcomes compared to non-rural communities, including in rural, northern/central Illinois. Understanding community perceptions about vaccination is critical for developing targeted responses to improve vaccine uptake in rural communities and meet global vaccination targets.

Purpose: This study examines COVID-19 vaccine attitudes and barriers as well as the impact of COVID-19 on specific health behaviors of residents in rural northern/central Illinois to inform efforts to increase vaccine uptake.

Methods: In collaboration with community partners and local health departments, we conducted a 54-item, English-language, online questionnaire from Feb 11 to March 22, 2021; the questionnaire included the COVID behavioral questionnaire scale (CoBQ), as well as questions on intention to vaccinate, vaccination attitudes, and barriers to vaccine access. Descriptive and bivariate analyses assessed participant differences based on intention to vaccinate.

Results: Most unvaccinated survey respondents (n = 121) were White (89.3%) and female (78.5%), with an average age of 52.3±14.1 years. Lack of intention to vaccinate was negatively associated with trust in the science behind vaccine development (P = .040), belief in the safety of the vaccine (P = .005) and belief that the vaccine was needed (P=.050). CoBQ scores of respondents who intended to get vaccinated differed significantly from those who did not (P<.001), showing a greater negative impact of COVID-19 on engaging in health behaviors for vaccine-hesitant participants.

Conclusion: Study findings show mistrust of science and lack of confidence in vaccine safety are barriers to vaccination in rural northern Illinois residents. Similar results have been reported in low- and middle-income countries. *Ethn Dis*.2022:32(4):305-314; doi:10.18865/ed.32.4.305

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Introduction

COVID-19 vaccination is integral to the public health measures being deployed globally to suppress the pandemic.[1] Several highly effective vaccines have been developed,[2] which have prevented an estimated 1.1 million deaths and 10.3 million hospitalizations by November 2021 in the United States alone.[3] Although these vaccines have shown reduced effectiveness in preventing infection from the highly transmissible Omicron variant, they remain highly effective for preventing hospitalization and deaths.[4]

Despite vaccine effectiveness, disparities in global vaccination rates persist. The World Health Organization's target of fully vaccinating 70% of the world's population by mid-2022 [5] has already been met among high (74.3%) and upper middle-income (74.3%) countries.[6] However, vaccination rates are lagging in lower-middle (55.6%) and low (17.4%) income countries.[6] These disparities have been attributed to a variety of factors including limited health care infrastructure, delays in obtaining vaccine supplies, and vaccine hesitancy.[7,8] Vaccine hesitancy is defined simply as any degree of reluctance to take a vaccine—it can be attributed to a variety of factors that may differ between communities and social circles.[9] As access to

COVID-19 vaccines continues to improve in low- and middle-income countries (LMIC), which tend to be more rural,[10] efforts to maximize vaccine uptake will need to incorporate effective strategies to combat vaccine hesitancy in rural communities.

Globally, across income levels, residing in a rural community has consistently been associated with COVID-19 vaccine hesitance.[11-13] Those living in rural communities are more likely to identify as culturally conservative, have lower levels of health literacy, and have a greater distrust of government and the medical establishment.[14-16] Distrust in information sources has been shown to have a particularly strong association with COVID-19 vaccine hesitance.[12,14,17] The above-mentioned factors are ultimately interrelated and can contribute to the proliferation of false information and conspiracy theories regarding COVID-19 in rural communities.[14,17,18] Understanding vaccination attitudes and barriers in rural communities is critical for developing strategies to increase rural vaccine uptake and meet global targets.

This study examines COVID-19 vaccine attitudes and barriers as well as the impact of COVID-19 on specific health behaviors of residents in rural northern/central Illinois to inform efforts to increase vaccine uptake in rural Illinois.

Illinois is a midwestern state with 83 of its 102 counties designated as rural. As of March 23, 2022, only 49.0% of rural Illinois residents had been fully vaccinated compared to 66.1% of urban residents.[19] This study examines COVID-19 vaccine attitudes and barriers as well as the impact of COVID-19 on specific health behaviors of residents in rural northern Illinois to inform efforts to increase vaccine uptake in rural northern/central Illinois.

Methods

This cross-sectional survey study was conducted in northern/central Illinois counties from Feb 11, 2021 – March 22, 2021, with a convenience sample of adults. Our study was approved by the Institutional Review Board at the University of Illinois College of Medicine. The survey was voluntary, and by completing the survey participants provided consent.

Participants

The survey was implemented online and in-person. To facilitate participant recruitment online, the study was advertised in partnership with four community organizations and a local health department that covered two rural counties. Community partners shared the survey on their Facebook pages and distributed paper flyers that included a QR code and link to the survey. Participants were also recruited to complete the survey in-person on tablet computers at two rural pharmacies. The health department and community partners were chosen because of the long-standing relationship with the researchers. Rural pharmacies were added since they expressed interest and we had pharmacy students who were doing community rotations there. All completed responses were collected anonymously in Qualtrics, and no personal identifying information was collected. This ensured the privacy and confidentiality of all study respondents.

Participation in the online survey was voluntary. At the rural pharmacies, participants completed surveys on a tablet. Pharmacy students who were doing a community rotation at these locations approached potential participants and if they expressed interest, provided a tablet for them to respond to the survey.

Participant eligibility was determined by residence in a rural community within the surveyed counties based on Rural-Urban Commuting Area (RUCA) codes,[20] which designate rurality for census tracts and zip codes based on measures of population density, urbanization, and daily commuting patterns. Once data collection was complete, participants' rurality was confirmed using zip code of residence and assigning the appropriate RUCA code. A total of 221 individuals completed the survey, and 26 surveys were excluded for the following reasons: no zip code provided (n=7); the respondent did not reside in Illinois (n = 13); the respondent

provided a non-rural zip code (n = 6). This resulted in a final sample of 195 responses. Only 11 of these responses were collected in-person in the rural pharmacies. We then classified responses by vaccination status (n = 74 vaccinated, n = 121 unvaccinated). Since we were interested in pandemic attitudes and vaccination barriers in the unvaccinated population, analysis was restricted to the unvaccinated participants (n = 121).

Survey Instrument

The survey was programmed into Qualtrics, an online survey platform. Responses were collected anonymously, and participants had the option to enter a drawing for a $10 gift card. At the end of the study, 20 respondents were randomly selected to receive a gift card.

The 54-item survey included questions on attitudes toward the COVID-19 pandemic, COVID vaccination hesitancy, barriers to vaccine access, intention to vaccinate, and socio-demographic characteristics. These questions were taken from survey items used by the KFF COVID Vaccine Monitor.[21] The previously validated 17-item COVID-19 Behavioral Questionnaire (CoBQ),[22] designed to assess the effect of COVID-19 on engagement in health behaviors, was also included as part of the instrument.

Variables of Interest

Attitudes toward the COVID vaccine.

Participants were asked their perspectives about the COVID vaccine using 9 survey items related to vaccine science, administration, safety, and effectiveness, using a 4-point Likert scale (1= strongly disagree, 2= disagree, 3=agree, 4=strongly agree). Responses were recoded as dichotomous variables indicating agreement or disagreement with the statement, where agreement corresponded to a negative attitude toward the vaccine. Additionally, participants were asked their level of worry about hospitalization and spread of COVID using a 4-point Likert scale (1=very worried, 2=somewhat worried, 3=not too worried, 4=not at all worried). These responses were also recoded as dichotomous variables where agreement with the statement indicated worry about COVID.

Barriers to Accessing the COVID Vaccine

Five survey items asked participants about their likelihood of getting the vaccine if they lacked transportation to the vaccination site, had to travel a long distance to get the vaccine, had to wait in line for a long time, or had to pay for the vaccine. Participants were also asked their likelihood of getting the vaccine if their health care provider recommended it. These items were assessed using a 4-point Likert scale (1=very likely, 2=likely, 3=unlikely, and 4=very unlikely). Responses were recoded as dichotomous variables indicating likelihood of taking the vaccine.

We sought to account for participants who were actively planning to vaccinate but did not yet have access to the vaccine. To account for this on the survey instrument, respondents who were unvaccinated and indicated that they would receive the vaccine as soon as possible (n=68) were skipped from answering attitudes and barrier-related questions. It is likely that these respondents had a high intention to vaccinate and thus would not find relevance in the survey items inquiring about vaccine attitudes and barriers.

Engagement in Health Behaviors.

A 17-item previously validated COVID-19 Behavioral Questionnaire (CoBQ) was included in the survey instrument to assess the effect of COVID-19 on engaging in health behaviors. The scale includes items related to accessing needed health care during the pandemic (eg, seeking treatment for chronic illnesses); engaging in behaviors to prevent the spread of COVID-19 (eg,, masking, social distancing); involvement in healthy lifestyle habits (eg, nutrition, physical activity, and sleep); and assessing the psychological effects of COVID.[22]

The CoBQ scale has four domains: Public Awareness, General Health Habits (GHH), Social/Mental Health, and Chronic Health Maintenance. Wording of some items in the scale was modified to improve understanding and tailor it for rural residents. However, the meaning and intent of the original items was maintained. The CoBQ score uses a 4-point Likert scale (strongly disagree=1, disagree=2, agree=3, strongly agree = 4). Nine items on the scale correspond to negative health behaviors during the pandemic (eg, not eating healthfully and not seeking care for chronic illnesses); and participants who agreed with those statements were assigned higher CoBQ scores. The eight re-

maining scale items represent positive health behaviors (eg, avoiding crowds, masking, and following social distancing guidelines). These items were reverse coded on the 4-point Likert scale as follows: strongly disagree=4, disagree=3, agree=2, strongly agree = 1; thus, we ensured uniform directionality of all statements on the 17-item CoBQ scale. As a result, CoBQ scores ranged from 17 to 68, and higher scores indicated a greater negative impact of COVID-19 on engaging in health behaviors.

Data Analysis

Participant responses were stratified by their intention to vaccinate. Descriptive statistics were computed to characterize key demographics such as race, gender, age, income, and education. Questionnaire items on attitudes toward the COVID vaccine and perceived barriers to vaccination were analyzed using chi square and Fisher's Exact tests to compare differences in responses based on intention to vaccinate. A mean CoBQ score was calculated, along with mean subscale scores for each domain. Comparisons of mean CoBQ scores were made based on vaccination intent, and independent samples t-tests were used to determine significant differences between the two groups. All analyses were conducted using SAS Version 9.4. Significance levels were set at .05.

Results

Out of the 121 unvaccinated respondents, the majority were White and 78.5% were female, which is higher than the proportion of females in the general population (51%). Eighty-eight (72.7%) intended to get the COVID vaccine while 33 (27.3%) did not (Table 1). Participants who did not intend to get the vaccine were generally younger (M = 46.5, SD = 13.1 years) than those who were planning to get vaccinated (M = 54.5, SD = 13.9 years, P = .005). There were no significant differences in intention to vaccinate based on household income (over/under $50,000, P =

Table 1: Demographics of the unvaccinated study participants, N=121

	Do not intend to vaccinate, n = 33	Intend to vaccinate, n = 88
	n (%)	n (%)
Sex		
Male	5 (15.2)	19 (21.6)
Female	27 (81.8)	68 (77.3)
Gender unknown	1 (3.0)	1 (1.1)
Age		
18-34	7 (21.2)	9 (10.2)
35-49	10 (30.3)	17 (19.3)
50-64	14 (42.5)	40 (45.5)
65+	1 (3.0)	21 (23.9)
Age unknown	1 (3.0)	1 (1.1)
Mean Age (SD)	46.5 (13.1)	54.5 (13.9)
Race		
White, non-Hispanic	29 (87.9)	77 (87.5)
Hispanic	1 (3.0)	2 (2.3)
Black/African American	0 (0)	7 (7.9)
Other	3 (9.1)	2 (2.3)
Education		
< Bachelor's degree	21 (65.6)	45 (51.7)
≥ Bachelor's degree	11 (34.4)	42 (48.3)
Annual Income		
≤ $35,000	4 (14.8)	9 (11.8)
$35,001- $75,000	14 (51.9)	40 (52.6)
>$75,000	9 (33.3)	27 (35.6)
Health Insurance		
Insured	30 (90.9)	83 (94.3)
Uninsured	3 (9.1)	5 (5.7)

Table 2. Attitudes of the COVID-19 vaccine in unvaccinated individuals, N=53

	Do not intend to vaccinate, n=33	Intend to vaccinate, n=20	P
	n (%)	n (%)	
I do not trust the science behind the COVID vaccine			
Agree	23 (69.7)	7 (36.8)	.040
Disagree	10 (30.3)	12 (63.2)	
Total	33 (100)	19 (100)	
I do not believe the COVID vaccine is safe			
Agree	19 (70.4)	4 (12.5)	.005
Disagree	8 (29.6)	12 (87.5)	
Total	27 (100)	16 (100)	
I do not believe the COVID vaccine is needed			
Agree	14 (53.8)	3 (18.8)	.050
Disagree	12 (46.2)	13 (81.2)	
Total	26 (100)	16 (100)	
I am not concerned about COVID			
Agree	19 (70.4)	4 (26.7)	.055
Disagree	8 (29.6)	11 (73.3)	
Total	27 (100)	15 (100)	
I'm worried about spreading COVID to others without knowing[a]			
Worried	10 (30.3)	55 (62.5)	.002
Not worried	23 (69.7)	33 (37.5)	
Total	33 (100)	88 (100)	
I'm worried I might get COVID and require hospitalization[a]			
Worried	9 (27.3)	52 (59.1)	.002
Not worried	24 (72.7)	36 (40.9)	
Total	33 (100)	86 (100)	

a. The full participant pool responded to these survey items

.062) and education (college degree versus no college degree, P = .176).

Attitudes of the COVID-19 Vaccine in Unvaccinated Individuals

Intention to vaccinate was negatively associated with trust in the science behind vaccine development (P = .040), belief in the safety of the vaccine (p = .005), and belief that the COVID vaccine was needed (P = .050) (Table 2). A greater proportion of respondents who did not intend to vaccinate also reported a lack of concern for COVID, but the relationship was not significant (P = .055).

Individuals who lacked intent to vaccinate were less likely to report being worried about getting COVID and requiring hospitalization (P = .002) or spreading the virus without knowing (P = .002). Intention to vaccinate was not significantly associated with concern for the side effects of the vaccine (P = 1.00) or trust of the drug companies manufacturing the vaccine (P = .211) There were also no significant differences in intention to vaccinate based on a participant or family members testing positive for COVID (P= .527 and .369 respectively). Relationships that were not significant are not shown in Table 2.

Perceived Barriers to Accessing the COVID Vaccine

Most participants who lacked intention to vaccinate reported barriers to accessing the vaccine. These barriers included not having a way of getting to the vaccination site (P = .040), having to travel a long distance to get there (P= .034), or having to pay for the vaccine (P=.002) (Table 3). In addition, participants who lacked intention to vaccinate remained unlikely to get the vaccine even if their health care provider recommended it (P = .002). Waiting in line for the vaccine was not significantly associated with vaccination intent (P = .157).

Impact of COVID-19 on Health Behaviors

Figure 1 shows the distribution of overall CoBQ scores and scores for each of the four domains. The mean CoBQ score for all participants was 37.4 ± 7.07 (n = 97). Those who did not intend to get the vaccine had significantly higher scores (M = 42.4, SD = 7.1) than those who intended to vaccinate (M = 35.7, SD = 6.2; P < .0001). Similarly, participants lacking intention to vaccinate had significantly higher scores in the Public Awareness domain (M = 15.6, SD = 5.4) than those who intended to get the vaccine (M = 9.9, SD = 3.4; P<.0001). There were no significant differences in mean scores, based on intention to vaccinate, for the General Health (P = .966), Social/Mental Health (P = .152) and Chronic Health Maintenance (P = .707) domains.

Discussion

This study sought to identify factors that contribute to vaccine hesitancy in rural northern/central Illinois counties in the United States. Vaccine hesitancy has been an ongoing public health issue, and hesitancy toward the COVID vaccine is particularly prevalent in rural communities.[11-13] Our study identified several factors associated with lack of intention to vaccinate, including: vaccine safety concerns; distrust in vaccine development; and belief that the vaccine was not needed. These findings are similar to other studies carried out in rural communities in the United States and globally[12,23,24] and highlight the need for community-tailored strategies to address specific areas of distrust.

A lower concern for COVID-19 susceptibility in rural areas of the United States has also contributed to vaccine hesitancy. Our study shows that most participants who did not intend to vaccinate reported lack of worry about a severe COVID infection or transmission of the virus to others. These findings are consistent with studies carried out in global communities, especially in LMICs, where the lower severity of COVID cases has been associated with a reduced perceived susceptibility to the virus.[25] In LMICs, the COVID-19 pandemic impacted urban areas earlier than rural communities.[26] A similar trend was observed in the United States, where rural communities started showing increased hospitalizations, high mortality rates, and morbidity associated with COVID later in the trajectory of the pandemic.[27, 28] Because our study was conducted in early 2021, prior to the Delta vari-

Table 3. Barriers to accessing the COVID-19 vaccine in unvaccinated individuals, N=53

	Do not intend to vaccinate, n=33	Intend to vaccinate, n=20	P
	n (%)	n (%)	
Likely to get the vaccine if I have to pay for it			
Likely	3 (9.1)	10 (50.0)	.002
Not likely	30 (90.9)	10 (50.0)	
Total	33 (100)	20 (100)	
Likely to get the vaccine if my health care provider has specifically recommended it			
Likely	8 (30.8)	11 (84.6)	.002
Not likely	18 (69.2)	2 (15.4)	
Total	26 (100)	13 (100)	
Likely to get the vaccine if I have to travel a long distance to get it			
Likely	0 (0.0)	3 (23.1)	.034
Not likely	25 (100)	10 (76.9)	
Total	25 (100)	13 (100)	
Likely to get the vaccine if I don't have a way to get to a vaccination site			
Likely	0 (0.0)	3 (23.1)	.040
Not likely	23 (100)	10 (76.9)	
Total	23 (100)	13 (100)	
Likely to get the vaccine if I have to wait in line for a long time			
Likely	2 (8.3)	4 (30.8)	.157
Not likely	22 (91.7)	9 (69.2)	
Total	24 (100)	13 (100)	

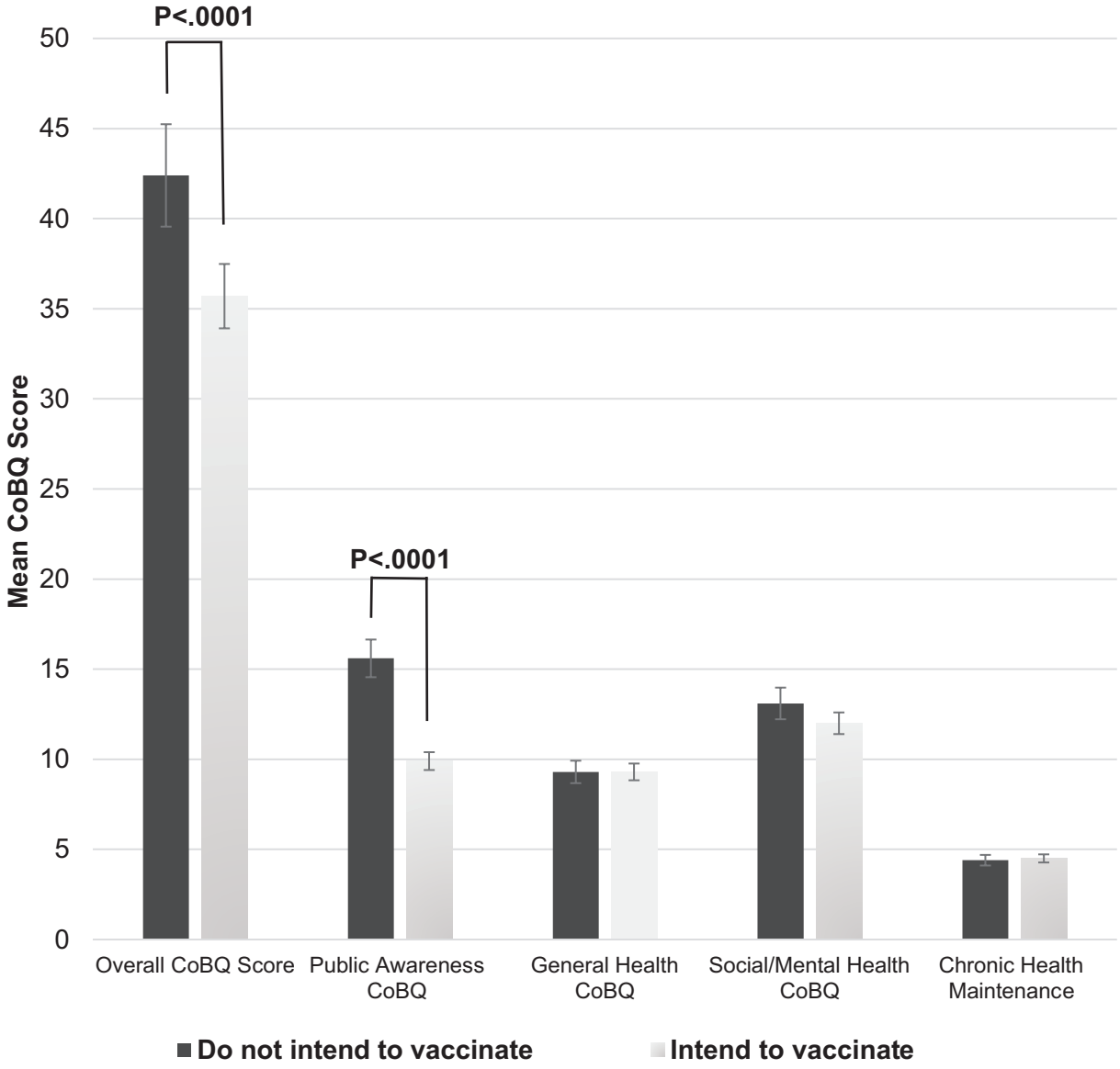

Figure 1. Comparison of participants' mean CoBQ scores by intention to vaccinate. The overall CoBQ score ranges from 17-68, with a higher score indicating a greater negative impact of the COVID-19 pandemic on health behaviors. The CoBQ scale also has 4 subdomains as highlighted in the figure. For public awareness, scores range between 6 and 24, with higher scores indicating a greater negative impact.

ant surge, the lower incidence rates when the vaccine was introduced may have led to lower perceived vulnerability to the virus and a lack of intention to vaccinate in rural areas.

We also found a significant association between barriers to accessing the vaccine and intention to vaccinate. Most individuals who did not intend to get the vaccine reported they would be unlikely to vaccinate if faced with barriers such as lack of access to a vaccination site, long travel distance, having to wait in line, or having to pay for the vaccine. These findings demonstrate the need to address physical barriers that may reduce willingness to receive the COVID vaccine. The recommendation from a health care provider was also not likely to change the minds

of respondents who lacked intention to vaccinate. This may indicate a lack of trust between health care providers and the communities they serve, and it warrants further investigation.

Finally, our study explored how the COVID-19 pandemic affected respondents' engagement in health behaviors. Because the survey was administered at a time when COVID vaccines were not readily available, we gained insights on how COVID restrictions affected the general health, social/mental health, and public awareness of study participants. We also explored the impact of the pandemic on respondents' management of chronic health issues.

Participants who did not intend to vaccinate had higher mean CoBQ scores, indicating a greater impact of the pandemic on their health behaviors. Results from the four CoBQ domain scores shed light on these findings. For example, the Public Awareness domain included items such as attending large gatherings and not wearing masks outside the home, behaviors related to measures put in place to prevent the spread of COVID-19. The mean Public Awareness score was higher for participants who did not intend to vaccinate, showing that a larger proportion of these respondents engaged in behaviors that were not recommended by public health professionals.

There were no significant differences in the General Health, Social/Mental Health, and Chronic Health Maintenance domains. These results show that across both groups, participants reported a similar influence of the pandemic on corresponding health behaviors. For example, poor habits such as irregular sleeping patterns, smoking/drinking, and reduced exercise were reported, regardless of intention to vaccinate. These findings highlight the impact of the pandemic on our study respondents and northern Illinois at large.

Study Strengths and Limitations

A primary strength of our study is that it was conducted shortly after the emergency use authorization of COVID-19 vaccines by the Food and Drug Administration (FDA) in December 2020. During this time, 18% of US adults had received at least one dose of the COVID vaccine, while another 37% planned to get vaccinated as soon as the vaccine was available to them.[2,3] By conducting our study during this timeframe, we were able to assess perceptions of individuals who did not yet have access to the COVID vaccine.

This study had several limitations. We used a convenience sample from rural northern/central Illinois counties; thus, generalizability of our findings may be limited to this area. However, the racial demographics of our survey (88% White) reflect that of rural Illinois (92% White)[29] and other rural areas in the Midwest. Our sample also included individuals with higher levels of education than in rural Illinois; 55% of respondents had a bachelor's degree or higher compared to 19% in rural Illinois.[30] However, most participants who did not intend to vaccinate were younger and had less education. Because the literature shows that vaccine hesitancy has been negatively associated with age and education,[31] the subset of study participants who did not intend to vaccinate may better reflect predominantly White rural Illinois populations than our overall sample.

COVID vaccine hesitancy is a polarizing issue in the United States. Thus, respondents who lacked intention to vaccinate may have been less likely to complete our survey. Because we intended to capture the unique perspectives of unvaccinated respondents, we excluded participants who were actively planning to vaccinate, but did not yet have access to the vaccine (n=68), from answering the questions related to attitudes and barriers in our survey. This ultimately reduced the sample size. Replicating the study with a larger sample size of individuals who do not intend to receive the COVID-19 vaccine is warranted.

Despite these limitations, COVID vaccine access and hesitancy in rural communities remains concerning. This study contributes to the limited knowledge around improving COVID vaccination rates in rural communities of the United States. Future work should focus on community-engaged ways to addressing the factors contributing to vaccine hesitancy.

Implications of Findings to Global Settings

Previous studies across the globe have reported consistent themes in COVID-19 vaccine hesitancy among participants. A mistrust in government, negative perceptions of health service delivery, safety concerns, and misinformation about the COV-

ID-19 vaccines are common reasons for reduced vaccine acceptance.[12,23,24] These findings are consistent with our study, where concerns about vaccine safety and a mistrust of vaccine development was significantly associated with intention to vaccinate.

The COVID-19 pandemic has highlighted the importance of universal vaccination to reduce COVID-related mortality and morbidity. Higher vaccination rates in rural communities may be achieved by reducing barriers to vaccine access and addressing factors that are positively associated with distrust of the COVID vaccines. Public health interventions, such as mobile clinics and providing transportation to vaccination centers, could address system-level barriers for rural residents who intend to get the vaccine[25,32]

Similarities between our study and findings from global communities demonstrate the need for community engagement. Building trust between healthcare providers and the communities they serve could help dispel misinformation and encourage vaccine uptake. Messages regarding the COVID-19 vaccines should be tailored to specific communities and advocated by trusted community partners.[33]

This study reiterates that vaccine hesitancy is a universal concept and that the attitudes and barriers associated with COVID vaccine uptake are similar in rural US and global communities.

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Conflict of Interest

No conflicts of interest to report.

Author Contributions

Research concept and design: Khare, Pluta, Mercadante, Law; Acquisition of data: Khare, Ng; Data analysis and interpretation: Khare, Zimmermann, Kazungu, Ng, Mercadante; Manuscript draft: Khare, Kazungu, Pluta, Law; Statistical expertise: Khare, Zimmermann, Kazungu, Ng, Mercadante; Administrative: Khare, Zimmermann, Kazungu, Pluta, Law; Supervision: Khare, Zimmermann, Mercadante

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