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COVID-19 vaccine access and attitudes among people experiencing homelessness from pilot mobile phone survey in Los Angeles, CA

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Abbreviations: AOR, adjusted odds ratio; COVID-19, coronavirus disease 2019; FQHC, federally qualified health center; OR, odds ratio; PEH, people experiencing homelessness; PHQ-4, patient health questionnaire-4
Abstract

Background

People experiencing homelessness (PEH) are at high risk for COVID-19 complications and fatality, and have been prioritized for vaccination in many areas. Yet little is known about vaccine acceptance in this population. The objective of this study was to determine the level of vaccine hesitancy among PEH in Los Angeles, CA and to understand the covariates of hesitancy in relation to COVID-19 risk, threat perception, self-protection and information sources.

Methods and findings

A novel mobile survey platform was deployed to recruit PEH from a federally qualified health center (FQHC) in Los Angeles to participate in a monthly rapid response study of COVID-19 attitudes, behaviors, and risks. Of 90 PEH surveyed, 43 (48%) expressed some level of vaccine hesitancy based either on actual vaccine offers (17/90 = 19%) or a hypothetical offer (73/90 = 81%). In bivariate analysis, those with high COVID-19 threat perception were less likely to be vaccine hesitant (OR=0.34, P=.03), while those who frequently practiced COVID-19 protective behaviors were more likely to be vaccine hesitant (OR=2.21, P=.08). In a multivariate model, those with high threat perception (OR=0.25, P=.02) were less likely to be hesitant, while those engaging in COVID-19 protective behaviors were more hesitant (OR=3.63, P=.02). Those who trusted official sources were less hesitant (OR=0.37, P=.08) while those who trusted friends and family for COVID-19 information (OR=2.70, P=.07) were more likely to be hesitant.

Conclusions

Findings suggest that targeted educational and social influence interventions are needed to address high levels of vaccine hesitancy among PEH.
Introduction

People experiencing homelessness (PEH), who have high rates of comorbid conditions more typical of individuals 15-20 years older than their chronological age [1–3], are extremely susceptible to COVID-19 (coronavirus disease 2019), with higher risk of hospitalization and death from infection.[4,5] Highly effective vaccines against SARS-CoV-2, the virus that causes COVID-19, may thus hold an outsized benefit for PEH, particularly those living in congregate settings such as shelters or unsheltered encampments that had previously seen COVID-19 outbreaks.[6,7] Yet concerns persist about vaccine hesitancy among this population. Studies have already documented that populations with elevated risks of current and lifetime homelessness are hesitant to accept vaccines more generally, most notably African American, low income and low schooling populations. [8–10] Behavioral models of vaccine hesitancy highlight the complex role of threat perception, activation and trust in vaccine decisions.[11,12] All of these concerns may be at play given the physical and mental health issues and social isolation facing PEH.[13] Yet few studies have documented vaccine hesitancy for any condition among PEH [14], and we know of no study that has addressed COVID-19 vaccine hesitancy in this population.

Using a unique, rapidly-deployed online survey of homeless patients of a Federally Qualified Health Center (FQHC) in Los Angeles, we describe levels of vaccine uptake and hesitancy, and address covariates of hesitancy in terms of COVID-19 vulnerability, threat perception, protection and information sources, along with demographic covariates.

Data and Methods

This study was designed as a pilot for a larger platform to address the challenge of gathering ongoing, longitudinal data from PEH through monthly online surveys. A university-
Based research team worked closely with an FQHC partner with strong homeless outreach and an active electronic health record system with messaging platform. The analysis met all requirements of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines, as shown in S1 STROBE Checklist. Because the study was designed prior to the development of a vaccine, analyses were not pre-specified in any protocols.

Potential patient participants were identified as homeless by the FQHC based on self-report from a patient questionnaire and/or the presence of an ICD-10 diagnosis code for homelessness at any point in their patient history (N=3,145). A total of 1,537/3,145 (48.9%) clicked on the pre-screening survey. Respondents were screened as survey-eligible if they were age 18+, living in LA County, and met the US Department of Housing and Urban Development definition of homeless: “People who are living in a place not meant for human habitation, in emergency shelter, in transitional housing, or are exiting an institution where they temporarily resided.” Of the 190 individuals meeting these criteria, 125 answered the survey (65.8%). The Month 3 survey that incorporated vaccine questions was completed by 90 respondents, for a 73% retention rate (90/125). Age/sex/race composition of the study population was compared to the source population of patients in the EHR system.

Once enrolled in the study, surveys were delivered through a HIPAA-compliant, cloud-based data collection platform that was designed to suit the capabilities of the study population, with extensive consultation with a lived experience advisory group and testing with unhoused clients. Informed consent was conducted via the survey questionnaire, requiring affirmative consent before proceeding with the survey and providing complete informed consent documentation at the start of each survey. A 5-minute baseline demographic and risk factor survey was conducted December 2020 through January 2021. Monthly surveys lasted 15 minutes on average and included questions on COVID-19 risk perception, protective behaviors and information sources along with physical and mental well-being. The third monthly survey
conducted February 15-26, 2021 added questions on vaccine uptake and acceptability.

Participants received financial incentives of $5 for the baseline and for each monthly survey.

The study protocols were approved by the 1st author’s university IRB.

**Dependent variables:** Vaccine uptake was measured with a two-part question that first asked whether a respondent had been offered a vaccine, followed by a hesitancy question based on actual or hypothetical behavior. For those who had been offered a vaccine, individuals who did not accept the vaccine were coded as vaccine hesitant. Among those who had not been offered the vaccine, respondents were asked if they would take the vaccine if they were offered it, with possible responses of “yes,” “no” or “prefer not to answer.” Those who responded “no” or “prefer not to answer” were coded as vaccine hesitant.

**Independent variables:** The initial baseline survey included self-reports of age (18-34, 35-44, 45-54, 55-64, 65+), sex/gender (male/female) and race/ethnicity (White non-Hispanic, any Hispanic/Latino, Black non-Hispanic, other). Vulnerability to severe COVID-19 complications was assessed at baseline using self-reports of the CDC’s list of underlying medical conditions (CDC). Sheltered/unsheltered status was measured in the monthly survey based on where the respondent slept the previous night. COVID-19 threat perception was measured using a modified 4-item adaptation of the Fear of COVID-19 scale[15], with “high threat perception” classified as responding “agree/strongly agree” to at least 3/4 questions. COVID-19 self-protective behavior was measured using a four-item index of how frequently the respondent wore a mask, washed their hands, stayed 6 feet from others, and avoided touching their face. Anxiety/depression was measured using the Patient Health Questionnaire-4 (PHQ-4), with moderate-severe psychological distress classified using the documented scoring system.[16]

**Statistical analysis:** After describing the univariate distribution for all dependent and independent variables, we conduct bivariate analysis of vaccine hesitancy in terms of all
independent variables using two-tailed chi-square tests of differences in proportions and two-
tailed t-tests of differences in means. We then estimated a multivariate model including all
factors shown to be significant in bivariate analysis. All statistical analyses were performed in
Stata 16. Due to the relatively small sample size, we report significance at both the 5% and 10%
levels.

Results:

The mean age of the sample was 48.7 and 59% of respondents were female (Table 1).
The sample was predominantly White (49%), followed by Hispanic/Latino (18%), other (18%),
and Black/African American (9%). Most respondents were unsheltered (44%). More than half
(52%) of respondents were coded as having moderate/severe psychological distress according
to the PHQ-4 screening. Thirty three percent of respondents perceived COVID-19 as a high
threat, and 42% reported high COVID-19 protective behavior. More than half reported trust in
some official source (62%) or mass media (56%), while 42% reporting trusting personal
information sources such as friends, family or social media.
### Table 1. Summary statistics by COVID-19 vaccine hesitancy

|                                | No hesitancy (n=47) | Hesitancy (n=43) | Total (n=90) | P value* |
|--------------------------------|---------------------|------------------|--------------|----------|
| **Age**                        | mean (95% CI)       | mean (95% CI)    | mean (95% CI)|          |
| 15                             | 49.8 (45.9-53.7)    | 47.6 (43.4-51.7) | 48.7 (45.9-51.5) | .43      |
| **Sex (female)**               | 0.60 (0.45-0.73)    | 0.58 (0.43-0.72) | 0.59 (0.48-0.69) | .89      |
| **Race**                       |                     |                  |              |          |
| White                          | 0.47 (0.33-0.61)    | 0.51 (0.36-0.66) | 0.49 (0.39-0.59) |          |
| Black/African American         | 0.11 (0.04-0.23)    | 0.07 (0.02-0.20) | 0.09 (0.04-0.17) | .83      |
| Hispanic/Latino                | 0.15 (0.07-0.28)    | 0.21 (0.11-0.36) | 0.18 (0.11-0.27) |          |
| Other                          | 0.19 (0.10-0.33)    | 0.16 (0.08-0.31) | 0.18 (0.11-0.27) |          |
| Unreported                     | 0.09 (0.03-0.21)    | 0.05 (0.01-0.17) | 0.07 (0.03-0.14) |          |
| **Housing status**             |                     |                  |              |          |
| Unsheltered                    | 0.47 (0.33-0.61)    | 0.42 (0.28-0.57) | 0.44 (0.34-0.55) |          |
| Sheltered                      | 0.32 (0.20-0.47)    | 0.30 (0.18-0.46) | 0.31 (0.22-0.42) | .57      |
| Doubled up/hotel               | 0.13 (0.06-0.26)    | 0.23 (0.13-0.38) | 0.18 (0.11-0.27) |          |
| Other                          | 0.09 (0.03-0.21)    | 0.05 (0.01-0.17) | 0.07 (0.03-0.14) |          |
| **PHQ-4 Score**                | 6.62 (5.67-7.57)    | 4.95 (3.86-6.04) | 5.84 (5.11-6.57) | .02      |
| **PHQ-4 Moderate/Severe**      | 0.62 (0.47-0.75)    | 0.41 (0.27-0.57) | 0.52 (0.42-0.63) | .06      |
| **COVID-19 Threat Index (out of 4)** | 2.11 (1.64-2.57) | 1.24 (0.82-1.67) | 1.70 (1.38-2.03) | .008     |
| I fear COVID more than anything else | 0.51 (0.37-0.65) | 0.32 (0.19-0.48) | 0.42 (0.32-0.53) | .07      |
| I feel anxious when hearing about COVID | 0.55 (0.41-0.69) | 0.37 (0.23-0.52) | 0.47 (0.36-0.57) | .08      |
| I'm more likely to get COVID than most | 0.49 (0.35-0.63) | 0.17 (0.08-0.32) | 0.34 (0.25-0.45) | .002     |
| I'm more likely to get very sick from COVID than most | 0.55 (0.41-0.69) | 0.39 (0.25-0.55) | 0.48 (0.37-0.58) | .13      |
| **COVID-19 Threat - High (≥ 3)** | 0.45 (0.31-0.59) | 0.20 (0.10-0.35) | 0.33 (0.24-0.44) | .01      |
| **COVID-19 Protective Behavior Index (out of 4)** | 1.66 (1.27-2.05) | 2.15 (1.66-2.63) | 1.89 (1.58-2.19) | .12      |
| Always wash hands after bathroom, before eating | 0.47 (0.33-0.61) | 0.55 (0.39-0.69) | 0.51 (0.40-0.61) | .45      |
| Always stay 6 feet apart from people I didn't live with | 0.45 (0.31-0.59) | 0.50 (0.35-0.65) | 0.47 (0.37-0.58) | .62      |
| Always wear a mask | 0.51 (0.37-0.65) | 0.60 (0.44-0.74) | 0.55 (0.44-0.66) | .41      |
| Always try not to touch mouth, nose, eyes, face | 0.19 (0.10-0.33) | 0.46 (0.32-0.62) | 0.32 (0.23-0.42) | .006     |
| **COVID-19 Protective Behavior - High (≥3)** | 0.34 (0.22-0.49) | 0.51 (0.36-0.66) | 0.42 (0.32-0.53) | .10      |
| **COVID-19 info from official sources** | 0.71 (0.56-0.83) | 0.51 (0.36-0.66) | 0.62 (0.51-0.71) | .06      |
| **COVID-19 info from media** | 0.64 (0.49-0.77) | 0.46 (0.32-0.62) | 0.56 (0.45-0.66) | .09      |
| **COVID-19 info from personal sources** | 0.36 (0.23-0.51) | 0.49 (0.34-0.64) | 0.42 (0.32-0.53) | .21      |

*Tests for significance by vaccine acceptance. Reported P values correspond to chi-square tests for categorical variables and 2-tail t-tests for continuous variables.

Individual COVID-19 Threat Index items refer to those who responded "Agree" or "Strongly Agree" to each statement, with high threat perception coded as responding "Always" or "Almost Always" to at least 3/4 items.

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Figure 1 shows that, of the 90 respondents in the sample, 17 (19%) have been offered the vaccine, 10 of whom accepted. Among the 73 not offered the vaccine, 37 (51%) said they would take it if offered, 23 said they would not (32%), and 13 declined to answer (17%). Given these results, 43 (48%) expressed vaccine hesitancy, as defined above. Among those who rejected an offer of the vaccine or stated that they would not get the vaccine if offered (n=30), the most common reasons cited for vaccine hesitancy or refusal were fear of side effects (37%), wanting to have more information (30%), and rejection of all vaccines (27%) (Figure 2).

**Fig 1. COVID-19 vaccine hesitancy by prior vaccine access.** Respondents who were offered a vaccine (n=17) were asked whether or not they received the vaccine; those who received the vaccine (n=10) were classified as not vaccine hesitant and those who did not receive the vaccine were classified as vaccine hesitant (n=7). Respondents who had not been offered the vaccine (n=73) were asked if they would take the vaccine. Those who said they would take the vaccine (n=37) were classified as not hesitant and those who said they wouldn’t (n=23) or declined to answer (n=13) were classified as hesitant.
Fig 2. Reasons for vaccine hesitancy among those who refused an actual or hypothetical offer of COVID-19 vaccine. Respondents who refused an actual or hypothetical offer of the COVID-19 vaccine were asked their reason(s) for refusal (n=30). Other possible reasons for vaccine hesitancy that were not selected by any participants included “I am not at risk for COVID-19” and “I could not afford the vaccine.”

Bivariate analysis (Table 1) revealed no significant differences in vaccine hesitancy across any key demographic variables, including age, sex, race, and last-night housing status. Hesitant respondents scored as having lower PHQ-4 scores (4.95 vs. 6.62, P=.02) and were less likely to have moderate/severe psychological distress (41% vs 62% P=.06). Respondents classified as vaccine-hesitant scored lower on the COVID-19 threat index (1.24, compared to 2.11, P=.008) and were less likely to report high threat perception based on 3 out of 4 perceived threats (20% vs. 45%, P=0.01). Hesitant respondents were not significantly more likely to engage in ≥3 of 4 reported COVID-19 protective behaviors (51% vs. 34%, P=.10), but were significantly more likely to avoid touching their faces (46% vs. 19%, P=.006). They were less likely to trust COVID-19 protection information from official sources (51% vs. 71%, P=.06) or mass media (46% vs. 64%, P=.09) and no more likely to trust information from friends or social media (49% vs. 36%, P=.21).
A multivariate model showed that respondents with high COVID-19 threat perception were significantly less likely to be vaccine-hesitant (OR=0.25, \(P=0.02\)) (Table 2). Those engaging in highly protective behavior were more likely to be vaccine-hesitant (OR=3.63, \(P=0.02\)). Those trusting official sources were significantly less likely to be hesitant (OR=0.37, \(P=0.08\)) and those trusting personal contacts more likely to be hesitant (OR=2.70, \(P=0.07\)). A two-tailed t-test of equality in the coefficients for COVID-19 information sources revealed significantly higher levels of hesitancy for personal contacts vs. official sources (chi-square=4.84, \(P=0.09\)) and personal contacts vs. mass media (chi-square = 4.88, \(P=0.09\)), with no significant difference between official sources vs. mass media.

Table 2. Model of COVID-19 vaccine hesitancy

| Factor                                      | OR (95% CI) | \(P\) value | AOR (95% CI) | \(P\) value |
|---------------------------------------------|-------------|--------------|--------------|-------------|
| COVID-19 Threat Index - High                | 0.34 (0.13, 0.91) | 0.03         | 0.25 (0.08, 0.80) | 0.02        |
| COVID-19 Protective Behavior - High         | 2.21 (0.92, 5.31) | 0.08         | 3.63 (1.26, 10.47) | 0.02        |
| PHQ-4 - Moderate/Severe                     | 0.49 (0.21, 1.17) | 0.11         | 0.64 (0.24, 1.71) | 0.38        |
| COVID-19 info from official sources         | 0.41 (0.17, 0.99) | 0.05         | 0.37 (0.12, 1.11) | 0.08        |
| COVID-19 info from media                    | 0.50 (0.21, 1.19) | 0.12         | 0.52 (0.19, 1.41) | 0.20        |
| COVID-19 info from personal sources         | 1.81 (0.76, 4.32) | 0.18         | 2.70 (0.93, 7.81) | 0.07        |
| \(n\)                                       | 85          |              | 85           |             |
| Pseudo \(R^2\)                              |             |              | 0.172        |             |

Discussion

Our findings provide initial evidence of high levels of hesitancy towards the COVID-19 vaccine among unhoused individuals. Based on a combination of actual and hypothetical behavior, 48% showed hesitancy toward the vaccine, considerably higher than the 31-35% observed in the general population over a similar period [9,10]. The share who had been offered the vaccine was comparable to the general population of LA County at the time, and rates of hesitancy were nearly identical in actual and hypothetical responses.
Our findings point to the complex role of threat perception, activation and information in vaccine hesitancy among PEH. In adjusted models, respondents reporting higher COVID-19 fear were one-third as likely to express vaccine hesitancy. At the same time, however, individuals who fully engaged in protective behaviors (e.g. mask-wearing) had nearly 4 times greater odds of vaccine hesitancy. Indeed, those who were hesitant towards the vaccine were more likely to engage in each of the four reported protective behaviors. This suggests that individuals who have actively engaged in COVID-19 protective measures over the past year may now be less accepting of the vaccine. Those who trusted COVID-19 information from official sources and news media were less hesitant, while those trusting personal sources (i.e. friends/family and social media) were relatively more hesitant. While we did not have sufficient power to test significance in reasons for hesitancy, we note that a higher proportion of those with high protective behavior reported reasons such as “I am part of a risk group and want more info,” “I fear it will have unpleasant side effects,” and “I do not believe the vaccine will protect me.” Given that vaccine-hesitant individuals are often more vocal in their beliefs, this points to the opportunity to leverage interpersonal networks as pathways of influence by focusing on individuals who may be especially activated or vocal about risks ascribed to both the disease itself and the vaccine. [17]

This rapid-reaction pilot study has a number of limitations. First, the sample size was small and addressed patients only in one portion of West Los Angeles. Nevertheless, the results have been received as valuable to public health officials who are supporting additional enrollments across all service areas to increase the sample. Second, while all homeless-flagged patients with phones had the opportunity to answer the survey and response rates were considerably higher than most online or phone-based polls, we know that those who answered the survey were more likely to be female (59% vs. 35%) and less likely to be African-American (9% vs. 24%) than that clinic’s homeless patient base as a whole. Given the lack of differences
in hesitancy across any demographic groups and the small sample size, we did not report weighted results. Finally, we note that these interviews were conducted prior to PEH receiving universal vaccine eligibility on March 15, 2021, and that some hesitancy may more accurately reflect indifference or frustration at the difficulty of obtaining the vaccine.

In spite of these limitations, our findings point to challenges in widespread vaccine scaleup that are not so different than those faced in the general population. It is important to know that those people who need the vaccine most - those who fear COVID-19 but are less likely to protect themselves through social distancing measures - are those most highly willing to be vaccinated. But achieving widespread vaccine acceptance may be far more challenging among individuals who are more proactive with protective behaviors but who may be more skeptical of the COVID-19 vaccine and who may have low trust in official information sources.

**Conclusion**

Preliminary results from a small survey of PEH in Los Angeles reveal a high rate of vaccine hesitancy in this population, with higher levels of hesitancy observed among those with low threat perception, those engaging in self-protective behaviors, and those with higher trust in personal sources of information versus official sources. Our data suggest the need for targeted educational and social influence interventions to increase vaccine uptake among PEH, who are at greater risk of suffering from severe COVID-19 than the general population. Additional data collected on a larger, more representative sample is necessary to determine differences in vaccine attitudes across demographic variables like race.

**Author contributions:** Dr. Kuhn had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. **Concept and design:** Kuhn, Henwood, Gelberg, King. **Acquisition of data:** Kuhn, Henwood, Lawton, Murali,
Kleva. **Analysis and interpretation of data:** Kuhn, Henwood, Lawton. **Drafting of the manuscript:** Lawton, Kuhn. **Critical revision of the manuscript for important intellectual content:** Kuhn, Henwood, Lawton, Kleva, Murali, Gelberg, King. **Statistical analysis:** Lawton, Kuhn. **Obtained funding:** Kuhn, Henwood. **Administrative, technical, or material support:** Kuhn, Henwood, Lawton, Kleva, Murali, King, Gelberg. **Supervision:** Kuhn, Henwood.

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