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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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2 homelessness from pilot mobile phone survey in Los Angeles, CA

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28 Abbreviations: AOR, adjusted odds ratio; COVID-19, coronavirus disease 2019; FQHC, federally

29 qualified health center; OR, odds ratio; PEH, people experiencing homelessness; PHQ-4,

30 patient health questionnaire-4

## 31 **Abstract**

### 32 **Background**

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

### 39 **Methods and findings**

40 A novel mobile survey platform was deployed to recruit PEH from a federally qualified  
41 health center (FQHC) in Los Angeles to participate in a monthly rapid response study of COVID-  
42 19 attitudes, behaviors, and risks. Of 90 PEH surveyed, 43 (48%) expressed some level of  
43 vaccine hesitancy based either on actual vaccine offers (17/90 = 19%) or a hypothetical offer  
44 (73/90 = 81%). In bivariate analysis, those with high COVID-19 threat perception were less  
45 likely to be vaccine hesitant (OR=0.34,  $P=.03$ ), while those who frequently practiced COVID-19  
46 protective behaviors were more likely to be vaccine hesitant (OR=2.21,  $P=.08$ ). In a multivariate  
47 model, those with high threat perception (OR=0.25,  $P=.02$ ) were less likely to be hesitant, while  
48 those engaging in COVID-19 protective behaviors were more hesitant (OR=3.63,  $P=.02$ ). Those  
49 who trusted official sources were less hesitant (OR=0.37,  $P=.08$ ) while those who trusted friends  
50 and family for COVID-19 information (OR=2.70,  $P=.07$ ) were more likely to be hesitant.

### 51 **Conclusions**

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

54

## 55 **Introduction**

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

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

## 75 **Data and Methods**

76           This study was designed as a pilot for a larger platform to address the challenge of  
77 gathering ongoing, longitudinal data from PEH through monthly online surveys. A university-

78 based research team worked closely with an FQHC partner with strong homeless outreach and  
79 an active electronic health record system with messaging platform. The analysis met all  
80 requirements of the Strengthening the Reporting of Observational Studies in Epidemiology  
81 (STROBE) guidelines, as shown in S1 STROBE Checklist. Because the study was designed  
82 prior to the development of a vaccine, analyses were not pre-specified in any protocols.

83 Potential patient participants were identified as homeless by the FQHC based on self-  
84 report from a patient questionnaire and/or the presence of an ICD-10 diagnosis code for  
85 homelessness at any point in their patient history (N=3,145). A total of 1,537/3,145 (48.9%)  
86 clicked on the pre-screening survey. Respondents were screened as survey-eligible if they were  
87 age 18+, living in LA County, and met the US Department of Housing and Urban Development  
88 definition of homeless: "People who are living in a place not meant for human habitation, in  
89 emergency shelter, in transitional housing, or are exiting an institution where they temporarily  
90 resided." Of the 190 individuals meeting these criteria, 125 answered the survey (65.8%). The  
91 Month 3 survey that incorporated vaccine questions was completed by 90 respondents, for a  
92 73% retention rate (90/125). Age/sex/race composition of the study population was compared to  
93 the source population of patients in the EHR system.

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

103 conducted February 15-26, 2021 added questions on vaccine uptake and acceptability.

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

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

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

113 **Independent variables:** The initial baseline survey included self-reports of age (18-34, 35-44,  
114 45-54, 55-64, 65+), sex/gender (male/female) and race/ethnicity (White non-Hispanic, any  
115 Hispanic/Latino, Black non-Hispanic, other). Vulnerability to severe COVID-19 complications  
116 was assessed at baseline using self-reports of the CDC's list of underlying medical conditions  
117 (CDC). Sheltered/unsheltered status was measured in the monthly survey based on where the  
118 respondent slept the previous night. COVID-19 threat perception was measured using a  
119 modified 4-item adaptation of the Fear of COVID-19 scale[15], with "high threat perception"  
120 classified as responding "agree/strongly agree" to at least 3/4 questions. COVID-19 self-  
121 protective behavior was measured using a four-item index of how frequently the respondent  
122 wore a mask, washed their hands, stayed 6 feet from others, and avoided touching their face.  
123 Anxiety/depression was measured using the Patient Health Questionnaire-4 (PHQ-4), with  
124 moderate-severe psychological distress classified using the documented scoring system.[16]

125 **Statistical analysis:** After describing the univariate distribution for all dependent and  
126 independent variables, we conduct bivariate analysis of vaccine hesitancy in terms of all

127 independent variables using two-tailed chi-square tests of differences in proportions and two-  
128 tailed t-tests of differences in means. We then estimated a multivariate model including all  
129 factors shown to be significant in bivariate analysis. All statistical analyses were performed in  
130 Stata 16. Due to the relatively small sample size, we report significance at both the 5% and 10%  
131 levels.

## 132 **Results:**

133         The mean age of the sample was 48.7 and 59% of respondents were female (Table 1).  
134 The sample was predominantly White (49%), followed by Hispanic/Latino (18%), other (18%),  
135 and Black/African American (9%). Most respondents were unsheltered (44%). More than half  
136 (52%) of respondents were coded as having moderate/severe psychological distress according  
137 to the PHQ-4 screening. Thirty three percent of respondents perceived COVID-19 as a high  
138 threat, and 42% reported high COVID-19 protective behavior. More than half reported trust in  
139 some official source (62%) or mass media (56%), while 42% reporting trusting personal  
140 information sources such as friends, family or social media.

141

142 **Table 1. Summary statistics by COVID-19 vaccine hesitancy**

143

	<u>No hesitancy (n=47)</u>		<u>Hesitancy (n=43)</u>		<u>Total (n=90)</u>		<i>P</i> value <sup>a</sup>
	mean	(95% CI)	mean	(95% CI)	mean	(95% CI)	
<b>Age</b>	49.8	(45.9-53.7)	47.6	(43.4-51.7)	48.7	(45.9-51.5)	.43
<b>Sex (female)</b>	0.60	(0.45-0.73)	0.58	(0.43-0.72)	0.59	(0.48-0.69)	.89
<b>Race</b>							
White	0.47	(0.33-0.61)	0.51	(0.36-0.66)	0.49	(0.39-0.59)	.83
Black/African American	0.11	(0.04-0.23)	0.07	(0.02-0.20)	0.09	(0.04-0.17)	
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)	
<b>Housing status</b>							
Unsheltered	0.47	(0.33-0.61)	0.42	(0.28-0.57)	0.44	(0.34-0.55)	.57
Sheltered	0.32	(0.20-0.47)	0.30	(0.18-0.46)	0.31	(0.22-0.42)	
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)	
<b>PHQ-4 Score</b>	6.62	(5.67-7.57)	4.95	(3.86-6.04)	5.84	(5.11-6.57)	.02
<b>PHQ-4 Moderate/Severe</b>	0.62	(0.47-0.75)	0.41	(0.27-0.57)	0.52	(0.42-0.63)	.06
<b>COVID-19 Threat Index (out of 4)<sup>b</sup></b>	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
<b>COVID-19 Threat - High (≥ 3)</b>	0.45	(0.31-0.59)	0.20	(0.10-0.35)	0.33	(0.24-0.44)	.01
<b>COVID-19 Protective Behavior Index (out of 4)<sup>c</sup></b>	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
<b>COVID-19 Protective Behavior - High (≥3)</b>	0.34	(0.22-0.49)	0.51	(0.36-0.66)	0.42	(0.32-0.53)	.10
<b>COVID-19 info from official sources</b>	0.71	(0.56-0.83)	0.51	(0.36-0.66)	0.62	(0.51-0.71)	.06
<b>COVID-19 info from media</b>	0.64	(0.49-0.77)	0.46	(0.32-0.62)	0.56	(0.45-0.66)	.09
<b>COVID-19 info from personal sources</b>	0.36	(0.23-0.51)	0.49	(0.34-0.64)	0.42	(0.32-0.53)	.21

144

145 <sup>a</sup>Tests for significance by vaccine acceptance. Reported *P* values correspond to chi-square tests for

146 categorical variables and 2-tail t-tests for continuous variables

147 <sup>b</sup>Individual COVID-19 Threat Index items refer to those who responded "Agree" or "Strongly Agree" to

148 each statement, with high threat perception coded as responding "Always" or "Almost Always" to at least

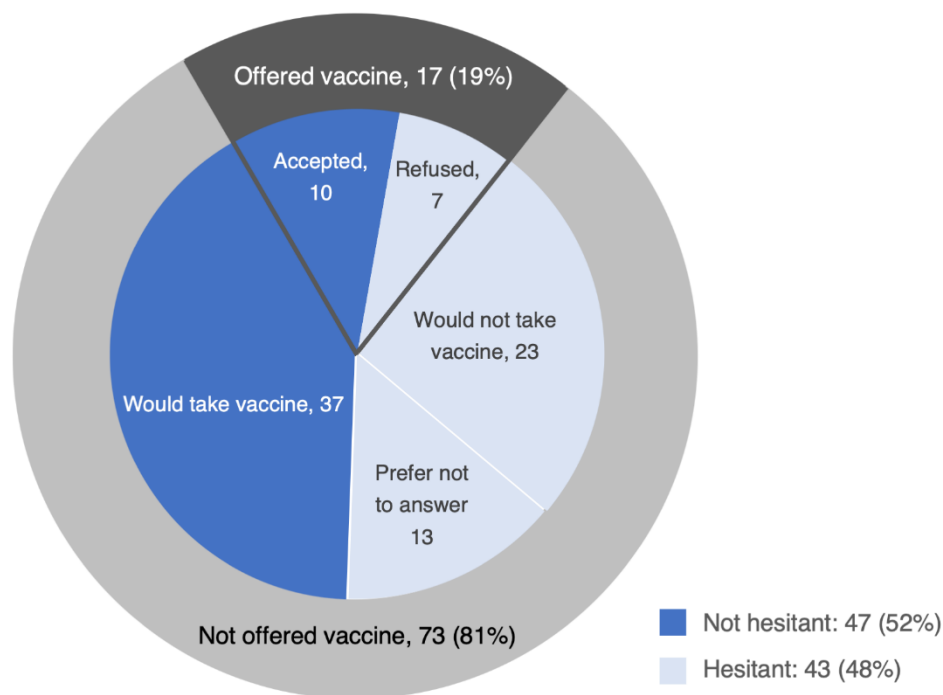
149 3/4 items

150

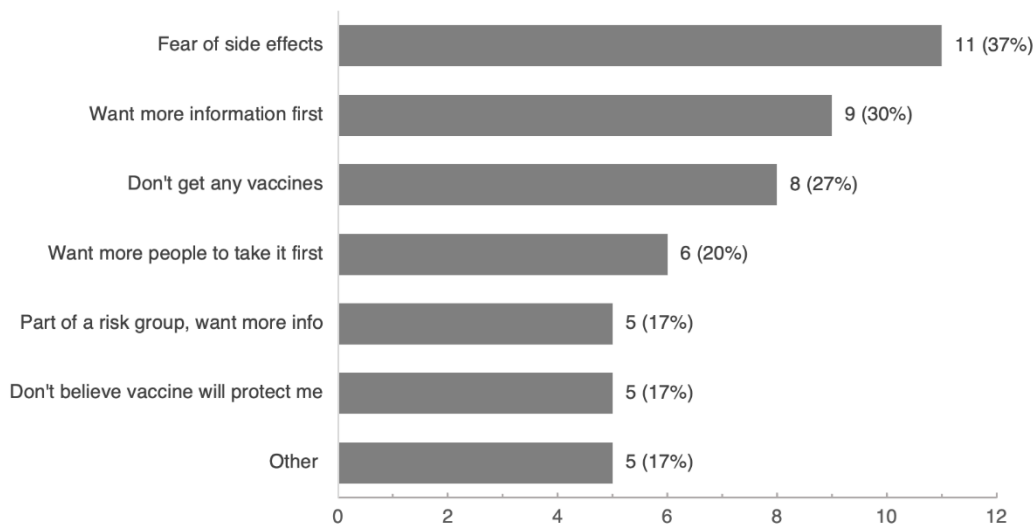
151



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



159 **Fig 1. COVID-19 vaccine hesitancy by prior vaccine access.** Respondents who were offered  
160 a vaccine (n=17) were asked whether or not they received the vaccine; those who received the  
161 vaccine (n=10) were classified as not vaccine hesitant and those who did not receive the  
162 vaccine were classified as vaccine hesitant (n=7). Respondents who had not been offered the  
163 vaccine (n=73) were asked if they would take the vaccine. Those who said they would take the  
164 vaccine (n=37) were classified as not hesitant and those who said they wouldn't (n=23) or  
165 declined to answer (n=13) were classified as hesitant.  
166



167  
168 **Fig 2. Reasons for vaccine hesitancy among those who refused an actual or hypothetical**  
169 **offer of COVID-19 vaccine.** Respondents who refused an actual or hypothetical offer of the  
170 COVID-19 vaccine were asked their reason(s) for refusal (n=30). Other possible reasons for  
171 vaccine hesitancy that were not selected by any participants included “I am not at risk for  
172 COVID-19” and “I could not afford the vaccine.”  
173

174 Bivariate analysis (Table 1) revealed no significant differences in vaccine hesitancy  
175 across any key demographic variables, including age, sex, race, and last-night housing status.  
176 Hesitant respondents scored as having lower PHQ-4 scores (4.95 vs. 6.62,  $P=.02$ ) and were  
177 less likely to have moderate/severe psychological distress (41% vs 62%  $P=.06$ ). Respondents  
178 classified as vaccine-hesitant scored lower on the COVID-19 threat index (1.24, compared to  
179 2.11,  $P=.008$ ) and were less likely to report high threat perception based on 3 out of 4 perceived  
180 threats (20% vs. 45%,  $P=0.01$ ). Hesitant respondents were not significantly more likely to  
181 engage in  $\geq 3$  of 4 reported COVID-19 protective behaviors (51% vs. 34%,  $P=.10$ ), but were  
182 significantly more likely to avoid touching their faces (46% vs. 19%,  $P=.006$ ). They were less  
183 likely to trust COVID-19 protection information from official sources (51% vs. 71%,  $P=.06$ ) or  
184 mass media (46% vs. 64%,  $P=.09$ ) and no more likely to trust information from friends or social  
185 media (49% vs. 36%,  $P=.21$ ).

186 A multivariate model showed that respondents with high COVID-19 threat perception  
 187 were significantly less likely to be vaccine-hesitant (OR=0.25,  $P=.02$ ) (Table 2). Those engaging  
 188 in highly protective behavior were more likely to be vaccine-hesitant (OR=3.63,  $P=0.02$ ). Those  
 189 trusting official sources were significantly less likely to be hesitant (OR=0.37,  $P=.08$ ) and those  
 190 trusting personal contacts more likely to be hesitant (OR=2.70,  $P=.07$ ). A two-tailed t-test of  
 191 equality in the coefficients for COVID-19 information sources revealed significantly higher levels  
 192 of hesitancy for personal contacts vs. official sources (chi-square=4.84,  $P=.09$ ) and personal  
 193 contacts vs. mass media (chi-square = 4.88,  $P=0.09$ ), with no significant difference between  
 194 official sources vs. mass media.

195 **Table 2. Model of COVID-19 vaccine hesitancy**  
 196

Factor	OR	(95% CI)	P value	AOR	(95% CI)	P value
COVID-19 Threat Index - High	0.34	(0.13, 0.91)	.03	0.25	(0.08, 0.80)	.02
COVID-19 Protective Behavior - High	2.21	(0.92, 5.31)	.08	3.63	(1.26, 10.47)	.02
PHQ-4 - Moderate/Severe	0.49	(0.21, 1.17)	.11	0.64	(0.24, 1.71)	.38
COVID-19 info from official sources	0.41	(0.17, 0.99)	.05	0.37	(0.12, 1.11)	.08
COVID-19 info from media	0.50	(0.21, 1.19)	.12	0.52	(0.19, 1.41)	.20
COVID-19 info from personal sources	1.81	(0.76, 4.32)	.18	2.70	(0.93, 7.81)	.07
n	85			85		
Pseudo R <sup>2</sup>						0.172

197  
 198 **Discussion**  
 199 Our findings provide initial evidence of high levels of hesitancy towards the COVID-19  
 200 vaccine among unhoused individuals. Based on a combination of actual and hypothetical  
 201 behavior, 48% showed hesitancy toward the vaccine, considerably higher than the 31-35%  
 202 observed in the general population over a similar period [9,10]. The share who had been offered  
 203 the vaccine was comparable to the general population of LA County at the time, and rates of  
 204 hesitancy were nearly identical in actual and hypothetical responses.

205 Our findings point to the complex role of threat perception, activation and information in  
206 vaccine hesitancy among PEH. In adjusted models, respondents reporting higher COVID-19  
207 fear were one-third as likely to express vaccine hesitancy. At the same time, however,  
208 individuals who fully engaged in protective behaviors (e.g. mask-wearing) had nearly 4 times  
209 greater odds of vaccine hesitancy. Indeed, those who were hesitant towards the vaccine were  
210 more likely to engage in each of the four reported protective behaviors. This suggests that  
211 individuals who have actively engaged in COVID-19 protective measures over the past year  
212 may now be less accepting of the vaccine. Those who trusted COVID-19 information from  
213 official sources and news media were less hesitant, while those trusting personal sources (i.e.  
214 friends/family and social media) were relatively more hesitant. While we did not have sufficient  
215 power to test significance in reasons for hesitancy, we note that a higher proportion of those  
216 with high protective behavior reported reasons such as “I am part of a risk group and want more  
217 info,” “I fear it will have unpleasant side effects,” and “I do not believe the vaccine will protect  
218 me.” Given that vaccine-hesitant individuals are often more vocal in their beliefs, this points to  
219 the opportunity to leverage interpersonal networks as pathways of influence by focusing on  
220 individuals who may be especially activated or vocal about risks ascribed to both the disease  
221 itself and the vaccine. [17]

222 This rapid-reaction pilot study has a number of limitations. First, the sample size was  
223 small and addressed patients only in one portion of West Los Angeles. Nevertheless, the results  
224 have been received as valuable to public health officials who are supporting additional  
225 enrollments across all service areas to increase the sample. Second, while all homeless-flagged  
226 patients with phones had the opportunity to answer the survey and response rates were  
227 considerably higher than most online or phone-based polls, we know that those who answered  
228 the survey were more likely to be female (59% vs. 35%) and less likely to be African-American  
229 (9% vs. 24%) than that clinic’s homeless patient base as a whole. Given the lack of differences

230 in hesitancy across any demographic groups and the small sample size, we did not report  
231 weighted results. Finally, we note that these interviews were conducted prior to PEH receiving  
232 universal vaccine eligibility on March 15, 2021, and that some hesitancy may more accurately  
233 reflect indifference or frustration at the difficulty of obtaining the vaccine.

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

## 241 **Conclusion**

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

250 **Author contributions:** Dr. Kuhn had full access to all of the data in the study and takes  
251 responsibility for the integrity of the data and the accuracy of the data analysis. *Concept and*  
252 *design:* Kuhn, Henwood, Gelberg, King. *Acquisition of data:* Kuhn, Henwood, Lawton, Murali,

253 Kleva. *Analysis and interpretation of data*: Kuhn, Henwood, Lawton. *Drafting of the manuscript*.  
254 Lawton, Kuhn. *Critical revision of the manuscript for important intellectual content*: Kuhn,  
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266 played an instrumental role in designing the survey and rapidly adding new questions,  
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268 provided by our lived expertise group, a panel of individuals with past or current homelessness  
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