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Short communication

Disparities in COVID-19 vaccine hesitancy among Los Angeles County adults after vaccine authorization

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ABSTRACT

An equitable COVID-19 vaccine rollout is a necessary piece of the public health strategy to end the current pandemic; however, vaccine hesitancy may present a major hurdle. This study examines racial/ethnic and income-based disparities in vaccine hesitancy in Los Angeles County, a recent epicenter of the pandemic in the US, immediately after the Food and Drug Administration issued its emergency use authorization of a COVID-19 vaccine. We conducted online, stratified cross-sectional surveys of 1,984 adults living in Los Angeles County between December 2020 and January 2021 to assess hesitancy towards getting a COVID-19 vaccine. We used multivariable logistic regression to predict vaccine hesitancy after adjusting for covariates and calculated weighted population level estimates of hesitancy and reasons for hesitancy. Blacks and Hispanics were significantly more likely to be hesitant than Whites (AOR = 3.3, P < 0.001; AOR = 2.1, P = 0.008) as were those in the lowest income group (annual income <$20,000 compared to >$100,000) (AOR = 1.8, P = 0.009). Additionally, those having no confidence in doing things online (AOR = 3.3, P < 0.001) were less likely to accept the vaccine than those who were confident. Compared to hesitant White respondents, Black respondents had higher mistrust of the government (36.1% vs 22.1%, P = 0.03) and Black and Hispanic respondents were more likely to want to wait to see how the vaccine works (41.2% and 42.0% vs 27.3%, P = 0.02 and P = 0.006). Our study suggests that culturally appropriate messaging that addresses concerns for lower income and racial/ethnic minority communities, as well as alternatives to online vaccine appointments, are necessary for improving vaccine rollout.

1. Introduction

At the start of 2021, Los Angeles County was the pandemic's epicenter; cases rose steeply and over 200 people were dying each day from COVID-19 (Los Angeles County, 2021) Racial/ethnic minority groups and lower-income persons in Los Angeles were more likely to contract, become hospitalized and die from COVID-19 (LA County Daily COVID-19 Data, 2021). During this surge, the Food and Drug Administration also issued its first emergency use authorization for a COVID-19 vaccine (Commissioner, 2020). Since the beginning of the vaccine rollout, public health officials have been trying to understand how to improve vaccine acceptance rates in communities hardest hit by the pandemic (Tewarson et al., 2021). Previous studies report significant differences in COVID-19 vaccine hesitancy by race, socioeconomic status, gender, flu vaccine acceptance and education levels (Daly and Robinson, 2020; Jarrett et al., 2015). However, only a few studies have surveyed individuals after a COVID-19 vaccine was available (Hamel et al., 2021).

In this study, we examine income and racial/ethnic disparities in vaccine hesitancy as well as reasons behind this hesitancy in Los Angeles, immediately following COVID-19 vaccine authorization.

2. Methods

We conducted an online, stratified cross-sectional survey of adults living in Los Angeles County between December 5, 2020 and January 10, 2021. Participants were drawn from an online Qualtrics market research panel of volunteer survey respondents. Panelists were invited

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via an emailed electronic link or prompted on the respective survey platform to participate in a Spanish or English survey on COVID-19 in exchange for voucher incentives. We prespecified quotas for race/ethnicity, sex and income, and then reweighted responses using the 2019 American Community Survey to match the demographics of Los Angeles County. The University of Southern California institutional review board approved the study.

The survey instrument included questions that were based on validated questions from the National Health Interview Survey (National Health Interview Survey, 2021), the Behavioral Risk Factor Surveillance System (Behavioral Risk Factor Surveillance System Questionnaires, 2021), the PhenX toolkit (Toolkit and July, 2021), as well as questions proposed by our research team (Supplement). Questions were pre-tested in Spanish and English and modified to improve comprehension and understandability. We asked participants Would you be willing to get the COVID-19 once it is available and defined vaccine hesitancy as "probably" or "definitely" not on a 4-item scale. Vaccine hesitant respondents were asked why they were unwilling to get vaccinated. Participants provided demographic information and were asked about their health, risk factors for acquiring or having severe COVID-19, access to care, intention to get a flu vaccine, political preferences, and comfort with doing things online (COVID-19 and Your Health, 2020). We used multivariable logistic regression models to predict vaccine hesitancy across race/ethnicity and income groups and controlled for demographic characteristics, access to care, risk factors for COVID-19 as well as hypothesized predictors of vaccine hesitancy: US born, household size of 4 or more people, favorability of Donald Trump, health insurance type, having a regular doctor/clinic, self-rated health status, worked outside the home during the past week, intent to receive a flu vaccine, week survey was taken and the respondent's geographic region in Los Angeles County (Service Planning Area) (Kreps et al., 2020; Kerr et al., 2020). We weighted responses by race/ethnicity, income, and sex using the 2019 American Community Survey for Los Angeles County to calculate population level estimates of hesitancy and reasons for hesitancy by race/ethnicity and income. Tests for differences across race/ethnicity and income were conducted using weighted, unadjusted linear probability models, comparing each group to a reference group (Non-Hispanic White or Income>$100,000) Statistical analyses were performed in Stata 15 with α set at 0.05.

3. Results

Of the 6,686 individuals who were invited to participate in the survey, 3,086 responded and 2,017 were eligible (defined as adults who live in Los Angeles County) – a response rate of 30.2%. We analyzed 1,984 surveys that met data quality checks.

Race/ethnicity and income were independently associated with vaccine hesitancy, even after adjusting for covariates (Table 1). Blacks and Hispanics were more likely to be hesitant compared to Whites (Adjusted Odds Ratio [AOR] = 3.3, 95% C.I.: 2.2, 5.0, P < 0.001; AOR = 2.1, 95% C.I.: 1.2, 3.6, P = 0.008). Those with the lowest incomes (<$20,000/year) were more likely to be hesitant compared to the highest income group (>$100,000, AOR = 1.8, 95% C.I.: 1.2, 2.7, P = 0.009). Those who were age 65 or older were less likely to be hesitant (AOR = 0.5, 95% C.I.: 0.3, 0.9, P = 0.02) however those who had a possible or established high-risk condition for COVID-19 were not significantly less likely to be hesitant those without high-risk conditions. Having "little" or "no confidence" in doing things online was associated with hesitancy compared to individuals who were very confident (AOR = 2.7, 95% C.I.: 1.7, 4.2; AOR = 3.3, 95% C.I.: 1.8, 6.0, P < 0.001). Descriptive statistics and unadjusted and adjusted odds ratios for all covariates in the model are included in Appendix Table 1.

Overall, 28.3% of Los Angeles County Adults were estimated to have vaccine hesitancy (Table 2). Hesitancy was most common among Black (42.1%), Hispanic (30.7%) and very-low income (41.6%) and low-income participants (36.6%). Among those age 65 and over, 17.2%

Table 1
Descriptive Statistics and Logistic Regression Models to Predict COVID-19 Vaccine Hesitancy in Los Angeles (December 2020-January 2021).[a]

	n (%)	OR (95% CI)	*P*-value	AOR[b] (95% CI)	*P*-value
Race/Ethnicity[c]					
Non-Hispanic White	396 (20.0)	Ref		Ref	
Asian	298 (15.0)	1.0 (0.7, 1.5)	0.94	0.8 (0.5, 1.5)	0.51
Black	339 (17.1)	3.4 (2.4, 4.8)	<0.001	3.3 (2.2, 5.0)	<0.001
Hispanic	922 (46.5)	2.2 (1.6, 2.9)	<0.001	2.1 (1.2, 3.6)	0.008
Other	29 (1.4)	7.6 (3.4, 16.8)	<0.001	3.6 (1.4, 9.1)	0.008
Annual household income					
>$100,000	552 (27.8)	Ref		Ref	
$50,000-$99,999	682 (34.4)	1.5 (1.1, 1.9)	0.007	0.9 (0.7, 1.3)	0.57
$20,000-$49,999	455 (22.9)	2.1 (1.6, 2.8)	<0.001	1.2 (0.8, 1.7)	0.44
<$20,000	295 (14.9)	3.1 (2.3, 4.2)	<0.001	1.8 (1.2, 2.7)	0.009
Sex					
Male	910 (45.9)	Ref		Ref	
Female	1058 (53.3)	1.5 (1.2, 1.8)	<0.001	1.3 (1.0, 1.6)	0.06
Non-binary, transgender or other	16 (0.8)	1.8 (0.7, 5.1)	0.25	1.5 (0.4, 4.8)	0.54
Age					
18–29	652 (32.9)	Ref		Ref	
30–36	571 (28.8)	0.8 (0.6, 1.0)	0.06	0.8 (0.6, 1.1)	0.25
40–64	634 (32.0)	0.6 (0.5, 0.8)	<0.001	0.7 (0.5, 1.0)	0.04
>65	127 (6.3)	0.4 (0.2, 0.6)	<0.001	0.5 (0.3, 0.9)	0.02
High Risk Conditions					
No high-risk condition	942 (47.5)	Ref		Ref	
Possibly higher risk conditions[e]	528 (26.6)	0.9 (0.7, 1.1)	0.24	0.8 (0.6, 1.1)	0.25
Highest Risk Conditions[d]	514 (25.9)	0.7 (0.6, 0.9)	0.004	0.9 (0.6, 1.2)	0.30
Confidence in doing things online					
Very confident	310 (61.0)	Ref		Ref	
Somewhat confident	568 (28.6)	1.1 (0.9, 1.4)	0.29	1.2 (0.9, 1.5)	0.28
Only a little confident	127 (6.4)	2.6 (1.8, 3.8)	<0.001	2.7 (1.7, 4.2)	<0.001
Not at all confident	79 (4.0)	4.5 (2.8, 7.1)	<0.001	3.3 (1.8, 6.0)	<0.001

Abbreviations, OR, odds ratio; AOR, adjusted odds ratio.

[a] Vaccine Hesitancy is defined as "no, probably not" or "no, definitely not willing" to get the COVID-19 vaccine once it is available vs "yes, probably" or "yes, definitely".

[b] The adjusted odds ratio test uses a multivariable regression model which controls for covariates listed in this table and US born, household size of 4 or more people, favorability of Donald Trump, health insurance type, having a regular doctor/clinic, self-rated health status, education level, worked outside the home during the past week, intent to receive a flu vaccine, week survey was taken and the respondent's geographic region in Los Angeles County (Service Planning Area).

[c] Black race includes 55 respondents who also self-identified as Hispanic ethnicity. Other race includes non-Hispanic respondents who self-identified as American Indian, Alaska Native, Native Hawaiian, other Pacific Islander or other race.

[d] Highest risk conditions (any selected): obesity (body mass index of 30 or higher), smoking, pregnancy, heart disease, cancer, chronic kidney disease, chronic obstructive pulmonary disease, sickle cell disease, or diabetes.

[e] Possibly higher risk conditions (any selected, without selecting any highest risk conditions): high blood pressure or hypertension, overweight (body mass index of 25 or higher), asthma, cystic fibrosis, weakened immune system, liver disease.

were hesitant; while among those with established high-risk conditions for COVID-19, 24.2% were hesitant. Most respondents were "probably" (28.4%) as opposed to "definitely" (11.3%) not willing to get vaccinated. The most common reason for hesitancy was worry about side effects or safety, followed by wanting to wait and see how the vaccine worked and a lack of trust in the government to develop the vaccines. Compared to hesitant White respondents, Black respondents had higher mistrust of the government (36.1% vs 22.1%, P = 0.03) and Black and Hispanic respondents were more likely to want to wait to see how the vaccine works (41.2% and 42.0% vs 27.3%, P = 0.02 and P = 0.006).

4. Discussion

Our study finds that over one in four individuals in Los Angeles is hesitant to get the COVID-19 vaccine. Additionally, racial/ethnic and income-based disparities in vaccine hesitancy persist even after COVID-19 vaccine authorization. These results are particularly concerning in that residents were surveyed at the height of the Winter 2020-2021 surge in cases, when the county averaged 15,000 new cases daily. Notably, our results suggest that low confidence in doing things online is independently associated with hesitancy. Yet most local governments have employed web-based technologies for individuals to sign up for vaccine appointments (Jarrett et al., 2015).

However, the disparities and high rates of vaccine hesitancy we observed may be reversible. Given that the majority of hesitant individuals said they were "probably" as opposed to "definitely" not willing to accept the vaccine; and many wanted to "wait and see how the vaccine worked", there may be opportunities to influence behaviors in many hesitant individuals (Daly and Robinson, 2020).

Public health departments and health systems must collaborate with community-based organizations to develop culturally appropriate messaging to lower-income and racial/ethnic communities. Additionally, the county should develop effective alternatives to online vaccine appointments and utilize non-web-based platforms to disseminate information about the safety and efficacy of the vaccine. As Los Angeles County continues to try to reach unvaccinated residents, developing and testing strategies to address resident's key concerns about the COVID-19 vaccine is essential to increasing vaccine coverage and reducing the likelihood of future outbreaks.

CRediT authorship contribution statement

Sonali Saluja: Conceptualization, Methodology, Investigation,

Table 2
COVID-19 Vaccine Hesitancy and Reason for Hesitancy in Los Angeles by Race/Ethnicity and Annual Household Income (December 2020–January 2021)[a].

No. (Weighted %)										
	Race and Ethnicity[b]						Annual Household Income			
	Total	Non-Hispanic White	Asian	Black	Hispanic	Other	<$20,000	$20,000-$50,000	$50,000-$100,000	>$100,000
Vaccine Hesitant (definitely or probably will not get the COVID-19 Vaccine)	577 (28.4%)	70 (21.7%)	52 (17.8%)	143 (42.1%)[c]	294 (30.7%)c	18 (68.0%)[c]	128 (41.6%)[d]	158 (36.6%)[d]	181 (25.1%)[d]	110 (18.3%)
Definitely will not get the COVID-19 vaccine	228 (11.3%)	36 (10.5%)	13 (5.2%)[c]	59 (18.1%)c	112 (11.5%)	8 (23.1%)	55 (17.9%)[d]	63 (13.8%)[d]	73 (10.4%)[d]	37 (6.6%)
Probably will not get the COVID-19 vaccine	349 (17.1%)	34 (11.2%)	39 (12.6%)	84 (24.0%)c	182 (19.2%)	10 (44.9%)c	73 (23.6%)d	95 (22.8%) d	108 (14.7%)	73 (11.8%)
Hesitant among those under age 65 with highest risk conditions[e]	121 (24.2%)	12 (14.9%)	7 (17.4%)	36 (41.3%)c	62 (25.9%)	4 (70.3%) c	25 (50.3%)d	33 (29.8%) d	42 (23.0%) d	21 (11.6%)
Hesitant among those over age 65	21 (17.2%)	6 (13.4%)	4 (22.3%)	6 (20.6%)	4 (25.1%)	1 (45.4%)	1 (4.7%)	8 (30.6%)	9 (13.5%)	3 (10.2%)
Reason for not wanting the COVID-19 vaccine (among those with vaccine hesitancy)										
Worried about COVID-19 vaccine effects or safety	346 (59.0%)	44 (60.6%)	33 (58.3%)	81 (54.4%)	180 (60.7%)	8 (53.3%)	70 (50.5%)	97 (62.4%)	116 (64.4%)	63 (55.5%)
Don't think the vaccine will work	115 (19.7%)	17 (21.4%)	6 (8.9%)	31 (26.3%)	57 (18.6%)	4 (23.3%)	20 (17.0%)	36 (21.9%)	41 (22.3%)	18 (15.8%)
Don't trust the government to develop a COVID-19 vaccine	187 (31.4%)	20 (22.1%)	15 (34.8%)	51 (36.1%)c	96 (33.1%)	5 (33.0%)	37 (28.0%)	54 (31.0%)	58 (32.7%)	38 (34.5%)
Don't trust the pharmaceutical companies to develop a COVID-19 vaccine	140 (24.8%)	22 (31.2%)	13 (26.4%)	35 (27.1%)	66 (20.8%)	4 (23.3%)	31 (25.2%)	41 (25.0%)	45 (26.1%)	23 (21.7%)
Want to wait to see how it works first	236 (38.8%)	22 (27.3%)	25 (44.6%)	60 (41.2%)c	121 (42.0%)c	8 (38.6%)	38 (28.2%)d	63 (34.7%)	89 (48.6%)	46 (43.0%)
Don't believe in getting vaccinated in general	86 (15.0%)	17 (18.6%)	4 (8.6%)	18 (13.3%)	45 (15.2%)	2 (16.5%)	19 (13.1%)	23 (14.8%)	27 (15.9%)	17 (16.3%)
Don't think I will get COVID-19	63 (10.9%	7 (10.0%)	2 (6.2%)	20 (15.8%)	30 (9.1%)	4 (23.3%)	22 (15.2%)	14 (10.3%)	13 (6.7%)	14 (13.0%)

[a] Percentages in this table are weighted by race/ethnicity, income, and sex using the 2019 American Community Survey to calculate population level estimates for Los Angeles County.

[b] Black race includes 55 respondents who also self-identified as Hispanic ethnicity. Other race includes non-Hispanic respondents who self-identified as American Indian, Alaska Native, Native Hawaiian, other Pacific Islander or other race.

[c] Race/Ethnic group significantly different from non-Hispanic White group (P < 0.05).

[d] Income group significantly different from >$100,000 group (P < 0.05).

[e] Highest risk conditions (any selected): obesity (body mass index of 30 or higher), smoking, pregnancy, heart disease, cancer, chronic kidney disease, chronic obstructive pulmonary disease, sickle cell disease, or diabetes.

Resources, Writing - original draft, Visualization, Supervision, Project administration, Funding acquisition. **Chun Nok Lam:** Methodology, Software, Validation, Formal analysis, Data curation, Writing - review & editing. **Danielle Wishart:** Conceptualization, Writing - original draft. **Alec McMorris:** Conceptualization, Writing - review & editing. **Michael Cousineau:** Conceptualization, Writing - review & editing. **Cameron Kaplan:** Conceptualization, Methodology, Software, Formal analysis, Resources, Writing - review & editing, Supervision, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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