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Social Determinants of Health Associated With SARS-CoV-2 Testing and Vaccine Attitudes in a Cross-Sectional Study of Latinx Individuals in Oregon

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Introduction: Latinx communities have reported higher barriers to SARS-CoV-2 testing and vaccination and experienced disproportionate COVID-19 burden, especially compared with non-Latinx Whites. Social determinants of health models explain health inequities; however, it is unknown how each social determinant of health is associated with SARS-CoV-2 testing and vaccination attitudes among Latinx Americans. This study determined the relative importance of social determinants of health indicators on testing and vaccine attitudes among Latinxs and whether English proficiency and parental nativity moderate associations.

Methods: Cross-sectional survey data were collected between January and December 2022. Multilevel structural equation path modeling addressed the nonindependence of respondents nested within 52 SARS-CoV-2 testing sites across Oregon, U.S. Equality constraints were used to test for differences in the magnitudes of the associations.

Results: Latinx respondents (n=1,247) predominantly spoke Spanish at home (94%) and had no U.S.-born parents (92%). Pandemic vulnerability (β=0.95, p<0.001), economic insecurity (β=0.17, p<0.001), and discrimination (β=0.16, p<0.001) were associated with testing hesitancy; education was associated with vaccine hesitancy (β=0.15, p<0.001); and education (β=0.13, p<0.001) and discrimination (β=0.08, p<0.01) were associated with vaccine safety acceptance. Social determinants of health associations were statistically equal in magnitude. English proficiency moderated the associations from discrimination (β=0.07, p<0.01) and economic insecurity (β= −0.09, p<0.05) to vaccine hesitancy. Parental nativity moderated the associations from economic insecurity to testing hesitancy (β= −0.21, p<0.001) and lack of healthcare access to vaccine hesitancy (β=0.37, p<0.01).

Conclusions: Findings from this study identified distinct social determinants of health paths to testing and vaccine attitudes among Latinxs as well as by English proficiency and parental nativity. These results inform culturally responsive disease prevention for Latinx subgroups.

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INTRODUCTION

The U.S. has seen disparities in coronavirus disease 2019 (COVID-19) preventive behaviors and outcomes between Hispanic/Latina/o/e/x (referred to as Latinx in the remaining parts of this paper) and non-Latinx White populations. From 2020 to 2022, Latinxs were more likely to report severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) testing and vaccination barriers and hesitancy, test positive for SARS-CoV-2, have negative economic repercussions after testing positive, require hospitalization, and die from COVID-19 compared with non-Latinx White counterparts.[1–6] Moreover, age-adjusted mortality rates increased from 2019 to 2020 for all race−ethnicity−sex groups but increased most for Latinxs.[7]

The NIH[8] calls for a better understanding of upstream systemic conditions for downstream impact on health inequities.[9–11] These systemic conditions or social determinants of health (SDOH) can be supportive or unsupportive of health. *Healthy People 2030*'s SDOH Model outlines 5 SDOH domains: economic conditions such as employment and poverty; healthcare access, including supports for timely, high quality health services; educational access, such as high-quality instruction and employment prospects; environmental conditions, such as neighborhood poverty and crime; and social conditions, such as racial, ethnic, sex or gender discrimination and social support.[12] The inequitable distributions of supportive versus unsupportive SDOH across populations contributes to health disparities.[13,14] For example, SDOH models explain that the COVID-19 disparities mentioned earlier between Latinxs and non-Latinx Whites are,[1–6] in large part, the result of disproportionately present unsupportive systemic conditions (e.g., limited employment options) and disproportionately absent supportive systemic conditions (e.g., access to health care) in Latinx communities compared with those in non-Latinx White communities. Indeed, all 5 SDOH domains have been linked to testing and vaccination outcomes,[15–27] although most studies have focused on economic, healthcare, and educational SDOH. Although SARS-CoV-2 testing and vaccination attitudes, such as hesitancy toward and perceived safety of these services, strongly predict testing and vaccination engagement,[28,29] it is unknown which SDOH are the strongest predictors of such attitudes among Latinxs because a direct comparison of determinants in a single study has not been conducted.

Moreover, there are important within-group differences among Latinxs, by which the strength and direction of the association between SDOH and SARS-CoV-2 testing and vaccination attitudes are likely to vary, including English language access and family immigration status. Regarding language access, the results in the literature are mixed. Access to English has been associated with both greater exposure to evidence-based public health messages linked to greater testing and vaccination and greater exposure to misinformation from unofficial sources linked to testing and vaccination hesitancy.[4,30,31] These findings suggest that English proficiency may moderate the association between healthcare SDOH and testing and vaccination because access to public health messaging appears to be supportive for Latinxs who have English language access. In addition, a substantial number of U.S. Latinxs are immigrants or live in mixed-status families, and immigration factors are associated with high levels of stress and affect a variety of SDOH and COVID-19 outcomes.[30,32–34] Despite variations in language and family immigration status, culturally tailored strategies are often based on the singular identity of being Latinx,[15] contributing to disproportionate disease burdens among Latinxs. There remains a need to evaluate the potential moderating effects of English proficiency and family immigration status on a variety of SDOH and to do so in a single model for direct comparisons across SDOH.

This study evaluated the registered aim of an NIH-funded Rapid Acceleration of Diagnostics-Underserved Populations (RADx-UP[35]) project focusing on promoting COVID-19−preventive behaviors among Oregon's Latinx communities. National disparities were mirrored in Oregon, such that Latinx Oregonians were overrepresented in COVID-19 cases, hospitalizations, and deaths and underrepresented among those vaccinated.[36,37]

In summary, this study aimed to test a multilevel SDOH model in the context of COVID-19 to inform culturally responsive COVID-19 prevention and control strategies, especially among the most affected Latinx subgroups. Studies have shown that SDOH often impact many health behaviors and outcomes in similar ways,[38–41] thus, more knowledge on the strongest SDOH predictors of SARS-CoV-2 testing and vaccine attitudes can inform strategies to promote favorable attitudes toward other public health services (e.g., influenza vaccinations and Type 2 diabetes screenings) relevant to Latinx communities. This study addressed the following research questions and hypotheses: (1) What is the relative strength of the association between distinct SDOH, SARS-CoV-2 testing, and vaccination attitudes among Latinx participants? On the basis of prior literature,[15–27] the authors hypothesized that economic, educational, and healthcare access SDOH will be more strongly associated with vaccine and testing outcomes than with social and environmental SDOH. (2) How do these associations vary according to English proficiency and parental nativity (immigration-related factors)? The authors expected English proficiency to moderate the strength of the association between healthcare access, testing, and vaccination outcomes. Moreover, the authors hypothesized that the strength of all SDOH associations with testing and vaccination outcomes would be stronger among those with at least 1 non−U.S.-born parent than among those with both parents born in the U.S.

Although all 5 SDOH domains and potential moderators have been independently linked to testing and vaccination attitudes and other COVID-19 outcomes,[15−27] this is the first study to explore all SDOH domains in 1 multilevel model to identify the strongest predictors of such attitudes among Latinxs and the degree to which English proficiency and parental nativity moderate the associations.

METHODS

Study Sample

The sample in this cross-sectional study includes persons aged ≥15 years who visited one of the authors' RADx-UP SARS-CoV-2 testing events in January−December 2022. Participating counties (*n*=11) in Oregon hosted 272 testing events at 52 sites. Events were free and advertised to Latinx communities through culturally tailored outreach (Budd et al.[42] and National Institute of Health[43] provide the details). Participants provided informed consent and completed a 188-question survey (69% in Spanish and 31% in English) on site using paper, smartphone, or iPad (mean=35 minutes, SD=23). The study procedures were approved by the University of Oregon's IRB, and the data were accessible through the RADx Data Hub.[44]

These analyses include baseline data only of 1,247 respondents (mean age=39.2 years, SD=13.8) who self-identified as Hispanic, Latino/a/x, or Latinx ethnic subgroup (77% specified Mexican/Mexican American). Table 1 shows that most respondents were female (65%), identified as women (63%), had no U.S.-born parents (92%), spoke Spanish at home (94%), did not receive an education beyond high school (71%), were employed (62%), were not essential workers (59%), and had health insurance (private: 31%, public: 23%). Fifty-five percent of the respondents reported speaking English very well, and 45% reported speaking English neither well nor at all.

Measures

Three primary outcomes were specified regarding testing and vaccine attitudes: a testing hesitancy latent variable and 2 vaccine subscales—vaccine safety acceptance and vaccine hesitancy. As part of the RADx-UP[35] project, the RADx-UP Center for Data Collection and Coordination required the authors to use the testing and vaccine

Table 1. Characteristics of the Study Sample (N=1,247)

Characteristic	*n* (valid %)
Sex	
Female	756 (64.51)
Male	411 (35.07)
Prefer not to answer	5 (0.43)
Intersex	0 (0.00)
Missing	75
Gender	
Woman	767 (63.28)
Man	438 (36.14)
Nonbinary/other	7 (0.58)
Missing	35
Latinx ethnicity[a]	
Mexican	959 (76.90)
Hispanic and Latino/a/x	565 (45.31)
Indigenous to Mexico	164 (13.15)
Other Hispanic or Latino/a/x	140 (11.23)
Central American	60 (4.81)
South American	24 (1.92)
Puerto Rican	11 (0.88)
Central American Indigenous	9 (0.72)
South American Indigenous	5 (0.40)
Cuban	2 (0.16)
Dominican	1 (0.08)
Missing	0
Additional race or ethnicity[b]	
Indigenous	187 (15.00)
White	59 (4.73)
Black or African American	14 (1.12)
Native Hawaiian or other Pacific Islander	12 (0.96)
Asian	12 (0.96)
Middle Eastern or North African	9 (0.72)
Number of parents born in the U.S.	
0	1,103 (92.07)
1	63 (5.26)
2	32 (2.67)
Missing	49
Spanish spoken at home	1,173 (94.44)
Missing	5
Monolingual English	60 (4.83)
Missing	5
Speaks English...	
Very well	363 (32.21)
Well	260 (23.07)
Not well	344 (30.52)
Not at all	160 (14.20)
Missing	120
Education	
Less than high school	508 (42.83)
High school diploma or GED	334 (28.16)

(*continued on next page*)

Table 1. Characteristics of the Study Sample (N=1,247) (*continued*)

Characteristic	*n* (valid %)
Some college or technical	191 (16.10)
Bachelor's or higher	153 (12.90)
Missing	61
Employed	775 (62.15)
Missing	0
Essential worker	514 (41.22)
Missing	0
Loss of household employment since 2020	616 (53.20)
Missing	89
Insurance status	
Uninsured	408 (39.42)
Private	320 (30.92)
Public	238 (23.00)
Don't know	69 (6.67)
Missing	212

[a]Participants selected any number of options (checkbox), and identifying as Hispanic or Latino/a/x was a requirement to be included in this study sample.
[b]Participants selected an additional race or ethnicity to Hispanic or Latino/a/x only when applicable.

acceptance subscales. In addition, the extant literature has identified distinct reasons for hesitance to engage in testing versus vaccination,[45,46] supporting the use of different testing and vaccination hesitance measures. The authors conducted exploratory factor analyses on each subscale's items using principal component analysis with the following recommended criteria for the optimal factor structure of the scale scores[47,48]: (1) oblimin rotation allowing correlation among exploratory factors, (2) eigenvalues of unrotated factors >1, and (3) each factor accounting for >5% of the total variance. In addition, the authors conducted both parallel analyses and Velicer's minimum average partial correlation analyses.[49] Parallel analyses directly compare eigenvalues for the ranked ordered principal component analysis loadings with eigenvalues generated from randomly ordered data.[49] Criteria for meaningful factors were those with higher eigenvalues from those randomly generated (i.e., eigenvalues > the random parallel 95% quantile are retained); thus, meaningful variance is obtained above chance. On the basis of these criteria, the test items obtained a single-domain latent variable (testing hesitancy) with 2 subscale indicators (testing barriers and concerns). The vaccine items resulted in 2 orthogonal domains: vaccine safety acceptance and vaccine hesitancy.

For testing hesitancy, the testing barriers scale included 6 items (e.g., *The testing site was too far away*; α=0.87), and the testing concerns scale included 7 items (e.g., *I was afraid of losing my job*; α=0.84). Test items were rated as 0 (no), 1 (somewhat), or 2 (yes). Vaccine safety acceptance included 4 items (e.g., *I feel protected after getting vaccinated*; α=0.93). Vaccine hesitancy consisted of 11 items (e.g., *Vaccination programs are a big con*; α=0.88). The vaccine items were rated on a scale ranging from 1 (strongly disagree) to 6 (strongly agree).

In terms of social determinants of health, environmental conditions were set as site-level (Level 2) indicators. They included the NIH's pandemic vulnerability index and the U.S. Crime Index on the basis of testing site ZIP code.[50] Pandemic vulnerability is a composite county-level measure of infection rate, population size, and proportions of residents of minoritized races and ethnicities; available interventions; and environmental and health vulnerabilities at any particular time of the pandemic.[51,52] Self-report respondent-level (Level 1) SDOH measures came from the RADx-UP's Center for Data Collection and Coordination and PhenX Toolkit.[53,54] The PhenX SDOH Core Measure assessed housing, food and water insecurity, employment, and workplace safety (economic insecurity, sum score raw scale 0−6); health insurance and coverage and healthcare and medicine access (lack of healthcare access, sum score raw scale 0−6); and highest level of education (education, binned categories 1−7). Four items (e.g., *You are treated with less respect than other people*, sum score scaled 0−20) from the PhenX Everyday Discrimination Scale assessed the frequency of discrimination on the basis of demographic characteristics (e.g., race, sex).[55,56]

Moderators were self-reported English proficiency and parental nativity. English proficiency was rated on a scale of 1 (*I speak English very well*) to 4 (*Not at all*) in response to *How well do you speak English?* Parental nativity was a single item coded 0 (no parents U.S. born), 1 (1 parent U.S. born), and 2 (both parents U.S. born). The effect codes were applied to the moderation tests.

Statistical Analysis

In May 2023, the authors conducted structural equation path modeling (SEM) to evaluate both research questions. SEM combines multiple regression and factor analyses simultaneously. The regression path estimates are presented in the form of standardized betas. To address clustering of participants within testing sites, the path analyses were specified as a 2-level model in Mplus 8.10.[57] One advantage of multilevel SEM is the handling of missing data using full information maximum likelihood with robust SEs, which are more statistically reliable than listwise deletion in mixed model regressions and less computationally complex than multilevel imputation.[58,59] Model fit was evaluated with the following recommended criteria: a chi-square $p>0.05$, a comparative fit index >0.95, a chi-square ratio (χ^2/df) <2.0, and a root mean square error of approximation <0.08.[60,61] Levels 1 and 2 statistical controls were included in analyses. To compare the relative importance of the magnitudes of SDOH variables, the authors used a series of equality constraints. The constraints determine whether the 2 paths are statistically equivalent or whether a given path is significantly stronger or weaker in magnitude.

RESULTS

The means, SDs, and correlations are presented in Table 2. The results of the hypothesized main effects of the SDOH model are presented in Figure 1 as standardized beta coefficients. At the testing site level (Level 2), pandemic vulnerability was significantly and positively associated with testing hesitancy (β=0.95, p<0.001). The high standardized path coefficient and explained variance are a result of nonsignificant Level 2 variance in testing hesitancy between sites, commonly observed in SEM analyses.[62] The model obtained excellent fit (χ^2[12]=19.42, p=0.08, comparative fit index=0.99, root mean square error of approximation=0.025).

Greater economic insecurity was associated with greater testing hesitancy reported by respondents (β=0.17, p<0.001). However, economic insecurity was not associated with the vaccine outcomes. Lack of healthcare access was not associated with any of the outcomes. Higher education was associated with higher vaccine safety acceptance (β=0.13, p<0.001) and was also associated with higher vaccine hesitancy (β=0.15, p<0.001). Higher levels of discrimination were associated with higher testing hesitancy (β=0.16, p<0.001); however, conversely, discrimination was associated with higher beliefs in vaccine safety acceptance (β=0.08, p<0.01).

In the next step of the evaluation, the authors tested whether the SDOH paths were similar in magnitude to better understand their comparative relevance to outcomes. Table 3 presents the results of the equality constraint tests for the significant SDOH paths. The findings indicated that equality constraints could not be rejected, meaning that the associations were statistically equal in magnitude. That is, the significant SDOH paths were weighted similarly in terms of their relevance to the theoretical model. The within-site respondent-level model explained 11%, 2%, and 3% of the variance in testing hesitancy, vaccine hesitancy, and 3% of vaccine safety acceptance, respectively.

The final stage of the analysis focused on tests for subgroup differences based on English language proficiency and parental nativity. The results of the moderation tests are presented in Table 4. English proficiency did not moderate the association of SDOH with testing hesitancy or vaccine safety acceptance. English proficiency moderated the associations from discrimination (β=0.07, p<0.01) and economic insecurity (β= −0.09, p<0.05) to vaccine hesitancy. As illustrated in Figure 2, the positive association of discrimination with vaccine hesitancy shown in Figure 1 was significantly amplified for higher English-proficient participants than for lower English-proficient participants. The positive main

Table 2. Means, SDs, Pairwise Sample Size, and Bivariate Correlations Among Study Variables

Variable	1	2	3	4	5	6	7	8	9	10
1. Testing concerns	—									
2. Testing barriers	**0.62*****	—								
3. Vaccine safety	0.05	**0.06***	—							
4. Vaccine hesitancy	0.00	0.01	**0.41*****	—						
5. Crime index[a]	0.01	−0.01	0.01	0.02	—					
6. Pandemic vulnerability[a]	**0.10*****	**0.15*****	0.02	−0.01	**0.26*****	—				
7. Economic insecurity	**0.21*****	**0.21*****	**−0.10*****	−0.05	0.01	−0.00	—			
8. Lack of healthcare access	**0.18*****	**0.16*****	**−0.07****	−0.05	0.00	−0.02	**0.68*****	—		
9. Education	**-0.13*****	**−0.21*****	**0.18*****	**0.15*****	**0.08****	−0.02	**−0.35*****	**−0.25*****	—	
10. Discrimination	**0.12*****	**0.10****	**0.08*****	0.00	0.02	**0.06***	0.05	0.05	**0.12*****	—
Mean	2.69	2.05	8.63	12.44	139.04	0.53	1.54	1.53	3.59	5.60
SD	3.56	2.93	5.74	5.77	66.51	0.03	1.99	1.58	1.67	3.02
n	1,093	1,046	1,170	1,149	46	46	1,115	1,206	1,186	1,169

Note: Boldface indicates statistical significance (*p<0.05, **p<0.01, and ***p<0.001).
[a]Correlations for crime index and pandemic vulnerability were reported for person-level file, and means, SDs, and sample size were reported from site-level file.

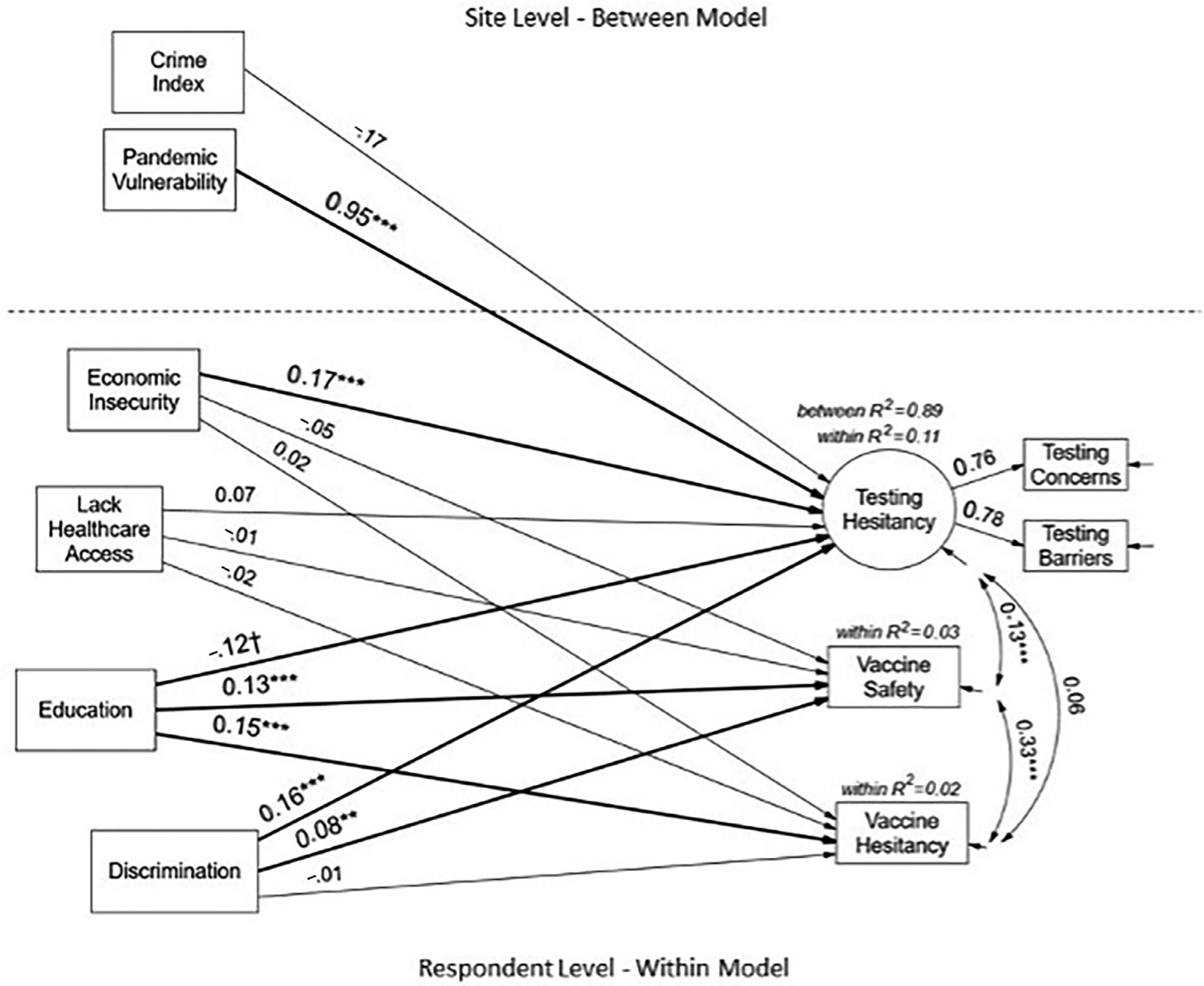

Figure 1. Multilevel structural equation path model for test of social determinants of health and SARS-CoV-2 testing and vaccine attitudes among Latinx Oregonians (N=1,247).

Note: †$p<0.06$, **$p<0.01$, and ***$p<0.001$.

Paths are standardized estimates, and the magnitudes of associations across significant paths were statistically equal. Model fit: χ^2 (12)=19.42, p=0.08, CFI=0.99, RMSEA=0.025.

CFI, comparative fit index; RMSEA, root mean square error of approximation.

Table 3. Nested MLR Model Comparisons for Tests of SDOH Equality Constraints

MLR Model	χ^2	*df*	Scaling correction factor[a]	Scaled $\Delta\chi^2$	Δ *df*	Δ Scaling correction Factor	*p*-value	Conclusion
1. Figure 1 no constraints	19.401	12	0.592					
2. Education = discrimination = economic Insecurity->testing hesitancy	16.804	14	0.709					
3. Education = discrimination -> vaccine safety acceptance	20.678	13	0.629					
4. Model 2 versus Model 1				−0.058	2	1.411	1.00	Fail to reject
5. Model 3 versus Model 1				1.418	1	1.073	0.23	Fail to reject

[a]Sattora−Bentler scaled chi-square difference.

MLR, maximum likelihood with robust standard errors; SDOH, social determinants of health; Δ, change.

Table 4. Respondent-Level English Proficiency and Parental Nativity Moderators of Hypothesized Social Determinants of Health Predictors

Variable	Testing hesitancy β	Testing hesitancy SE	Vaccine safety β	Vaccine safety SE	Vaccine hesitancy β	Vaccine hesitancy SE
English proficiency ×						
lack of healthcare access	0.03	0.04	−0.04	0.04	−0.02	0.04
education	−0.07	0.05	0.01	0.03	0.01	0.04
discrimination	−0.03	0.07	0.03	0.03	**0.07****	0.03
economic insecurity	0.06	0.08	−0.02	0.05	−**0.09***	0.04
R^2	0.12		0.05		0.04	
ΔR^2	0.01		0.02		0.02	
MLSEM model fit	χ^2 (13)=19.50, p=0.11, CFI=0.99, RMSEA=0.023					
Parental nativity ×						
lack of healthcare access	0.09	0.10	0.24	0.18	**0.37****	0.13
education	−0.03	0.07	0.01	0.10	−0.13	0.08
discrimination	0.06	0.10	0.07	0.05	0.11	0.07
economic insecurity	−**0.21****	0.07	−0.21	0.14	−**0.24***	0.12
R^2	0.12		0.06		0.04	
ΔR^2	0.00		0.03		0.02	
MLSEM model fit	χ^2 (17)=25.24, p=0.09, CFI=0.99, RMSEA=0.023					

Note: Boldface indicates statistical significance (*p<0.05, **p<0.01, and ***p<0.001).
Δ denotes change.
CFI, comparative fit index; MLSEM, multilevel structural equation model; RMSEA, root mean squared error of approximation.

association of economic insecurity with vaccine hesitancy, on the other hand, was amplified for participants with lower economic insecurity.

Illustrated in Figure 3, the data indicated that the association of economic insecurity with testing hesitancy was greater for those with 2 U.S.-born parents than for those with both parents born outside the U.S. (β= −0.21, p<0.01). Similarly, having both parents U.S. born buffered the relationship of economic insecurity with vaccine hesitancy relative to having parents born outside the U.S. Finally, the association between lack of healthcare access and vaccine hesitancy was amplified among those with 2 U.S.-born parents (β=0.37, p<0.01). Overall, the moderators explained an additional 1%−3% of the variance in the SDOH model. The moderation results are shown in Figures 2 and 3.

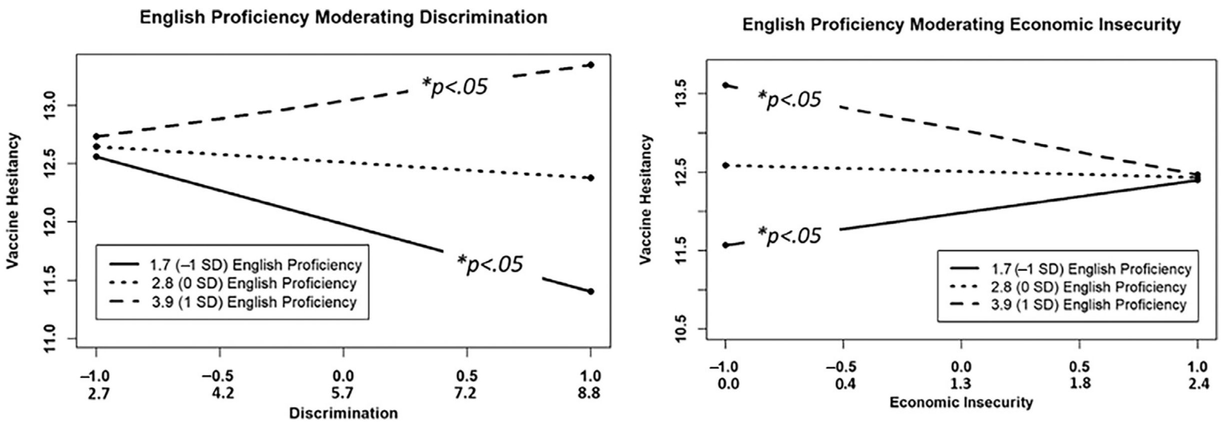

Figure 2. Moderation of English proficiency on associations from discrimination and economic insecurity, respectively, to vaccine hesitancy.

Both Z score scaling and raw score scaling are provided for X-axis and SD of moderators. Moderating associations are displayed as simple slopes plotting of ±1 SD for levels of English proficiency (scaled 1−4) and for the association of discrimination (scaled 1−20). Johnson-Neyman region of significance is indicated by significance level of the simple slope at *p<0.05. Substantively, the positive association of discrimination on vaccine hesitancy in Figure 1 was significantly amplified for higher English-proficient participants than for lower English-proficient participants. At the right, the positive main association of economic insecurity on vaccine hesitancy was amplified for participants with lower English proficiency.

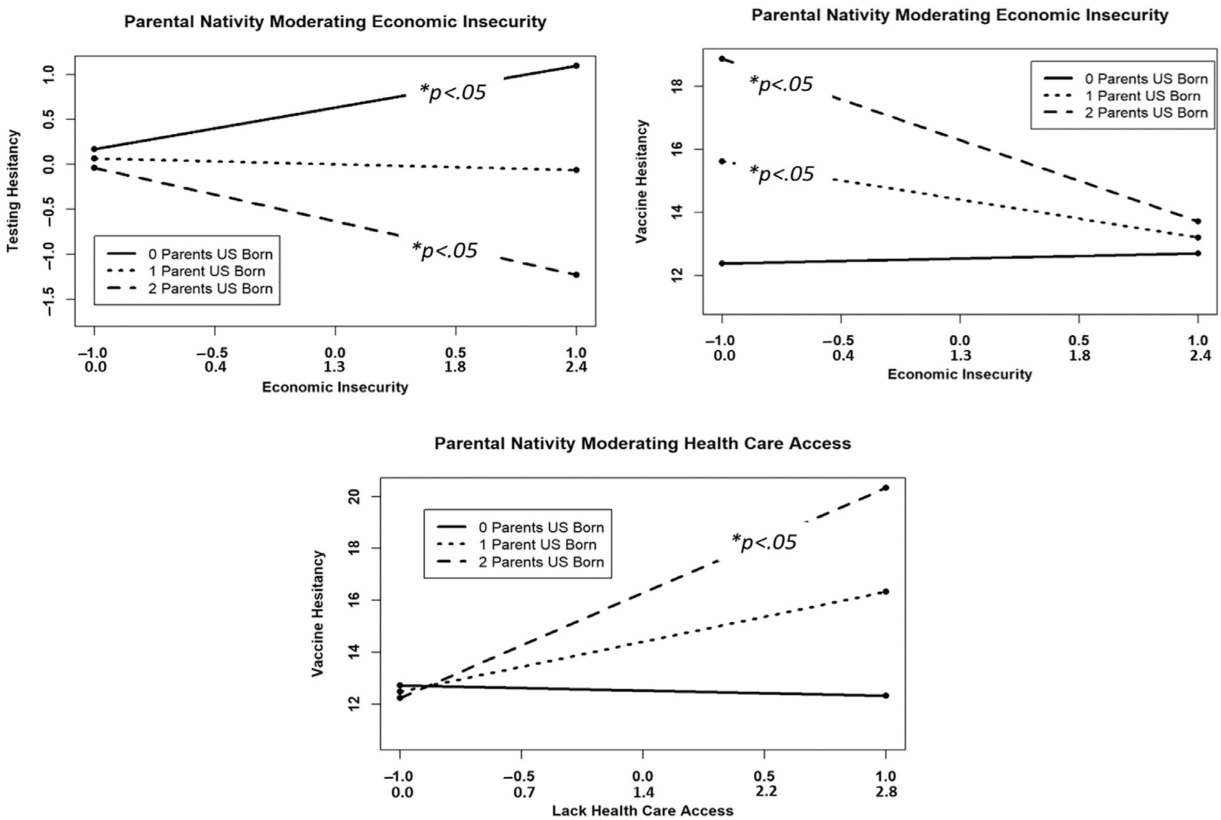

Figure 3. Moderation of parental nativity status on association from economic insecurity to testing hesitancy, economic insecurity on vaccine hesitancy, and association of lack of healthcare access on vaccine hesitancy.

Both Z score scaling and raw score scaling are provided for X-axis and SD of moderators. Moderating associations are displayed as simple slopes plotting of ±1 SD for levels of economic insecurity (scaled 0−6) and for lack of health care access (scaled 0−6). Johnson-Neyman region of significance is indicated by significance level of the simple slope at $*p<0.05$. The data indicated that the association of economic insecurity with testing hesitancy was greater for having both parents born outside the U.S. than for having both parents born in the U.S. Similarly, having both parents U.S. born buffered the relationship of economic insecurity with vaccine hesitancy relative to having parents born outside the U.S. Finally, lack of healthcare access on vaccine hesitancy was amplified when having both parents being of U.S. born.

DISCUSSION

This study tested a multilevel and more comprehensive SDOH model than most SDOH-focused studies, identified distinct paths between SDOH and testing and vaccine attitudes, determined the relative importance of each path for each outcome and moderation with English proficiency and parent nativity, and did so within a sample of only Latinx individuals.[63−69] The proportion of variance explained by SDOH in testing hesitancy is considered large, whereas the variances explained in vaccine hesitancy and safety acceptance are considered small but meaningful.[70] These results can inform disease mitigation efforts among Latinx communities for COVID-19 and beyond.[13]

Regarding research Question 1, our hypothesis that economic, educational, and healthcare access SDOH would be more strongly associated with vaccine and testing outcomes than social and environmental SDOH was not supported. The study findings showed that distinct SDOH were associated with each of the 3 outcomes but did not differ significantly in terms of relative importance. Pandemic vulnerability at the testing site level was the environmental SDOH associated with testing hesitancy, reflecting the strength of the community context and pandemic phase in Latinx attitudes toward testing. Two respondent-level SDOH—economic insecurity and discrimination experience—were positively associated with testing hesitancy. Together, these findings suggest that efforts to reduce testing hesitancy among Latinxs in more vulnerable communities should be multilevel, aligning with social−ecologic approaches.[71] Extant literature, including among Latinx communities, suggests that testing misinformation,[46,72] negative economic repercussions of testing positive (e.g., loss of job, leave without pay),[72] mistrust regarding treatment at the testing site (e.g., questioning citizenship status),[3,43] and sharing of personal information could link these SDOH to greater testing hesitancy.[73,74] As such, the authors recommend better employment protection policies and evidence-based interventions, such as Promotores de Salud (i.e., community health workers), to promote one-on-one and community-wide trust and engagement in preventive health services.[42,75]

Surprisingly, discrimination was positively associated with greater acceptance of vaccine safety. This finding is inconsistent with a study that identified a link between racial, ethnic, and language discrimination in healthcare settings and lower odds of COVID-19 vaccination among Latinxs, African Americans, and Native Americans.[76] One possible explanation for disparate findings is the difference in measures: whereas Sanchez and colleagues[76] (2021) evaluated discrimination in healthcare settings, the measure utilized in this study captured discriminatory experiences across everyday contexts. Although the lack of healthcare access was not a significant SDOH, healthcare discrimination (e.g., shorter appointments or delayed or denied access to care) may limit access to vaccine safety information. A second explanation for the discrepancy across studies could be differences in the target population; the present sample showed low discrimination scores, which may have limited the ability to detect an effect. The respondents' low discrimination scores and a high proportion of foreign-born parents may reflect the protective experiences of recent immigrants described in the Hispanic and immigrant paradoxes.[77,78]

Consistent with extant studies,[79] education was at least marginally associated with all 3 outcomes.[16,17] However, the positive association between education and vaccine hesitancy was inconsistent with some other findings.[79,80] Galletly et al.[81] (2021) indicated that deportation concerns are major barriers to engaging in SARS-CoV-2 testing and vaccination, and these concerns can supersede favorable attitudes toward these services. The study respondents (particularly those with high education) may perceive the vaccine to be safe and have other reasons (e.g., immigration-related concerns) to be hesitant to pursue vaccination. Although pandemic vulnerability, economic insecurity, discrimination, and education were all associated with testing and/or vaccination attitudes, these associations did not differ in magnitude, indicating that no SDOH was more strongly linked to a certain type of testing or vaccination attitude.

In contrast to prior literature,[19] lack of healthcare access was not associated with any outcome. Although 46% of the study sample did not have health insurance, it is possible that Oregon's accessible services through RADx-UP projects, state and local health departments, and community-based organizations lessened the potential role of limited healthcare access in testing and vaccination attitudes. The RADx-UP project provided free, trauma-informed, and culturally responsive SARS-CoV-2 testing and vaccination, community outreach, and health education to the Oregon Latinx community.[42,43,82,83]

Regarding research Question 2, the hypothesis that English proficiency would moderate the strength of the associations between healthcare access, testing, and vaccination outcomes was not supported. English proficiency had no moderating effect on testing hesitancy or vaccine safety acceptance but had moderate associations with economic insecurity and discrimination against vaccine hesitancy. Specifically, respondents with low English proficiency had higher vaccine hesitancy under conditions of low economic insecurity but lower vaccine hesitancy in the face of higher discrimination than those with higher English proficiency.[4] The varied pattern of language associations in this study replicates the mixed results in the literature and underscores the need to more precisely characterize linguistic access to public health information. Interpreters and multilingual resources for Latinx communities were limited,[84] and information in Spanish was often absent on health authorities' websites throughout the pandemic.[31] Ultimately, health information must match the languages of the intended audience to achieve health equity.[85–87]

The authors also evaluated the moderating effect of parental nativity to understand the immigration-related family factors known to correlate with health disparities. The hypothesis that all SDOH associations with testing and vaccination outcomes would be stronger among those with at least 1 non−U.S.-born parent than among those with both parents born in the U.S. was also not supported. Parental nativity moderated SDOH associations with testing and vaccine hesitancy but not vaccine safety acceptance. Specifically, having no U.S.-born parents indicated more testing hesitancy under conditions of high economic insecurity and more vaccine hesitancy under conditions of poor healthcare access. These results suggest that immigration-related stress among family systems may amplify the association between economic insecurity and poor healthcare access to testing and vaccine hesitancy.[88] In a recent study, approximately 1 in 3 Latinx immigrants felt that COVID-19 public health efforts could jeopardize immigration prospects.[81] In 2020, Latinxs also expressed testing and vaccine hesitancy because they believed that engagement in these services would include sharing their personal information with a system that could place family members at risk for deportation.[19]

In summary, the study findings suggest that subgroups of Latinx individuals (1) with low English proficiency and who are more economically secure or (2) who have no U.S.-born parents and low economic security should be prioritized to promote testing confidence. However, subgroups of Latinx individuals (1) with high English proficiency and a low incidence of discrimination or (2) who have no U.S.-born parents and poor healthcare access should be prioritized for vaccine confidence promotion efforts.

Limitations

Regarding the study limitations, the sample reflects Oregon's demographics, which lack the diversity of Latinx subgroups and SDOH across the country, thus limiting generalizability. For example, Latinxs of Mexican origin were overrepresented (77%) compared with the national Latinx population (59.5%).[89] Similarly, the majority of respondents had no U.S.-born parents (92%), limiting the power to test the moderation of 1 versus 2 U.S.-born parents. Moreover, the use of parental nativity as a proxy for immigration-related family factors is not ideal. However, the authors emphasized a trauma-informed approach and participation in testing events; therefore, immigration status and documentation were not solicited. Replication with greater variability in SDOH, Latinx subgroups, and geographic reach could further clarify the most important SDOH in SARS-CoV-2 testing and vaccination attitudes among the Latinx subgroups. Finally, although the findings of this study were evaluated considering existing SDOH theories, the analyses were associative in nature, and future research is needed to empirically evaluate the causal effects.

CONCLUSIONS

Unlike most COVID-19 studies, these data reflect testing and vaccination attitudes during the pandemic phase, when vaccine access was burgeoning, and the omicron variant was prevalent in the U.S. In summary, this study elucidated novel interactions among subgroups of Latinxs and their respective links with distinct SDOH, and SARS-CoV-2 testing and vaccine attitudes. These findings represent an emerging understanding of the SDOH-to-health-outcome complexities within Latinxs, highlighting the need for within-group research to inform preventive efforts.

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