Promoting health equity during a pandemic: Approaches to address vaccination burden and health inequities amongst under-served populations in U.S. and Mexico

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Promoting health equity during a pandemic: Approaches to address vaccination burden and health inequities amongst under-served populations in U.S. and Mexico

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Editorial: Promoting health equity during a pandemic: approaches to address vaccination burden and health inequities amongst under-served populations in U.S. and Mexico

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KEYWORDS

COVID-19, vaccination, under-served populations, health equity, community health

Editorial on the Research Topic
Promoting health equity during a pandemic: approaches to address vaccination burden and health inequities amongst under-served populations in U.S. and Mexico

COVID-19 exacerbated existing health inequities and led to unique ones in vulnerable and historically underserved populations. This edition of *Frontiers* documents the multiple challenges associated with COVID-19 and efforts to ameliorate them among diverse populations that reside in the US Mexico border region and beyond.

The border between Mexico and the United States is a complex space where the unique social and economic context of the region impacts the health, economy and other social determinants which contribute to significant health inequities among the diverse populations that inhabit the region. One consequence of the COVID-19 pandemic was to further aggravate these existing health inequities. For example, Muñiz-Salazar et al. describes how the pandemic interrupted ongoing efforts to detect TB and provide treatment for tuberculosis in the state of Baja California. It also documented how the pandemic limited existing TB services and required service providers to develop and adapt new strategies to detection and treatment such as relying on telemedicine. In another study, Wagler et al. reveals the impact of the pandemic on specific social determinants of health that lead to high-risk behaviors such as unhealthy diets.

The COVID-19 pandemic not only aggravated existing health inequities but also led to unique ones as well. Several of the articles in this Research Topic remind us that technical solutions, such as vaccines, need to account for the social context within which they are implemented to ensure their widespread adoption. A case study in Tucson, Arizona of workers at beauty salons and auto shops provides solid information in addressing this topic in the article by Moreno Ramírez et al.. It also reminds us of the centrality of essential

workers to the functioning of society and the importance of integrating the workplace into the public health response. Studies in Miami-Dade County and Arizona also highlight that social determinate of health, such as migration, that are commonly found on the border are not limited to the geographical region. Bastida et al. and Nuño T. et al. provide evidence of the causes of vaccine hesitancy and acceptance allowing public policymakers to consider the impact of health messages and intervention programs anchored by scientific evidence and the authenticity of the messenger. Finally, Harvey-Vera et al. centers the experience of people who inject drugs and how social stigma and discrimination that they experience along with the limited access to health services complicates COVID-19 vaccination efforts. It reminds us of the importance of accounting for the heterogeneity within populations and the need to tailor interventions to a variety of life circumstances.

Migration is another social determinate of health that plays a prominent role in public health efforts in the border region and beyond. The intense mobility that is a trait at the border posed the challenge of detecting COVID-19 infection among migrant populations as lack of transparency in information and lack of institutional coordination are evidenced by Rangel Gómez, Varela, et al.. Cruz Piñeiro and Ibarra report results from interviews of Central American and Caribbean immigrants stranded in four border cities in Mexico. The experience of these immigrants speaks to the impact of over-crowded shelters and lack of access to services affected the mental, social, and economic health of this population from a diverse cultural and economic perspective. Also deported Mexican migrants faced an increased risk of COVID-19 infections due to a lack of vaccines and unhealthy conditions in detention settings in the US as is described by Martínez-Donate et al..

Several articles in this Research Topic address the unique mental health impacts of the COVID-19 pandemic. Morales Chainé et al. addresses the mental health symptoms that impacted the population suffering from COVID-19 and the need to target specific populations such as women with psychological care. Furthermore, Jaramillo et al. attests to the centrality of mental health issues to the pandemic. The article not only contributes evidence from the 794 screenings but also documents a unique strategy of bi-directional monitoring among non-specialized health personnel at the Health Windows and Mobile Health Units for the immigrant population that will allow the promotion and early care for mental health beyond the COVID pandemic. The impact of COVID-19 on the healthy development of adolescents is still an interrogation mark, evidence is key to understanding how long COVID-19 plays a role in depression and anxiety, and other acute and long-term illnesses. Nuño V. L. et al. describes the procedure to gather evidence that in the future may inform policy in a multifaceted study of adolescents 12 to 17 years through intersectionality theory.

The articles in this Research Topic not only highlight the impact of the COVID-19 pandemic on the health of different populations in the border region and beyond but also highlight the challenges and limitations of public health efforts to ensure access to effective messages, services, and interventions. Migrant communities are fluid and require cultural humility from service provides and public health officials to create credible and culturally sensitive information as Rangel Gómez, Cruz-Piñeiro, et al. concludes.

Lower health insurance rates limited English proficiency, and fear of deportation and discrimination, among others, require public health organizations to adopt non-traditional engagement and outreach approaches such as Ventanillas de Salud (VDS) and Mobile Health Units (MHU) to engage effectively with these populations. Several articles in this Research Topic highlight factors, such as availability and health regulations, that negatively impacted the health of those populations with comorbid conditions such as diabetes, hypertension, and obesity. Infante et al. calls for an inclusive policy that, together with the assistance of civil society organizations, helped migrants to overcome barriers to service and make public health institutions more accessible.

To address some of these limitations, the Centers for Disease Control and Prevention (CDC) funded several multi-year cooperative agreements with existing national networks serving immigrant communities across the United States with the goal of improving health promotion and response activities with limited English proficiency (LEP) Latino essential workers, their families, and the communities where they live. One such cooperative agreement, entitled "*Improving Clinical and Public Health Outcomes through National Partnerships to Prevent and Control Emerging and Re-Emerging Infectious Disease Threats*" fostered a partnership among the Mexican Section of the USMBHC, the Latino Commission on AIDS (LCOA) and Alianza Americas (AA) to integrate their existing infrastructure and relationships with these communities into the COVID-19 response efforts. Rosales et al. describes the efforts of the Mobile Health Units (MHU) that formed and essential part of this cooperative agreement. Their work was guided by three strategies: disseminate and adopt; inform and adapt; and target and train; with the aim of improve health promotion and development of healthcare strategies as a direct response to health emergencies such as the COVID-19 pandemic.

Collaborative approaches to support transborder communities during the COVID-19 pandemic were put in place all along the border region to address the health needs with proper communication, coordination, and collaboration as described by Jiménez and Kozo. New collaborative models such as Ventanillas de Salud and Mobile Health Units reveal the importance of networks that allow putting forward preventive health activities for historically underserved populations as Rangel Gómez, Salazar, et al. describes.

Mobile Outreach Vaccination and Education for Underserved Populations (MOVE UP) as well as Mobile Health Units institutionalized a network of collaboration to bridge the health equity gap for disadvantaged populations such as American Indians, Hispanics, and Blacks as is the case in Arizona. Fingesi et al. examines the need to analyze policy interventions to inform and evaluate the impacts of perceptions and experiences of COVID-19.

Latinx populations and immigrant communities experienced higher rates of infection, were overrepresented in essential jobs and were often excluded from government assistance programs such as unemployment benefits and health insurance subsidies or coverage. Furthermore, limitations of public health institutions to effectively address factors such as limited English proficiency, rural locations, and other structural barriers to health complicated access health information, interventions, and care during the COVID-19

pandemic. This issue of *Frontiers* not only identifies health impacts of COVID-19 but helps to build an evidence-base for diverse strategies to improve access to culturally competent health services for historically underserved populations. If translated into practice, the collaborative efforts and models discussed in this Research Topic will serve to build a more inclusive Public Health infrastructure to address endemic health inequities as well as better prepare society for the next pandemic.

Conflict of interest

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Screening Tool for Mental Health Problems During COVID-19 Pandemic: Psychometrics and Associations With Sex, Grieving, Contagion, and Seeking Psychological Care

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Background: The COVID-19 pandemic has created a public mental health crisis. Brief, valid electronic tools are required to evaluate mental health status, identify specific risk factors, and offer treatment when needed.

Objective: To determine the construct validity, reliability, and measurement invariance of a brief screening tool for mental health symptoms by sex, loss of loved ones, personal COVID-19 status, and psychological care-seeking during the COVID-19 pandemic. Furthermore, the aim involved establishing a predictive pattern between the mental health variables.

Method: A total sample of 27,320 Mexican participants, with a mean age of 32 years (*SD* = 12.24, *range* = 18–80), 67% women (*n* = 18,308), 23.10% with a loss of loved ones (*n* = 6,308), 18.3% with COVID-19 status (*n* = 5,005), and 18.40% seeking psychological care (*n* = 5,026), completed a questionnaire through a WebApp, containing socio-demographic data (sex, loss of loved ones, COVID-19 status, and psychological care-seeking) and the dimensions from the Posttraumatic Checklist, Depression-Generalized Anxiety Questionnaires, and Health Anxiety-Somatization scales. We used the confirmatory factor analysis (CFA: through maximum likelihood to continuous variable data, as an estimation method), the invariance measurement, and the structural equational modeling (SEM) to provide evidence of the construct validity of the scale and the valid path between variables. We analyzed the measurement invariance for each dimension by comparison groups to examine the extent to which the items showed comparable psychometric properties.

Findings: The tool included eight dimensions: four posttraumatic stress symptoms - intrusion, avoidance, hyperactivation, and numbing, as well as depression, generalized

anxiety, health anxiety, and somatization The tool's multidimensionality, was confirmed through the CFA and SEM. The participants' characteristics made it possible to describe the measurement invariance of scales because of the participants' attributes. Additionally, our findings indicated that women reported high generalized anxiety, hyperactivation, and depression. Those who lost loved ones reported elevated levels of intrusion and health anxiety symptoms. Participants who reported having COVID-19 presented with high levels of generalized anxiety symptoms. Those who sought psychological care reported high levels of generalized anxiety, intrusion, hyperactivation, and health anxiety symptoms. Our findings also show that intrusion was predicted by the avoidance dimension, while health anxiety was predicted by the intrusion dimension. Generalized anxiety was predicted by the health anxiety and hyperactivation dimensions, and hyperactivation was predicted by the depression one. Depression and somatization were predicted by the health anxiety dimension. Last, numbing was predicted by the depression and avoidance dimensions.

Discussion and Outlook: Our findings indicate that it was possible to validate the factor structure of posttraumatic stress symptoms and their relationship with depression, anxiety, and somatization, describing the specific bias as a function of sociodemographic COVID-19-related variables. We also describe the predictive pattern between the mental health variables. These mental health problems were identified in the community and primary health care scenarios through the CFA and the SEM, considering the PCL, depression, generalized anxiety, health anxiety, and somatization scales adapted during the COVID-19 pandemic. Therefore, future studies should describe the diagnosis of mental health disorders, assessing the cut-off points in the tool to discriminate between the presence and absence of conditions and mental health cut-off points. Community and primary care screening will lead to effective early interventions to reduce the mental health risks associated with the current pandemic.

Limitations: Future studies should follow up on the results of this study and assess consistency with diagnoses of mental health disorders and evaluate the effect of remote psychological help. Moreover, in the future, researchers should monitor the process and the time that has elapsed between the occurrence of traumatic events and the development of posttraumatic stress and other mental health risks through brief electronic measurement tools such as those used in this study.

Keywords: stress, mental health symptoms, CFA, measurement invariance, COVID-19

INTRODUCTION

The risk of suffering from SARS-CoV-2 (COVID-19) began at the end of 2019 in Hubei Province, China, and spread worldwide. By 29 March 2022, over 150.4 million people had been diagnosed with COVID-19, and there had been 2.7 million deaths, with a mortality rate of 1.8%, in America alone (Panamerican Health Organization, 2022). Moreover, the risk of suffering from COVID-19 and losing loved ones to COVID-19 is associated with stress, depression, and anxiety (Rogers et al., 2020), which are not always followed by seeking psychological care.

Necho et al. (2021), summarized data on mental health symptoms from 16 studies assessing 78,225 participants. They reported 37.54% suffering from stress, 38.12% from anxiety,

and 34.31% from depression and pointed out COVID-19 as a potential public mental health problem for the global community. In Mexico, Morales-Chainé et al. (2020, 2021a,b) reported high frequencies of stress, sadness, and anxiety symptoms according to an evaluation of 33,044 participants during the COVID-19 pandemic. These studies reported that mental health symptoms have varied due to sex, COVID-19 condition, alcohol abuse, and suffering from abuse. Measuring these mental health conditions is therefore essential.

Posttraumatic stress disorder (PTSD), which is no longer coded as an anxiety disorder in the Statistical Manual of Mental Disorders (American Psychiatric Association [APA], 2013), has been measured throughout a Checklist (PCL) developed by Weathers et al. (1994). It has been developed several tool versions

-one for the military (PCL-M), one for civilians (PCL-C), and one for special populations (PCL-S; McDonald and Calhoun, 2010). Consequently, the validation of PCL-C is crucial to its remote use during the COVID-19 pandemic.

As a result of using the PCL-C, its 17-item instrument (Five-option Likert response) has been validated to assess stress in different samples, particularly the civil population (PCL-C) experiencing traumatic events. Asmundson et al. (2000), reported the PCL-C factor structure. Specifically, they reviewed 349 papers on their Confirmatory Factor Analysis (CFA) in primary care settings, using the Diagnostic and the American Psychiatric Association [APA] (2000). Researchers reported that the hierarchical model of four factors was an adequate fit model, comprising an $X^2(114) = 392.21$, a Root Mean Square Error of Approximation *(RMSEA)* = 0.08, a Standardized Root Mean Square Residual *(SRMR)* = 0.07, a Tucker-Lewis Index *(TLI)* = 0.9, and a Comparative Fit Index *(CFI)* = 0.091. Subsequently, in McDonald and Calhoun (2010), reported the temporal stability, internal consistency, test-retest reliability, and convergent validity of the PCL-C. In Wilkins et al. (2011), after analyzing 72 papers, reported adequate fit indices indicating a satisfactory four-factor structure.

It is known that the PCL correlates moderately to firmly with other mental health symptoms such as those related to anxiety, depression, and physical functioning (McDonald and Calhoun, 2010). Elhai and Palmieri (2011) recommended analyzing both the factor structure latent variables of the PCL and the screening instruments correlating with it. These could shed light on the etiology, evolution, and treatment of PTSD and these other mental health symptoms from their early stages.

In this respect, Goldberg et al. (2017) measured depression and anxiety symptoms in 1,488 participants with a scale of 10, five-option-response items. They concluded that their tool was a valid screening instrument for depression-anxiety diagnosis in primary care settings (with 89.6% of above threshold mood or anxiety disorder diagnoses). Morales-Chainé et al. (2021a) adapted the scale with 0 to 10-option-response items. They reported that the avoidance-depression scale resulted with a Cronbach alpha of 0.73, a $X^2(10) = 15913.02$, a *RMSEA* = 0.014, a *SRMR* = 0.005, a *TLI* = 0.999, and a *CFI* = 1. The authors also reported that the generalized anxiety scale got a Cronbach alpha of 0.93, a $X^2(6) = 30,032$, a *RMSEA* = 0, a *SRMR* = 0, a *TLI* = 1.000, and a *CFI* = 1.

Regarding the assessment of somatization and based on a review of 31 theoretical papers, Velasco et al. (2006) have suggested that these symptoms coexisted with pathological anxiety and depression diagnoses. They have defined somatic symptoms such as those with a non-organic cause (SWOC) and signs of unjustified clinical occurrence. Velasco et al. (2006) have concluded that SWOC is associated with contextual, demographic, and individual subjectivity.

Afterward, Morales-Chainé et al. (2021b) reported a somatization scale with a Cronbach alpha of 0.96, a $X^2(10) = 20656.78$, a *RMSEA* = 0.009, a *SRMR* = 0.002, a *TLI* = 0.999, and a *CFI* = 1. They also reported a health anxiety scale with a $X^2(6) = 42,994.87$, a *RMSEA* = 0, a *SRMR* = 0, a *TLI* = 1, and a *CFI* = 1.

After validating the named scales, Morales-Chainé et al. (2021a) reported a predictive path between dimensions, where sadness and anxiety were associated with acute stress. Particularly, Morales-Chainé et al. (2021b), through a structured equational model (SEM) found a similar path where avoidance predicted acute stress, acute stress predicted health anxiety, health anxiety predicted generalized anxiety and somatization, and generalized anxiety/depression predicted numbing/anger.

In the context of good-fitted tools to measure mental health symptoms, Elhai and Palmieri (2011) suggested considering the moment when those instruments are administered, the sociodemographic characteristics of the population, settings, and research methods to maintain a better understanding of the symptoms and the valid factor structure of the tools. Together with the PCL-C, decisions about factor structure and the latent variables of anxiety, depression, and somatization symptoms may differ due to participants' country, clinical setting, or demographic characteristics (Goldberg et al., 2017).

Moreover, the assessment of tools measurement invariance, suggested by McDonald and Calhoun (2010) and Elhai and Palmieri (2011), are actions that could reveal the biases between compared groups when analyzing sociodemographic variables (Millsap, 2011). Calculation of the measurement invariance could guide decision-making on risky levels of mental health that could vary because of the population's characteristics (community vs. specialized settings), type of traumatic events, and cultural conditions (Wilkins et al., 2011).

As a tool of measurement invariance assessment (metric, strong, and strict) by comparing samples (by sex or care-seeking), the CFA generates evidence of the structural stability of the measurement. Invariance measurement is a way to establish how many of the groups-of-comparison differences and the between-symptoms predictive level result from the latent variables of interest, which could be an effect of the differences in the psychometric characteristics of the items. It is, therefore, possible to compare groups by sociodemographic or cultural factors or willingness to accept intervention (Elhai and Palmieri, 2011). The structure factor of mental health screening and its fitted model analyses are justified when researchers must work with new populations, different cultures, traumas, or novel methods, such as those used during the COVID-19 pandemic (Elhai and Palmieri, 2011). Research on the structure factor of screening tests could be linked to events during the COVID-19 pandemic, when convenience took priority over accuracy during the early stages of mental health symptoms, and when the mental-health-symptoms relationships are beneficial to understanding their progression.

Since mental health risks progress and are associated with sociodemographic conditions, it is essential to describe their relationship by analyzing measurement invariance and the scope of these comparisons with a verified structure factor test in Mexico. Accordingly, the purpose of this study was to determine the construct validity and reliability of a brief screening tool for (a) mental health symptoms; (b) comparing mental health symptoms by sex, loss of loved ones, COVID-19 status, and psychological care-seeking during the COVID-19 pandemic; through (c) examining measurement

invariance of the test items between comparison groups, and (d) establishing the predictive pattern between mental health variables through the SEM.

METHOD

Design

We used a correlational study in which participants were invited to enter a programmed platform, WebApp, between 1 January and 31 August 2021. The link was available through the Mexican Health Ministry Website (announced by press conferences on the radio, television, and Internet).

Participants were asked to read the instructions. *The risk of suffering from COVID-19 is an unprecedented social condition that affects us. The current COVID-19 pandemic is a situation in which we must understand our feelings. As a result, we should see what to do about it and where to find professional help based on evidence whenever needed. We, therefore, invite you to answer the following questionnaire. You will receive feedback on your answers and counseling to cope with the emotions, thoughts, and behaviors due to the current health contingency. Your participation is voluntary, and the information you provide will be treated confidentially. Your information management will be attached to the Mexican privacy policies for personal data treatment.*

Participants

We surveyed 27,320 persons whom participation was voluntary. Thus, sample wasn't homogeneous. Participants were 32 years ($SD = 12.24$; range = 18–80; 10.4% of 18–19; 25.5% of 20–24; 16% of 25–29; 12.2% of 30–34; 10% of 35–39; 8% of 40–44; 6.8% of 45–49; 4.8% of 50–54; and 6.5% over 55 years), 67% were women ($n = 18,308$), 23.10% reported the loss of loved ones ($n = 6,308$), 18.30% reported COVID-19 symptoms or diagnosis ($n = 5,005$), and 18.40% were seeking remote psychological care ($n = 5,026$: see **Table 1**).

Participants agreed to answer the survey according to the privacy policies established in the General Protection of Personal Information in Possession of Obligated Parties Act (Spanish Acronym LGPDPPSO, 2017) and the General Office of the Community Care Guidelines of the National Autonomous University of Mexico (Spanish Acronym DGACO-UNAM). Data were asymmetrically encrypted. The database was held in the official university domain, with security locks to protect the information and guarantee their management with the participants' informed consent.

Researchers explained to participants that confidentiality would be maintained by calculating general averages in the informed consent form. Participants were told that they would be used for dissemination and epidemiological research. They had the right to decline the use of their information and withdraw from participation in the study. Incentives were not given, but immediate feedback was supplied in psychoeducational tools (infographics, videos, and Moodle ® courses on COVID-19, self-care, relaxation techniques, problem-solving, and socioemotional management skills). Phone numbers were provided to obtain remote psychological care from the Health Ministry and the

UNAM Services. Finally, the benefits of accessing the platforms or calling to deal with mental health conditions were described. A data section to request remote psychological care was included where participants could give their phone number or email so that they could be contacted. The protocol was approved by the Psychology College Ethics Committee on Applied Research from UNAM on 16 October 2020.

Instruments

For this study, we used a WebApp programmed through Linux®, PHP®, HTML®, CSS®, and JavaScript® software (Morales-Chainé et al., 2020, 2021a,b). The Cronbach alpha of the tool was 0.96. It included (1) sociodemographic and COVID-19-related variables: sex, loss of loved ones due to COVID-19, COVID-19 state (suspected or confirmed COVID-19), and remote psychological care-seeking; (2) the PCL-C test with 15 items (adapted from Weathers et al., 1994; Asmundson et al., 2000 by Morales-Chainé et al., 2020, 2021a,b), with 10 option responses (from zero, nothing, to 10, totally), and a four-factor structure [intrusion, with five items (e.g., *I repeatedly think or imagine I am going to get sick*), avoidance, with three items (e.g., *I try to avoid thinking, feeling, or talking about the disease*), numbing, with four items (e.g., *I have lost interest in activities I previously enjoyed*), and hyperactivation, with three items (e.g., *I find it difficult to fall or stay asleep*)]; (3) depression (Arrieta et al., 2017; Goldberg et al., 2017; Morales-Chainé et al., 2021b), consisting of 3 items with 10 response options from 0 to 10 (e.g., *I experience very little interest or pleasure in activities*); (4) Generalized Anxiety scale (Goldberg et al., 2017), comprising 5 items with 10 response options from 0 to 10 (e.g., *I have felt nervous or on edge*); (5) Health Anxiety scale (Velasco et al., 2006; Morales-Chainé et al., 2020), which has 4 items, with response options from 0 to 10 (e.g., *I feel worried about my general state of health*); and (6) Somatization scale, with four items with response options from 0 to 10 [Velasco et al., 2006; Morales-Chainé et al., 2020; e.g., *I monitor myself (self-touching, self-observation, etc.), I record what I note or feel in my body*].

Data Analysis

We examined the multidimensionality of the scale to provide its construct-validity evidence. We run the confirmatory factor analysis (CFAs) through the maximum-likelihood to continuous-variable-data estimation method (Elhai and Palmieri, 2011).

The factors considered were an intrusion, avoidance, hyperactivation, numbing, depression, generalized anxiety, health anxiety, and somatization. The multidimensional model was adjusted, and the final items in each scale obtained standardized factor loadings above 0.4. The overall fit of the models was assessed using the chi-square goodness of fit test. Since the chi-square goodness of fit test is over-sensitive to large sample sizes, more emphasis was given to fit indices such as the CFI, TLI, RMSEA, and SRMR. Models with CFI and TLI values greater than 0.9 and RMSEA and SRMR values smaller than 0.08 and 0.06 were considered indicators of adequate data fit (Browne and Cudeck, 1993; West et al., 2012). Modification Indices (MI) were examined to determine which items needed to be correlated to get a better model adjustment.

TABLE 1 | Participants' distribution by sex, loss of loved ones, COVID-19 status, and psychological care-seeking groups.

					Total						
Women				Men				Total			
n		%		*n*		%		*n*		%	
18,308		67.00		9,012		33.00		27,320		100%	
n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Non-loss of loved one		Loss of loved one		Non-loss of loved one		Non-loss of loved one		Non-loss of loved one		Non-loss of loved one	
13,985	76.4	4,323	23.6	7,027	78	1,985	22	21,012	76.9	6,308	23.1
Non-Covid-19 status		Covid-19 status		Non-Covid-19 status		Covid-19 status		Non-Covid-19 status		Covid-19 status	
14,926	81.5	3,382	18.5	7,389	82	1,623	18	22,315	81.7	5,005	18.3
Non-psychological care-seeking		Psychological care-seeking		Non-psychological care-seeking		Psychological care-seeking		Non-psychological care-seeking		Psychological care-seeking	
14,685	80.2	3,623	19.8	7,609	84.4	1,403	15.6	22,294	81.6	5,026	18.4

The statistical procedure consisted of several analytical steps. Based on the sex of the participants, first, the entire sample was randomly divided into two subsamples to compare and verify the CFA results through its replication, getting the multidimensional model. Two groups resulted in 13,660 participants in sample 1 and 13,660 in sample 2 (same men-women proportion in both samples). The distribution of participants according to sex, loss of loved ones due to COVID-19, COVID-19 status, and psychological care-seeking groups for both sub-samples and the total sample is shown in **Supplementary Appendix A**.

The second step involved fitting the model to each of the two samples and the entire sample through the chi-square goodness of fit test, emphasizing the fit indices. The factors loading of each item and scale are shown in **Supplementary Appendix B**. Once we determined the final model, the third step involved calculating the reliability of the tool with their Cronbach Alpha and the correlations between scales with the Pearson analysis to identify the level of the relationship and the independence between the dimensions. Correlations are shown in **Supplementary Appendix C**.

The fourth step consisted of analyzing the measurement invariance for the whole sample for each dimension by comparison group (by sex, loss of loved ones, COVID-19 status, and psychological care-seeking), to examine the extent to which the items showed equivalent psychometric properties. A series of multiple-group CFA models fit the data, each with increasing equality constraints in the item parameters (Jöreskog, 1971; Sörbom, 1974; Vanderberg and Lance, 2000).

Prior, configural invariance was tested by allowing all parameters (loadings, thresholds, and unique factor variances) to be freely estimated. Next, metric invariance was assessed by constraining the item loadings to equality across comparison groups. Strong measurement invariance was tested by constraining the item thresholds to equality across comparison groups. Finally, strict measurement invariance tested equality across comparison groups in the unique factor variances. Nested

models were evaluated using the chi-square test for continuous data. We also examined the CFI and TLI change from the less restricted model to the more constrained model (Δ). The more constrained model with changes in the CFI values of 0.01 or less was regarded as good (Cheug and Rensvold, 2002), and the RMSEA values of 0.015 or less were also considered acceptable. In cases where the invariance models did not fit the data, partial invariance was examined by allowing some of the item parameters to vary between groups. Modification Indices (MI) were examined to determine which item parameters needed to be freely estimated across groups. The measurement invariances were calculated for each study's comparison group (e.g., sex). As a result of the invariance measurement, we calculated Cohen's d, considering comparison groups' thresholds, unique variance, and standard deviation from the fitted strict model (e.g., sex).

The fifth step examined the difference between groups with the whole sample according to the latent means of dimensions (e.g., loss of loved ones). In the final invariance model, we constrained each group's latent variables, comparing the model's fit with and without constraints in the means. Again, significant chi-square values, CFI values of less than 0.01, and RMSEA values differences (Δ) of less than 0.015 indicated that the constrained means model was a model with restrictions with a good fit, meaning there were no significant differences between groups.

In the sixth step, we undertook means, standard deviation, multivariate analysis, and return to Cohen's *d* effect analysis to consider such means comparison of the dimensions with the whole sample. Finally, we integrated an overall model, including the prediction between latent variables via a chi-square test and their fit indices through structural equation modeling (SEM; Morales-Chainé et al., 2021b).

The descriptive analyses were conducted in IBM ® SPSS 25 software. The confirmatory factor loading analysis, and the structural equation modeling, were conducted in RSTUDIO ® 1.4.1106 through the Lavaan 0.6-9 package, ending after the necessary number of iterations to estimate the standard

errors, observed information, and Hessian observed information. Specifically, through the maximum-likelihood packages, we used the Model Optimization Method, the number of free parameters, and observations to validate the models. Furthermore, we used the Model Test User Model with their test statistics, degrees of freedom, p-value (chi-square), and the Model Test Baseline Model packages to get the fit index.

FINDING

Confirmatory Factorial Analyses

Results from the eight-factor model are shown in **Table 2**. The fits to the data in both samples were adequate, with $RMSEAs < 0.08$, $SRMRs < 0.06$, and $TLIs$, and $CFIs > 0.9$, indicating a similar factor structure between them and with the total one. Thus, a similar CFA model was obtained in the two samples and the whole one. As noted in **Table 2**, overall model, in sample 1, obtained a $X^2(406) = 20,479.87$, $p < 0.001$; a $RMSEA = 0.06$; a $SRMR = 0.049$; a $CFI = 0.928$; and a $TLI = 0.917$. The overall model for sample 2 obtained a $X^2(406) = 23,536.61$, $p < 0.001$; a $RMSEA = 0.065$; a $SRMR = 0.042$; a $CFI = 0.936$; and a $TLI = 0.927$. The overall model for the whole sample showed a $X^2(406) = 43,509.5$, $p < 0.001$; a $RMSEA = 0.062$; a $SRMR = 0.046$; a $CFI = 0.933$; and a $TLI = 0.923$. The factor loadings from each item of the eight factors for each sample and the total one, resulting from the CFAs, are included in **Supplementary Appendix B**. The correlations between scales are shown in **Supplementary Appendix C**. In addition, **Table 2** shows Cronbach's analysis coefficients for each dimension and overall model, in both sub-samples and the total sample. Reliability values were $\alpha = 0.95$ for sample 1, $\alpha = 0.97$ for sample 2, and $\alpha = 0.96$ for the total sample.

The MI resulted in adding a correlation between the items *I repeatedly have nightmares about the disease,* and *I have unwanted physical reactions when I think about the disease (such as arrhythmia, hyperventilation, sweating)* from the intrusion dimension in the whole sample and the two subsamples. Additionally, for sample 2, specifically in the intrusion dimension, a correlation between the following items was added: *I try to avoid thinking, feeling, or talking about the disease*, and *I try to avoid looking up or referring to official information on the disease.* The MI also indicated a correlation between items *I have lost interest in activities I previously enjoyed,* and *I have felt distant from people with whom I regularly interact since the pandemic,* for the numbing dimension of sample 1 and for the total sample. Finally, the MI indicated a correlation between items *I feel worried about my general state of health,* and

I believe that I suffer from a severe physical disease (even though it hasn't been confirmed), as well as between *I am currently worried about a certain number of physical pain spots in my body,* and *I believe I am suffering from a severe physical disease (even though it hasn't been confirmed)* in the health anxiety dimension, in sample 2 and in the total sample.

Measurement Invariance

Tables 3A–D show the results of measurement invariance models comparisons of the eight dimensions, by sex, loss-of-loved-ones, COVID-19 status, and psychological care-seeking, respectively. As expected, the difference in the chi-square test of model fit of the configural, metric, strong, and strict invariance models was significant in most comparisons due to the large sample sizes; we considered the change in CFIs and RMSEA. As in every comparison, we incorporated the correlation between the four pairs of items referred to in the CFAs section (intrusion, numbing, and health anxiety dimensions) as MI indicated. Specifically, by sex and psychological care-seeking comparison groups, correlations between the first three pairs of items were restricted to equality during the invariance measurement calculation, obtaining an adequately fitted model. For the loss of loved ones and COVID-19 status groups, we added the restricted correlations between the four pairs of items of health anxiety during the invariance measurement calculation. In **Table 4**, we resumed the freely estimated parameters resulting from the measurement invariance analysis. We did it to avoid overemphasizing the nuisances in the assessed groups.

Given that the change differences (Δ) between the measurement invariance models are smaller than 0.01 for the $CFIs$ and smaller than 0.015 for the $RMSEAs$, **Table 3A** shows that the intrusion, avoidance, hyperactivation, depression, generalized anxiety, and somatization dimensions obtained a measurement invariance between sex groups. The numbing and health anxiety dimensions obtained a partial measurement invariance between them. Additionally, **Table 3A** shows that restricted means models of intrusion, numbing, generalized anxiety, health anxiety, and somatization, compared to those when means were freely estimated by sex, resulted in changes that were smaller than 0.01 for the $CFIs$ and smaller than 0.015 for the $RMSEAs$.

Table 3B shows that intrusion, depression, generalized, and health anxiety dimensions obtained a measurement invariance by reporting the loss of a loved one condition. The avoidance, numbing, hyperactivation, and somatization dimensions obtained a partial measurement invariance. Moreover, **Table 3B** shows that restricted means models of generalized anxiety, compared to those when means were freely estimated by the loss

TABLE 2 | Fit indices, Chi-square analysis, and Cronbach's alpha, of the overall tool, for each sub-sample, and from the whole one.

	X^2	df	$p \leq$	RMSEA	SRMR	CFI	TLI	Cronbach's alpha
Overall CFA								
Sample 1	20479.870	406	0.001	0.060	0.049	0.928	0.917	0.95
Sample 2	23536.610	406	0.001	0.065	0.042	0.936	0.927	0.97
Total	43509.500	406	0.001	0.062	0.046	0.933	0.923	0.96

TABLE 3A | Differences between models' chi-squares, df, measurement invariance fit indices (configural, metric, strong, and strict), and means, by sex for all dimensions.

Models	X^2(df)	CFI	TLI	RMSEA	SRMR	ΔX^2 (Δdf)	ΔX^2's p-value	ΔCFI	ΔRMSEA	ΔTLI
Intrusion										
Configural	631.39 (8)	0.992	0.981	0.076	0.014					
Metric	655.08 (12)	0.992	0.987	0.063	0.017	23.69 (4)	0.000	0.000	−0.013	−0.006
Strong	792.55 (16)	0.990	0.988	0.060	0.020	137.47 (4)	0.000	0.002	−0.003	−0.001
Strict	1017.68 (21)	0.988	0.988	0.059	0.027	225.13 (5)	0.000	−0.002	−0.001	0.000
Strict with correlations between items	1040.49 (22)	0.987	0.989	0.058	0.027	247.94 (6)	0.000	−0.003	−0.002	−0.001
Means comparison	1416.20 (23)	0.983	0.985	0.067	0.053	375.71 (1)	0.000	0.004	0.009	0.004
Avoidance										
Configural										
Metric	33.44 (2)	0.998	0.995	0.034	0.014					
Strong	95.77 (4)	0.995	0.993	0.041	0.018	62.34 (2)	0.000	0.003	0.007	0.002
Strict	166.11 (7)	0.991	0.993	0.041	0.021	70.33 (3)	0.000	0.004	0	0.000
Means comparison	527.16 (8)	0.972	0.979	0.069	0.051	361.05 (1)	0.000	0.019	0.028	0.014
Numbing										
Configural	0.45 (2)	1.000	1.000	0.000	0.000					
Metric	21.16 (5)	1.000	0.999	0.015	0.008	20.71 (3)	0.000	0.000	0.015	0.001
Strong	157.04 (8)	0.996	0.995	0.037	0.015	135.87 (3)	0.000	0.004	0.022	0.004
Partial strong	25.01 (6)	1.000	0.999	0.015	0.008	3.85 (1)	0.050	0.000	0.000	0.000
Partial strict	95.02 (8)	0.998	0.997	0.028	0.014	70.00 (2)	0.000	−0.002	0.013	0.002
Partial strict with correlations between items	101.67 (9)	0.998	0.997	0.027	0.015	76.66 (3)	0.000	−0.002	0.012	0.002
Means comparison	214.95 (10)	0.995	0.994	0.039	0.028	113.28 (1)	0.000	0.003	0.012	0.003
Hyperactivation										
Configural										
Metric	7.14 (2)	1.000	1.000	0.014	0.005					
Strong	21.03 (4)	0.999	0.999	0.018	0.007	13.90 (2)	0.001	0.001	0.004	0.001
Strict	44.89 (7)	0.999	0.999	0.020	0.008	23.86 (3)	0.000	0.000	0.002	0.000
Means comparison	705.13 (8)	0.978	0.984	0.08	0.074	660.24 (1)	0.000	0.021	0.060	0.015
Depression										
Configural										
Metric	41.06 (2)	0.999	0.997	0.038	0.013					
Strong	88.86 (4)	0.998	0.997	0.039	0.015	47.81 (2)	0.000	0.001	0.001	0.000
Strict	274.48 (7)	0.993	0.994	0.053	0.035	185.61 (3)	0.000	−0.005	0.014	0.003
Means comparison	817.79 (8)	0.979	0.984	0.086	0.073	543.31 (1)	0.000	0.014	0.033	0.010
Generalized anxiety										
Configural	464.27 (10)	0.996	0.992	0.058	0.008					
Metric	486.93 (14)	0.996	0.994	0.050	0.010	22.66 (4)	0.000	0.000	−0.008	−0.002
Strong	715.39 (18)	0.994	0.993	0.053	0.015	228.46 (4)	0.000	0.002	0.003	0.001
Strict	930.92 (23)	0.992	0.993	0.054	0.017	215.53 (5)	0.000	−0.002	0.001	0.000
Means comparison	1579.62 (24)	0.987	0.989	0.069	0.068	648.70 (1)	0.000	0.005	0.015	0.004
Health anxiety										
Configural	173.92 (2)	0.997	0.984	0.079	0.007					
Metric	187.21 (5)	0.997	0.993	0.052	0.010	13.29 (3)	0.004	0.000	−0.027	−0.009
Partial metric	174.09 (3)	0.997	0.990	0.065	0.007	0.174 (1)	0.677	0.000	−0.014	−0.006
Partial strong	195.71 (4)	0.997	0.991	0.059	0.009	21.62 (1)	0.000	0.000	−0.006	−0.001
Partial strict	284.20 (6)	0.996	0.992	0.058	0.012	88.49 (2)	0.000	−0.001	−0.001	−0.001
Partial strict with correlations between items	288.27 (7)	0.996	0.993	0.054	0.012	92.57 (3)	0.000	−0.001	−0.005	−0.002
Means comparison	429.66 (8)	0.994	0.990	0.062	0.033	141.38 (1)	0.000	0.002	0.008	0.003
Somatization										
Configural	43.79 (4)	0.998	0.995	0.027	0.005					
Metric	46.38 (7)	0.998	0.997	0.020	0.007	2.59 (3)	0.460	0.000	−0.007	−0.002
Strong	174.43 (10)	0.993	0.992	0.035	0.015	128.05 (3)	0.000	0.005	0.015	0.005
Strict	202.62 (14)	0.992	0.993	0.031	0.017	28.19 (4)	0.000	−0.001	−0.004	−0.001
Means comparison	221.248 (15)	0.991	0.993	0.032	0.019	18.63 (1)	0.000	0.001	0.001	0.000

TABLE 3B | Differences between models' chi-squares, df, measurement invariance fit indices (configural, metric, strong, and strict), and means, by groups with the loss of loved ones, for all dimensions.

Models	X^2(df)	CFI	TLI	RMSEA	SRMR	ΔX^2 (Δdf)	ΔX^2's p-value	ΔCFI	ΔRMSEA	ΔTLI
Intrusion										
Configural	644.58 (8)	0.992	0.980	0.076	0.015					
Metric	779.60 (12)	0.990	0.984	0.068	0.025	135.01 (4)	0.000	0.002	−0.008	−0.004
Strong	810.17 (16)	0.990	0.987	0.060	0.026	30.57 (4)	0.000	0.000	−0.008	−0.003
Strict	1304.20 (21)	0.984	0.985	0.067	0.044	494.03 (5)	2E-104	−0.006	0.007	0.002
Strict with correlation between items	1378.48 (22)	0.983	0.984	0.067	0.042	568.31 (6)	0.000	−0.007	0.007	0.003
Means comparison	2372.29 (23)	0.970	0.974	0.086	0.082	993.81 (1)	0.000	0.013	0.019	0.010
Avoidance										
Configural										
Metric	1.43 (2)	1.000	1.000	0.000	0.002					
Strong	54.96 (4)	0.997	0.996	0.031	0.01	53.53 (2)	0.000	0.003	0.031	0.004
Partial strong	7.41 (3)	1.000	1.000	0.010	0.005	5.98 (1)	0.014	0.000	0.010	0.000
Partial strict	251.72 (5)	0.986	0.984	0.060	0.035	244.31 (2)	0.000	0.014	0.050	0.016
Partial strict 2	11.90 (4)	1.000	0.999	0.012	0.005	4.49 (1)	0.034	0.000	0.002	0.001
Means comparison	437.12 (5)	0.976	0.972	0.080	0.046	425.22 (1)	0.000	0.024	0.068	0.027
Numbing										
Configural	20.90 (2)	1.000	0.997	0.026	0.003					
Metric	23.65 (5)	1.000	0.999	0.017	0.004	2.74 (3)	0.433	0.000	−0.009	−0.002
Strong	247.56 (8)	0.994	0.991	0.047	0.016	223.91 (3)	0.000	0.006	0.030	0.008
Partial strong	97.06 (7)	0.998	0.996	0.031	0.009	73.41 (2)	0.000	0.002	0.014	0.003
Partial strict	135.69 (10)	0.997	0.996	0.030	0.012	38.62 (3)	0.000	−0.001	−0.001	0.000
Partial strict with correlation between items	149.42 (11)	0.997	0.996	0.030	0.012	52.361 (4)	0.000	−0.001	−0.001	0.000
Means comparison	453.00 (12)	0.989	0.989	0.052	0.038	303.58 (1)	0.000	0.008	0.022	0.007
Hyperactivation										
Configural										
Metric	1.90 (2)	1.000	1.000	0.000	0.002					
Strong	59.00 (4)	0.998	0.997	0.032	0.008	57.10 (2)	0.000	0.002	0.032	0.003
Partial strong	11.98 (3)	1.000	0.999	0.015	0.004	10.08 (1)	0.002	0.000	0.015	0.001
Partial strict	50.38 (5)	0.999	0.998	0.026	0.007	38.40 (2)	0.000	−0.001	0.011	0.001
Means comparison	297.88 (6)	0.991	0.991	0.06	0.041	247.50 (1)	0.000	0.008	0.034	0.007
Depression										
Configural										
Metric	8.93 (2)	1.000	0.999	0.016	0.003					
Strong	43.58 (4)	0.999	0.998	0.027	0.009	34.65 (2)	0.000	0.001	0.011	0.001
Strict	76.15 (7)	0.998	0.998	0.027	0.010	32.56 (3)	0.000	−0.001	0.000	0.000
Means comparison	231.66 (8)	0.994	0.996	0.045	0.031	155.51 (1)	0.000	0.004	0.018	0.002
Generalized anxiety										
Configural	455.00 (10)	0.996	0.993	0.057	0.007					
Metric	471.72 (14)	0.996	0.995	0.049	0.009	16.72 (4)	0.002	0.000	−0.008	−0.002
Strong	709.86 (18)	0.994	0.994	0.053	0.015	238.14 (4)	0.000	0.002	0.004	0.001
Strict	769.33 (23)	0.994	0.995	0.049	0.016	59.47 (5)	0.000	0.000	−0.004	−0.001
Means comparison	1056.46 (24)	0.991	0.993	0.056	0.045	287.13 (1)	0.000	0.003	0.007	0.002
Health anxiety										
Configural	00.00 (0)	1.000	1.000	0.000	0.000					
Metric	9.16 (3)	1.000	1.000	0.012	0.004	9.16 (3)	0.027	0.000	0.012	0.000
Strong	56.68 (6)	0.999	0.998	0.025	0.007	47.53 (3)	0.000	0.001	0.013	0.002
Strict	212.64 (10)	0.997	0.996	0.039	0.015	155.95 (4)	0.000	−0.002	0.014	0.002
Strict with correlation between items	218.24 (12)	0.997	0.997	0.035	0.015	161.56 (6)	0.000	−0.002	0.010	0.001
Means comparison	679.61 (13)	0.990	0.991	0.061	0.055	461.37 (1)	0.000	0.007	0.026	0.006
Somatization										
Configural	35.82 (4)	0.999	0.996	0.024	0.006					
Metric	73.91 (7)	0.997	0.995	0.026	0.012	38.08 (3)	0.000	0.002	0.002	0.001
Strong	180.10 (10)	0.992	0.991	0.035	0.017	106.19 (3)	0.000	0.005	0.009	0.004
Strict	456.88 (14)	0.980	0.983	0.048	0.031	276.78 (4)	0.000	−0.012	0.013	0.008
Partial strict	267.28 (13)	0.989	0.990	0.038	0.021	87.18 (3)	0.000	−0.003	0.003	0.001
Means comparison	645.53 (14)	0.972	0.976	0.057	0.045	378.25 (1)	0.000	0.017	0.019	0.014

TABLE 3C | Differences between models' chi-squares, df, measurement invariance fit indices (configural, metric, strong, and strict), and means, per COVID-19 condition, for all dimensions.

Models	X^2(df)	CFI	TLI	RMSEA	SRMR	ΔX^2 (Δdf)	ΔX^2's p-value	ΔCFI	ΔRMSEA	ΔTLI
Intrusion										
Configural	689.71 (8)	0.991	0.978	0.079	0.015					
Metric	865.09 (12)	0.989	0.982	0.072	0.026	175.38 (4)	0.000	0.002	−0.007	−0.004
Strong	995.33 (16)	0.987	0.984	0.067	0.028	130.24 (4)	0.000	0.002	−0.005	−0.002
Strict	1942.93 (21)	0.975	0.977	0.082	0.053	947.60 (5)	1E-202	−0.012	0.015	0.007
Partial strict	1320.00 (20)	0.983	0.983	0.069	0.038	324.68 (4)	5E-69	−0.004	0.002	0.001
Partial strict with correlation between items	1320.38 (21)	0.983	0.984	0.067	0.039	325.05 (5)	0.000	−0.004	0.000	0.000
Means comparison	2726.06 (22)	0.965	0.968	0.095	0.091	1405.68 (1)	0.000	0.018	0.028	0.016
Avoidance										
Configural										
Metric	22.83 (2)	0.999	0.997	0.028	0.009					
Strong	99.31 (4)	0.995	0.992	0.042	0.016	76.47 (2)	0.000	0.004	0.014	0.005
Strict	593.92 (7)	0.967	0.972	0.078	0.050	494.61 (3)	0.000	0.028	0.036	0.020
Partial strict	135.99 (6)	0.993	0.993	0.040	0.016	36.68 (2)	0.000	−0.002	−0.002	−0.001
Means comparison	609.39 (7)	0.967	0.971	0.079	0.050	473.40 (1)	0.000	0.026	0.039	0.022
Numbing										
Configural	15.03 (2)	1.000	0.998	0.022	0.002					
Metric	22.22 (5)	1.000	0.999	0.016	0.004	7.19 (3)	0.066	0.000	−0.006	−0.001
Strong	279.42 (8)	0.994	0.990	0.050	0.016	257.20 (3)	0.000	0.006	0.034	0.009
Partial strong	98.07 (7)	0.998	0.996	0.031	0.009	75.85 (2)	0.000	0.002	0.015	0.003
Partial strict	133.28 (10)	0.997	0.996	0.030	0.012	35.21 (3)	0.000	−0.001	−0.001	0.000
Partial strict with correlation between items	142.02 (11)	0.997	0.997	0.030	0.012	43.95 (4)	0.000	−0.001	−0.001	−0.001
Means comparison	423.27 (12)	0.990	0.990	0.050	0.034	281.24 (1)	0.000	0.007	0.020	0.007
Hyperactivation										
Configural										
Metric	2.99 (2)	1.000	1.000	0.006	0.003					
Strong	90.09 (4)	0.997	0.996	0.040	0.010	87.10 (2)	0.000	0.003	0.034	0.004
Partial strong	3.00 (3)	1.000	1.000	0.000	0.003	0.00 (1)	0.944	0.000	−0.006	0.000
Partial strict	4.85 (4)	1.000	1.000	0.004	0.003	1.86 (1)	0.173	0.000	0.004	0.000
Means comparison	234.81 (5)	0.993	0.992	0.058	0.035	229.96 (1)	0.000	0.007	0.054	0.008
Depression										
Configural										
Metric	10.03 (2)	1.000	0.999	0.017	0.004					
Strong	69.92 (4)	0.998	0.997	0.035	0.011	59.89 (2)	0.000	0.002	0.018	0.002
Partial strong	13.61 (3)	1.000	0.999	0.016	0.004	3.58 (1)	0.058	0.000	−0.001	0.000
Partial strict	24.80 (5)	0.999	0.999	0.017	0.004	11.19 (2)	0.004	−0.001	0.001	0.000
Means comparison	249.19 (6)	0.994	0.994	0.054	0.035	224.40 (1)	0.000	0.005	0.037	0.005
Generalized anxiety										
Configural	470.56 (10)	0.996	0.992	0.058	0.007					
Metric	513.92 (14)	0.996	0.994	0.051	0.011	43.36 (4)	0.000	0.000	−0.007	−0.002
Strong	728.15 (18)	0.994	0.993	0.054	0.015	214.23 (4)	0.000	0.002	0.003	0.001
Strict	767.63 (23)	0.994	0.995	0.049	0.016	39.48 (5)	0.000	0.000	−0.005	−0.002
Means comparison	1349.98 (24)	0.989	0.991	0.064	0.058	582.35 (1)	0.000	0.005	0.015	0.004
Health anxiety										
Configural	0.00 (0)	1.000	1.000	0.000	0.000					
Metric	57.00 (3)	0.999	0.997	0.036	0.012	57.00 (3)	0.000	0.001	0.036	0.003
Partial metric	0.723 (1)	1.000	1.000	0.000	0.001	0.723 (1)	0.395	0.000	0.000	0.000
Partial strong	0.723 (1)	1.000	1.000	0.000	0.001	000.00 (0)	0.000	0.000	0.000	0.000
Partial strict	1.62 (2)	1.000	1.000	0.000	0.001	0.894 (1)	0.344	0.000	0.000	0.000
Partial strict with correlation between items	15.49 (4)	1.000	0.999	0.015	0.002	14.77 (3)	0.002	0.000	0.015	0.001
Means comparison	931.94 (5)	0.986	0.865	0.116	0.063	916.44 (1)	0.000	0.014	0.101	0.134
Somatization										
Configural	35.81 (4)	0.999	0.996	0.024	0.006					
Metric	131.52 (7)	0.994	0.990	0.036	0.016	95.72 (3)	0.000	0.005	0.012	0.006
Strong	322.88 (10)	0.986	0.983	0.048	0.023	191.35 (3)	0.000	0.008	0.012	0.007
Strict	789.25 (14)	0.965	0.970	0.064	0.040	466.37 (4)	0.000	−0.021	0.016	0.013
Partial strict	508.21 (13)	0.978	0.979	0.053	0.026	185.34 (3)	0.000	−0.008	0.005	0.004
Means comparison	1222.10 (14)	0.945	0.953	0.079	0.057	713.89 (1)	0.000	0.033	0.026	0.026

TABLE 3D | Differences between models' chi-squares, df, measurement invariance fit indices (configural, metric, strong, and strict), and means per psychological care-seeking condition, for all dimensions.

Models	X^2(df)	CFI	TLI	RMSEA	SRMR	ΔX^2 (Δdf)	ΔX^2's p-value	ΔCFI	ΔRMSEA	ΔTLI
Intrusion										
Configural	638.60 (8)	0.992	0.980	0.076	0.015					
Metric	768.77 (12)	0.991	0.984	0.068	0.024	130.16 (4)	0.000	0.001	−0.008	−0.004
Strong	868.88 (16)	0.989	0.987	0.062	0.025	100.11 (4)	0.000	0.002	−0.006	−0.003
Strict	1099.79 (21)	0.987	0.987	0.061	0.034	230.91 (5)	7E-48	−0.002	−0.001	0.000
Strict with correlations between items	1105.41 (22)	0.987	0.988	0.060	0.034	236.52 (6)	0.000	−0.002	−0.002	−0.001
Means comparison	1445.23 (23)	0.982	0.985	0.067	0.051	339.82 (1)	0.000	0.005	0.007	0.003
Avoidance										
Configural										
Metric	2.27 (2)	1.000	1.000	0.003	0.003					
Strong	31.47 (4)	0.998	0.998	0.022	0.006	29.20 (2)	0.000	0.002	0.019	0.002
Partial strong	2.33 (3)	1.000	1.000	0.000	0.003	0.06 (1)	0.810	0.000	−0.003	0.000
Partial strict	2.65 (4)	1.000	1.000	0.000	0.003	0.33 (1)	0.567	0.000	0.000	0.000
Means comparison	228.28 (5)	0.988	0.985	0.057	0.030	225.62 (1)	0.000	0.012	0.057	0.015
Numbing										
Configural	3.27 (2)	1.000	1.000	0.007	0.001					
Metric	124.42 (5)	0.997	0.993	0.042	0.015	121.15 (3)	0.000	0.003	0.035	0.007
Partial metric	29.29 (4)	0.999	0.998	0.022	0.008	26.02 (2)	0.000	0.001	0.015	0.002
Partial strong	73.02 (6)	0.998	0.997	0.029	0.012	43.73 (2)	0.000	0.001	0.007	0.001
Partial strict	100.35 (8)	0.998	0.997	0.029	0.012	27.32 (2)	0.000	0.000	0.000	0.000
Partial strict with correlations between items	144.83 (9)	0.997	0.996	0.033	0.013	71.81 (3)	0.000	−0.001	0.004	0.001
Means comparison	1766.95 (10)	0.957	0.948	0.113	0.086	1622.12 (1)	0.000	0.040	0.080	0.048
Hyperactivation										
Configural										
Metric	1.435 (2)	1.000	1.000	0.000	0.002					
Strong	15.22 (4)	1.000	0.999	0.014	0.005	13.78 (2)	0.001	0.000	0.014	0.001
Strict	41.81 (7)	0.999	0.999	0.019	0.009	26.59 (3)	0.000	−0.001	0.005	0.000
Means comparison	2198.75 (8)	0.928	0.946	0.142	0.125	2156.94 (1)	0.000	0.071	0.123	0.053
Depression										
Configural										
Metric	188.94 (2)	0.995	0.985	0.083	0.022					
Partial metric	14.02 (1)	1.000	0.998	0.031	0.004					
Partial strong	27.16 (2)	0.999	0.998	0.030	0.004	13.14 (1)	0.000	0.001	−0.001	0.000
Partial strict	67.27 (4)	0.998	0.997	0.034	0.009	40.11 (2)	0.000	−0.001	0.004	0.001
Means comparison	2684.14 (5)	0.927	0.912	0.198	0.137	2616.86 (1)	0.000	0.071	0.164	0.085
Generalized anxiety										
Configural	465.67 (10)	0.996	0.992	0.058	0.008					
Metric	638.19 (14)	0.994	0.992	0.057	0.018	172.51 (4)	0.000	0.002	−0.001	0.000
Strong	737.39 (18)	0.994	0.993	0.054	0.020	99.21 (4)	0.000	0.000	−0.003	−0.001
Strict	937.57 (23)	0.992	0.993	0.054	0.024	200.17 (5)	0.000	−0.002	0.000	0.000
Means comparison	3433.32 (24)	0.970	0.975	0.102	0.133	2495.75 (1)	0.000	0.022	0.048	0.018
Health anxiety										
Configural	171.53 (2)	0.997	0.984	0.079	0.007					
Metric	378.19 (5)	0.994	0.986	0.074	0.024	206.67 (3)	0.000	0.003	−0.005	−0.002
Strong	624.85 (8)	0.991	0.986	0.075	0.025	246.66 (3)	0.000	0.003	0.001	0.000
Strict	891.71 (12)	0.987	0.987	0.073	0.029	266.86 (4)	0.000	−0.004	−0.002	−0.001
Strict with correlations between items	898.73 (13)	0.986	0.988	0.071	0.030	273.88 (5)	0.000	−0.005	−0.004	−0.002
Means comparison	1619.58 (14)	0.976	0.979	0.092	0.068	720.85 (1)	0.000	0.010	0.021	0.009
Somatization										
Configural	34.97 (4)	0.999	0.996	0.024	0.005					
Metric	58.78 (7)	0.998	0.996	0.023	0.009	23.81 (3)	0.000	0.001	−0.001	0.000
Strong	155.55 (10)	0.994	0.992	0.033	0.012	96.77 (3)	0.000	0.004	0.010	0.004
Strict	313.57 (14)	0.987	0.989	0.040	0.018	158.03 (4)	0.000	−0.007	0.007	0.003
Means comparison	535.45 (15)	0.977	0.982	0.05	0.033	221.88 (1)	0.000	0.010	0.010	0.007

TABLE 4 | Resulting freely estimated loadings, thresholds, and unique factor variances from partial measurement invariances, for all items in each dimension by comparison group.

Items	Comparison groups			
	Sex	**Loss of loved one**	**COVID-19 status**	**Psychological care-seeking**
Intrusion				
B1. I repeatedly think or imagine I am going to get sick.				
B2. I repeatedly have nightmares about the disease.			Unique factor variances	
B4. I feel uneasy when people talk about the disease.				
B5. I have unwanted physical reactions when I think about the disease (e.g., arrhythmia, hyperventilation, sweating).				
D5. I feel scared of the risk of getting infected.				
Avoiding				
C1. I try to avoid thinking, feeling, or talking about the disease.				
C2. I try to avoid looking up or referring to official information on the disease.		Thresholds and unique factor variances		Thresholds and unique factor variances
C3. I have trouble remembering the recommendations issued by the authorities regarding the pandemic.		Unique factor variances		
Numbing				
C4. I have lost interest in activities that I previously enjoyed.	Thresholds and unique factor variances			
C5. I have felt distant from people with whom I regularly interact since the beginning of the pandemic.				Loadings, thresholds, and unique factor variances
C6. I struggle to care about my loved ones.				Unique factor variances
C7. I feel that my future is uncertain due to the disease.	Thresholds and unique factor variances			
Hyperactivation				
D1. I find it difficult to fall or stay asleep.			Thresholds and unique factor variances	
D2. I feel angry.			Unique factor variances	
D3. I find it difficult to pay attention.		Thresholds and unique factor variances		
Depression				
I want to hurt myself.			Thresholds and unique factor variances	Loadings, thresholds, and unique factor variances
Dep2-Goldberg. R31. I feel little interest or pleasure in activities.				
Dep1-Goldberg. R32. I have felt down, depressed, or hopeless.				
Generalized anxiety				
AnsG1. I have felt nervous or on edge.				
AnsG2. I have felt unable to control my worrying.				
AnsG3. I have felt so restless it was hard to keep still.				
AnsG4. I have had trouble relaxing.				
AnsG5. I have felt afraid something awful could happen.				
Health anxiety				
I feel worried about my general state of health.	Loadings, thresholds, and unique factor variances		Loadings, thresholds, and unique factor variances	
I am currently worried about a certain number of physical pain spots in my body.			Thresholds and unique factor variances	
It scare me that I may have any severe physical disease.				
I believe I am suffering from a severe physical disease (even though it has not been confirmed).			Loadings, thresholds, and unique factor variances	
Somatization				
I monitor myself (self-touching, self-observing, etc.), recording what I note or feel in my body.				
I read (or I am interested in TV or radio shows) about severe physical disease.				
I talk to my family and friends about my physical pain spots.				
I feel like staying in bed, take my temperature, take my pulse, change my diet and take my meds; even though, they have not been prescribed by a doctor).		Unique factor variances		

of a loved one, resulted in changes smaller than 0.01 for the *CFIs* and smaller than 0.015 for the *RMSEAs*.

Table 3C shows that the generalized anxiety dimension obtained a measurement invariance by the COVID-19-condition. The remaining dimensions obtained a partial measurement invariance. **Table 3C** also shows that the restricted means model of generalized anxiety dimension, compared to the freely estimated means one, by the COVID-19-condition, resulted in changes smaller than 0.01 for the *CFIs* and smaller than 0.015 for the *RMSEAs*.

Table 3D shows that the intrusion, hyperactivation, generalized, health anxiety, and somatization dimensions obtained a measurement invariance by psychological care-seeking condition. The avoidance, numbing, and depression dimensions obtained a partial measurement invariance. **Table 3D** also shows that the restricted means models of the intrusion, and somatization dimensions, compared to those where the psychological care-seeking condition freely estimated means, resulted in changes smaller than 0.01 for the *CFIs* and smaller than 0.015 for the *RMSEAs*.

Table 4 resumed the freely estimated parameters resulting from partial measurement invariances, for all items, by dimension and group. Regarding the intrusion dimension and to prevent nuisances from being overemphasized in the fit models, we freely estimated the unique factor variances of the item *I repeatedly have nightmares about the disease* by COVID-19 status.

For the avoidance dimension, we freely estimated the thresholds and unique factor variances of the item *I try to avoid looking up or referring to official information on the disease* by loss of loved ones and psychological care-seeking groups. Also, we freely estimated the unique factor variances of the item *I have trouble remembering the recommendations issued by the authorities regarding the pandemic* by loss of loved ones, COVID-19 status, and psychological care-seeking groups.

As for the numbing dimension, we freely estimated thresholds and unique factor variances of the item *I have lost interest in activities I previously enjoyed* by sex group. We also freely estimated the loadings, thresholds, and unique factor variances of the item *I have felt distant from people with whom I regularly interact since the beginning of the pandemic* by the psychological care-seeking group. Additionally, we freely estimated the unique factor variances of the item *I struggle to care about my loved ones* by psychological care-seeking groups. Lastly, we freely estimated thresholds and unique factor variances of the item *I feel my future is uncertain because of the disease* by sex, loss of loved ones, and COVID-19 status groups.

Regarding the hyperactivation dimension, we freely estimated the thresholds, and unique factor variances of the item *I find difficult to fall or stay asleep*, and the unique factor variances of the item *I feel angry,* both for COVID-19-status groups. We also freely estimated thresholds and unique factor variances of the item *I find it difficult to pay attention* to the loss of a loved one group.

For the depression dimension, we freely estimated thresholds and unique factor variances of the item *I feel like doing things to hurt myself* by COVID-19-status, loadings, thresholds, and

unique factor variances of the same item for psychological care-seeking groups.

Regarding the health anxiety dimension, we freely estimated the loadings, thresholds, and unique factor variances of the item *I feel worried about my general state of health* per sex and COVID-19 status groups. We freely estimated the loadings, thresholds, and unique factor variances of the item *I am currently worried about a certain number of physical pain spots in my body* by sex and the thresholds and unique factor variances of the same item by per COVID-19 status groups. Lastly, we freely estimated the loadings, thresholds, and unique factor variances of the item *I believe I am suffering from a severe physical disease (even though it hasn't been confirmed)* by COVID-19 status groups.

For the somatization dimension, we freely estimated the unique factor variances of the item *I choose to stay in bed, take my temperature, take my pulse, change my diet and take meds, etc. (even though they had not been prescribed by a physician)* by loss of loved ones, and COVID-19 status groups.

Our findings on the fit models suggest that all dimensions can be used to compare means between comparison groups, considering the specifically structured bias of the items.

Comparison Groups Means

Table 5 shows the mean (*M*) for all dimensions by sex, loss of loved ones, COVID-19 status, psychological care-seeking, *F* values, degrees of freedom, *p*-values from the multivariate analyses, and the Cohen *d* effect size from invariance measurement. Despite the high mean generalized anxiety for women, restricted means models and Cohen-d analysis suggested a moderate difference for men ($d = -0.341$). Participants' sex had a low effect on intrusion, avoidance, numbing, health anxiety, and somatization means ($d = -0.263$, $d = -0.27$, $d = -0.282$, $d = -0.169$, and $d = -0.064$, respectively). For the remaining dimensions, based on the freely estimated means models, the Cohen's *d* size effect analyses indicated moderate differences between hyperactivation means ($d = -0.364$) and depression ($d = -0.318$) between these groups.

Once again, although participants who reported losing loved ones obtained high means for numbing, hyperactivation, and generalized anxiety ($M > 0.05$), it is essential to consider the restricted means models fit and the Cohen-d analysis results. Our findings suggest that the difference in generalized anxiety means between those who reported the loss of loved ones and those who did not was low ($d = -0.249$). This comparison can therefore be made because of a good dimension factor structure. For the remaining dimensions, based on the freely estimated means models, the Cohen's *d* size effect analyses indicated minimal differences for the numbing ($d = -0.261$), hyperactivation ($d = -0.219$), and depression ($d = -0.186$) dimensions means between comparison groups. Furthermore, from freely estimating parameters, our results showed moderate differences between groups for the intrusion ($d = -0.492$), avoidance ($d = -0.321$), health anxiety ($d = -0.324$), and somatization ($d = -0.333$) dimension means.

Based on the restricted mean models, our results suggest that the generalized anxiety dimension was moderately different between those who reported COVID-19 status and those who

TABLE 5 | Dimensions means by sex, loss of loved ones, COVID-19 status, psychological care-seeking groups, F, df, *p*-values, from the multi-variate analyses, and Cohen's d effect size from invariance measurement.

Dimension	Men		Women		ANOVA		Cohen's d
	M	*SD*	*M*	*SD*	*F* (1, 27,318)	*p* <	
Intrusion	31.56	27.41	38.09	27.95	333.52	0.001	−0.263
Avoidance	24.05	23.77	29.22	24.76	270.01	0.001	−0.270
Numbing	42.66	31.35	48.84	30.38	244.56	0.001	−0.282
Hyperactivation	43.93	32.82	54.52	31.99	650.52	0.001	−0.364
Depression	35.84	31.13	44.70	31.53	481.74	0.001	−0.318
Gen. anxiety	42.34	34.44	53.42	33.57	646.69	0.001	−0.341
Health anxiety	36.61	31.14	42.78	31.60	232.27	0.001	−0.169
Somatization	28.02	24.35	29.50	24.40	22.30	0.001	−0.064

Dimension	Non-loss of loved one		Loss of loved one		ANOVA		Cohen's d
	M	*SD*	*M*	*SD*	*F* (1, 36,809)	*p*-value	
Intrusion	32.96	27.07	45.84	28.53	1070.08	0.001	−0.492
Avoidance	25.81	24.11	33.19	25.18	445.61	0.001	−0.321
Numbing	44.93	30.96	53.02	29.61	338.04	0.001	−0.261
Hyperactivation	49.46	32.95	56.24	31.06	211.13	0.001	−0.219
Depression	40.67	31.98	45.46	30.35	111.20	0.001	−0.186
Gen. anxiety	47.76	34.41	56.41	32.87	312.4	0.001	−0.249
Health anxiety	38.46	31.21	48.36	31.61	485.68	0.001	−0.324
Somatization	27.31	23.57	34.68	26.17	449.82	0.001	−0.333

Dimension	Non-COVID-19 status		COVID-19 status		ANOVA		Cohen's d
	M	*SD*	*M*	*SD*	*F* (1, 36,809)	*p*-value	
Intrusion	32.73	26.71	50.24	28.82	1704.44	0.001	−0.658
Avoidance	25.79	23.91	35.19	25.92	612.18	0.001	−0.397
Numbing	45.24	30.94	53.76	29.43	315.51	0.001	−0.274
Hyperactivation	49.38	32.91	58.35	30.37	312.29	0.001	−0.260
Depression	40.71	31.95	46.54	29.97	139.27	0.001	−0.234
Gen. anxiety	47.38	34.25	60.38	32.22	601.81	0.001	−0.388
Health anxiety	37.50	30.70	55.22	31.38	1351.36	0.001	−0.576
Somatization	26.87	23.28	38.55	26.81	970.11	0.001	−0.514

Dimension	Non-psychological care-seeking		Psychological care-seeking		ANOVA		Cohen's d
	M	*SD*	*M*	*SD*	*F* (1, 36,809)	*p*-value	
Intrusion	34.35	27.54	42.99	28.61	398.23	0.001	−0.307
Avoidance	26.43	24.11	32.29	25.93	235.18	0.001	−0.253
Numbing	43.63	30.62	60.87	27.74	1344.86	0.001	−0.613
Hyperactivation	47.01	32.46	68.84	27.05	1965.333	0.001	−0.807
Depression	37.28	30.68	61.71	28.11	2678.83	0.001	−0.852
Gen. anxiety	45.28	33.88	69.64	28.34	2243.46	0.001	−0.823
Health anxiety	38.30	31.18	51.58	31.06	744.32	0.001	−0.449
Somatization	27.96	24.16	33.69	24.85	227.87	0.001	−0.272

Dimension	Total	
	M	*SD*
Intrusion	35.94	27.94
Avoidance	27.51	24.56
Numbing	46.80	30.84
Hyperactivation	51.03	32.65
Depression	41.78	31.67
Gen. anxiety	49.76	34.26
Health anxiety	40.74	31.58
Somatization	29.01	24.39

did not ($d = -0.388$). Regarding the freely estimated means models, we also found low effects for the numbing ($d = -0.274$), hyperactivation ($d = -0.26$), and depression ($d = -0.243$) dimension means between these groups. Our results also showed moderate differences between the intrusion ($d = -0.658$), avoidance ($d = -0.393$), health anxiety ($d = -0.576$), and somatization ($d = -0.514$) dimension means between groups.

For the restricted means models, our findings suggest that somatization had mildly significant effects ($d = -0.272$), and that intrusion had moderately significant effects ($d = -0.307$), due to the psychological care-seeking condition. For the free means fit models, the Cohen's d size effect analyses indicated small differences for the avoidance ($d = -0.253$) dimension means between those who sought psychological care and those who did not. Our results also showed moderate differences between groups for the numbing ($d = -0.613$), and health anxiety ($d = -0.449$) dimensions means. Moreover, results showed large differences between group means for the hyperactivation ($d = -0.807$), depression ($d = -0.852$), and generalized anxiety ($d = -0.823$) dimensions.

Structural Equation Modeling

Figure 1 shows the resulting structural equation modeling (SEM). As latent variables, the model included intrusion, avoidance, numbing, hyperactivation, depression, generalized anxiety, health anxiety, and somatization. **Figure 1** shows the group of items for each latent variable, their factorial loads, the regression coefficients, and their residuals. The fit model resulted from 95 iterations with 74 parameters [$X^2(422) = 46,793.39$, $p < 0.001$], with a $CFI = 0.927$, a $TLC = 0.92$, an $RMSEA = 0.063$ (0.063–0.064), and an $SRMR = 0.056$. Note that the difference in the free-degrees between CFA and SEM resulted from the added parameters of the SEM's model—latent variables relationships. Consequently, our results indicated that the intrusion latent variable was predicted by the avoidance one ($R^2 = 0.743$). Health anxiety was predicted by the intrusion latent variable ($R^2 = 0.831$). Generalized anxiety was predicted by health anxiety ($R^2 = 0.281$) and hyperactivation ($R^2 = 0.742$). The hyperactivation dimension was predicted by the depression latent variable ($R^2 = 0.959$). Depression and somatization were predicted by health anxiety ($R^2 = 0.654$ and $R^2 = 0.841$, respectively). Finally, in the SEM, the numbing latent variable was predicted by depression and avoidance ($R^2 = 0.838$, and $R^2 = 0.225$, respectively).

DISCUSSION

This study aimed to determine the construct validity, reliability, and measurement invariance of a brief screening tool for mental health symptoms by sex, loss of loved ones, personal COVID-19-status, and psychological care-seeking during the COVID-19 pandemic. Furthermore, the aim involved establishing a predictive pattern between the mental health variables. Our findings suggest that it was possible to validate the mental health dimensions assessed throughout a WebApp, with a fit model replication by the CFA with two samples of Mexican

participants. Dimensions, in general, were constituted by factorial loadings over 0.4. Our findings indicated that we obtained a multidimensional, eight-scale instrument for the evaluation of stress (PCL-C), depression, generalized anxiety, health anxiety, and somatization based on the CFA procedures.
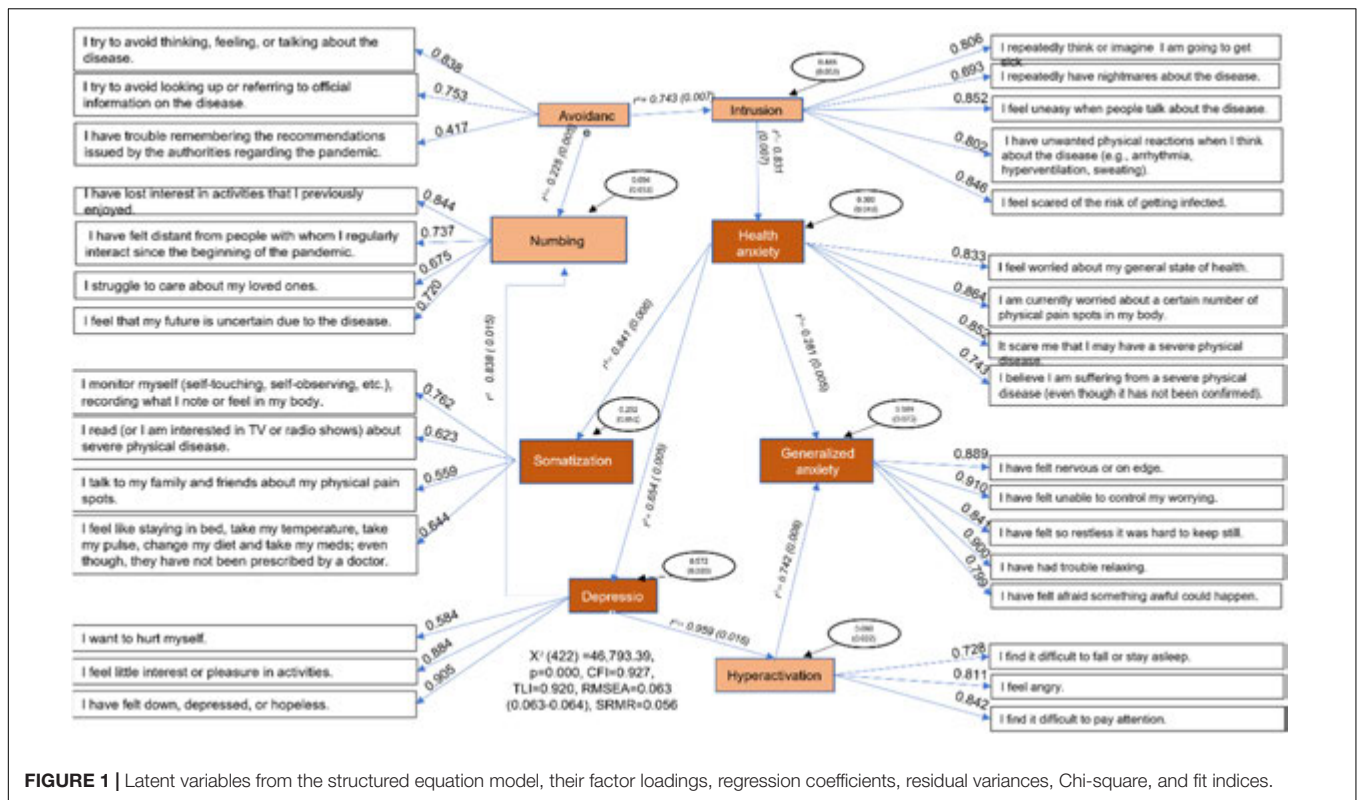
Four latent variables were included in the PCL-C adapted to the COVID-19 pandemic—intrusion, avoidance, hyperactivation, and numbing dimensions (Weathers et al., 1994; Morales-Chainé et al., 2020, 2021a,b). Findings also suggested latent variables of depression, generalized anxiety (Goldberg et al., 2017), health anxiety, and somatization (Velasco et al., 2006; Morales-Chainé et al., 2020, 2021a,b). Although all the dimensions were related, they were regarded as independent.

Our findings suggested that PCL-C (adapted from Weathers et al., 1994), depression, generalized anxiety (adapted from Goldberg et al., 2017), health anxiety, and somatization scales (from Velasco et al., 2006) were validated by their scheduled remote application during the COVID-19 pandemic for Mexicans. Specifically, CFA yielded a model with the goodness of fit in eight dimensions, replicated with two samples, using the Chi-square, CFI, TLI, $RMSEA$, and $SRMR$ good indexes procedure (Browne and Cudeck, 1993; West et al., 2012). Thus, dimensions resulting from structural factorial analysis -intrusion, avoidance, hyperactivation, numbing (from PCL-C), depression, generalized anxiety, health anxiety, and somatization, could screen for mental health risks in the civil population experiencing events related to the COVID-19 pandemic.

Moreover, findings of invariance measurement (Millsap, 2011) enabled us to analyze and define a comparison procedure to screen for mental health symptoms, using the instrument's factor structure. Importantly our findings suggest that is possible to compare generalized anxiety between all the groups in the study. The intrusion means were compared between the sex, loss of loved ones, and psychological care-seeking variables. Avoidance means were comparable between sex groups. Numbing means were comparable between those reporting loss of loved ones or COVID-19-status groups. Hyperactivation means were comparable between sex and those seeking remote psychological care groups. Depression means were comparable to the group of sex and loss of loved ones. Health anxiety means were comparable between loss of loved ones and psychological care-seeking groups. And somatization means were comparable between sex and psychological care-seeking groups.

Consequently, the results of the measurement invariance showed that women reported high levels of generalized anxiety, hyperactivation, and depression. Those who had lost a loved one reported a high level of intrusion and health anxiety symptoms. Participants who reported COVID-19 status also reported high levels of generalized anxiety symptoms. These findings are very similar to those reported by Morales-Chainé et al. (2021b). Moreover, in the present study, we also found that those who seek psychological care reported high levels of generalized anxiety, intrusion, hyperactivation, and health anxiety symptoms.

Given the freely estimated loadings, thresholds, and unique factor variances, it was possible to match the remaining dimensions and comparison groups considering the bias in the reviewed items. As Morales-Chainé et al. (2021b) noted, our

FIGURE 1 | Latent variables from the structured equation model, their factor loadings, regression coefficients, residual variances, Chi-square, and fit indices.

findings suggest that those losing loved ones reported high levels of avoidance and somatization symptoms. However, the current study suggests considering the bias created by *looking up, referring to official information on the disease, not remembering the recommendations issued by the authorities regarding the pandemic,* and *feeling like staying in bed, taking their temperature, taking their pulse, changing their diet, taking meds, etc. (even though they had not been prescribed by a physician).* Despite high avoidance and somatization of losing someone, further research should analyze the variables originating from such psychometric bias.

Moreover, our findings indicate that those suspected of being infected by COVID-19 reported high levels of intrusion, avoidance, health anxiety, and somatization, including bias about *having nightmares about the disease, not remembering the recommendations issued by the authorities, feeling worried about their general state of health and physical pain spots in the body, believing they were suffering from a severe physical disease (even though it had not been confirmed), and feeling like staying in bed, taking their temperature, taking their pulse, changing their diet, taking meds, etc. (even though they have not been prescribed by a physician).* According to COVID-19 status, such psychometric bias should be studied in future research despite considering high intrusion, avoidance, health anxiety, and somatization.

Our findings suggest that those seeking remote psychological care reported high levels of numbing and depression, which bias included *feeling distant from people with whom they had regularly interacted since the beginning of the pandemic, struggling to care about their loved ones,* and *wanting to hurt themselves.* The bias in

such items should be addressed in the subsequent studies despite the accepted high levels of numbing and depression.

In keeping with Asmundson et al. (2000), Velasco et al. (2006), Goldberg et al. (2017), and Morales-Chainé et al. (2020, 2021a,b) in the present study, we screened mental health risks characterized by stress, depression, generalized anxiety, health anxiety, and somatization symptoms. Moreover, these symptoms were related to specific events such as losing loved ones, suspecting, or having COVID-19, and sociodemographic conditions such as sex. But the novel assumption was to show how those mental health symptoms were related to psychological care-seeking (Goldberg et al., 2017), through CFA analysis for measurement invariance.

Our findings indicate that it was possible to validate the factor structure of stress symptoms and their relationship with depression, anxiety, and somatization. We also described the specific bias as a function of sociodemographic conditions reported by participants during the COVID-19 pandemic. This identification was conducted in community and primary health care scenarios and with the CFA of the PCL, depression, generalized anxiety, health anxiety, and somatization scales, adapted for use during the COVID-19 pandemic (Morales-Chainé et al., 2020, 2021a,b).

Furthermore, in the future, researchers could monitor the process and the time elapsed between the occurrence of traumatic events and the development of PTSD, as well as other mental health risks, through measurement tools such as those used in this study. However, the present study suggested an association between these dimensions with depression,

anxiety, and somatization. Already Elhai and Palmieri (2011) recommended studying such associations to better define the etiology and development of PTSD in the early stages.

The final model suggested that intrusion was predicted by avoidance symptoms. The health anxiety latent variable was predicted by intrusion stress symptoms (Morales-Chainé et al., 2021b). Moreover, generalized anxiety, the latent variable with higher levels in women, those suspected of having or being infected with COVID-19, and those who sought remote psychological care, were predicted by health anxiety and hyperactivation symptoms. The hyperactivation latent variable, as a stress symptom, was predicted by depression symptoms. According to the final model, depression and somatization were predicted by health anxiety. Finally, the numbing latent variable was predicted by depression and avoidance ones. As a result of the high prevalence of stress, anxiety, and depression in the global world related to the COVID-19 pandemic, it is essential to screen for these mental health conditions at the community and primary health care level (Necho et al., 2021).

This sequence of symptoms could help predict more severe disorders. Consequently, the programmed tools helped identify depression early, together with anxiety symptoms, as Goldberg et al. (2017) established. They proposed that depression was closely associated with anxiety symptoms. Authors noted that anxious depression could be the most common comorbidity, helping to predict more severe disorders at the community level. Goldberg et al. (2017) proposed that anxious depression (high scores on both scales) could be the most common risk in people seeking specialized or regular care. However, early identification of mental health symptoms could be considered in terms of the common variance between different emotional disorders to monitor continuity in the anxiety and depression case-no-case progression. Therefore, Goldberg et al. (2017) considered it essential to establish screening in each territorial entity, interpreting the results by each specific community context.

Moreover, in that sequence of symptoms, the SSCOs were strongly related to anxiety and depression, suggesting that SSCOs were successfully screened by sex, COVID-19 status, loss of loved ones, and seeking remote psychological care. According to Velasco et al. (2006), SSCO etiology and maintenance could be related to lifestyles, learning, beliefs, and antisocial behaviors that could be related to the COVID-19 pandemic. Further studies should address the specific processes explaining these conditions and relationships.

Nevertheless, in the current research, it was possible to develop a decision-making strategy due to the tool's psychometric characteristics and the stress, depression, anxiety, and somatization latent variables, in Mexico. These conditions could vary by country, clinical scenario, and population characteristics (Goldberg et al., 2017). However, it is possible to detect a psychological disorder efficiently and early in the community and provide the necessary primary care by monitoring these symptoms (Moos, 1995).

Furthermore, the measurement invariance procedure, suggested by McDonald and Calhoun (2010) and Elhai and Palmieri (2011), ensured the detection of specific biases from symptoms and comparison groups (Millsap, 2011),

which is essential to consider when specific populations and disturbing phenomena are analyzed. The identification of bias addresses decision-making because mental health symptoms vary depending on the context (Wilkins et al., 2011). CFA ensured evidence about the psychometric structure of the scales through the assessment of the measurement invariance between the comparison groups in this study. A significant contribution of this study was the measurement invariance examination. This specific contribution is a requirement for establishing a valid comparison between groups by latent variables rather than the differences in the psychometric structure of the scale items.

Moreover, future studies should describe posttraumatic stress diagnosis, assessing the cut-off points in the PCL's intrusion, avoidance-numbing, and hyperactivation symptoms. It could discriminate between the presence and absence of stress levels, as Taylor et al. (1998) and McDonald and Calhoun (2010) recommended. Future studies could help distinguish between anxiety and somatization levels (Velasco et al., 2006; Goldberg et al., 2017; Morales-Chainé et al., 2020, 2021a,b) when experiencing events such as the COVID-19 pandemic.

The PCL, depression-generalized anxiety, and health anxiety-somatization scales are a realistic group of descriptions for early, parsimonious mental health symptom screening in community and primary health care services. Implementing effective evidence-based psychosocial interventions would be helpful to reduce the care gap and promote mental health (Li et al., 2020). Rather than a diagnostic strategy, the early screening of mental health symptoms (McDonald and Calhoun, 2010) is a tool for achieving efficient programming, resulting from a step-by-step, evidence-based intervention, given the lack of specialized professionals in Latin American countries.

LIMITATIONS

Since the present study was not a diagnosis of mental health disorders, future studies should ensure their follow-up and assess consistency with these diagnoses and evaluate the effect of remote psychological help. Since this study is not longitudinal, in the future, researchers could monitor the process and the time that has elapsed between the occurrence of traumatic events and the development of a posttraumatic stress disorder, as well as other mental health risks, through measurement tools such as those used in this study.

One limitation referred to bias. We considered it necessary to study the sources of the bias from the items identified through the invariance measurement and unexplained variance from the SEM. Moreover, note that we did not assess the age as a confounder in the data analyses, and our sample was not homogeneous because the participation was voluntary. Thus, evaluating invariance due to age groups as a confounder would help identify other bias origins when such wide variations of participants' age are like those considered here. Next, studies should consider age groups to assess invariance measurement. Dynamically, identifying the source of bias would make it possible to increase the accuracy of mental health symptom screening and halt the evolution of mental illness.

Another limitation refers to psychometrical considerations. CFA was a useful defining factor structure of the mental health tools. Invariance measurement helped analyze how individuals responded to items, and SEM helped identify the unexplained variances from latent variables. Even though, we should carefully consider the results from the use of the Cronbach Alpha analysis. We didn't study the uncorrelated errors among items and the effect of violating this assumption on alpha (Green and Hershberger, 2000). Thus, such conditions produce an unprecise high estimate of reliability that must be considered in future studies.

Additionally, we must consider a strategy to increase the representativeness of our sample to analyze mental health symptoms. Because participants voluntarily chose to contribute, we could not achieve this condition. Finally, subsequent studies should consider social determinants during the COVID-19 pandemic, such as age, unemployment, intra-familial violence, and the use of drugs such as alcohol and tobacco, to understand how they contribute to the early emergence of mental health symptoms.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the Universidad Nacional Autónoma de México. The participants provided their written informed consent to participate in the study.

AUTHOR CONTRIBUTIONS

SM and MR contributed to the writing and initial data analysis. SM, RR, AL, ABM, ABA, CT, GP, IL, LB, and MR contributed to the data analysis review, discussion, and data interpretation. All authors contributed to the article and approved the submitted version.

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The Development of a Collaborative Binational Strategy to Support the San Diego-Tijuana Transborder Community During the COVID-19 Pandemic

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The COVID-19 pandemic illustrates the need for and importance of cross-border public health collaboration. San Diego, California and Tijuana, Baja California are an interconnected region with one of the busiest international borders in the world and hundreds of thousands bi-directional crossings each day. As the sister cities witnessed the rising case numbers early in the pandemic, it became essential and urgent to implement a formal structure to facilitate cross-border COVID-19 communication, coordination, and collaboration. The present article describes how the development of a Collaborative Binational Strategy led to coordinated outreach and initiatives that addressed access and equity in the transborder region. Through examples, the article illustrates how regional leaders in San Diego and Tijuana harnessed existing transborder partnerships to collaboratively build infrastructure and communication pathways to exchange data, guidance, troubleshoot shared challenges, build capacity, and establish cross-border testing and vaccine opportunities. The challenges, lessons learned, and best practices may inform other multi-level, interdisciplinary, and cross-border jurisdictions on how to support a transborder community during a pandemic or other health emergency.

Keywords: COVID-19 pandemic, COVID-19, border, transborder, cross-border collaboration, US-Mexico border, binational, health equity

INTRODUCTION

The start of the COVID-19 pandemic created similar challenges to residents and leaders in San Diego, California and Tijuana, Baja California; both experienced a rapid increase in cases, outbreaks, hospitalizations, and mortality. It was essential and urgent to leverage existing partnerships to develop a collaborative approach to address the needs of the transborder community. The County of San Diego Health and Human Services Agency engaged with its counterpart, the ISESALUD Tijuana Health Services Jurisdiction, and other key binational partners to establish a Binational Strategy to facilitate cross-border COVID-19 communication, coordination, and collaboration.

BACKGROUND AND RATIONALE

The County of San Diego Health and Human Services Agency (HHSA) serves a diverse population of 3.3 million individuals. Thirty-four percent of the San Diego County population is Latino, there is a large immigrant community, and it is reported that over 450,000 (1) individuals speak a language other than English at home. San Diego is also home to an international border crossing, and it is believed to be one of the busiest in the world with over 150,000 individuals crossing the border northbound in a single day (2). People cross for many reasons, including work, recreation, shopping, education, family visitation, and healthcare access.

According to an estimate provided by the U.S. Consulate in Tijuana in an April 2020 email and data cited by the National Institute on Statistics and Geography (INEGI), ~132,000 to 265,000 U.S. citizens live in Baja California (3). There is also a large proportion of the San Diego essential workforce that live in Baja California and cross the border every day to work in agricultural fields, retail, hospitals, other healthcare facilities and many other critical industries. Many are on the front lines of the COVID-19 response.

While comprising a significant portion of the overall county population, the southern region of San Diego County is home to a large and growing Latino and transborder population (61.3% identify as Latino) (4) which has experienced the highest COVID-19 positivity rates in the county (5). Early in the pandemic, the Department of Homeland Security implemented border crossing restrictions, limiting trips for only essential reasons and for U.S. Citizens and Lawful Permanent residents only (6). When the restrictions were implemented in March 2020, crossings initially decreased to ~50,000 crossings per day, but then steadily increased over time to average ~100,000 per day by March 2021 (7). This highlights the transborder essential work force and region connectedness and reinforces the concern about potential disease transmission.

Within this context, the needs for cross-border communication and coordination were evident and garnered immediate support. The County of San Diego has established and maintained strong partnerships with counterparts in Baja California as part of the County's *Live Well San Diego* vision to achieve a healthy, safe, and thriving region by building better systems and improving collaboration through regional partnerships and collective impact (8). The region is fortunate to have several longstanding binational partnerships that enable regular cross-border communication, coordination, and collaboration which have existed for decades.

These critical partnerships represent governmental agencies at the local, State and Federal levels on both sides of the border as well as with academic, medical, and non-profit organizations. Several HHSA departments work binationally and oversee the coordination of large binational initiatives. For instance, in collaboration with the US-México Border Health Commission, HHSA coordinates the annual binational *Love Your Heart/Ama Tu Corazón* campaign in all states along the US-Mexico border to raise awareness about heart health by offering free blood pressure screenings (9). The HHSA Office of Border Health has existed for 27 years with the role of facilitating communication and collaboration among the health agencies at the local level in San Diego and Tijuana (10). This is the only County-level border health office across the entire border region.

Another example includes the 15-year collaboration among the County of San Diego and Imperial County's Epidemiology Programs, the California Department of Public Health's Office of Binational Border Health—Border Infectious Disease Surveillance Program, and the State of Baja California on binational surveillance, case investigation, and reporting. This partnership is essential for prompt notification of new cases in border counties, coordinating binational case investigations, containment, and mitigation strategies.

When emergencies or situations requiring immediate response arise, such as with the COVID-19 pandemic, HHSA utilizes established communication pathways to communicate with its counterpart, ISESALUD Tijuana Health Services Jurisdiction (which also represents the jurisdictions of Tecate and Rosarito) and other key binational partners.

INTERVENTION DESCRIPTION

When the COVID-19 pandemic began in early 2020, regional public health leaders in San Diego, California and Tijuana, Baja California immediately began communicating and sharing data, updates, response strategies and offering support to one another. Due to existing and longstanding cross-border collaboration and partnerships, this effort unfolded quickly and seamlessly through traditional communication channels.

Simultaneously, the County of San Diego established a larger incident command structure to respond to the pandemic and to address coordination across disciplines. The County created nine sectors and 13 sub-sectors to facilitate regular communication, coordination, resource allocation, and address emerging needs. HHSA leaders who regularly work with Mexico, noted the urgency of developing a binational response strategy and the "Binational Sector" was formed with a local focus on the San Diego-Tijuana transborder region. The County of San Diego Board of Supervisors understood the importance of a dedicated binational response and recognized the transborder community in press conferences to create broad awareness and support.

The Binational Sector is led by the County Community Operations Officer within the Department of Homeless Solutions and Equitable Communities (HSEC) with support from a team comprised of HSEC and Public Health Services, Office of Border Health staff. The Binational Sector Lead and team regularly facilitate cross-border collaboration, outside of the pandemic, in multiple areas related to public health and emergency preparedness. The Binational Sector's main role is to share data, updates for situational awareness, response strategies, guidance, establish connections, facilitate equitable testing and vaccine access, and provide general coordination support to partners on both sides of the border.

PARTNERSHIPS

ISESALUD Tijuana Health Services Jurisdiction

In partnership with ISESALUD Tijuana Health Services Jurisdiction, the Binational Sector developed infrastructure to formalize regular cross-border communication with key binational partners to address COVID-19 in the San Diego-Tijuana transborder region. They have remained an essential partner throughout the pandemic and on October 26, 2021, the County of San Diego Board of Supervisors recognized ISESALUD Tijuana Health Services Jurisdiction as a formal *Live Well San Diego* partner for their collaboration over two decades addressing mutual concerns in the areas of infectious and chronic disease prevention, health promotion, capacity building, and emergency preparedness, and many other important topics.

Consulate General of Mexico in San Diego

The County of San Diego has worked closely with the Consulate General of Mexico (Mexican Consulate) in San Diego for decades on cross-border issues and the partnership has facilitated important initiatives throughout the pandemic. Not only have they played an essential role through advocacy and coordinating key activities, but the Latino community also trusts information from the Consulate and feels safe accessing their services at their offices in Central San Diego. Since the beginning of the pandemic, the County remained in close communication with the Consulate, sharing concerns, data, recommendations, and collaborating on outreach, testing, and vaccines efforts.

US-México Border Health Commission

The US-México Border Health Commission is also a longstanding and critical partner on multiple binational endeavors. Outside the pandemic, for years they have served as an important leader on all aspects of binational health communication and collaboration. Throughout the pandemic, they have provided guidance, made critical connections, and ensured a broader conversation was taking place among all the border states in both the United States and Mexico to address challenges, share best practices, and identify improvement opportunities.

METHODS

The Binational Sector is comprised of three main functions: cross-border communication, testing and vaccine efforts, and binational coordination.

Cross-Border Communication

To facilitate ongoing formal communication with binational partners, the Binational Sector established weekly video conference meetings in partnership with ISESALUD Tijuana Health Services Jurisdiction and other key partners, primarily representing the government, academic, and healthcare sectors. The video conference meetings have a local focus and each one includes an epidemiological update from both the County of San Diego and the ISESALUD Tijuana Health Services Jurisdiction,

followed by a discussion among participants. To meet the needs of the bilingual audience, the Binational Sector contracts with a company that provides simultaneous English-Spanish interpretation *via* the Zoom platform. The Binational Sector also produces a biweekly, bilingual COV19 Binational newsletter highlighting epidemiological data at the local, state, and federal levels of the United States and Mexico, the latest local updates, and other helpful and timely resources for both California and Baja California.

Outside the scheduled video conference meetings, the Binational Sector plays a key role in facilitating regular communication among binational partners. The Binational Sector Lead also presents to various stakeholders on the COVID-19 transborder response as well as responds to numerous inquiries, varying in complexity, and confers with internal and external experts to provide responses and guidance. Further, with the goal of streamlining messaging and presenting consistent recommendations, the Binational Sector prioritized outreach and communication through media opportunities to reach the transborder community to increase confidence and adherence to public health measures.

Testing and Vaccine Efforts

The County established a regional COVID-19 testing and vaccination ecosystem with health equity in the center. It was a priority to place accessible sites in disproportionately impacted communities, including many in the southern region of the County, where a significant proportion of the transborder population resides. This was achieved through working with trusted partners to provide testing and vaccines at their frequented locations. Partners included City leaders, the Mexican Consulate, churches, markets, and others who offered accessible sites throughout the region.

Binational Coordination

In addition to the specific focus areas described previously, the Binational Sector provides and facilitates general support among many partners. Examples include facilitating multiple transborder Personal Protective Equipment donations, connecting partners with philanthropic opportunities, and troubleshooting unique challenges and requests.

RESULTS

Cross-Border Communication
Video Conference Meetings

The Binational Sector began hosting video conference meetings on March 26, 2020, in partnership with ISESALUD Tijuana Health Services Jurisdiction and other key binational partners (primarily government agencies). The meetings focused on the San Diego-Tijuana transborder region. From March 2020 to April 2021, the meetings took place every 2 weeks. Beginning May 2021, the meetings moved to a monthly basis. At the time this article is submitted for publication, thirty-eight video conference meetings will have taken place.

At each meeting, the Binational Sector Lead facilitates and provides relevant updates related to binational specific efforts

and the broader response. The County of San Diego Public Health Officer and the ISESALUD Tijuana Health Services leadership team (e.g., Director, Deputy Director, or Chief Epidemiologist) provide epidemiological summaries and related guidance. Following the epidemiological and general updates, a discussion takes place as well as an occasional presentation. Presentation examples include the Baja California Secretary of Health presenting their business safe reopening guidelines and the UN Refugee Agency in Tijuana sharing an overview of how the COVID-19 pandemic impacted Tijuana's migrant shelters.

Newsletter

Between April 2020 and December 2021, the Binational Sector produced and disseminated 35 newsletters to a binational audience. Each newsletter contained updated local, state, and federal epidemiological data and guidance from the United States and Mexico. As the pandemic evolved, it mirrored the needs of the moment such as updated testing and vaccine accessible locations for the transborder community. It also highlighted donation opportunities, and other helpful and timely resources related to mental health services, treatment opportunities, and other support services in both California and Baja California.

General Communication

The Binational Sector Lead and team respond to frequent complex inquiries and requests and coordinate with internal and external partners to develop guidance and responses. Due to the close relationships with binational partners, any concern that is communicated is flagged and elevated immediately for a response and guidance. Examples include data requests to illustrate the impact of the COVID-19 pandemic on Mexican-born nationals residing in San Diego and clarification questions related to vaccine eligibility in San Diego for the transborder population that reside in Mexico.

The Binational Sector Lead has also been invited to present on its activities on various panels, webinars, community presentations, and conferences. These opportunities have facilitated a broader conversation among local, state, national, and border state partners. There are many webinars and calls that take place on a regular basis to share information, exchange data and discuss effective strategies. One example in which the Binational Sector Lead participated in a panel discussion was during a *COVID-19 Virtual Seminar Along the United States Mexico Border Region,* hosted by the US-México Border Health Commission, in collaboration with the University of Arizona. The panelists shared COVID-19 data and examples of response best practices.

Media

At the time of this publication, the Binational Sector Lead has participated in several press events and more than 60 bilingual interviews on multiple TV and radio stations, in addition to print publications, that reach a transborder audience. As the pandemic has evolved, the topics and nature of the conversations have changed to reflect the priorities of the moment. At the beginning of the pandemic, topics centered around non-pharmaceutical interventions, promoting public

assistance programs, addressing mental health, providing testing information, data, and addressing the disproportionate impact on the Latino population. As testing became more available in the southern part of the region, and the port of entry testing site was established, the interviews shifted focus to a conversation on the enhanced outreach campaign to the transborder Latino population and the use of promotores to help navigate online appointment platforms. Later interview topics centered on school reopening guidelines, the vaccine rollout strategy, and misinformation surrounding the vaccine.

The Binational Sector Lead has also participated in several press conferences with city and community partners on COVID-19 collaborative efforts and responded to numerous written media inquiries for local publications that reach a transborder audience.

Testing and Vaccine Efforts
Testing Sites

In the Fall of 2020, with the support of the County of San Diego Board of Supervisors, the HHSA Director, and other key community partners, the Binational Sector Lead facilitated the opening of strategic testing sites at various locations (schools, markets, churches, etc.) frequented by the transborder Latino population. One key location was the Mexican Consulate and testing events took place at their site weekly between September 14, 2020 and June 28, 2021 and during popup events until February 3, 2022. In total, there were 39 testing days and 8,029 tests performed in partnership with the County of San Diego. To further increase access and trust, promotores assisted individuals in booking testing appointments. The Consulate testing site was so successful that it later transitioned to becoming a vaccination site.

Another strategic testing site was implemented at the San Ysidro Port of Entry to create quick and easy access for individuals who cross the border daily, many of whom comprise San Diego's essential work force. Customs and Border Protection played an important role in approving access, providing logistical support, and streamlining the population flow. The County of San Diego provided nursing staff to assist with administering the tests. The San Ysidro Port of Entry testing site was open every weekday for 217 days and performed 22, 874 tests from August 12, 2020 to June 30, 2021.

Vaccine Sites and Events

The Mexican Consulate, UC San Diego, the Secretary of Health in Baja California, U.S. Customs and Border Protection, and many binational business partners, started a pilot border vaccine project in May 2021. Over a 2-week period, nearly 10,000 vaccines were administered to US-owned Tijuana maquiladora employees at the San Ysidro Point of Entry. The pilot was so successful that it was extended to eventually vaccinate over 27,000 people and was replicated in other jurisdictions along the US-Mexico border.

The Binational Sector Lead also played a role, along with the County of San Diego's "T3" team (T3 - a strategy that focuses on testing, tracing, and treatment), the California Department of Public Health, and the US Consulate in Tijuana, to provide

COVID-19 vaccines to H-2A workers crossing into the U.S. from Tijuana, Mexico, at vaccination sites near the US-México border. The CDC supported the project through promotion at local agricultural sites.

The Mexican Consulate eventually became a regular vaccine site for mobile, popup and special vaccine events. In total, there were 41 vaccine events and 3, 256 vaccines administered in partnership with the County of San Diego between March 24, 2021 and December 2, 2021. Another strategic vaccine site was at the Southwestern College located less than ten miles from the San Ysidro and Otay Mesa ports of entry. The site was open for 79 days and 18, 866 vaccines were administered in partnership with the County of San Diego between February 2, 2021 and June 29, 2021.

Two other Binational Sector-supported vaccine events focused on children ages 12–18 years old from Baja California. One took place in San Diego at the Mexican Consulate on November 5, 2021 and the other took place on November 18, 2021 at the centrally-located Tijuana Cultural Center in Tijuana, Baja California. It was a collaboration with the Baja California Secretary of Health, ISESALUD Tijuana Health Services Jurisdiction, the Mexican Consulate in San Diego, the County of San Diego, the US-México Border Health Commission, Tijuana Innovadora, and many other organizations. Vaccines were donated by the County of San Diego HHSA.

Binational Coordination
Personal Protective Equipment Donations
The Binational Sector provides general support with coordinating transborder collaborative projects. It has coordinated several cross-border Persona Protective Equipment (PPE) donations over the last 18 months. One substantial request involved the Binational Sector's coordination of a large State of California PPE donation *via* the County of San Diego to the Baja California ISESALUD Tijuana Health Services Jurisdiction who disseminated items to public hospitals, fever clinics, Tijuana Red Cross and Tijuana Civil Protection. This request involved coordinating with local and state officials in California as well as the Mexican Consulate, the Baja California Secretary of Health, and the revenue service of the Mexican federal government. After a few months of communication, permit processing and inventory accounting, the request was approved by the Mexican federal government and on November 12, 2020, 83 pallets of PPE were transported by four semi-trucks from a warehouse in San Diego to a warehouse in Tijuana. The same day, the Baja California Secretary of Health and ISESALUD Tijuana Health Services Jurisdiction arranged a reception and press conference with key partners including the Binational Sector Lead and Mexican Consulate to acknowledge their appreciation of the large donation and overall partnership.

Partner Coordination
Another important role the Binational Sector has played throughout the pandemic relates to aligning interests and bridging key partners and stakeholders. The Binational Sector facilitated communication among multiple partners interested in volunteering, donating, addressing complex challenges.

One example in which the Binational Sector provided coordination was when the need was identified for streamlining a notification pathway for individuals with COVID-19 who are released from hospitals in San Diego County and returning to their home in Mexico. Ensuring that each entity in the pathway is given advanced notification, is essential for preparedness, to take the necessary precautions and to ensure the patient is supported along their journey and when they reach their destination. The Binational Sector facilitated meetings among the County of San Diego Emergency Medical Services, the County of San Diego's Epidemiology program, the California Department of Public Health, Office of Binational Border Health, Centers for Disease Control and Prevention Division of Global Migration and Quarantine US-Mexico Unit, Tijuana Red Cross, and the ISESALUD Tijuana Health Services Jurisdiction to develop a notification pathway for Mexico-bound discharged patients who are traveling *via* ambulance. Once all participating entities provided input and agreed on a process, the pathway was finalized and implemented across the San Diego County hospital system.

DISCUSSION

Recognizing the region's interconnectedness, that San Diego County and Tijuana share a transborder population, and the fact that disease spread is multi-directional, the need for a Binational Sector to coordinate cross-border communication, collaboration, and coordination was essential. Fortunately, the County of San Diego HHSA and its counterpart ISESALUD Tijuana Health Services Jurisdiction had a strong existing relationship and had collaborated on multiple endeavors for decades prior to the COVID-19 pandemic. The pandemic deepened this relationship due to the increased communication and coordination between the two entities, further solidifying their commitment to work together and support one another. This partnership underscores the need to maintain and foster the broader collaborative transborder agency network.

The pandemic has highlighted the need to further understand the unique life circumstances of transborder communities and how they impact health outcomes. A significant number of daily border crossings continued throughout the pandemic, even with the Department of Homeland Security's border crossing restrictions in place, given the essential nature of cross border activity in the region. It is vital to take this into consideration when designing binational public health interventions. There is a need to continue to identify opportunities to intervene, support, and connect the transborder community to available resources. Further, it is important to examine ways to streamline public health messaging to ensure the guidance is consistent on both sides of the border, especially during public health emergencies or natural disasters.

The COVID-19 pandemic has also highlighted inequities that exist in our communities of color and how they contribute to health disparities. One of the greatest challenges has been implementing health measures and prevention strategies while recognizing that these changes greatly impact the economy

and when the economy suffers, the already disadvantaged communities suffer even more. One key community is the transborder essential work force. To mitigate these challenges, the Binational Sector focused on increasing access to testing and vaccine sites and conducting community outreach by employing promotores and partnering with media that reach a broad transborder audience.

There has also been a keen awareness of the mental health impact of the pandemic on the broader community and one can imagine the impact has been even greater on the transborder Latino community. To address these types of inequities and health disparities, the San Diego County HHSA inaugurated a new department, the Department of Homeless Solutions and Equitable Communities, to ensure that all operations are conducted through an equity lens. This new department will have a prominent binational focus within its Office of Immigrant and Refugee Affairs.

The COVID-19 pandemic has also provided an opportunity to strengthen emergency preparedness and cross-border response activities. Several partners including the City of San Diego, the San Diego County Office of Emergency Services and Emergency Medical Services, the California Governor's Office of Emergency Services, and Civil Protection and fire departments in Baja California have a history working together and they worked closely throughout the COVID-19 pandemic. These relationships have deepened and have leveraged an opportunity to improve cross-border emergency communication infrastructure, protocols, and other processes.

Other opportunities for improvement include dedicating resources to support a robust infrastructure to facilitate binational contact tracing and case notification, additional testing, treatment, and vaccine sites at ports of entry, and streamlining processes for sharing and donating resources across the border.

CONCLUSION

The interdependence between the two sister states creates a need for mutual support during times of crisis. From a public health perspective, this region is considered one with a shared community and shared health challenges. With the constant fluidity, diseases can spread quickly in both directions, as is proving evident with the COVID-19 pandemic. For these reasons, it is critical for leaders on both sides of the border to communicate regularly and work together to support the transborder community. It was essential to implement a formal structure to facilitate regular binational communication, coordination, and collaboration to respond to COVID-19 jointly and effectively. Coming together during this challenging time has only strengthened the existing partnerships and cross-border

network, bringing various agencies and entities together in a more profound way. By creating an effective infrastructure and deepening cross-border relationships, it will be possible to reestablish this sector in the event of any future public health emergency or natural disaster and it will be feasible to carry out the same successful and impactful operations.

Prior to the pandemic and ongoing are several other cross-border collaborative efforts at the local, state, and federal levels across the border region. These efforts include academic, government, and non-profit partners and have focused on volunteer efforts, philanthropy, testing, vaccines, and coordinated medical care. At the time of this publication, the County of San Diego Binational COVID-19 Sector is the only county-level formal cross-border structure created in response to the pandemic. It received a 2021 National Association of County and City Health Officials Innovative Practice Award for "Ongoing cross-border (San Diego-Tijuana) COVID-19 collaboration" and a National Association of Counties 2022 Achievement Award for "COVID-19 Cross-Border Vaccination Efforts." Due to its logical structure and components, it can be replicated in other global cross-border regions.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

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Access to Health Care for Migrants Along the Mexico-United States Border: Applying a Framework to Assess Barriers to Care in Mexico

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Background: Migrants in Mexico are entitled to care at all levels, independently of their migration status. However, previous studies show that access to care is difficult for this population. As the movement of in-transit migrants and asylum seekers has been interrupted at the Mexico-United States border by migration policies such as the "Remain in Mexico" program, and by border closures due to the COVID-19 pandemic, the Mexican health system has the challenge of providing them with health care. Levesque et al.'s framework, according to which access occurs at the interface of health system characteristics and potential users' abilities to interact with it, is a useful theoretical tool to analyze the barriers faced by migrants.

Objective: The objective of this article is to analyze the barriers to access the public Mexican health system, encountered by migrants in cities in Mexican states at the Mexico-United States border during the COVID-19 pandemic.

Methods: Data came from a multiple case study of the response of migrant shelters to health care needs during the COVID-19 pandemic. The study consisted of a non-probability survey of migrants with a recent health need, and interviews with persons working in civil society organizations providing services to migrants, governmental actors involved in the response to migration, and academics with expertise in the subject. We analyzed the quantitative and qualitative results according to Levesque et al.'s framework.

Results: 36/189 migrants surveyed had sought health care in a public service. The main limitations to access were in the availability and accommodation dimension (administrative barriers decreasing migrants' ability to reach the system), and the affordability dimension (out-of-pocket costs limiting migrants' ability to pay). Civil society organizations were a major source of social support, helping migrants overcome some of the barriers identified.

Conclusions: While Mexico's health regulations are inclusive of migrants, in practice there are major barriers to access public health services, which might inhibit migrants

from seeking those services. In order to comply with its commitment to guarantee the right to health of all persons, the Mexican health authorities should address the implementation gap between an inclusive policy, and the barriers to access that still remain.

INTRODUCTION

Globally, migrants face multiple barriers in accessing health services, which go beyond those of the local, non-migrant population. These include legal barriers such as the exclusion of irregular migrants from publicly funded health care systems, the cost and availability of services, limited information on how to access services, language and cultural differences, and discrimination (1). From the perspective of rights and universal health coverage, there is a need to develop policies that consider this underserved population, and to include them in the health systems of the recipient countries (2, 3). Access to health care in the context of migration is one of the structural determinants of the health outcomes of migrants (4).

Access to health services is defined as the possibility a person has of getting in contact with a service when in need, and to see the need solved -within the ability of current knowledge and procedures- (5–7). The classic concept of access by (7) included five dimensions: i) availability (the presence of health care facilities); ii) accessibility (geographical proximity); iii) accommodation (the fit between the organization of services and the characteristics of potential users); iv) affordability (related to cost); and v) acceptability (perceptions of potential users regarding the services, as well as the attitudes of providers toward users). Later models have kept similar dimensions, adding the role of demand-side (potential users) characteristics to the supply-side (health system) ones in determining the possibility to access care.

More recently, (6) proposed a model centered on the person (or "patient"), in which access is understood as a process that begins with a health need, and in the best case scenario continues through the contact and interaction with health services, ending in the resolution of the need. The model emphasizes the interplay between people's "abilities" and the characteristics of the health services, and how elements from both can impact access. A recent scoping review found that Levesque et al.'s framework has been increasingly employed in the past few years, because of its combination of individual and health system factors, and also for its focus in access as a process with multiple steps where barriers can occur (8). However, only nine of 31 studies included in that review were conducted in low- and middle-income countries (LMICs), and only one of them (9) focused of migrants. Another six studies which did focus on migrants had been conducted in high-income countries of Europe or Eastern and South Eastern Asia. To the best of our knowledge, this is the first studies to apply Levesque et al.'s framework to the health care access of migrants in Latin America.

Historically, the main migration flow in Mexico has been the movement of Mexicans to and from the United States of America (US). Added to this, Mexico has been a major route for in-transit migrants from other countries who aim to reach the US. More recently, the number of in-transit migrants has increased, their demographic profile has diversified, and this flow has included more and more persons who flee their countries of origin because of violence, natural disasters, or political prosecution, and intend to apply for asylum (10). Therefore, what used to be a population of in-transit, mainly economic migrants, is better described now as a mixed migrant flow, composed of economic migrants, asylum seekers and displaced persons (11).

In 2018, during the Trump administration, the US federal Government implemented the "Remain in Mexico" program, which forced asylum seekers presenting at the Mexico-US land border to wait in the former country while their case was being considered in the latter (12). Following the onset of the COVID-19 pandemic, a second obstacle was passed by the US Government. This was the "Title 42" measures, which allowed migration authorities to return persons to Mexico without processing their asylum claims, on the basis of the health risks associated with receiving them in migration facilities (13). This combination of migration policies has resulted in large numbers of migrants becoming stranded in Mexican border cities for prolonged periods, many of them residing in migrant shelters operated by civil society organizations (CSOs). Although there are no accurate estimates of the number of migrants living in these conditions, some studies show that the arrivals into Mexican border cities of persons who aim to apply for asylum in the US have been in the thousands per month in the past years for cities such as Ciudad Juárez and Tijuana, with occasional outbursts such as the "migrant caravans" (14). In the fiscal year 2021, there were 1.7 million encounters with (persons detained by) the US Border Patrol in the US-Mexico border (15), and even though this number includes an important percentage of recidivists, it still points to the important numbers of persons that can at some point be staying in cities in the Mexican side of the border.

In this new situation, the Mexican health system has the challenge of guaranteeing migrants access to health services, as mandated by its recognition of health as a human right independent of migration status (16, 17). A recent amendment to the Art 77 bis 7 of Mexico's General Health Law grants free access to public health services (including medicines and supplies) to all persons in the country, so that migrants (including irregular migrants) are entitled to health care at all levels of the health system (18). However, an implementation gap remains, and in

practice the members of mixed migrant flows are not always able to access services (19).

Our objective in this article is to analyze the barriers to access the public Mexican health system, encountered by migrants in cities in Mexican states at the Mexico-US border during the COVID-19 pandemic. We employ Levesque et al.'s model as an analytic tool to describe how supply- and demand-side elements interact in the process of access. In what follows, we begin with a brief description of Levesque et al.'s model. Then, we present the methods and results of our study. We close with a discussion of the main barriers faced by migrants, and a reflection on Levesque et al.'s model.

Levesque et al.'s Health Access Model

As referred above, (6) describe access as a process that goes from health care needs to health care results. At each phase of the process, a person's abilities interact with dimensions of the health care system in a way that either hinders or facilitates access. The five abilities, according to the framework, are: 1) to perceive a health need; 2) to seek care; 3) to reach health care services; 4) to pay for services; and 5) to engage with health care. These abilities are determined by personal characteristics, as well as by the social context at different levels. Correspondingly, the five dimensions of the health care system are 1) approachability by potential users; 2) acceptability by potential users; 3) availability and accommodation to the potential users' needs; 4) affordability for the users; and 5) appropriateness of the service.

The process begins with the ability to perceive a health need, and to know which health care is required and exists. This perception can be determined by a person's knowledge and beliefs related to health. The system's approachability also influences those perceptions, so that people in need of care are either detected by the system (via screening) or know that the system is there for them to use. A health service can be more or less approachable as it becomes more or less visible to potential users, for example by means of outreach strategies.

In the second phase, access depends on a person's ability to seek care in a given service, a decision that will depend on personal values, cultural norms and the knowledge of health care options. Ability to seek is related to personal autonomy. It also depends on the acceptability of the system to the people it is supposed to serve. A service will achieve acceptability if its professional values, norms, and culture are adjusted to those of potential users. If services are less acceptable to some groups of the community, then inequities in access will result. For example, discrimination of some groups can make a service less acceptable to ethnic, sexual or other minorities.

Thirdly, a person needs to have the ability to reach the system, getting in actual contact with it. Among the personal characteristics that can limit the ability to reach are difficulties with physical mobility, working hours or living arrangements. Also important in this sense are material resources (e.g. economic means for transportation). On the supply side, geographical location, hours of opening and facility settings are examples of characteristics that constitute the dimension of availability and accommodation. Administrative or bureaucratic barriers can also be included in this dimension.

Fourthly, ability to pay is an important determinant of access, and is dependent on income and other sources of economic resources such as savings, and loans, that allow the person to cover health care expenditures, ideally without incurring in catastrophic expenses. It also encompasses the opportunity cost related to loss of income when an individual dedicates time to health care seeking. The relevance of individual ability to pay, however, is contingent to the health system's organization in terms of its charging (or not) for services, out-ot-pocket expenses vs. different types of insurance, cost of services, and social insurance schemes, which define the system's affordability dimension.

Finally, the ability to engage with the system once contact has been established requires all the elements that enable a person to adhere and follow up with treatment. Ability to engage refers to individuals' participation and involvement in their health-related decision-making including treatment. On the supply side, this requires an organization capable of providing continuity of care, and good quality services that can address the health need, which are part of the dimension of appropriateness. Appropriateness is thus the fit between services and the clients' needs. The appropriateness of a service is determined by the correct assessment of a health problem and quality of treatment (both technical and interpersonal).

MATERIALS AND METHODS

Design

In this article, we report on the secondary analysis of data from a comparative case study (20). The parent study's objective was to analyze how migrant shelters acted during the COVID-19 pandemic in order to promote migrants' right to health. This was a mixed methods study, in which quantitative and qualitative methods (described below) were combined with a complementarity rationale, meaning the methods were used to measure overlapping but also different facets of a phenomenon, yielding an enriched, elaborated understanding of it (21). In the study design, the two methods had the same importance, and were implemented simultaneously and interactively. Four shelters (cases) were selected for the parent study, with the aim of obtaining a sample that varied in terms of internal capacities (as evidenced by time in operation, internal organization and services that the shelters provide beyond humanitarian assistance, number of paid staff, and number of people they could receive) and context (presence in the city of other migrant protection organizations, presence of federal human right agencies, population of the city, number of health care facilities and personnel). Data were collected from June to September 2021.

The quantitative component consisted of a survey of migrants residing in or receiving services such as food donations from the shelters. Since the main focus was on health care access, a non-probability, theory driven sample strategy was followed, in which we recruited participants who had experienced a health need during their time in the shelter. Given budgetary and logistic limitations, we did not calculate a sample size, but aimed to reach a quota of 80 adults who had experienced a health need during

their time in the shelter, 80 adults in charge of a minor who had experienced a health need during their time in the shelter, and 80 women who were pregnant or had recently given birth. For the purposes of this article, we employ the survey's responses of the first two groups, and of women who reported that, in addition to their pregnancy-related need, they had experienced another health issue during their time in the shelter. Selection criteria for the quantitative phase were: a) having stayed or being in touch with the shelter for at least two nights; b) being 18 years of age or older; and c) having had a health need (or being in charge of a minor who had one) during their time in the shelter. The survey included questions about sociodemographics, migration, health issues, health care seeking, health services utilization, and satisfaction with health services.

The qualitative component consisted of semi-structured interviews with key actors of the response to migrants' needs. This included staff and volunteers of the migrant shelters, and informants working with SCOs, governmental and international agencies. Selection criteria for this component were: a) having knowledge of the situation of health and health care access of migrants in the city; and b) being 18 years of age or older. The interview guide was designed to target the parent study's objectives of describing the elements that facilitated or hindered the shelters' health-related response. It included questions on the main health care needs of migrants from the informants' point of view, barriers and facilitators to health care access, and how the shelters responded to the above before and during the COVID-19 pandemic. Since data collection took place during periods of high transmission of SARS-CoV-2, we conducted all interviews over video-conference. We recorded the audio of the interviews, and, because of budgetary constraints, conducted analysis of the records without transcribing them. To avoid losing important aspects of the data, we prepared a matrix with the main analytic dimensions of interest, and two researchers independently listened to the records and took notes about each dimension, as well as on novel aspects emerging from the interviews. When a quote was considered of relevance, the researcher transcribed it into the matrix. Then, a round of discussion was conducted between all researchers, in which the matrix was refined. The main qualitative data source for the analysis in this article was the final version of the matrix, but we went back to the original recordings for reference when needed during the iterative process of discussion of results described below.

Analysis

For this article, we applied Levesque et al.'s model a posteriori (i. e., we did not use it as a guide for study design). Instead, after data collection we identified that our results regarding migrants' health care access could be best summarized by this model, and conducted a secondary analysis integrating quantitative and qualitative data with the model as a framework. In accordance to the mixed methods approach of the study, we sought to increase the meaningfulness and trustworthiness of the results by illustrating them with results from both methods.

In order to do this, we followed an iterative cycle, in which all authors of this article equally participated. First, we familiarized

TABLE 1 | Characteristics of migrants surveyed in shelters ($n = 189$)[a], by group.

Variable	Adults with a health care need ($n = 102$)	Minors with a health care need[b] ($n = 74$)	Women with a pregnancy-related need ($n = 13$)
Female	32 (31%)	33 (45%)	13 (100%)
Age, years (mean, s.d.)	36 (15)	5 (4)	24 (4)
Country/region of birth			
Central America	90(88%)	62 (84%)	11 (85%)
Mexico	10 (10%)	12 (16%)	2 (15%)
Colombia	1 (1%)		
Cuba	1 (1%)		
Years of education (mean, s.d.)	8 (3)	4 (2)	6 (2)
Migration plans			
Returned from the US, plans to cross again[c]	22 (22%)	21 (28%)	2 (15%)
Waiting to cross into the US	63 (62%)	49 (66%)	11 (85%)
Plans to stay in Mexico or return to country of origin	17 (17%)	7 (9%)	

[a]Analysis sample: participants who responded questions on health care seeking. [b]As reported by the adult in charge of the minor. Migration plans in this group refers to plans that include the minor, and responses are not mutually exclusive. [c]Returned as part of the "Remain in Mexico" policy, expedited return or deportation.

ourselves with the matrix of interviews results and with the quantitative results. Second, we prepared a table with the five abilities and dimensions proposed in the model, and classified the results according to them. We then discussed how well the results mapped to the dimensions and abilities, and changed the table's content accordingly. We also took notes on aspects of the results that did not match the model. Finally, we employed the final version of the table to organize the presentation of results according to each phase of the process in Levesque et al.'s model, considering both demand side (abilities) and supply side (dimensions) elements at each phase.

Ethical Considerations

The study protocol was reviewed and approved by the Ethics Committee of El Colegio de la Frontera Norte. All participants were informed of the objectives and procedures of the study, or their right to refuse and withdraw consent, and of the measures that would be taken to preserve confidentiality. Participants read or were read an informed consent script, and gave verbal consent.

RESULTS

We recruited 219 migrants for the quantitative survey. Of them, 189 had valid responses to questions regarding health care seeking, and are therefore included in this analysis. Their distribution by groups and general characteristics of the analysis sample appear in **Table 1**. Most of them were originally from Central American countries, had a low level of education, and were waiting to cross to the US or had been returned after crossing.

For the qualitative component, we interviewed 22 key informants, of whom 11 were women and 11 men. Two were academics (both of also active in CSOs), nine worked for international organizations, nine for CSOs, and two for governmental agencies (one in health services, one in migration).

As per our sampling strategy, all migrants (or a minor they were on charge of) had experienced a health issue during their time in the city. The most frequently reported issues among adults were acute respiratory infections (including COVID suspect or confirmed cases), injuries as a result of accidents or violence, and mental health issues (self-reported depression, anxiety and insomnia). Likewise, acute respiratory infections were the most frequent health need among minors, followed by headache with non-specific causes, allergies and asthma.

Figure 1 shows the number of participants with valid responses in the questions about health care seeking. Of the 144 who sought care, 36 did so in a public facility. The rest of them were mostly seen in the shelters, in pharmacies, or in private services. A small number (7 cases) employed non-medical services such as a traditional healer, acupuncture or another.

Step 1: System's Approachability and the Person's Ability to Perceive

In order to be approachable, a health system must reach out to potential users. According to interviewees, the public health system sometimes engages in outreach activities in the form of visits to the shelters of teams from the local health jurisdictions that provide preventive services and care. In one of the cases, a doctor had been commissioned by the jurisdiction exclusively to provide services to migrants. Most of these services had been scaled back in the first months of the COVID-19 pandemic, but at the same time the health jurisdiction got in touch with the shelters' director in order to facilitate detection and care of COVID-19 cases.

> There's a [primary care clinic] close to the shelter. Since I've been here they [periodically] invited us three or five times to receive them for health fairs […] [IN THE FAIRS CONDUCTED IN THE SHELTER] they provide vaccination, talks, and other activities (*Female, staff of shelter*).

Approachability also requires that the system provides persons with information about available health care options, but the outreach activities described did not include this component. Added to this, we found that not knowing where to seek care was the second main reason for leaving a health need unattended, as reported by 12/45 (27%) participants who had not sought care. This was also mentioned by key informants.

> [MIGRANTS] are not going to go to the health services because they do not have any type of advice or anyone to guide them or refer them to where to go in case they require attention (*Female, staff of international organization*).

While we did not collect detailed information on the ability to perceive a health issue as a need, according to the survey only in four cases (all of them of minors) care was not sought because the

FIGURE 1 | Health care seeking by migrants who responded the quantitative survey. [1]WPRN: Women with a pregnancy-related need, responding questions on an additional, unrelated health need. [2]Responses to this question were not mutually exclusive. For minors, the reason was given by the adult in charge of them.
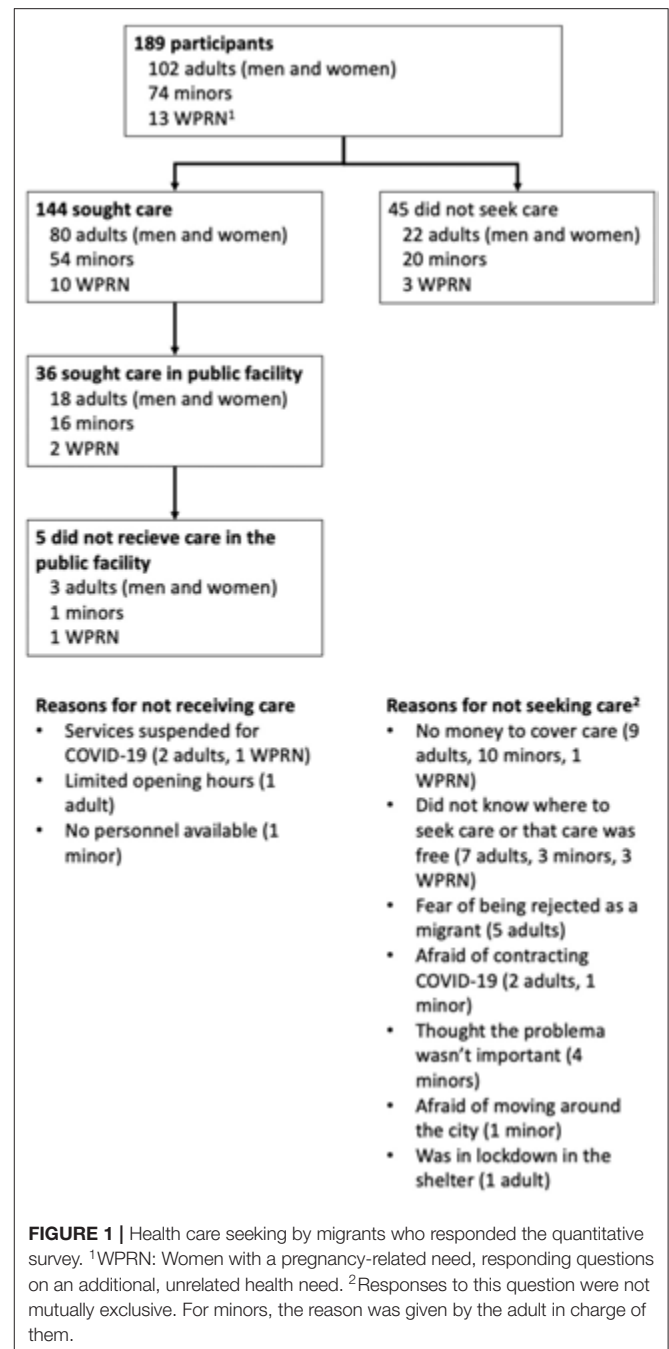
informant didn't think the problem was important. Two of these had symptoms of an acute infectious disease, one had chickenpox (as reported by the adult), and the other one's only symptom was lack of appetite. None of the adults abstained from seeking care because of this reason, so it seems that the need for health care is perceived by participants, but barriers arise in other aspects.

Thus, the main barrier to access in this step that we identified was lack of information about the services available, an aspect that was not considered in the health jurisdictions outreach activities.

Step 2: System's Acceptability and the Person's Ability to Seek

Acceptability, in the sense of conflict between the health care system organization and migrants' values or cultural expectations, did not appear as an issue in either the quantitative nor the qualitative components of our research. None of our interviewees mentioned cultural aspects that could impact the public health system's acceptability to migrants, and neither did respondents to the survey cited this as a reason for not seeking care. However, some mentioned that lack of awareness of migrants' rights on the part of health system workers was a barrier to access.

> [...] we have challenges associated with the lack of knowledge, as I was telling you, of the rights and the possibility of accessing, the rights of persons, because of lack of knowledge on the part of [...] health system staff (*Female, staff of shelter*).

Since 45/189 (24%) of participants in the survey had not sought care, there was evidence of limitations in the ability to seek. The main reason for not seeking care they referred was lack of money to pay for it, mentioned by 20/45 (44%), so that ability to pay and affordability, which are part of the fourth step in the model, actually had effects earlier in the process, by limiting a person's ability to seek care.

Another barrier to the ability to seek was migrants' lack of awareness of their right to receive care in the public services, which was mentioned by key informants during qualitative interviews.

> [...] many of them, not being familiar with the city, didn't know that they are supposed to be accepted in [public health care services] (*Female, staff of international organization*).

Thus, the main limitations in this step were lack of awareness of migrants' rights on the part of health care staff (which could be considered an element of the professional culture), and lack of ability to pay (which will be described in more detail in step four below).

Step 3: System's Availability and Accommodation, and the Person's Ability to Reach

In the cities where the four shelters were located, public health services were geographically available. All four had primary care services within a five-kilometer radius (an indicator of geographical accessibility) (22). Three of them also had general hospitals within that distance, and one a maternity hospital in that range. All four cities had general hospitals, and three had specialty hospitals (e.g., geriatrics, children's hospital). Distance from a healthcare facility was not listed as an issue among the migrants who had not sought care when experiencing a health issue.

However, location is not the only aspect of geographical availability that matters for access (8). The time and cost of traveling to the health care facility are also important in this regard, and, as one interviewee pointed out, the cities where the shelters are located have deficient and costly public transport, and poor walkability. Extreme climate and security (e.g., safety, crime) concerns, as well as lack of knowledge of the surroundings, also constituted barriers for migrants' ability to reach care in public health facilities.

> It's a challenge, because [...] all health services are either there [DOWNTOWN] or in another area, which is [NAME OF ZONE] [...] And that is the middle-class, more established area, so the shelters are far away (*Male, staff of international organization*). Added to that, another challenge is transport, [NAME OF CITY] is a city made for cars, public transport is deficient, apps like Didi or Uber are too expensive (*Female, staff of international organization*).

According to most interviewees, a major barrier in accessing the public health system was the exigency of presenting certain identification documents before being admitted for care in either primary care clinics or hospitals (this did not seem to be a barrier in the case of emergency services). This administrative barrier can be situated in the dimension of accommodation in the Levesque et al.'s model, as it implies a lack of adaptation of the system to the characteristics of its potential users (in this case, migrants without the required documents). While some interviewees mentioned that since the recent changes to the Mexican Health Law documents were no longer required by the public health facilities, most reported that this requisite was still in place. None of the migrants who responded the survey failed to receive care because of this reason, but it is possible that they were aware of the potential difficulty, and therefore did not even bother to go to the public services when in need. Access in these circumstances depended on discretionary decisions by the staff of public services, and of the arrangements migrant shelters were able to come to with them.

> Migrants are required to present and ID, or a letter from the migrant shelter, in order to be seen at the General Hospital. They can't just go to any primary care facility. We send them to the [NAME OF PRIMARY CARE CENTER] which is 10 min away by car and 40 min away walking, because there they accept them with or without an ID. There are three primary care centers where migrants without papers can go, not all centers receive them. There's one more that does receive asylum seekers as they already have a CURP. Whether they are received without or with identity documents depends on the center's administration (*Female, staff of shelter*).

Therefore, while geographical availability in terms of location was not a major barrier in the cases we studied, there were other difficulties related to transportation, and administrative barriers affecting the migrants' ability to reach the system also emerged. Support by CSOs and international organizations was the main facilitator in this step, as they provided transportation, accompanied migrants to help them navigate the system, or, as in the quote above, made agreements with the public health services so they would receive migrants sent there from the shelters.

Step 4: System's Affordability and the Person's Ability to Pay

Even though Mexico's public health care system is free of charge for all of those who have no other source of social security-related health services (18), chronic underfunding and other problems mean that, in most cases, patients have to pay out of pocket for expenses such as medicines or laboratory tests that are not available in the health care facility (Centro de Investigación Económica y Presupuestaria (23, 24). This constituted a major barrier, which as described above was the most frequent reason for not seeking care mentioned by the survey's respondents. Of the ones that sought and received care in the public system, 11/31 were required to pay for either medicines, laboratories or other services.

The migrants' ability to pay was limited by the fact that most of them had no source of income or were living of their savings. Besides, monthly income was low: 53/76 participants who responded a question about it had an income of <$3,500 Mexican pesos (about US$175), under the country's minimum wage (about US$220 at the time). Sometimes migrants were able to surpass the economic barriers to access public health services with the aid of the SCO's operating the migrant shelters.

> The shelter covers the expenses and medicine required when the primary care center doesn't have the medicines, or when the migrant doesn't have the resources. If there's a medicine needed, we check in the shelter to see if we have it, and if we don't there's an agreement with a pharmacy. The medicines are paid with funds from UNHCR and with money that we receive as donations (*Female, staff of shelter*).

Another aspect of affordability and the ability to pay had to do with the costs of transportation. We have mentioned this before, as part of the ability to reach, but as other authors have pointed, transportation could also be considered part of the expenses a person has to incur in order to reach services (8).

Thus, affordability was one of the dimensions in which barriers to access were more apparent in our data. As with accommodation, it could also influence the migrants' perception of the system, so that their ability to perceive could have been diminished by knowing beforehand that they would not be able to pay for care, and therefore decided not even seek contact with the health care facility.

System's Appropriateness and the Person's Ability to Engage

The dimension of appropriateness is better assessed through the results of the contact between the person and the health system, ideally ending in the resolution of the need. In our data, we only have evidence of the degree of satisfaction of those who had received some form of care in the public health system, which in general was high: 12/15 adults receiving care for themselves in the public system and 13/15 in charge of a minor who received care in the same system said they were satisfied with care. On the other hand, a process indicator that reflects the quality of care, and also the ability to engage on the patient's side, is whether the health care provider facilitates the patient's autonomy by explaining him/her the diagnosis and procedures to be followed. When asked about doctor-patient interactions, almost all who were seen in the public system or brought a minor in to receive care in it, reported they had been treated with respect, received a diagnosis, and were provided with written indications and explanations for how to take medicines. The only aspect relatively lacking was that 4/15 had not been asked if they had any doubts.

Thus, once in touch with the public health system, appropriateness and ability to engage seemed to be reasonably good. However, the small number of cases and lack of information on the resolution of the health need limits our capacity to reach conclusions in this regard.

DISCUSSION

In this article, we identified the barriers to access the public health care system in Mexico faced by members of mixed migrant flows. Given that according to the law the public system is open at all levels, free of charge, for migrants in Mexico, the fact that it is not the most sought-after option points to the fact that an implementation gap remains in Mexican health policies. We framed the barriers that help to explain this gap using Levesque et al.'s model. Our main conclusions are depicted in **Figure 2**.

In summary, we found that the main barriers occurred in the dimensions of affordability/ability to pay and availability and accommodation/ability to reach. This is similar to the results of other studies using Levesque et al.'s framework, which also have identified these two areas as relevant (8). An important finding, however, was that barriers classified as part of those dimensions could operate even in the first steps of the process, as migrants' ability to seek health care in the public health system might be hindered if the expectation of barriers makes them rule it out as a possibility. The decision to seek care in the public health system is also probably made after weighing the costs and benefits of different therapeutic options as well as the severity of health needs (25).

Using Levesque et al.'s framework in an empirical case study allowed us to assess its strengths and limitations. As other authors report, some results are difficult to categorize in a single dimension. For example, the distance or time to reach a health facility can be classified as an issue or availability, or of ability to pay (8). Some dimensions or aspects of dimensions that are important in the case of migrants are not completely captured by this model, as in the case of administrative barriers to access that persist even in the face of a normative right to care. Also, the model could be enhanced by considering the social determinants of individual abilities to access, such as the possibility of migrants to have decent work and sufficient salary, or their inclusion in other systems of social protection (1). Still, similar to other versions of access as a process (26–28), the model allowed us to systematically describe the barriers faced by migrants at each step.

A limitation of our study is that, since data came from a comparative case study of four sites, with non-probability sampling, we cannot claim that our results represent the situation of all member of mixed-migrant flows in Mexico. The intended sample size for women with reproductive care needs was not

FIGURE 2 | Barriers in the process of accessing health care. [1]Adapted from (6).
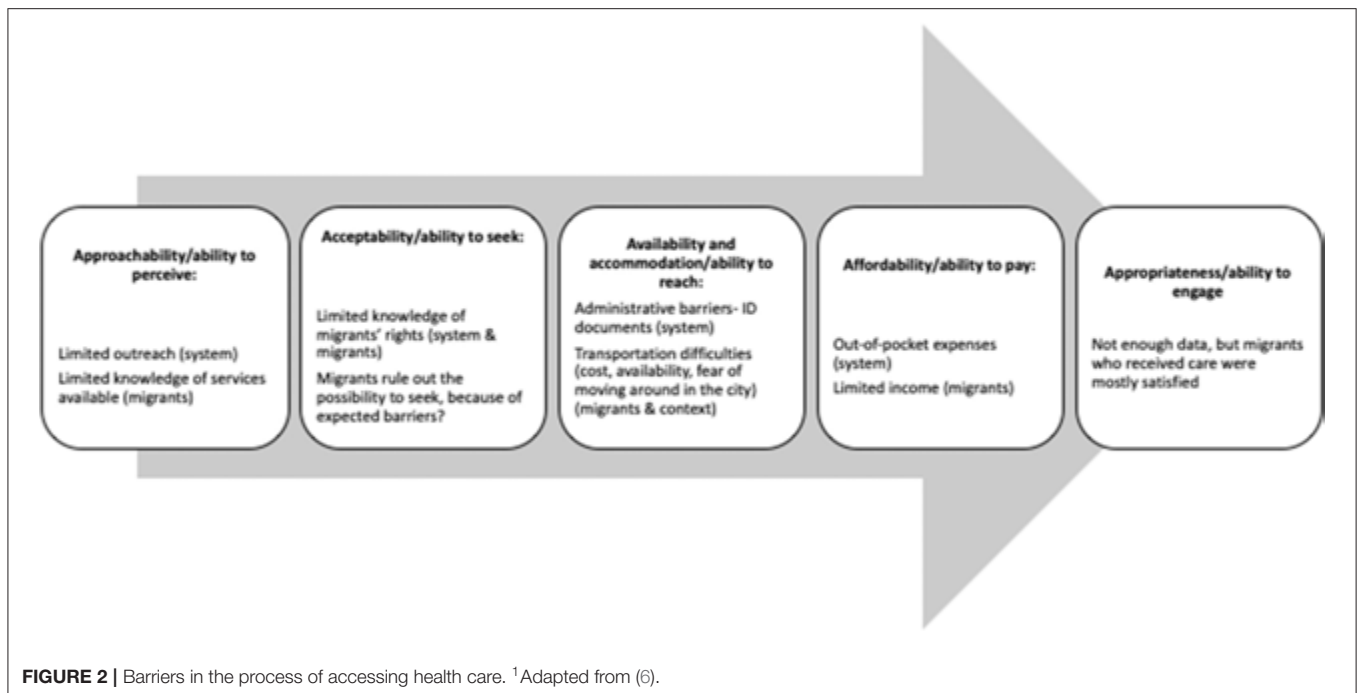
reached because there were not enough eligible women in the shelters during the period of data collection, and we had no members of the LGBTQ+ community among participants. Neither were we able to interview migrants who were not Spanish speakers.. Since not all shelters keep detailed records of the sociodemographic characteristics of migrants, we are not able to assess the representativeness of our sample, but as different groups might have different experiences in accessing health care, future studies should aim to include a more diverse sample. Another limitation is that data were collected during a peak of the COVID-19 pandemic, so some aspects of the health system's functioning might be different in comparison with other periods. However, the similarity of our results with some previous reports (29) makes us confident that they are a good representation of the situation. Not transcribing the interviews could represent a limitation, since transcription facilitates the management and sharing of information for analysis. However, in this work this limitation was resolved through the construction of an analytic matrix, and by having pairs of researchers listening to the interviews and filling the matrix, so that we were able to check the consistency of findings. Finally, we employed data from a study that was not designed with the Levesque et al.'s framework in mind.

As for the study's strengths, in contrast with others using this framework we were able to consider both the system's dimensions and the persons' abilities. Even if we did not have qualitative data on migrants' perspectives, we were able to include information from a migrants' survey, unlike some studies that only consider the opinion of health care providers and other experts.

To conclude, we found evidence that members of mixed migrant flows in Mexico experience barriers to access the public health care system, and identified the main dimensions in which those barriers appear. A corollary of our results is that legislation is not enough to ensure access, and there is a need to address the main gaps, removing administrative barriers, and ensuring that the public health system has the resources needed to protect its users from out-of-pocket expenses. Improving these aspects would be major steps in achieving the right to health for all, as mandated by the Mexican constitution.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Comité de Bioética, El Colegio de la Frontera Norte. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

Conceptualization and writing—original draft preparation: CI and IB. Methodology: CI, IV-M, CR-C, GN, and IB. Analysis

and writing—review and editing: CI, IV-M, CR-C, GN, SL-S, and IB. All authors contributed to the article and approved the submitted version.

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Impact of COVID-19 on tuberculosis detection and treatment in Baja California, México

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In 2020, Mexico reported the lowest tuberculosis (TB) incidence on record, and it is unclear to what extent COVID-19 has impacted TB surveillance, diagnosis, and treatment. It is important to understand COVID-19's impact in Baja California (BC), which has the highest TB burden in Mexico. With the increasing number of migrants and asylum seekers arriving in BC, limited resources and crowded living conditions increase the risk of TB transmission. The purpose of this study was to assess the impact of COVID-19 on TB diagnosis and treatment in BC. We were also interested in health disparities experienced by migrants in BC. We conducted a mixed methods analysis using quantitative surveillance data obtained from the Mexico National TB Program (NTP) and qualitative data collected through in-depth interviews and focus group discussions with TB program directors and personnel in BC's four provincial health jurisdictions. Compared to the year prior, surveillance data from March 2020 - February 2021 revealed that TB incidence in BC declined by 30.9% and favorable TB outcomes (TB cure or treatment completion) declined by 49.8%. Elucidating differences by migrant status was complicated by the lack of standardized collection of migrant status by the NTP. Qualitative analysis revealed that TB diagnostic and treatment supplies and services became limited and disproportionately accessible across jurisdictions since the pandemic began; however, favorable adaptations were also reported, such as increased telemedicine use and streamlined care referral processes. Participants shared that migrant status is susceptible to misclassification and that TB care is difficult due to the transitory nature of migrants. This study did not identify major differences in TB service delivery or access between migrants and non-migrants in BC; however, migrant status was frequently missing. COVID-19 has overwhelmed health systems worldwide, disrupting timely TB diagnostic and treatment services, and potentially caused underdiagnosis of TB in BC. TB programs in BC should quickly restore essential services that were disrupted by COVID-19 while identifying and preserving beneficial program adaptations, such as telemedicine and streamlined care referral processes. Improved methods for documenting migrant status of TB cases are also needed.

KEYWORDS

SARS-CoV-2, migration, *Mycobacterium tuberculosis*, qualitative analysis, incidence

Introduction

COVID-19 was declared a global pandemic by the World Health Organization on March 11, 2020 (1). In total, 1,813,188 COVID-19 deaths were reported that year globally, although excess mortality statistics indicate this number should be closer to 3 million (1). Conversely, new TB case reports have declined 18% worldwide from 7.1 million in 2019 to 5.8 million in 2020; however, TB-related deaths increased from 1.4 million in 2019 to 1.5 million in 2020 (2). One reason for these discrepancies may be due to variations in health system capacity. For example, the percentage of registered deaths alone ranged from 98% in European countries to 10% in African counties, suggesting that healthcare services and case management have been disproportionately impacted by the pandemic (1, 3).

On March 23, 2020, Mexico implemented the National Campaign for Healthy Distance (Jornada Nacional de Sana Distancia), a public health intervention that suspended all non-essential in-person activities for 2 months (4). On June 1, 2020, the "new normality" phase started, which was a plan to resume economic, social, and educational activities in Mexico according to a risk assessment system with levels that resembled a traffic light (5). Health systems in Mexico prioritized COVID-19 mitigation efforts and were overwhelmed by high COVID-19 case rates, consequently interrupting other health services (6). By December 27, 2020, Mexico reported 1,372,243 official cases and 121,837 confirmed deaths—the fourth most COVID-19 deaths at the time, behind the United States, Brazil, and India (7). Conversely, in 2020, Mexico reported its lowest TB case count (16,752) and incidence rate (13.1 cases per 100,000 persons) on record (8). COVID-19 is believed to have disrupted TB surveillance and treatment nationally and regionally in BC, where TB is highly endemic.

BC has the highest burden of TB in Mexico, with approximately 2,000 active cases annually (9), increasing slowly during the last years. In addition, BC has historically received thousands of migrants annually, who are especially vulnerable to airborne diseases like COVID-19 and TB due to crowded living situations that impede physical distancing and a lack of resources to maintain good hygiene (10, 11). In 2018, due to the growing number of migrant caravans seeking asylum from Central America and the Caribbean regions to the United States (US), US immigration authorities implemented the "metering" system, requiring migrants to wait in Mexico up to several months while their petitions were processing (12, 13). By early April 2020, as a result of an unilateral US response to COVID-19 control management, there were 14,400 waitlisted asylum seekers in 11 Mexican border cities, with 67% of these asylum seekers waiting in Tijuana, BC (14). Despite the influx of migrants in the state, BC reported lower TB incidence in 2020 than 2019 (51.0 vs. 63.6 cases per 100,000 persons, respectively). It is crucial to evaluate how COVID-19 has affected TB in BC,

especially among migrant populations due to their vulnerability and risk of transmission.

The purpose of this study was to assess changes in the NTP activities and performance during the COVID-19 pandemic and to describe the impact of these changes on the diagnosis and treatment of TB among migrant and non-migrant populations in BC, Mexico. Results from this study can be used to inform future TB policies and practices to overcome COVID-19 setbacks.

Methods

Study design

We conducted a mixed methods study in BC, Mexico in 2021. The study included a quantitative analysis of NTP data for TB cases diagnosed *before* (2019-2020) and *during* (2020-2021) the COVID-19 pandemic. Qualitative data were collected from individuals working at all levels of TB control in BC through focus group discussions and key informant interviews.

Setting and participants

The state of BC is in northwestern Mexico, bounded to the north by California and Arizona in the US. BC is divided into seven municipalities grouped into four health jurisdictions designated as JI–JIV (Figure 1). TB diagnosis in BC is made using confirmatory sputum smear microscopy and/or positive cultures for *M. tuberculosis*. Confirmed TB cases are reported to the General Directorate of Epidemiology of Mexico.

TB program directors as well as physicians, nurses, laboratorians, and community health workers from the State Tuberculosis Program were included from each jurisdiction. Individuals were eligible to participate if they worked at least 20 h per week in the 6 months prior to recruitment. Participants were recruited by email using contact information provided by directors from each health facility. We obtained endorsement from the facility directors to increase participation among the facility personnel.

Data collection

TB epidemiological data from 2019 to 2021 were extracted from Mexico's Ministry of Health management information system (https://tuberculosis.sinave.gob.mx/). These data were used to assess the impact of COVID-19 on TB treatment outcomes and case findings. The extracted data included TB case notifications and TB treatment outcomes (i.e., TB cure, treatment completion, treatment failure, incomplete treatment, relapse, loss to follow up, death, and conversion to drug resistance).

FIGURE 1
Map of Baja California, Mexico health jurisdictions included in the study. JI, Mexicali and San Felipe; JII, Tijuana, Rosarito, and Tecate; JIII, Ensenada; and JIV, San Quintin.
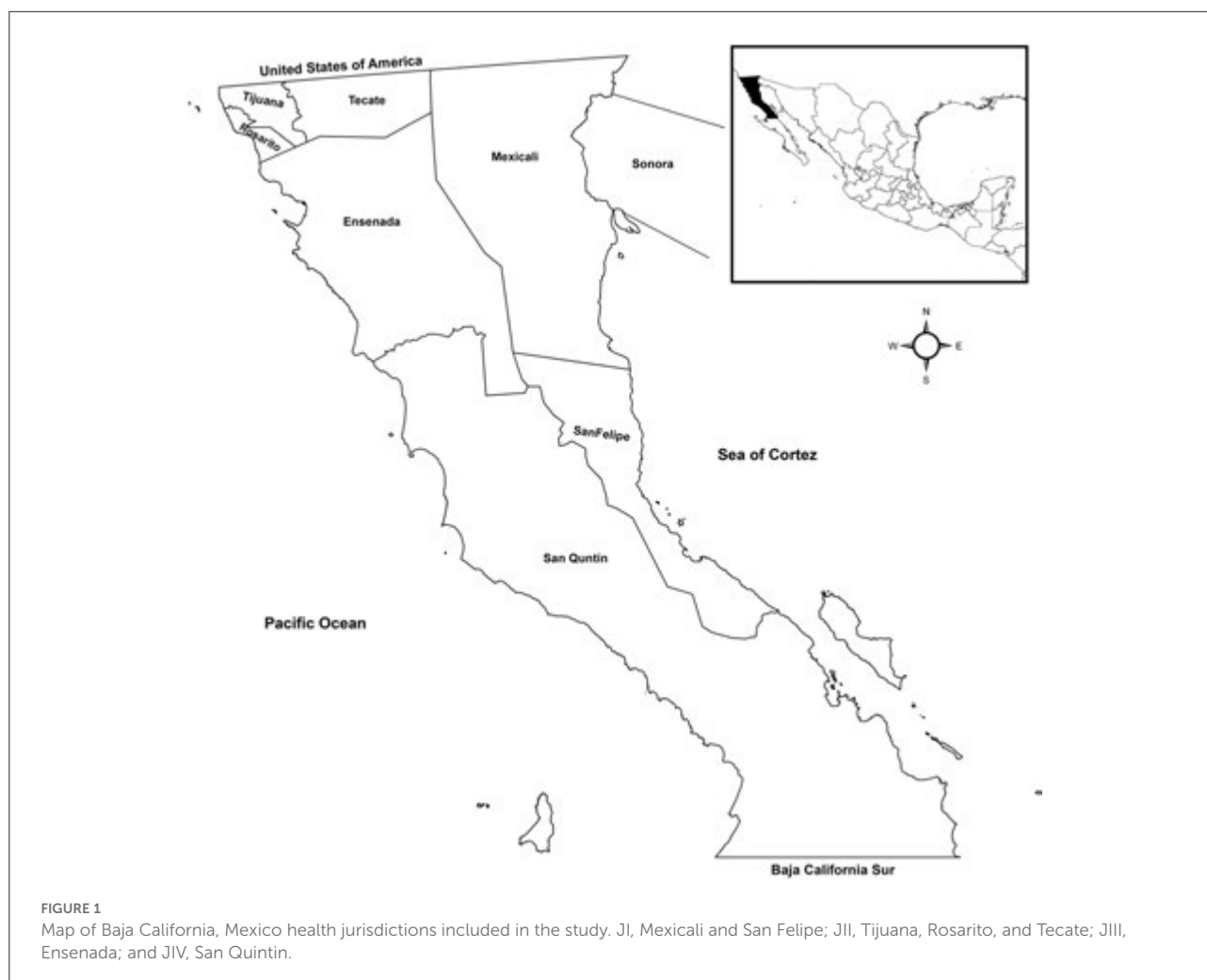
Focus groups were conducted to obtain information about strategies that were implemented during the COVID-19 lockdown to provide TB-related services to the community. Local health team officers, diagnostic supervisors, community health workers (promotoras) and nurses working in TB treatment centers participated in focus groups and excluded program directors to allow for open discussions. Focus groups consisted of 5–8 participants and lasted 60–90 min each. TB program directors participated in one-on-one in-depth interviews that lasted ∼40 min. All focus groups and in-depth interviews were conducted between April 26, 2021 and May 31, 2021 using videoconferencing due to COVID-19 restrictions on in-person meetings.

Focus group topics included strategies implemented at each level of care for TB (i.e., case identification, diagnosis, notification, and treatment) in response to the COVID-19 pandemic, with emphasis on strategies targeting migrants. Participants were asked to share their perceptions on how well these strategies worked and what additional strategies could be implemented to improve services for migrants. Other topics included: diagnostic processes and challenges; loss to follow-up; TB treatment adherence; access to health care facilities; challenges providing TB care during the COVID-19 pandemic; problems faced by patients with TB and their caregivers; resources available at work to help manage the impact of the pandemic; and innovations or adaptations employed to mitigate the impact of COVID-19 on TB services. Focus group discussion questions were modified for interviews with TB program directors that covered the same topics.

We were unable to stratify the surveillance data by migration status, because the NTP does not collect that information.

Data analysis

Quantitative analysis involved computing the monthly incidence of TB cases registered before (March 2019 to February 2020) and during (March 2020 to February 2021) the COVID-19

FIGURE 2
Tuberculosis cases registered by month in the year before and the first year during the COVID-19 pandemic, Baja California, México, 2019–2021. Data source: Mexico Ministry of Health management information system (https://tuberculosis.sinave.gob.mx/).
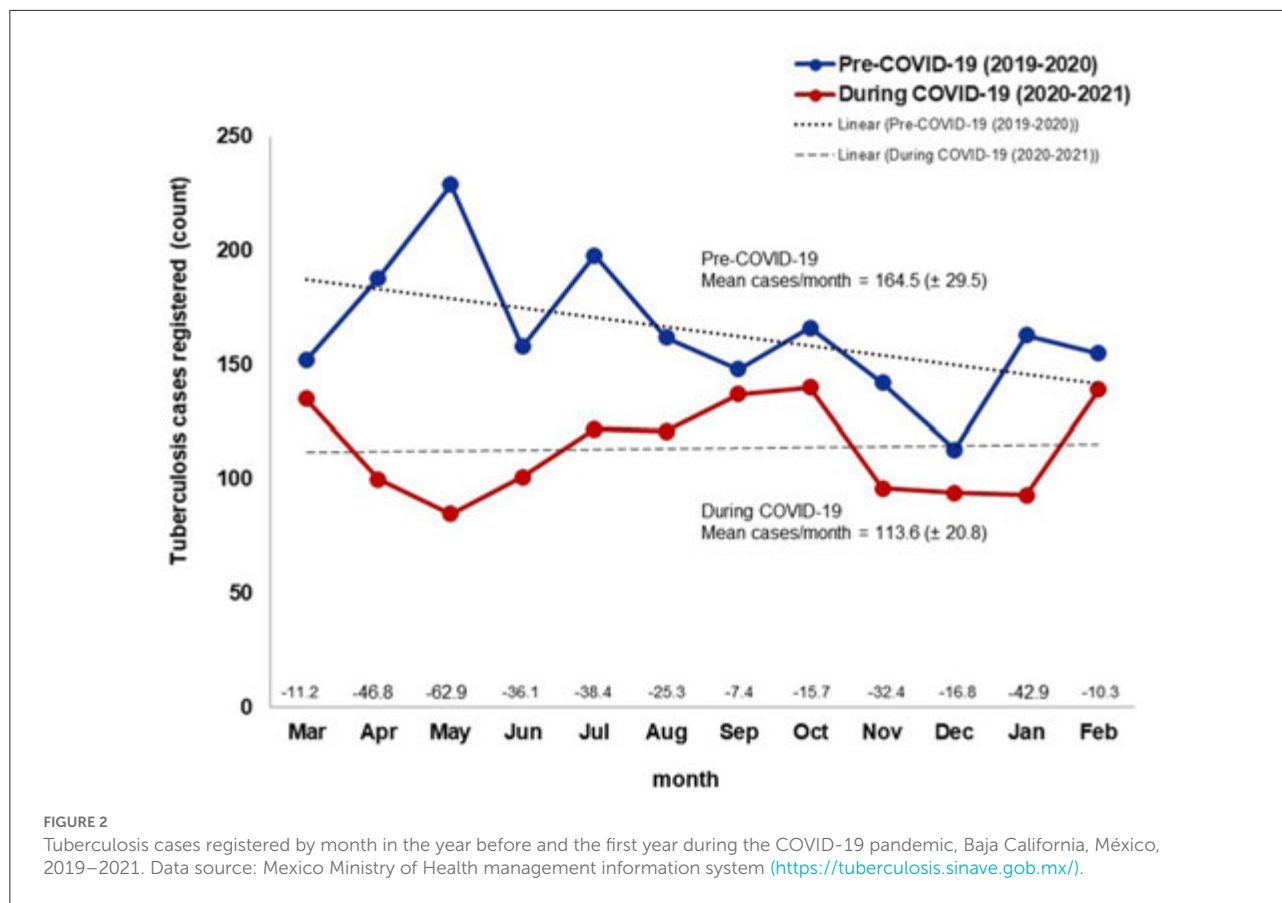
pandemic. *TB cure* and *treatment completion* were categorized as favorable TB outcomes, while *treatment failure, relapse, loss to follow-up, death, conversion to drug resistance*, and *incomplete treatment* were categorized as unfavorable treatment outcomes.

Focus group discussions and interviews were recorded and transcribed in Spanish (RMS, JEGF, PSRT, JFR and RZG). The transcripts were then translated into English by a single translator. Two bilingual co-investigators (RMS and JCM) reviewed the translations to ensure that the meanings and cultural contexts were preserved. When the translations were finalized, another researcher (TL) read and coded the transcripts using MAXQDA software (15). We used a modified grounded theory approach to identify emergent themes and developed a codebook related to TB surveillance and care. TL conducted data analysis independently and met with co-investigators (RSG and JCM) midway through the analysis to discuss initial themes observed in the transcripts and reconcile disagreements. TL completed reviewing the data and developed a codebook with quotes from the transcripts to support themes. Inductive themes that emerged from the qualitative data were used to draw original and unbiased conclusions to support and interpret quantitative findings.

Ethical considerations

A written permission letter for TB program data and to conduct the study was obtained from the NTP in Mexico City. Prior to conducting the study, the protocol was approved by the US Mexico Border Health Commission (Mexico section) Ethics Board with approval number 20-25-01-2021. Written informed consent was obtained from all focus group and in-depth interview participants. To protect the participants' privacy, study ID numbers were used instead of personal identifiers on all transcripts.

Results

Quantitative analysis

TB case notification

The number of registered TB cases diagnosed per month declined an average of 28.9% (50.9 cases) across the four health jurisdictions in BC during the COVID-19 pandemic compared to the same time frame the year before the pandemic (Figure 2). However, in August, September, December, and February, San
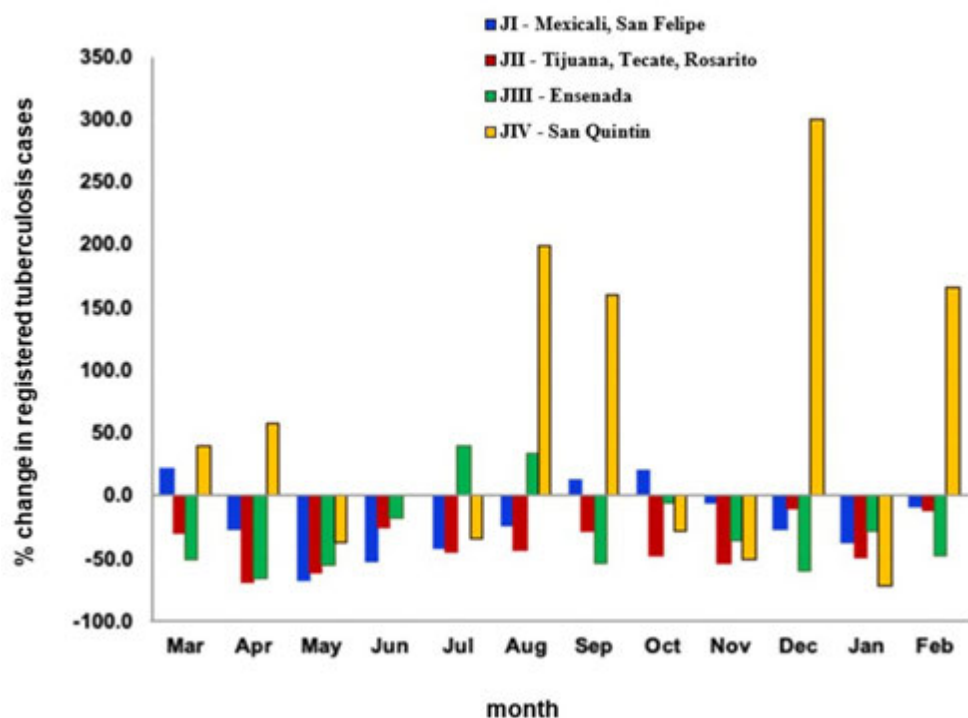
FIGURE 3
Change in the proportion of tuberculosis cases registered by month and health jurisdiction between the year before and the first year during the COVID-19 pandemic, Baja California, México, 2019–2021. Data source: Mexico Ministry of Health management information system (https://tuberculosis.sinave.gob.mx/).

Quintin reported >150% increases in cases registered between pre-COVID-19 and COVID-19 periods (Figure 3).

TB treatment outcomes

The number of TB treatment outcomes of notified cases decreased during the COVID-19 pandemic compared to the prior year, with the greatest percentage change (−89.9%) occurring in January (Figure 4). TB treatment outcomes decreased 46.7% (38.6 cases) overall in all four health jurisdictions between the pre-COVID-19 and COVID-19 periods. Figure 5 shows that the proportion of TB treatment outcomes decreased in nearly all months for all jurisdictions during the COVID-19 pandemic compared to the year prior, except in jurisdiction IV, which showed over 100% increase in April and October.

Qualitative analysis

Three in-depth interviews were conducted that included chiefs of the two main health centers in JII (Centro and Hospital General in Tijuana) and the State TB Program Coordinator. Six focus groups were conducted with a total of 43 individuals,

which included 16 (37.2%) nurses, 14 (32.6%) community health workers (promotoras), 8 (18%) physicians, 4 (9.3%) Jurisdictional TB Program Coordinators, and 1 (2.3%) State TB Program Coordinator. Major themes that emerged from this analysis (Figure 6) included: decreased case finding by promotoras and community outreach, delayed TB diagnoses, reduced availability of experienced promotoras, limited access to TB supplies and services, loss to follow-up, increased telecommunications, streamlined care process, reduced number of TB clinics. TB among migrants was also discussed. These themes are described below in detail with illustrative quotes from the data.

Decreased case finding by promotoras and community outreach

Promotoras and nurses mentioned that community TB screening activities were curtailed during COVID-19 because safety regulations prevented them from working in highly populated areas. Instead, they limited targeted screenings to rehabilitation centers and home visits to screen household contacts of TB cases. Participants speculated that this method did not reach all TB cases, which likely resulted in an underreporting of TB prevalence.
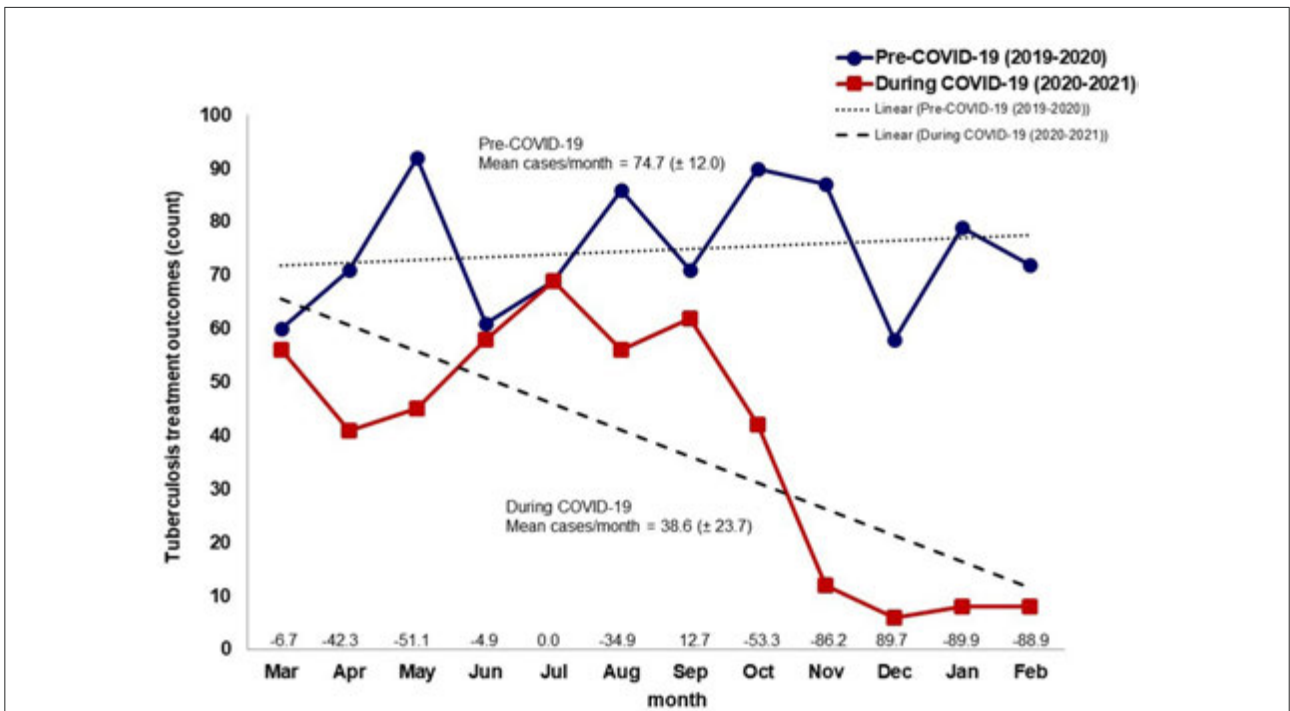
FIGURE 4

Number of tuberculosis treatment outcomes by month in the year before and the first year during the COVID-19 pandemic, Baja California, México, 2019–2021. Data source: Mexico Ministry of Health management information system (https://tuberculosis.sinave.gob.mx/).
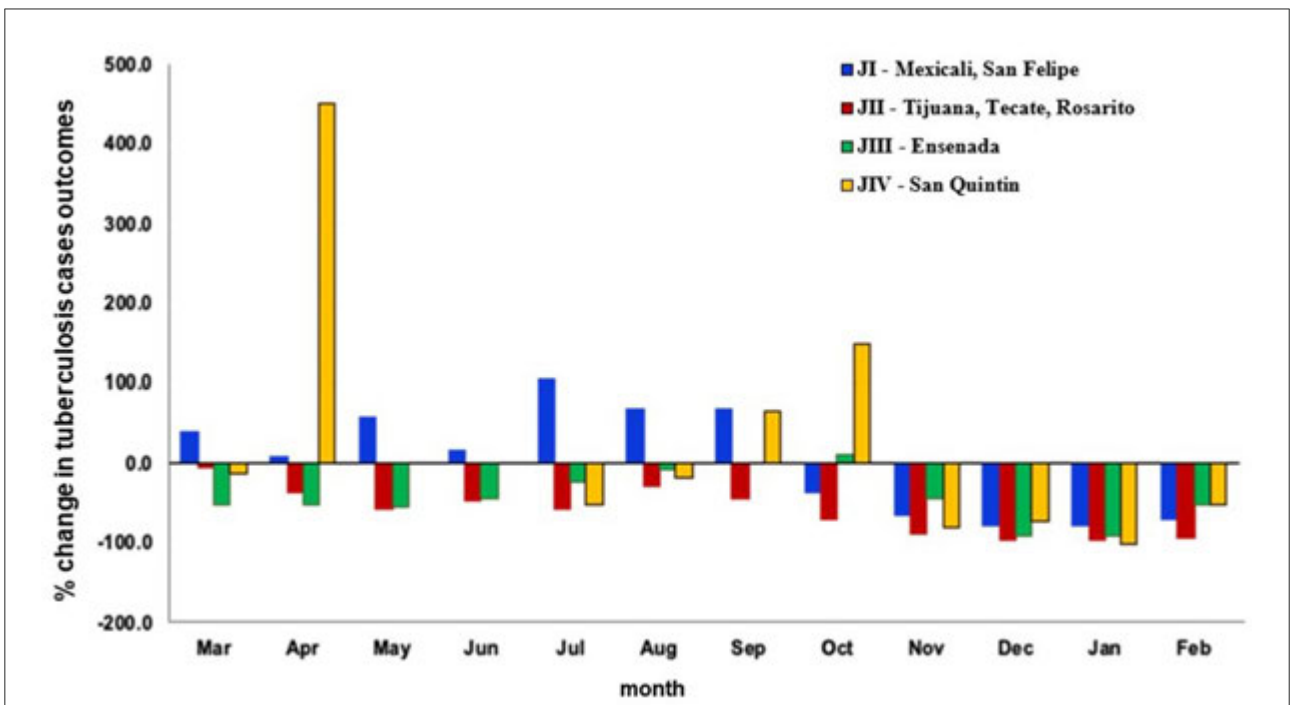
FIGURE 5

Change in the proportion of tuberculosis treatment outcomes between the year before and first year during the COVID-19 pandemic by month and health jurisdiction, Baja California, México, 2019–2021. Data source: Mexico Ministry of Health management information system (https://tuberculosis.sinave.gob.mx/).

Impacts of COVID-19 pandemic on tuberculosis (TB) case detection and service delivery in Baja California, México 2021. Pink, Negative impact; Green, Positive impact.
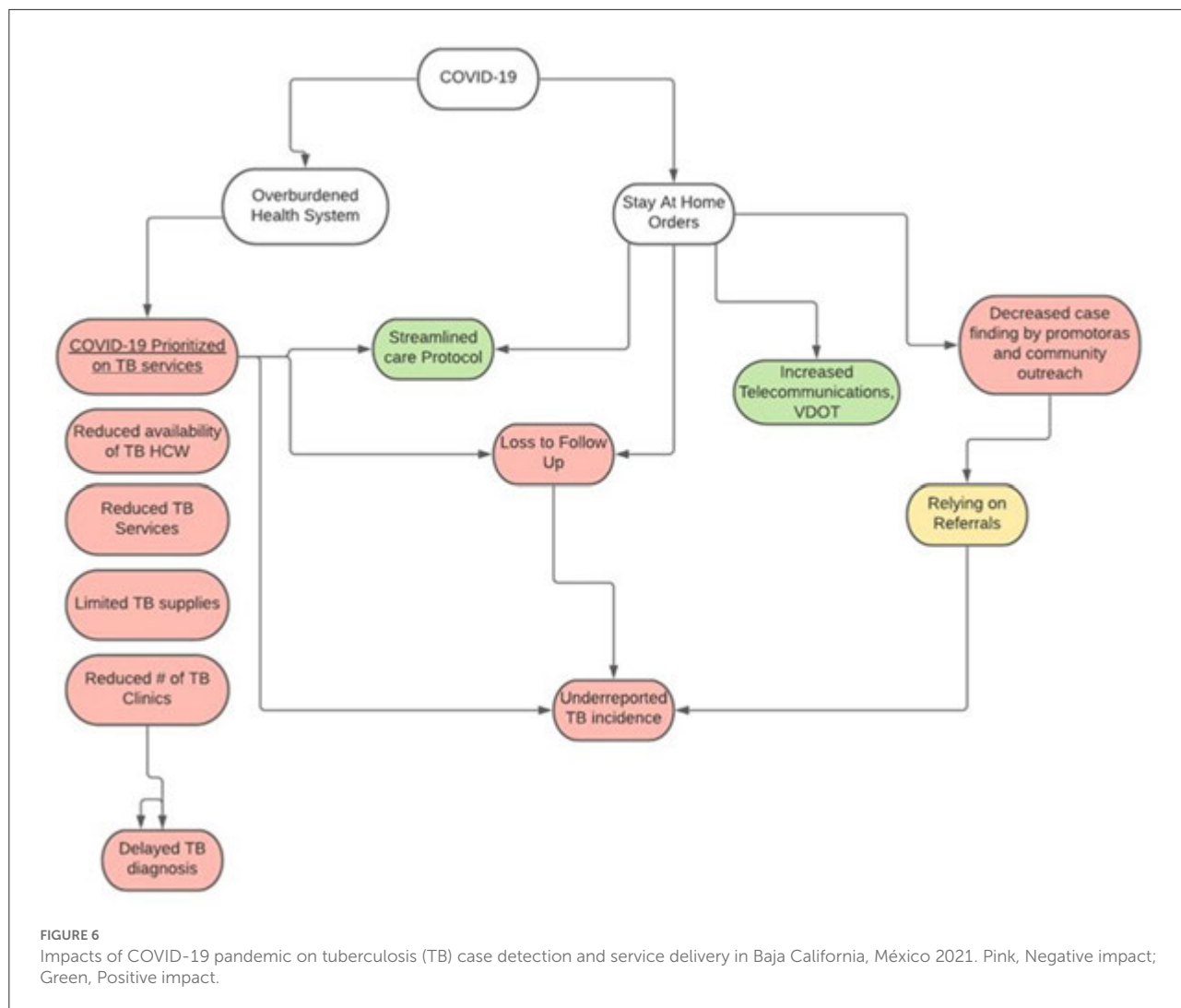
"We do not have promoters; the promoters are dedicated to other things, and it generates a problem of how we get the patient to come." [JII]

"The truth for now, we continue with most of our colleagues in the shelter. And the priority has been on COVID vaccination. So, there is a very little outing for intentional searches in the field area. We are doing it in the city center, only with the team we have in the Jurisdiction. Because, yes, we lack in that area; to go out to the field in agricultural areas, no!" [JII]

Delayed TB diagnosis

Most of the participants reported challenges with laboratory services, including a lack of laboratory diagnostic materials and a prioritization of COVID-19 testing over other tests,

which caused delays in TB diagnostic services. Participants also mentioned that patients presenting respiratory symptoms had to be tested for COVID-19 before testing for TB, further delaying TB diagnostic services and treatment. The number of TB sputum smears and cultures performed decreased during COVID-19, especially between May and September 2020. However, it was noted by several participants that these problems existed prior to the COVID-19 lockdown.

"…detection and laboratory acceptance did decrease because they also had very few personnel working. Most of the personnel were put on standby, so they always commented that they only had one laboratorian. Therefore, the number of samples received decreased." [JI]

"No, no it didn't stay the same because, in the issue of respiratory problem, you know how it all was, COVID! So, it all focused on that… if the patient is and fits within the

operational diagnosis of what COVID is, obviously you must go [rule out] what the pathology is and follow it up. So, in terms of [taking in patients] and all that, there have been modifications that have changed a lot; therefore, the diagnosis can sometimes take a little while to make because it's all about COVID now." [JIII]

Limited and disproportionate access to TB supplies and services

Most participants expressed their concerns about shortages on purified protein derivative tests and medications, reduced access to laboratories and X rays, and reduced access to mobile units. Lack of laboratory diagnostic materials and limited TB laboratory processing due to COVID-19 caused delays in delivery of diagnostic services. TB Program Coordinators mentioned that some health centers had to triage patients because they could not manage all the patients, which affected screening and health outcomes. Conversely, participants in a different jurisdiction reported that they did not experience problems with resources, suggesting disproportionate levels of screening, diagnosis, and treatment depending on the location.

"The TB program at the State level is abandoned. We have been struggling to get supplies, equipment maintenance; because everything is COVID, so the money that was available for tuberculosis has been diverted to COVID, and this is going to be a problem for us." [JII]

"What was not affected were the laboratory samples. The laboratory processes samples typically. Visits were not affected. The application of PPD [purified protein derivative] and PPD reading were not affected… well, the placement was not affected. Some rules were put in place to be able to continue with the admission of patients to rehabilitation centers. Some centers were not affected at all and allowed patients to enter daily; in my case, that was all." [JI]

Reduced availability of experienced TB health care workers (promotoras)

Most participants, including TB program coordinators, mentioned that the promotoras were re-assigned to support COVID-19 activities (diagnostic testing, epidemiology, and vaccination), consequently decreasing TB activities. The participants mentioned that although the TB program hired more contract workers and interns, they did not have the experience to diagnose and care for TB patients. Furthermore, since they were temporary workers, follow-up was frequently interrupted when their employment terms ended.

"All health centers here use intern doctors due to the pandemic; the contract doctors went to work at the fever clinics, but the modules where it was not a fever clinic, as my co-worker mentioned, respiratory symptoms could not be treated. So, not just because of the pandemic! It would be good if all the modules had a permanent doctor, or at the very least a doctor contractor. So that at least, TB patients can be cared for in the place where the patient lives." [JIV]

"What happened is that at one stage, I had even more contracted personnel, which was at the beginning of the pandemic, so I had a 50% reduction in personnel. Now I have fewer personnel, and of course, they ask me for fewer people, but they keep asking me for more people for the vaccination area." (Coordinators FGD)

Loss to follow up

As mentioned by most of the participants, all jurisdictions reported disruptions in directly observed therapy (DOT) for TB treatment monitoring. Stay-at-home orders, patient death, high transitory patterns, and COVID-19 screenings contributed to loss to follow up. Depending on the health system and its protocols, some systems managed to collect contact info and track down patients with TB; however, some patients in other jurisdictions were lost after being transferred to other health units.

"When the pandemic started, we had 29 patients with MDR [multi-drug resistant TB] treatment. Of the 29, 7 died. That is almost 25%! In other words, one out of every four patients we had died during the confinement. In some of them, we knew why, and in others, we did not. We were simply notified that they had died. We did not know if it was due to COVID or not, and we lost 3, which would be about 10%. They were lost to follow-up, so the impact of the pandemic was very strong with us, as it was in the rest of the world." [JIII]

"And the detections were also affected, as my colleague [Male 1] said, because our colleague sometimes did not even manage to look at them because they were sent back because they had a cough; they were sent to the fever clinic. And sometimes, as [Male 1] says, they were even negative and were probably tuberculosis, but because of COVID's panic, they were sent to the fever clinic and were not diagnosed; there was no detection. That did decrease a lot too." [JI]

Increased telecommunications

All participants including TB Program coordinators agreed that video directly observed therapy (i.e., patient treatment adherence monitoring delivered remotely *via* videoconference) expanded during the pandemic. The participants described that in response to prohibitions on in-person clinic or home visits, TB program staff began using synchronous video observed therapy (VOT) to monitor patient treatment adherence. Social media apps such as WhatsApp and Facebook Messenger were used to remotely observe patients swallowing their medications in real time. However, the use of VOT was limited to patients who had access to smartphones and cellular or Wi-Fi connections. Access to VOT varied by jurisdiction; San Quintin (largely rural jurisdiction) used VOT the least while Mexicali and Tijuana (largely urban) reported that 80% of TB cases used VOT.

> *"So around, between jurisdiction and health centers, 80% of the cases are on video DOTS. It has worked very well for us because when we detect the patient who comes in with us, we also search for contacts with the DOTS video telephones in the jurisdiction. If the patient is taking the medication correctly, we follow up with the patient, making the patient feel a little more secure. We are calling them more constantly, responding to their videos, and they can send us a message; how they feel if they have any adverse reaction. In this way, to be able to support and orient you."* [JII]

> *"I believe that if it worked for us, I believe that now the percentage of 30-40% of people who are in video DOTS because now the study we are doing is to see the characteristics of those who comply and those who do not comply with the video DOTS."* [JIII]

Streamlined care processes

All participants declared that the TB care process prior to COVID-19 was complicated for patients due to administrative barriers and paperwork. During the COVID-19 pandemic, all jurisdictions in BC simplified the process by scheduling all clinic visits, X-rays, and laboratory tests to minimize the amount of time patients spent in healthcare settings. Reducing bureaucratic procedures and bringing TB services and treatment to the patient homes helped reduce financial, transportation, and access barriers for patients.

For patients receiving second-line medications for drug resistant TB, the treatment process was modified. Instead of convening a case conference with COEFAR [Comité Estatal de Farmacorresistencia], the patient's clinical information was sent to the General Hospital infectious disease specialist, who

established the drug-resistant TB treatment plan and requested approval from the NTP. This modification to the administrative process reportedly reduced the time to start treatment by at least a month, and participants suggested that this change should be preserved going forward.

> *"And we have also supported them directly, going to the X-ray office or to the laboratory to schedule the tests that the specialist requests in scheduling that appointment. So, I repeat, I do not know if it is an innovation, but I think it is an excellent way to give the 'complete package' to the patient: schedule their appointment to do the tests and schedule all the examinations and laboratories they require."* [JI]

> *"We no longer required COEFAR [a reviewing committee] to analyze a patient with drug resistance... The hospital infectologist would rule or make the recommendation for treatment, and treatment was quickly requested from Mexico. We no longer paused to convening a meeting to analyze the case. This administrative process, which could take up to a month, was avoided."* [Key Informant]

Reduced number of TB clinics

All jurisdictions reported general challenges with routine TB screening, diagnosis, treatment, and prevention services during the COVID-19 pandemic. Reduction in clinic attendance was reported due to activity restrictions, fear of SARS-CoV-2 infection, policies restricting in-person visits, COVID-19 converted wards and entire hospitals, or complete closure of the health centers. Some patients could not attend the few health centers available because they were far from their homes, resulting in delayed diagnoses and treatment timelines, which contributed to loss to follow-up and unfavorable treatment outcomes. Some healthcare workers refused to work due to a lack of appropriate personal protective equipment, which impacted the TB services.

> *"In Tijuana, almost all health centers were converted to Clínica de Fiebre [fever clinics] and/or COVID Hospital, (4 medium load centers, 2 high load centers)."* [JII]

> *"The same thing the doctor was saying is practically the distance from the health centers. They are very far away from towns where only a mobile unit visits them; however, the mobile units do not carry tuberculosis treatment or does not handle TB patients. Then, the patient must be referred to a health unit, and, on some occasions, it is far away. And, if you*

are a patient who we can offer to bring you the treatment, we do; But now, in times of a pandemic, this option has become difficult for us." [JII]

Migrants

There were no differences between migrant and non-migrant TB services and screenings mentioned by focus group or in-depth interview participants. Participants reported using targeted screenings at rehabilitation centers to capture migrant patients; however, this method might not have captured all migrant TB patients. Tuberculosis screenings have been performed in recent migrant caravans that have come to Tijuana, but no cases of TB have been diagnosed.

Participants estimated that the number of migrant patients registered in the BC TB program is minimal, amounting to about 1–2% of the total number of cases. Participants explained that this low prevalence might be due to an increased number of transient migrants, patients concealing their migrant status, and migrant patients living in the municipality for longer than 5 years, thereby making them national cases. Participants in JI also reported difficulties with loss to follow up, particularly among US-Mexican binational patients.

"It is difficult to estimate; when we talk about tuberculosis cases in the Jurisdiction, it never represents less than 1 or 2% of the total number of cases; however, many of them, when they approach the services, are not perceived or are not reported as migrants… The program, which we must remember, is universal. So, although we ask them for a lot of information that is collected in the epidemiological study, they may lie or carry documents that may not be completely reliable." [JI]

"Since we are on the border, most of them go to work in the United States and come to live here in Mexicali. So, in our Program, 100% are binational… So, this is the only aspect in which we have had problems, that the patients have this facility, even though the checkpoint is closed; but these are patients who can cross and disappear, either from there or from here in Mexicali. So, I think this does affects us very much because we lose 100% follow-up."[JI]

Discussion

Our results indicate that COVID-19 negatively impacted TB case reporting and treatment outcomes in BC, Mexico in the first year of the pandemic. We found a sharp decline in case notifications for all forms of TB during the COVID-19 outbreak compared to the year prior. Focus group discussions and in-depth interviews revealed that the main causes of the decline in TB case notification were decreased case finding by promotoras

and community outreach workers, delayed TB diagnosis, and limited access to TB supplies and services during the lockdown. In contrast to these negative impacts of COVID-19, streamlined administrative processes and the increased use of telemedicine were viewed as positive outcomes from COVID-19.

All jurisdictions experienced negative impacts of the COVID-19 pandemic, ranging from minor to very significant during at least 1 month during COVID-19. TB clinics seemed to be most severely affected in May 2020, 2 months into the lockdown. Participants from all jurisdictions reported problems with obtaining adequate supplies and reagents, as well as with adapting to new requirements like physical distancing or working remotely. Staff shortages linked to lockdowns, isolation and quarantine, and relocation to COVID-19 units affected TB operations, especially in March and April of 2020. All jurisdictions experienced difficulties from personnel being re-allocated to COVID-19 vaccination services. TB diagnostic services and TB outcomes were severely affected, with the disruption peaking in May 2020 reported by all jurisdictions. The pandemic response also led to longer TB testing turnaround times, as well as suspension of diagnostics and treatment services. The number of TB notifications gradually improved after December 2020 as services were adapting to a "new normality phase."

Incidence of TB in 2020 was lower than 2019 nationally in Mexico and in BC (8, 9). While this may have been due to COVID-19 mitigation protocols, reduced laboratory testing and potential misclassification from TB patients reported as COVID death may have also driven this decline. A key informant revealed that they were unable to determine the cause of death for all their patients, suggesting that there may have also been cases of TB that died without being diagnosed.

Qualitative analysis revealed that patients presenting respiratory symptoms were redirected to "fever clinics" for SARS-CoV-2 screening. Patients who were negative for COVID-19 did not receive further testing and were often lost to follow-up, especially if they were transferred to fever units in other hospitals. Overburdened health systems from COVID-19 and lack of coordination among health systems contributed to loss to follow up and potentially misclassified cause of death.

Participants from San Quintin (JIV) and Ensenada (JIII) reported being able to follow all cases with and without COVID-19 symptoms; consequently, San Quintin reported higher TB notifications during COVID-19 in comparison to pre-COVID-19. Compared to the other jurisdictions, San Quintin is geographically dispersed and known for its agricultural export market (16). About 80% of the workforce in San Quintin is migrant, of which 54.5% are permanent migrants who have worked there for several years and 45.5% are temporary (17). Participants from San Quintin mentioned that they screened migrants for TB when they arrived to work on the farms, but this practice was suspended during the pandemic. Qualitative analysis did give insight on why registered TB in San Quintin

increased during the pandemic; TB program personnel from this jurisdiction conducted TB screening in addition to the COVID-19 survey for patients with cough with phlegm. In addition, they performed diagnostic TB tests.

Mexico is not unique in terms of the effects of COVID-19 on TB. According to a global survey, 25 of 44 countries had introduced changes to TB service delivery since the start of the COVID-19 pandemic, with 10 countries and nine countries reducing the number of in-patient and outpatient TB facilities, respectively (7). Like BC, challenges were also reported by TB professionals in both West African and European settings, especially regarding staff shortages and laboratory issues that predated COVID-19 (18). Consequently, TB incidence and TB mortality are projected to increase by 5–15% over the next 5 years, resulting in hundreds of thousands of additional TB deaths worldwide (19, 20). COVID-19 adaptations found in our study were similar to mitigation strategies used in other counties, such as reduced frequency of outpatient visits for treatment monitoring or drug dispensing, allowing TB patients to take a 1-month or more supply of anti-TB drugs home, expanded use of remote advice and support, and home delivery of anti-TB drugs (7).

Although immigration records suggest that more than 50% of the population in BC is migrant (21), there are sparse data about the migration status of TB cases in any jurisdiction in BC (8, 9). However, according to the participants of this study, 1 or 2% of the total number of TB cases in BC are migrant. Similarly, in California, 2% of TB patients were reported as migrant or seasonal worker pre-COVID-19 and during COVID-(22). Migration status information is important for TB programs to assess because migrants are at higher risk of communicable diseases, traumatic events, inadequate health care, etc. (23). Likewise, limited political visibility and protection for migrants further deteriorates their health, as seen during the pandemic when they disproportionately shouldered COVID-19 morbidity and mortality in 2020 (24). Identifying migrant patients and understanding their health is key to reducing mortality and improving population health.

Strengths and limitations

Migrant status data were not available for any jurisdiction, so we were unable to determine differences in TB treatment outcomes for migrant patients. TB burden among migrant populations in BC remains unclear, especially during the pandemic. Furthermore, this study does not reflect the perspectives of patients with TB during this time, which may have given insight on the quality and reach of these TB services. In addition, only healthcare workers were included in the qualitative phase of this study; thus, our findings are limited to provider perspectives on how COVID-19 impacted TB diagnosis

and treatment. Despite these limitations, we believe our study provides first-hand experiences of TB healthcare workers and program coordinators in BC during the pandemic.

Conclusion and future directions

This is the first study conducted in BC, Mexico to describe the impact of COVID-19 on the State TB Program performance. This study provides novel information about TB program strategies implemented in response to the COVID-19 pandemic that may have affected migrants in BC, Mexico. It will also identify additional TB program functions that should be addressed to better serve all TB patients, including migrants well beyond the COVID-19 pandemic. These findings will assist TB program directors at the local, state, and federal levels in Mexico to make evidence-based decisions around TB program policies.

TB control professionals in BC experienced challenges in delivering TB diagnosis and treatment services due to the COVID-19 pandemic and this study highlights the need for clear communication of guidelines, prioritization of routine TB service delivery, ongoing health education, and possible integration of TB and COVID-19 services to ensure that TB services are more resilient against the impact of this respiratory disease pandemic. Migrants with TB are potentially disproportionately impacted by COVID-19 due to crowded living conditions, reduced health screenings, and increased risk of loss to follow-up; however, migration status is not uniformly assessed by TB programs, making it difficult to fully understand their situation. Some positive TB program changes were noted, such as an increase in the use of telemedicine and a streamlined process for initiating treatment for patients with drug resistant TB, which programs should consider maintaining after the pandemic ends.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

RM-S and RSG conceived of, designed, and drafted the manuscript. RM-S, RSG, TL, JC-M, and JG-F conducted the qualitative analysis. RM-S, JG-F, RZ-G, JR-F, and PR-T contributed to quantitative data analysis. All authors contributed to the interpretation of data, revision of the manuscript for important intellectual content, and have read and approved of the final version of the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The Arizona Prevention Research Center partnerships in Arizona to promote COVID-19 vaccine health equity

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Background: Vaccine hesitancy in the face of the COVID-19 pandemic is a complex issue that undermines our national ability to reduce the burden of the disease and control the pandemic. The COVID-19 pandemic revealed widening health disparities and disproportionate adverse health outcomes in terms of transmission, hospitalizations, morbidity and mortality among Arizona's Latinx rural, underserved, farmworker, disabled and elderly populations. In March 2021, ~8.1% of those vaccinated were Latinx, though Latinxs make up 32% of Arizona's population. The Arizona Vaccine Confidence Network (AzVCN) proposed to leverage the expertise of the Arizona Prevention Research Center (AzPRC) and the resources of the Mel and Enid Zuckerman College of Public Health (MEZCOPH) Mobile Health Unit (MHU) to identify, implement and evaluate a MHU intervention to increase uptake of COVID-19 vaccines.

Methods: The AzVCN focused efforts on Latinx, rural, un/underinsured and farmworker communities in the four Arizona border counties that are at greater risk of COVID-19 morbidity and mortality and may have limited access to vaccination and other essential health services. The AzVCN used listening sessions to create a feedback loop with key stakeholders and critical health care workers to validate barriers/enablers and identify solutions to increase vaccination uptake emerging from the network. The AzVCN also implemented a community-based intervention using community health workers (CHWs) based in a MHU to increase knowledge of the COVID-19 vaccines, reduce vaccination hesitancy and increase vaccination uptake among Latinx rural, un/underinsured and farmworker populations in Southern Arizona.

Results: AzVCN outcomes include: identification of enablers and barriers of COVID-19 vaccination in the priority populations; identification of strategies and solutions to address vaccine hesitancy and increase vaccine uptake among priority population; and evidence that the proposed solutions being

tested through the AzVCN contribute to increased vaccine uptake among the priority populations.

Conclusion: Through these efforts the AzPRC contributed to the CDC's Vaccinate with Confidence Strategy by collaborating with CHWs and other key stakeholders to engage directly with communities in identifying and addressing structural and misinformation barriers to vaccine uptake.

Introduction

The COVID-19 pandemic revealed widening health disparities and disproportionate adverse health outcomes in terms of transmission, hospitalizations, morbidity and mortality among Arizona's rural, Hispanic/Latinx (henceforth referred as Latinx), American Indian, and elderly populations (1). Unfortunately, these were among the very populations with lower rates of COVID-19 vaccination in the early weeks of Arizona's COVID-19 vaccination rollout. In March 2021, ~8.1% of those vaccinated were Latinx and 1.1% were Native American although Latinxs make up 32% of Arizona's population and 5.3% are Native American (1). By May 2022 in Arizona, it was still below the population makeup of those groups, with ~20% of those receiving at least one COVID-19 vaccination dose being Latinx and 4.5% being Native American (2). Intractable health inequities relate to social determinants including socioeconomic status, lack of insurance, rural locations, limited English speaking skills, immigration status, unreliable transportation, difficulty obtaining childcare and other factors (3). Stigma, ageism, racism, and anti-immigrant policies further impede access to COVID-19 testing and vaccination (4). While county health departments (CHDs) responded by initiating pop-up clinics and other efforts, delays in COVID-19 vaccine availability exacerbated vaccine hesitancy in communities that were already mistrustful of health systems. In general, across the United States, there is a mistrust of vaccines and can be barriers to COVID-19 vaccinations, especially among racial/ethnic minority groups (5). In Arizona, findings from racial/ethnic minority focus groups found that COVID-19 vaccine hesitancy is multi-faceted, influenced by personal perceptions of vaccines, family and community relationships, and historical and structural factors (6). Among Latinx participants, religiosity was a key factor contributing to either vaccine hesitancy or confidence behaviors (6). Overall, lack of a unified message from the health care community, propagation of misinformation about the virus and the vaccine, long-standing distrust of vaccines, and structural barriers in the medical system all contributed to vaccine hesitancy (7).

Tailored interventions that address structural barriers for Latinx un/underinsured, farmworker and rural communities are essential to increasing COVID-19 vaccine availability and addressing vaccine hesitancy in Arizona. A key component also includes addressing negative emotions associated with the COVID-19 vaccine (8). Spanish speaking staff and providers who can communicate the importance and safety of the COVID-19 vaccines are a critical piece of the solution (9), as are trusted individuals such as community health workers (CHWs) who have an enduring presence in helping connect community members to services (10).

The Vaccine Confidence Network (VCN) is a Centers for Disease Control and Prevention (CDC) effort funded through Prevention Research Centers (PRCs) nationwide to address COVID-19 vaccine hesitancy and uptake. Originally called the Connecting Behavioral Science to COVID-19 Vaccination Demand Project (AZ CBS-CVD), this project leverages the expertise of PRCs nationwide. In Arizona, the Arizona Prevention Research Center (AzPRC) named our team the Arizona Vaccine Confidence Network (AzVCN). In partnership with the Mel and Enid Zuckerman College of Public Health (MEZCOPH) Mobile Health Unit (MHU) and the Refugees and Immigrants Community for Empowerment (RICE), project activities to address COVID-19 vaccine hesitancy were conducted to address structural and misinformation barriers that influence vaccine health equity, with a goal to increase uptake of COVID-19 vaccines among underserved Latinx communities.

Methods

Study team

The AzVCN was led by investigators from the AzPRC, funded by the CDC. To better understand the assets and needs of our priority communities, the AzPRC works closely with a Community Action Board (CAB). The CAB is composed of 25 organizations and programs that share a common agenda

of improving the quality of life in the border region. CAB members are responsible for guiding AzPRC activities and have expressed their support and commitment to expand upon our foundation of: (i) Developing and disseminating evidence-based strategies to address disparities in health promotion and disease prevention using the CHW model and (ii) Promoting health through environmental and systems change strategies on both a local and state level. CAB members provide feedback on project design and dissemination.

The AzPRC strives to address chronic disease health disparities in underserved populations in Southern Arizona. The Southern Arizona region includes four U.S. counties that lie on the U.S.-Mexico Border: Cochise, Pima, Santa Cruz, and Yuma. The AzPRC has been working with communities along this 389-mile-long border for over 20 years. Partner communities include: Douglas, Nogales, and Somerton/San Luis, as well as the Tohono O'Odham Nation which has lands that extend from just south of Casa Grande, through western Pima County and into Mexico.

Study design

In May 2021, the CDC's PRC network program awarded supplemental funding to all 26 PRCs in the United States to support the implementation of the CDC's COVID-19 vaccine confidence strategy. The CDC created the VCN to identify key behavioral insights to inform effective solutions to increase COVID-19 vaccine confidence and ultimately uptake. The VCN initiated as a thematic network of PRCs. The focus of the network was to more effectively translate best practices from behavioral science to improve immunization programming. The goal of the VCN was to conduct community-based evaluations to identify communities of focus, diagnose social and behavioral drivers of vaccine uptake, and design, implement, and scale up effective interventions to increase vaccine confidence and uptake at multiple levels. The broad geographic reach, diverse target populations, and strong relationships among VCN investigators at each PRC allowed the network to achieve a larger impact than any other individual PRC could achieve on its own. The guiding principle was that promoting confidence in vaccines requires more than messages. It requires commitments to listening, understanding, collaborating within communities, and changing how health services are delivered to better address the needs of individuals and communities. The study was determined to be "Exempt" by the University of Arizona Human Subjects Protection Program.

Priority population

The AzVCN targeted rural, un/underinsured and farmworker communities in the four counties that make up the Arizona-Mexico border region (Figure 1). These counties have significant Latinx populations (30–80%), mostly of Mexican origin, that experience underlying social and economic disparities that create higher risk of contracting COVID-19, as well as complications due to existing conditions such as hypertension (11, 12). Border residents are twice as likely to live in poverty, be uninsured, and experience higher rates of unemployment than the population of any individual U.S. state (13). These social determinants translate directly into social and economic contexts that create barriers to accessing health care, including vaccinations, beyond cost and lack of insurance. Farmworkers and other essential workers may face financial hardship from taking a day off work to get vaccinated or worry about losing work due to the ill effects of the vaccine response. A history of poor interpersonal interactions with health providers may exacerbate reluctance to seek the COVID-19 vaccine (14).

Data collection

Project data was collected in two primary methods. First, listening sessions with key stakeholders and critical health care workers were conducted in the Fall of 2021. The goal of the listening session was to create a feedback loop with these key stakeholders and critical health care workers that would validate barriers/enablers and identify solutions to increase COVID-19 vaccination uptake emerging from the network. The key stakeholders and critical health care workers were contacted by the study team leader *via* email to inquire about their willingness to participate in listening sessions. Second, at selected MHU community and vaccination events, CHWs provided MHU visitors with the opportunity to participate in a survey on vaccination intention/experience, enablers and barriers, and the intentions of family members. Events where the surveys were offered were selected based on availability of student interns to administer the survey and design to reach different regions of Southern Arizona. The survey consisted of tools made available through the national VCN network. The student interns administered the anonymous surveys, with data collected housed in a database separate from vaccine registration. Given that the MHU is able to provide services in diverse communities, we were able to collect data from people of all ages, in rural and urban settings, and with farmworkers and other essential workers. These data are essential in designing outreach as COVID-19 vaccines becomes more widely available.

Outcomes and statistical analysis for the evaluation plan

The primary outcomes of interest for this project include qualitative and quantitative data. Qualitative data were collected from listening sessions with stakeholders and critical health care

workers. Quantitative data will include vaccine intention and uptake variables. Variables of interest include demographics, vaccine knowledge, attitudes, and beliefs, enablers and barriers, comorbidities, and personal and family impacts. Data are stored in the HIPAA-compliant University of Arizona REDCap database program. Data will be exported to Stata 16 files (StataCorp, College Station, TX) for statistical analyses. Results of the ongoing quantitative survey will be tabulated upon conclusion of the survey data collection in August 2022.

Results

AzVCN activities

The AzVCN activities were designed to facilitate the identification and translation of effective strategies to implement COVID-19 immunization confidence and uptake. The activities have contributed to three overarching focus areas: (1) collecting data for action; (2) building the evidence base to increase COVID-19 vaccine confidence and uptake; and (3) evaluating solutions and increase community engagement. The AzVCN has been contributing to national PRC collaborative efforts to develop and utilize common data measures, aggregate data, and analyze data across sites, and develop best practice toolkits and social marketing materials.

Listening sessions

Specific activities in Arizona included listening sessions to create a feedback loop with key stakeholders and critical health care workers to validate barriers/enablers and identify solutions to increase COVID-19 vaccination uptake emerging from the network. The AzVCN implemented listening sessions starting with key stakeholders from Arizona-Mexico border counties and with the AzPRC CAB that is made up of representatives from CHDs, CHW organizations, federally qualified health centers (FQHCs), and grassroots organizations. We identified other stakeholder groups including critical healthcare providers who are interfacing with the priority communities. Our relationship to CHDs was critical in prioritizing the communities engaged in this project.

The AzVCN implemented listening sessions with key stakeholders, including the AzPRC community action board (CAB) that is made up of representatives from CHDs, CHW organizations, federally qualified health centers (FQHCs), and grassroots organizations. Five listening sessions were conducted in the summer and fall of 2021. Listening sessions were conducted with two Arizona County Public Health Department Directors from two different counties, a staff member from one county, two PRC staff, four Community Health Workers, three employees of an Area Health Education Center, and
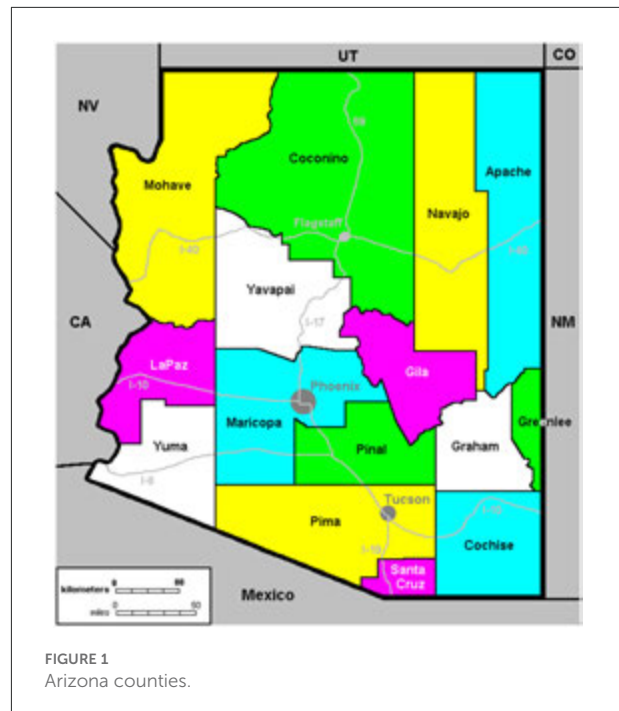
FIGURE 1
Arizona counties.

fifteen CAB members. All were adults over the age of 18. Four listening sessions were conducted *via* online Zoom meetings: two county sessions, one health education center session, and one CHW session. The CAB listening session was conducted in-person at an AzPRC quarterly CAB meeting. Summaries of the listening sessions are shown in Table 1. Results of note included several references in each session to misinformation (either through social media or among peers), improved need for consistent messaging, need to focus on youth, and constantly changing information.

Mobile health unit

The AzVCN partnered with the MEZCOPH to implement a community-based intervention using CHWs based in a MHU to address structural barriers and increase knowledge of COVID-19 vaccines, with a goal to reduce vaccination hesitancy and increase vaccination uptake among Latinx rural, un/underinsured and farmworker populations in Southern Arizona. MHUs units are effective in reducing structural, economic and social barriers to accessing health care service among our priority populations (15).

The MEZCOPH MHU conducts vaccine outreach and education in priority communities and allows for drop-in visits for COVID-19 vaccinations. In particular, the MHU partners with local county health departments to set up vaccination or health information events on a monthly basis. During the waiting periods before and after the vaccine, CHWs

TABLE 1 Listening session summaries.

Agency	Date	Participants	Barriers cited	Faciliators cited
Yuma county public health services district	9/9/21	2	• Farmworker employment • Misinformation • Sustainablity • Phrasing of booster doses • Funding to continue to do the work	• Time off work for vaccinations • Partnerhships • Communication • Bilingual staff
Southeast Arizona health education center	9/16/21	4	• Misinformation • Sustainablity • Hesitancy among rural population	• Collaborative Partnerhships • Communication • Bilingual staff • Testimonial videos in native language
Pima county and mariposa county community health workers	9/17/21	4	• Misinformation • Need for information in Spanish • Need to reach youth • Fear of being deported • Scheduling appointments	• Use of social media targeted to youth • Education efforts by CHWs • Trust
Cochise county health department	9/22/21	2	• Motivation for vaccination falling • Social media misinformation • Anti-vaccine groups (older, rural) • Allocation of resources • Non-specific public health messaging	• Trained staff • Communication • Targeted public health messaging • Mandates
AzPRC community advisory board	12/10/21	15	• Misinformation creates hesitancy • Social media • Young people feeling invincible • Keeping messaging constant • Constantly changing information • Convincing those that personally affected by COVID-19	• Cultural facilitators • Mixed methods strategy (policy, messaging) • CHWs provding binational information • Call centers to combat misinformation • Simple messaging more effective

provide on-site education on COVID-19 transmission and prevention strategies to protect family members living in the same household. The MHU also refers residents to other health and social services. The program brings educational and technological resources and the vaccine directly to the priority communities. CHW interventions provide an evidence-based approach to culturally tailoring messages and addressing social determinant needs that may create barriers to vaccination. With the MHU, CHWs will also be able to rapidly deploy strategies identified through the VCN network for evaluation.

In addition to CHD's promotion of these events, the MHU works with organizations, including consulate offices in different counties, non-profits, and community organizations, to advertise with tailored bilingual messaging that includes the dates/times that the MHU will be in specific areas and locations. The MHU provides services to un/underinsured, farmworker, Latinx, and rural communities throughout Southern Arizona. The MHU does not charge for services and no appointments are necessary. In one Arizona county, arrangements were made with farmworker employers to allow employees to take time off to get

vaccinated. The MHU travels across the four Arizona counties along the US-Mexico border. It conducts events during early morning, evening, and weekend hours to increase access. Over the past 5 months, the MHU has averaged 13 events per month.

Survey development and implementation

The AzVCN created a survey to conduct among patients of the MHU, either at COVID-19 vaccination events or other health events provided by the MHU. The survey contained CDC recommended survey items on COVID-19 vaccine confidence and uptake. The CDC requested all PRCs use their recommended core survey items to assess vaccine confidence and uptake in their priority communities, if feasible (Table 2). The main benefit of using these standardized items is to allow PRCs to compare their findings to CDC estimates for their state and the nation. Additionally, it will help the CDC understand the effectiveness of community engagement strategies used by PRCs to increase vaccine confidence and uptake in various

TABLE 2   CDC core survey items.

Construct	Question	Response scale	Source
BeSD domain: thinking and feeling domain			
Perceived susceptibility	How concerned are you about getting COVID-19?	Not at all concerned A little concerned Somewhat concerned Very concerned	NIS-ACM
Confidence in vaccine effectiveness	How important do you think getting a COVID-19 vaccine is to protect yourself against COVID-19?	Not at all important A little important Somewhat important Very important	NIS-ACM
Confidence in vaccine safety	How safe do you think a COVID-19 vaccine is for you?	Not at all safe Somewhat safe Very safe Completely safe	NIS-ACM
BeSD domain: social processes			
Social norms	If you had to guess, about how many of your family and friends have received a COVID-19 vaccine?	None Some Many Almost all	NIS-ACM
Provider recommendation	Has a doctor, nurse, or other health professional ever recommended that you get a COVID-19 vaccine?	Yes No Not sure	NIS-ACM
Exposure to misinformation	In the last month, have you seen or heard any negative information about the safety or effectiveness of COVID-19 vaccines?	Yes No Not sure	Other
BeSD domain: practical issues			
Perceived access	How difficult [would it be for you / was it for you] to get a COVID-19 vaccine?	Not at all difficult A little difficult Somewhat difficult Very difficult	NIS-ACM
Incentives	Have you heard of cash prizes or other rewards being offered in your area to people who get a COVID-19 vaccine?	Yes No Not sure	Omnibus
Requirements	Does your work or school require you to get a COVID-19 vaccine?	Yes No Unemployed/Not applicable (Not in school, home schooled) Not sure	NIS-ACM
BeSD domain: COVID-19 vaccination			
Behavior	Have you received at least one dose of a COVID-19 vaccine?	Yes No Not sure	NIS-ACM
Behavior	How many doses of a COVID-19 vaccine have you received?	One Two More than two Not sure	NIS-ACM

(Continued)

TABLE 2 Continued

Construct	Question	Response scale	Source
Brand	Which brand of COVID-19 vaccine did you receive?	Pfizer-Biontech	NIS-ACM
		Moderna	
		Johnson & Johnson/ Janssen	
		Other	
		Not sure	
Intentions	Ask if no vaccine doses received	Definitely get a vaccine	NIS-ACM
	How likely are you to get a	Probably get a vaccine	
	COVID-19 vaccine?	Not sure	
		Probably not get a vaccine	
		Definitely not get a vaccine	

populations. In addition, the AzVCN included optional survey items to assess perceptions of new variants and need for booster vaccinations The AzVCN survey was in process during the end of 2021 and continuing through summer 2022. As of May 1, 2022, 192 surveys of MHU patients had been completed.

Video testimonials

The AzVCN partnered with a non-profit organization in Arizona to create COVID-19 vaccination testimonial videos from respected community members. The RICE is a community-based, non-profit organization dedicated to serving and assisting Refugees, Asylees, and Immigrants in the Phoenix Metropolitan Area, created to close the service gaps that remain after the 90-day resettlement period testimonials in different languages by vaccine ambassadors/champions. In meetings with the AzVCN and RICE leadership, content of the testimonial videos was discussed. Testimonial videos that encourage specific immigrant communities in their native language to get the COVID-19 vaccine was the overarching message. The testimonials from respected community members discussed how they had received the OCVID-19 vaccine, how it affected them, and how it felt to do their part in bringing an end to the pandemic. Testimonial videos were filmed by the MEZCOPH Western Region Public Health Training Center in partnership with the RICE and the respected community members were selected by the RICE. Testimonial videos were created in French, Arabic, Persian, and Burmese and disseminated by RICE and the AzVCN to their networks and media channels.

Discussion

The AzVCN project activities has practical implications for addressing COVID-19 misinformation and vaccine uptake among underserved communities, especially Latinx rural, border, and farmworker populations. With a focus on providing activities that extends beyond addressing a single barrier, the AzVCN connects participants to COVID-19 information and vaccination opportunities. The CHWs at MHU events have a crucial role to play in COVID-19 vaccination uptake, particularly in addressing structural barriers, informational barriers, and behavioral barriers. The unique situation that US-Mexico border populations face underscores the importance of these project activities. The MHU is an important vehicle to gain access to an invisible population (e.g., the combination of the clinic being through the university and not the government and the partnerships with consulate offices). The non-governmental nature of the MHU with its trusted CHW bilingual and bicultural staff is of great importance for reaching undocumented/mixed status families and the consulate connection allows for binational collaborations to serve a transnational population.

COVID-19 vaccine acceptance among Latinx populations continues to be of high priority. It is encouraging that Latinx groups feel that COVID-19 vaccine endorsements from same-race medical professionals would increase their willingness to receive it and that they would also be motivated by receiving more information on the experiences of COVID-19 vaccine recipients who are of their own race and ethnicity (16). Our experiences with the MHU staff being public health professionals but also trusted community members of the same race and ethnicity addresses these issues related to the health system. In terms of technical issues of the health system, the MHU's ability to be nimble and participate in planned and pop-up events supplements the structural barriers inherent in a non-centralized health system.

This manuscript describes the AzVCN activities in 2021 and 2022 that were designed to facilitate the identification and translation of effective strategies to implement COVID-19

immunization programing. The COVID-19 pandemic is a once in a century event that revealed widening health disparities and disproportionate adverse health outcomes among underserved populations. In Arizona, these included Latinx, farmworker, border, rural, American Indian, and elderly populations. Throughout the pandemic, underserved populations were among the very populations with lower rates of COVID-19 vaccination, especially in the early weeks of Arizona's COVID-19 vaccination rollout. The listening session dialogues led to increased understanding of barriers and facilitators for COVID-19 vaccination and improved collaborations by delineating actions and results with a goal of validating facilitators/barriers in an iterative process. The partnership with the MHU allowed reach into underserved populations and addressed difficult barriers to overcome for these populations, including structural, informational, and behavioral barriers.

Limitations

Our experience in developing and implementing the activities of this project has some limitations. First, listening sessions were guided by a set of questions and prompts that were developed internally and may not be generalizable to other listening sessions from other PRCs. However, we did attempt to follow a standard set of questions and prompts for each session to be internally consistent and attempt to allow all listening sessions discuss similar items. Second, our events attended for our surveys were subject to student availability to conduct the survey. We attempted to reach as many different MHU events as possible, but there may be some underreporting among particular events.

Conclusion

As a participatory evaluation project, the AzVCN efforts contributed to the CDC's Vaccinate with Confidence Strategy by collaborating with CHWs and other key stakeholders to engage directly with communities in identifying and addressing barriers to vaccine uptake. By leveraging the MHU to address Latinx COVID-19 vaccination structural barriers and misinformation, especially among undocumented or mixed status families, the AzVCN has made an impact in the COVID-19 vaccine efforts in Arizona. Rural populations in Arizona show increased uptake of COVID-19 vaccinations (17). Further efforts can be informed by actionable plans because of our project, which can include key informant and stakeholder feedback and partnerships with MHUs to address structural and misinformation barriers that will likely continue to exist. By providing a detailed account of our methodology and

activities, we show that underserved populations can be reached, and COVID-19 vaccination knowledge and uptake can be impacted positively.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by University of Arizona Human Subjects Protection Program. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

TN: conceptualization of project and manuscript, project PI, methodology, formal analysis, roles, writing–original draft, and writing–review and editing. LAS: roles, writing–original draft, conceptualization, and writing–review and editing. AW-L: conceptualization and writing–review and editing. SC: overall PRC PI, roles, writing–original draft, supervision, and validation. JZ, KC, Ras, Res, and MM: roles, writing–original draft, and writing–review and editing. CF: database creation, roles, writing–original draft, and writing–review and editing. MI: project administration, conceptualization and writing–original draft, and writing–review and editing. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Food and housing security at a US Hispanic-Serving Institution: An examination before and during the COVID-19 pandemic

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University students occupy a socially marginal position and therefore are often underserved by academic and service institutions. This article analyzes food and housing security among students at The University of Texas at El Paso, a Hispanic-Serving Institution located in the U.S.-Mexico Border region. Findings of a sample of $n = 7{,}633$ university students are presented in the first cross-sectional, two-year food and housing security study on campus administered *via* platform Campus Labs Baseline. The first sample in 2019 consisted of $n = 2{,}615$ students representing 10.4% of student enrollment (25,177 total 2019 enrollment), and the second sample in 2020 was $n = 5{,}018$ representing 20.2% of student enrollment (24,879 total 2020 enrollment). To measure food security, the six-item short form of the U.S. Department of Agriculture (USDA) Household Food Security Survey Module was used. To document housing security, we created questions informed by student input. In this study, survey results are reported, and tests are conducted to assess the relationships between various student characteristics and food and housing security. Student characteristics significantly impacting food and housing security are probed further using data visualizations and subpopulation analysis with a focus on analyzing factors impacted by the COVID-19 pandemic. Results indicate that employment status, consistent employment status, hours per week, academic level, number of dependents, and gender are all factors associated with food security during the pandemic but not prior to the pandemic. Other factors, including, college affiliation, ethnicity/race, having any dependents and being head of household, living alone, mode of campus transportation and mode of the transportation, household income, and age, all were associated with food security in both academic years. Using these results, a critical analysis of past interventions addressing food and housing security is presented with a focus on

changes made during the pandemic. Recommendations are made for further data-driven interventions and future steps.

Introduction

Public health and health equality are essential for human development. Health is both a medical and social issue compounded by structural, economic, and environmental factors. If these factors are compromised, vulnerabilities can create health inequalities and human disasters (1). Low socioeconomic status is associated with poor birth outcomes, infectious diseases, chronic conditions, and life expectancy, which result from disparities that include poor access to health care, financial constraints, environmental differences, differential access to information, geographic locality, and behavioral factors (2). Economic instability is associated with worse health outcomes, forcing individuals to prioritize other issues such as rent and utility bills over food and health needs. Some key barriers to obtaining food include reduced access to supermarkets with healthier food options, as well as difficulty accessing federal nutrition assistance programs and food from food banks or pantries due to lack of these nearby, lack of transportation to get to them and complicated and time-consuming application process to access federal assistance. Informational barriers like the lack of awareness or understanding about available food and housing resources also may contribute to low utilization. In addition, the stigma associated with participation in public assistance programs may affect access as well (3).

Food security (FS) is "access by all people at all times to enough food for an active, healthy life" (4). Food insecurity "exists whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain" [(5), p. 1560]. Food insecurity is a risk factor for all types of malnutrition, food deficiencies, excess or imbalance of energy, as well as under and over nutrition like being overweight or obese due to insufficient intake and overconsumption of high-calorie/low-nutrient-dense foods (6). Food insecurity is more prevalent in urban areas, immigrant communities and among racial/ethnic groups, which are tied to lack to equity of resources leading to poor health outcomes that during periods of economic downturn, tend to increase (7). In addition, systemic inequities drive food and nutrition insecurity. Differences between racial and ethnic groups highlight a lack of equity that may lead to health disparities among food-insecure populations (8).

Housing security (HS) is defined as "availability of and access to stable, safe, adequate, and affordable housing and neighborhoods regardless of gender, race, ethnicity, or sexual orientation" [(9), p. 99]. Housing insecurity is a lack of access to safe, affordable, and quality housing, and it includes homelessness, housing instability, poor housing conditions, and low household or neighborhood safety (9). Housing insecurity is a determinant of multiple high-risk behaviors and poor health outcomes among adults (10), and it also contributes to several low health outcomes among children (11). In the United States, approximately one in 10 college students is homeless and 45% live in an unsafe environment with a wide range of challenges related to housing affordability and stability (12).

The relationship between education and health at both individual and regional levels is salient (1). In the United States, accessibility to colleges and universities has increased in the past 50 years, resulting in demographic composition changes with more low-income, first-generation, racial, and ethnic minority students enrolled than ever before (13, 14).

Nationally, the demographic characteristics of university students are shifting, and it is becoming more common for students to have children and work full-time while enrolled as full-time students (14). Food insecure students are also more likely than food secure students to experience housing insecurity, gain weight while attending college, partake in unhealthy diets with higher sugar and fat content, and experience psychological distress (15).

Among higher education students, basic needs insecurity—which includes food and housing insecurity—contributes to poor academic and health outcomes. Food and housing security is a basic need and if students' needs are not met, then they will be unable to engage in higher-level learning (13). Basic needs insecurity among college and university students is associated with several negative health outcomes, including decreased cognition and sleep quality, increased rates of certain chronic diseases, higher body mass index, higher odds of stress and depression, more emergency room visits and hospitalizations, and higher mortality rates (7, 13, 14).

A study by College and University Food Bank Alliance (16–18) revealed that 30% of college students in the U.S. are food insecure, and 56% of these students are employed, 75% receive financial aid and 43% participate in some type of campus meal plan. In addition, 36% are housing insecure, a number that increases to 51% for community college students, and 14% of students are homeless. The growing cost of campus tuition, health care, books, transportation, and living expenses have resulted in students having to decide between paying for bills or securing food forcing some students to leave college without obtaining degrees with financial concerns as the primary cause (16–18).

The COVID-19 pandemic exacerbated the financial challenges for many US households. Higher unemployment due to lockdowns and social distancing measures resulted in new or worsening economic barriers to basic needs security. In addition, public transportation was disrupted due to social distancing requirements, presenting a physical barrier to obtaining food for millions of Americans (7).

While young people are less vulnerable to severe illness from COVID-19, their education, work, and social lives have been interrupted by the pandemic (19). These interruptions have important consequences for public health, including an increase in anxiety and depressive symptoms and increased risk of psychiatric diagnosis (20). Beyond mental health, the combination of COVID-19 and food insecurity was found to promote gut anomalies, which could have acute or long-term health implications for infections and chronic conditions (21).

Importance of university response to FS and HS

It is critical to improve our understanding of the impact of the COVID-19 pandemic on food and housing security among higher education students. By measuring changes in basic needs security for this population, we can prepare for the likely public health and social consequences in the short and medium term. Furthermore, by identifying the key factors that are associated with food and housing security, we can more effectively direct limited resources to the students who are most in need and improve student academic outcomes in the long run. In this article, we analyze FS and HS among higher education students. The paper focuses on variables of importance that contribute to food and housing security to highlight some of the differences that coincided with the COVID-19 pandemic. In conclusion, we make recommendations for other institutions experiencing similar effects of the pandemic on student food and housing security.

Materials and methods

Participants

The study used a cross-sectional, survey-based design to examine FS and HS among university students at an urban Hispanic-Serving Institution. The survey study compares 2 years of data, including before and during the COVID-19 pandemic. The study setting is a Hispanic-Serving University located in the U.S.-Mexico border region. The student population is representative of the local community: over 83% of students are Hispanic and nearly 50% self-identify as a first-generation student (22).

Procedure

In 2019 and 2020, online surveys were administered to students *via* a university platform to collect, analyze, and translate data in real time. Author and co-authors prepared the study protocol and instrument, which was piloted in the focused population by a trained interviewer (first and senior author), and student feedback from the pilot survey helped inform the final version of the survey questions. Using a Customer Relationship Management Program (CRM), survey invitations were sent to all students at the HSI in Fall 2019 (October 7–23, 2019) and Fall 2020 (November 5–20, 2020). The student population over the age of 18 enrolled at the university in 2019 was 25,177, and in 2020 was 24,879. Four emails were sent by CRM, including the initial invitation and three reminders in both years. Participants who voluntarily accepted to be in the study consented electronically and completed the survey online. The survey contained 30–36 questions, took approximately 10 min to complete, was anonymous, and was open for at least 16 days each year. Participants had the option to enter a raffle for four $75-dollar electronic gift cards. A total of 6,484 (26%) participants—who met the inclusion criteria of being at least 18 years old and enrolled at the university at the time of study—completed the survey in 2019, and 12,536 (50%) participants completed the survey in 2020.

Measures

Both surveys contained questions that provide key measures of food security, housing security, and potential determinants of these outcomes among survey respondents. To measure FS, authors used the validated survey questions and scoring procedures from the six-item short form of the U.S. Department of Agriculture (USDA) Household Food Security Survey Module (23, 24). The USDA survey questions ask about different aspects of household food security in the past 12 months, and each

response option corresponds to a score. The responses to the six-item USDA survey were scored, summed, and categorized using the validated food security status groups reported in Bickel et al. (23). The resulting three categories of FS are: very low FS, low FS, and high or marginal FS. To measure HS, two survey questions were adapted—using input from college students in the target population—from the Los Angeles Community College District Survey of Student Basic Needs (25). The two HS measures were most suitable for the population of interest given the characteristics of their sample (25) and our community. The first HS survey question was: (Q18) "In the past 12 months, have you had a permanent address?" A "yes" response indicates higher HS, whereas a "no" response indicates lower HS. The second HS question was: (Q19) "Have you had to spend a night (or more) in any of the following: hotel or motel; home or room of a friend or acquaintance; home or room of a family member; shelter; transitional living center; public spaces like library, abandoned buildings, or a car." Higher frequency responses indicate lower HS, whereas lower frequency responses indicate higher HS.

For measures of potential determinants of FS and HS, the survey asked questions on income, education (enrollment status and academic level), employment (status, location, and number of weekly h), age, gender, race/ethnicity, transportation (mode and reliability), and living situation. For the survey question on gender, respondents were asked to indicate their preferred pronouns (he/him, she/her, they/them, other, or prefer not to respond). Some of the standard questions were taken or adapted from the Los Angeles Community College District Survey of Student Basic Needs to meet our community characteristics (25). The study was IRB approved as exempt in September 2019 and amended and approved in 2020, and it was launched by the University's Dean of Students Office.

Data cleaning and validation

All identifying information from the survey data was removed to protect confidentiality of participants, as well as responses with fully missing data. A missing value analysis was conducted for the remaining data in order to detect any further missing answers or patterns of missingness. However, data was deleted since missingness was not random (MAR) but exhibited strong patterns. Following this analysis, the observations that did not have levels recorded for food and housing security were deleted from the data. This results in a reduction in data as shown in Figure 1 consort diagram. Following this pre-processing stage, the data was readied for analysis by matching 28 variables common to both surveys. Some minor editing of variable levels was conducted in order to match results of the surveys. This was minor and inconsequential in each case except for household income where each year was aggregated to two levels (<$50,000 annual income and >=$50,000 annual income) since the levels provided as choices did not match

FIGURE 1
Consort diagram of 2019 and 2020 data collections.
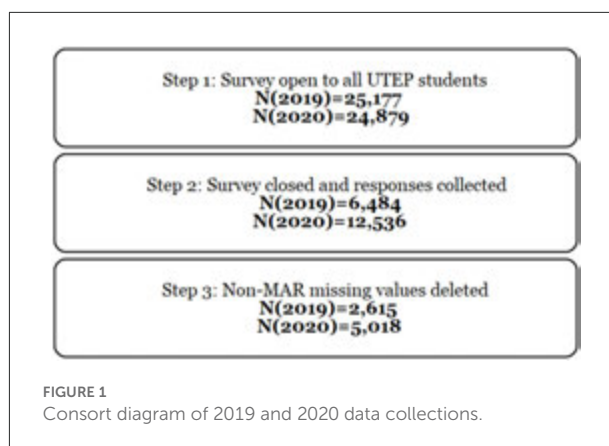
with higher granularity. Finally, the USDA categories for food security were programmatically created using the six measures included in each year's survey. These categories were validated by the USDA (23) and are used for reporting out food security results.

Statistical analysis

Descriptive statistics of the variables to both years were tested for association with the USDA food security outcomes and the housing security outcomes. When the factor was continuous, a simple F test from an ANOVA model was used to detect any difference in the means. When the data were categorical, exact Fisher tests with simulated p-values were used to test for association. These tests results were summarized with p-values in the analysis. Following the statistical tests, data visualizations were utilized to probe important factors that differ across the years. When a factor was deemed significant in 2020 but not 2019, we summarized this outcome using an appropriate visualization to understand the nature of the shift. All analyses were conducted in R (26) and made use of the ggplot2 (27) and summary (28) packages.

Results

Initial analysis implies that food security increased from 2019 to 2020, and there is some evidence that housing security—as measured by a permanent address—increased as well (see Table 1). The housing security results are mixed, because a higher percentage of respondents reported (at least sometimes) experiencing a lack of any address in 2020. The housing and food security results are complex and due to a variety of factors, some of which may be temporary in nature. We explore the factors below, and we return to these findings in the discussion.

To investigate the intersectionality of food and housing security across 2019 and 2020 regarding gender, ethnicity, age,

TABLE 1 Overall levels of food and housing security.

Characteristic	N	2019, N = 2,615[a]	2020, N = 5,018[a]
USDA rating	7,633		
Very Low FS		848 (32%)	1,174 (23%)
Low FS		618 (24%)	1,107 (22%)
High or marginal FS		1,149 (44%)	2,737 (55%)
(Missing)		0 (0%)	0 (0%)
Current living situation	7,627		
On campus		160 (6.1%)	131 (2.6%)
Off campus with family		1,832 (70%)	4,036 (80%)
Off campus no family		589 (23%)	804 (16%)
Other		28 (1.1%)	47 (0.9%)
Unknown		6	0
Permanent address	7,630		
Yes		2,331 (89%)	4,766 (95%)
No		281 (11%)	252 (5.0%)
Unknown		3	0
Frequency of no address	519		
Rarely		157 (59%)	136 (54%)
Sometimes		67 (25%)	83 (33%)
Often		43 (16%)	33 (13%)
Unknown		2,348	4,766

[a]n (%).

use of transportation, employment, being head of household, and income and public assistance, a more detailed table is produced. Table 2 presents the breakdown of all common variables across the years and by USDA food security category. Cochran-Mantel-Haenszel tests were performed for each variable and USDA rating stratified by Year. All tests were statistically significant, with the exception of Enrollment, demonstrating the need for the association analysis presented in Table 2. Additionally, Figures 2–8 illustrate the associations across the 2 years of the survey.

Food security results

According to the survey results, several variables have a different relationship with food security across survey years. In Table 2, there is a change in the employment status across the 2019 and 2020 cohort and its association with food security (p-value (2019) $=0.4$, p-value (2020) <0.001). Figure 2 illustrates the change in employment status across the 2 years. Note that the level "no" was not an option in 2019 and, hence, excluded. Additionally, the location of employment differs in association across the years (p-value (2019) <0.001, p-value (2020) $=0.2$). Figure 3 illustrates this change in association. Finally, also regarding employment, the level of employment is also different across years (p-value (2019) $=0.3$, p-value

(2020) <0.001), as demonatrated in Figure 4. In general, for the variables about employment status, there were more part-time employed students and fewer students working on campus during the pandemic than before. Moreover, the association between this and being food secure was associated with employment variables.

Regarding variables focused on student characteristics, there was an association now between academic level and food security that did not exist prior to the pandemic (see Figure 5). More senior and junior students were having issues with food security relative to other academic levels. The number of dependents also was no longer associated with food security (p-value (2019) $=0.002$, p-value (2020) $=0.6$). This was indicated particularly by less impact by number of dependents. Finally, other students' characteristics were associated with food security across both data collections.

Housing security results

The survey results also demonstrate changes in relationships between some key variables and housing security across survey years. Table 3 presents the results on housing security and factors associated. As with Table 2, Cochran-Mantel-Haenszel tests were performed for each variable and hunger status with Year as the stratification variable. Again, all tests were statistically

TABLE 2 Factors by year and USDA food insecurity group.

Characteristic	2019				2020			
	Very Low FS, $N = 848$[a]	Low FS, $N = 618$[a]	High or Marginal FS, $N = 1,149$[a]	p-value[b]	Very Low FS, $N = 1,174$[a]	Low FS, $N = 1,107$[a]	High or Marginal FS, $N = 2,737$[a]	p-value[b]
Enrollment				0.5				0.8
Full-time	727 (86%)	537 (87%)	974 (85%)		976 (83%)	932 (84%)	2,290 (84%)	
Part-time	119 (14%)	81 (13%)	175 (15%)		198 (17%)	175 (16%)	447 (16%)	
Employed?				0.4				<0.001
Full-time	536 (63%)	384 (62%)	695 (60%)		264 (22%)	215 (19%)	462 (17%)	
Part-time	312 (37%)	234 (38%)	454 (40%)		443 (38%)	450 (41%)	1,068 (39%)	
No					467 (40%)	442 (40%)	1,207 (44%)	
Consistently working?				<0.001				0.2
On campus	170 (32%)	172 (45%)	298 (43%)		102 (14%)	118 (18%)	259 (17%)	
Off campus	365 (68%)	212 (55%)	395 (57%)		605 (86%)	547 (82%)	1,271 (83%)	
H per week				0.3				0.001
19 h or more	243 (45%)	183 (48%)	347 (50%)		273 (39%)	316 (48%)	713 (47%)	
Less than 19 h	293 (55%)	200 (52%)	347 (50%)		434 (61%)	349 (52%)	817 (53%)	
Age				<0.001				<0.001
<18	0 (0%)	1 (0.2%)	4 (0.3%)		5 (0.4%)	9 (0.8%)	15 (0.5%)	
19–24	548 (65%)	431 (70%)	843 (73%)		730 (62%)	757 (69%)	1,946 (71%)	
25–34	194 (23%)	132 (21%)	189 (16%)		295 (25%)	258 (23%)	510 (19%)	
35–44	71 (8.4%)	38 (6.2%)	79 (6.9%)		99 (8.4%)	54 (4.9%)	164 (6.0%)	
45–64	35 (4.1%)	15 (2.4%)	32 (2.8%)		43 (3.7%)	24 (2.2%)	98 (3.6%)	
>65	0 (0%)	0 (0%)	1 (<0.1%)		0 (0%)	1 (<0.1%)	2 (<0.1%)	
Family income				<0.001				<0.001
< $50,000	782 (93%)	526 (86%)	809 (71%)		993 (85%)	890 (80%)	1,711 (63%)	
>= $50,000	62 (7.3%)	88 (14%)	328 (29%)		181 (15%)	217 (20%)	1,026 (37%)	
Academic level				0.4				<0.001
Freshman	105 (12%)	93 (15%)	170 (15%)		120 (10%)	142 (13%)	421 (15%)	
Sophomore	121 (14%)	101 (16%)	159 (14%)		147 (13%)	163 (15%)	403 (15%)	
Junior	240 (28%)	147 (24%)	282 (25%)		327 (28%)	295 (27%)	607 (22%)	
Senior	239 (28%)	183 (30%)	333 (29%)		439 (37%)	339 (31%)	814 (30%)	
Masters	102 (12%)	67 (11%)	148 (13%)		98 (8.3%)	105 (9.5%)	339 (12%)	
Doctoral	41 (4.8%)	25 (4.0%)	54 (4.7%)		41 (3.5%)	57 (5.1%)	143 (5.2%)	
Professional	0 (0%)	2 (0.3%)	3 (0.3%)		2 (0.2%)	6 (0.5%)	10 (0.4%)	
Commute mode				<0.001				<0.001
Missing	29 (3.4%)	20 (3.3%)	46 (4.0%)		64 (5.5%)	44 (4.0%)	187 (6.8%)	
Car (alone)	502 (59%)	363 (59%)	756 (66%)		764 (65%)	719 (65%)	1,794 (66%)	
Carpool	83 (9.8%)	59 (9.6%)	115 (10%)		121 (10%)	129 (12%)	321 (12%)	
Bus/public	42 (5.0%)	33 (5.4%)	58 (5.1%)		52 (4.4%)	53 (4.8%)	100 (3.7%)	
Bike	103 (12%)	80 (13%)	102 (8.9%)		90 (7.7%)	100 (9.0%)	189 (6.9%)	
Trolley	11 (1.3%)	10 (1.6%)	6 (0.5%)		12 (1.0%)	6 (0.5%)	11 (0.4%)	
Walk	62 (7.3%)	39 (6.4%)	36 (3.1%)		49 (4.2%)	37 (3.3%)	56 (2.0%)	
Other	13 (1.5%)	10 (1.6%)	25 (2.2%)		21 (1.8%)	19 (1.7%)	78 (2.8%)	

(Continued)

TABLE 2 Continued

Characteristic	2019				2020			
	Very Low FS, $N =$ 848[a]	Low FS, N $= 618$[a]	High or Marginal FS, $N =$ 1,149[a]	p-value[b]	Very Low FS, $N =$ 1,174[a]	Low FS, N $= 1,107$[a]	High or Marginal FS, $N =$ 2,737[a]	p-value[b]
Reliability of transportation				<0.001				<0.001
Not reliable	13 (1.5%)	3 (0.5%)	3 (0.3%)		40 (3.4%)	25 (2.3%)	47 (1.7%)	
Somewhat reliable	133 (16%)	46 (7.5%)	39 (3.4%)		192 (16%)	113 (10%)	134 (4.9%)	
Fairly reliable	320 (38%)	212 (35%)	283 (25%)		451 (38%)	464 (42%)	750 (27%)	
Very reliable	380 (45%)	352 (57%)	819 (72%)		491 (42%)	505 (46%)	1,806 (66%)	
Live alone?				<0.001				<0.001
Yes	134 (16%)	60 (9.7%)	73 (6.4%)		164 (14%)	104 (9.4%)	154 (5.6%)	
No	714 (84%)	556 (90%)	1,076 (94%)		1,010 (86%)	1,003 (91%)	2,583 (94%)	
Dependents?				<0.001				<0.001
Yes	169 (24%)	116 (21%)	175 (16%)		281 (28%)	203 (20%)	409 (16%)	
No	545 (76%)	439 (79%)	901 (84%)		729 (72%)	800 (80%)	2,174 (84%)	
How many?				0.002				0.6
1	56 (33%)	49 (42%)	65 (37%)		105 (37%)	88 (43%)	162 (40%)	
2–3	80 (47%)	57 (49%)	100 (57%)		142 (51%)	94 (46%)	207 (51%)	
>4	33 (20%)	10 (8.6%)	10 (5.7%)		34 (12%)	21 (10%)	40 (9.8%)	
Head of household				<0.001				<0.001
Yes	283 (33%)	158 (26%)	176 (15%)		404 (34%)	258 (23%)	464 (17%)	
No	565 (67%)	458 (74%)	970 (85%)		770 (66%)	849 (77%)	2,273 (83%)	
Current living situation				<0.001				<0.001
On campus	63 (7.4%)	39 (6.3%)	58 (5.1%)		58 (4.9%)	26 (2.3%)	47 (1.7%)	
Off campus with Family	503 (59%)	421 (68%)	908 (79%)		813 (69%)	876 (79%)	2,347 (86%)	
Off campus no family	267 (32%)	153 (25%)	169 (15%)		290 (25%)	194 (18%)	320 (12%)	
Other	14 (1.7%)	3 (0.5%)	11 (1.0%)		13 (1.1%)	11 (1.0%)	23 (0.8%)	
Permanent address				<0.001				<0.001
Yes	698 (82%)	555 (90%)	1,078 (94%)		1,065 (91%)	1,047 (95%)	2,654 (97%)	
No	150 (18%)	61 (9.9%)	70 (6.1%)		109 (9.3%)	60 (5.4%)	83 (3.0%)	
Frequency of no address				<0.001				<0.001
Rarely	65 (45%)	39 (66%)	53 (85%)		45 (41%)	30 (50%)	61 (73%)	
Somewhat	46 (32%)	15 (25%)	6 (9.7%)		49 (45%)	17 (28%)	17 (20%)	
Often	35 (24%)	5 (8.5%)	3 (4.8%)		15 (14%)	13 (22%)	5 (6.0%)	
Know of student homelessness				<0.001				<0.001
Yes	336 (40%)	166 (27%)	204 (18%)		417 (36%)	215 (19%)	326 (12%)	
No	511 (60%)	450 (73%)	945 (82%)		757 (64%)	892 (81%)	2,411 (88%)	
Ethnicity				0.002				<0.001
Hispanic/Latino	688 (81%)	522 (85%)	949 (83%)		881 (75%)	861 (78%)	2,101 (77%)	
American Indian	6 (0.7%)	5 (0.8%)	8 (0.7%)		17 (1.4%)	7 (0.6%)	14 (0.5%)	
Asian	17 (2.0%)	23 (3.7%)	40 (3.5%)		22 (1.9%)	34 (3.1%)	72 (2.6%)	

(Continued)

TABLE 2 Continued

Characteristic	2019				2020			
	Very Low FS, $N = 848^a$	Low FS, $N = 618^a$	High or Marginal FS, $N = 1,149^a$	p-value[b]	Very Low FS, $N = 1,174^a$	Low FS, $N = 1,107^a$	High or Marginal FS, $N = 2,737^a$	p-value[b]
Black	31 (3.7%)	19 (3.1%)	23 (2.0%)		49 (4.2%)	35 (3.2%)	47 (1.7%)	
Pacific Islander	3 (0.4%)	2 (0.3%)	2 (0.2%)		5 (0.4%)	3 (0.3%)	9 (0.3%)	
White	81 (9.6%)	33 (5.3%)	112 (9.8%)		175 (15%)	151 (14%)	457 (17%)	
Other	21 (2.5%)	13 (2.1%)	13 (1.1%)		25 (2.1%)	16 (1.4%)	37 (1.4%)	
Gender (pronouns)				0.7				0.016
He/Him	265 (31%)	185 (30%)	330 (29%)		347 (30%)	314 (28%)	824 (30%)	
She/Her	568 (67%)	422 (68%)	806 (70%)		775 (66%)	752 (68%)	1,849 (68%)	
They/Them	6 (0.7%)	4 (0.6%)	4 (0.3%)		27 (2.3%)	18 (1.6%)	25 (0.9%)	
Other	8 (0.9%)	7 (1.1%)	9 (0.8%)		9 (0.8%)	5 (0.5%)	16 (0.6%)	
Prefer no answer					16 (1.4%)	18 (1.6%)	23 (0.8%)	
College				0.025				<0.001
Business administration	88 (10%)	56 (9.1%)	132 (11%)		136 (12%)	130 (12%)	293 (11%)	
Education	59 (7.0%)	49 (7.9%)	87 (7.6%)		100 (8.5%)	106 (9.6%)	261 (9.5%)	
Engineering	113 (13%)	112 (18%)	200 (17%)		156 (13%)	186 (17%)	473 (17%)	
Health sciences	109 (13%)	83 (13%)	174 (15%)		123 (10%)	127 (11%)	318 (12%)	
Liberal arts	266 (31%)	149 (24%)	280 (24%)		361 (31%)	262 (24%)	635 (23%)	
Science	155 (18%)	116 (19%)	199 (17%)		190 (16%)	173 (16%)	465 (17%)	
Nursing	45 (5.3%)	44 (7.1%)	61 (5.3%)		83 (7.1%)	96 (8.7%)	244 (8.9%)	
Pharmacy	6 (0.7%)	1 (0.2%)	7 (0.6%)		8 (0.7%)	16 (1.4%)	17 (0.6%)	
Other	7 (0.8%)	8 (1.3%)	9 (0.8%)		17 (1.4%)	11 (1.0%)	31 (1.1%)	

[a]n (%).
[b]Fisher's exact test for count data with simulated p-value (based on 2,000 replicates).

significant, with the exception of Enrollment. Regarding housing security (permanent housing-yes or no), there was a slight difference in association for employment status and housing security (p-value (2019) = 0.03, p-value (2020) = 0.08). This indicates that more full-time students were housing secure during the pandemic as depicted in Figure 7.

Ethnicity also indicates a decrease in Hispanic/Latino students during the pandemic who have permanent housing as shown in Figure 8 (p-value (2019) <0.001, p-value (2020) =0.13). Other variables were and remain to be associated with housing security across 2019 and 2020.

Discussion

The results suggest that food security and one dimension of housing security—possessing a permanent address—improved among university students in the 2019 and 2020 samples. Specifically, levels of high or marginal food security increased from 44 in 2019 to 55% in 2020; levels of very low food security

decreased from 32 in 2019 to 23% in 2020; and possessing a permanent address increased from 89 in 2019 to 95% in 2020. In contrast, for the second measure of housing security (the frequency of lacking any address), there was an increase in the percentage of students who reported that at least sometimes they lacked any address.

Despite the pandemic's upheaval of academic, economic, and social structures, our findings demonstrate that fewer students at this HSI experienced very low food security and (one form of) low housing security during the first year of the pandemic. We are unable to determine why food and housing security improved among university students during the pandemic, but social assistance interventions—including the expanded efforts by the government, community organizations, and the University—may have played a key role (29–31). It also is important to note that the percentage of students in the sample who lived off campus with family increased from 70 in 2019 to 80% in 2020 (see Table 1), which could account for some of the increase in food security. Below we highlight some key factors that are associated with student food and housing security across

FIGURE 2
Employment status and food security.

FIGURE 3
Employment location and food security.
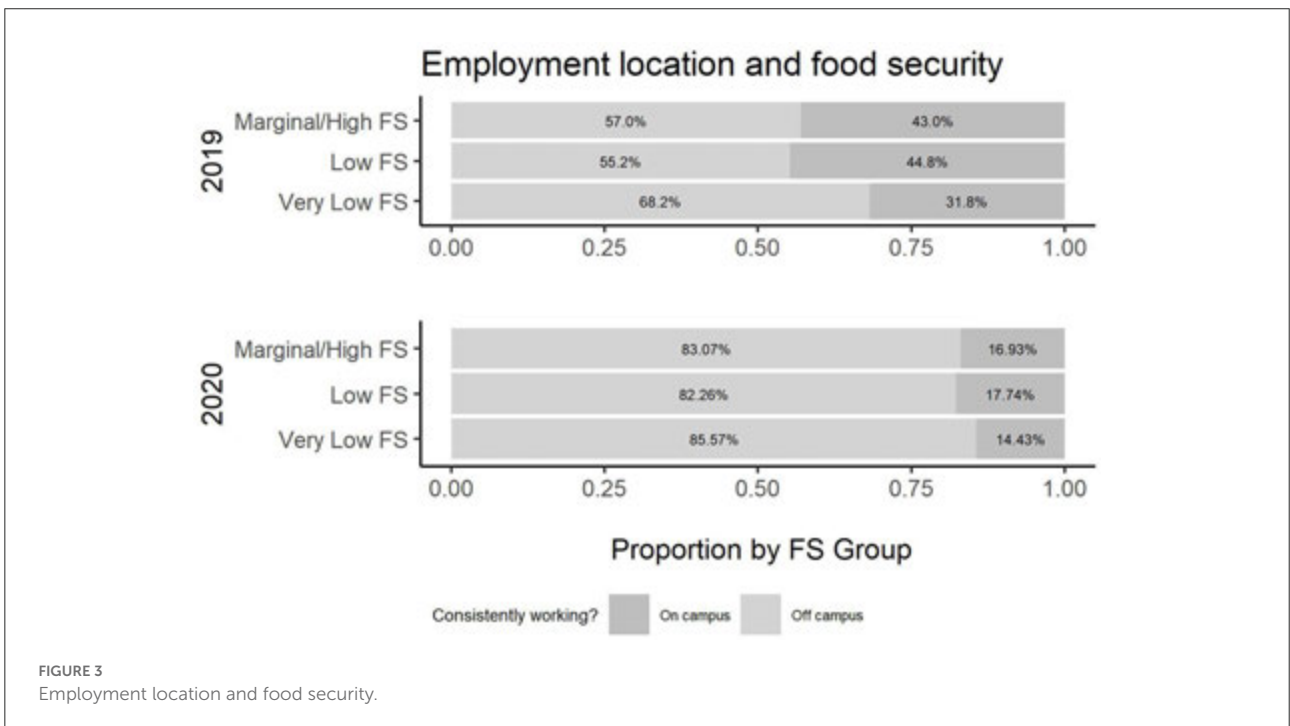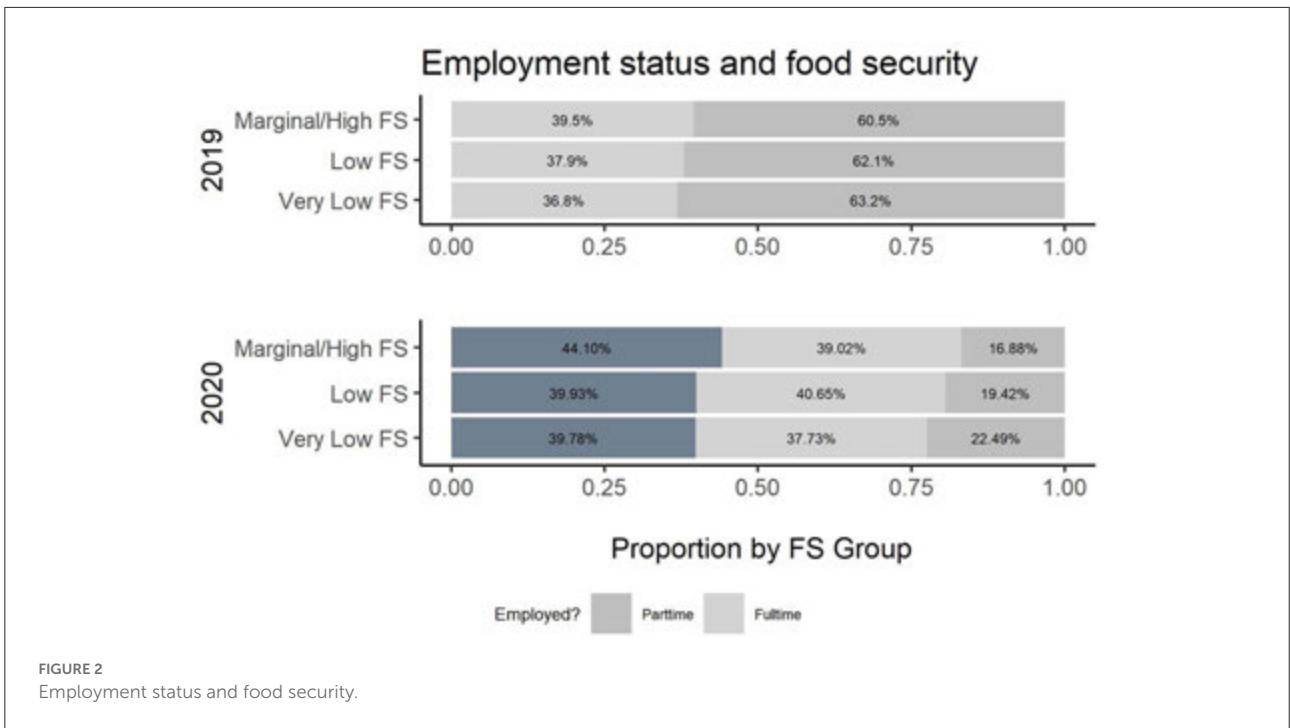
years and subsections, and in the next subsection we describe the University's efforts and develop a new model to improve food and housing security. University services prior and during the COVID-19 pandemic are listed in Table 4.

Employment status and other related employment variables were altered during the pandemic. Nationally, many who had worked full-time reduced their employment to part-time status or no employment (37). This change in employment status, along with a halting on payment plans for student loans and the financial assistance provided by the CARES Act (38), may have affected the changes in association with food and housing security. The results

Hours of employment and food security

FIGURE 4
Hours worked per week and food security.

Academic level and food security

FIGURE 5
Academic level and food security.
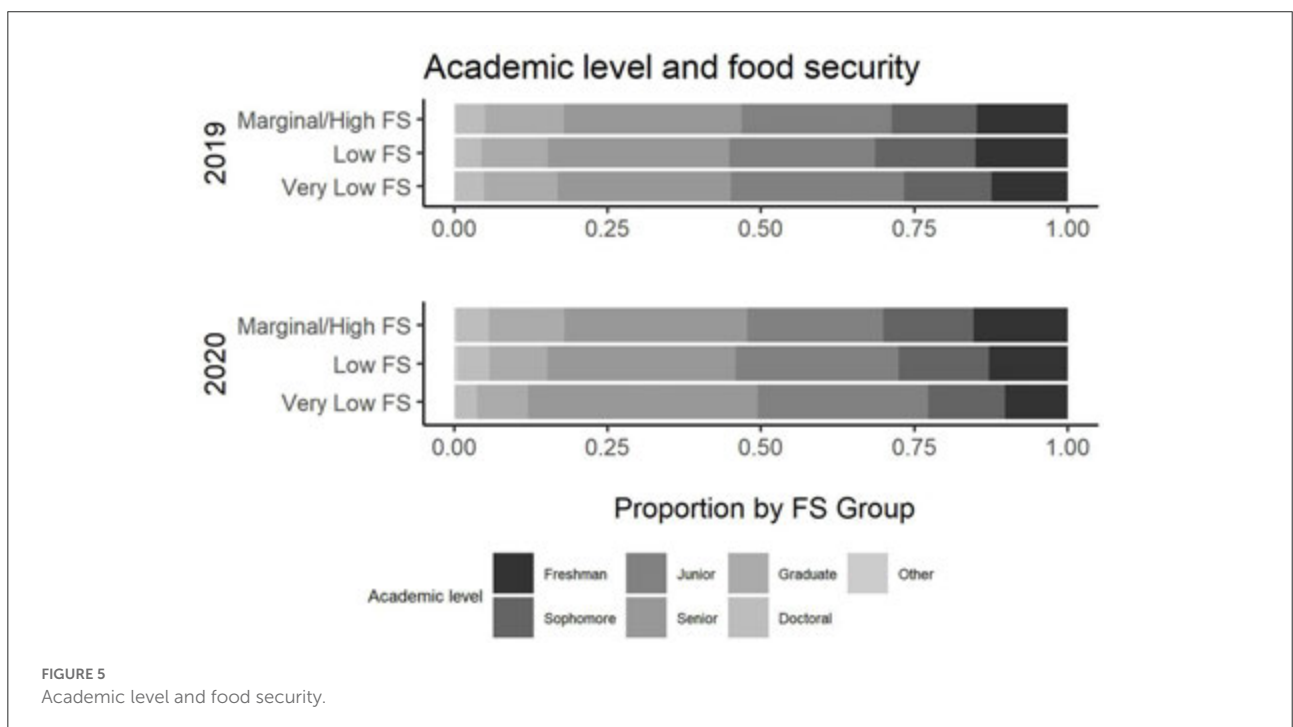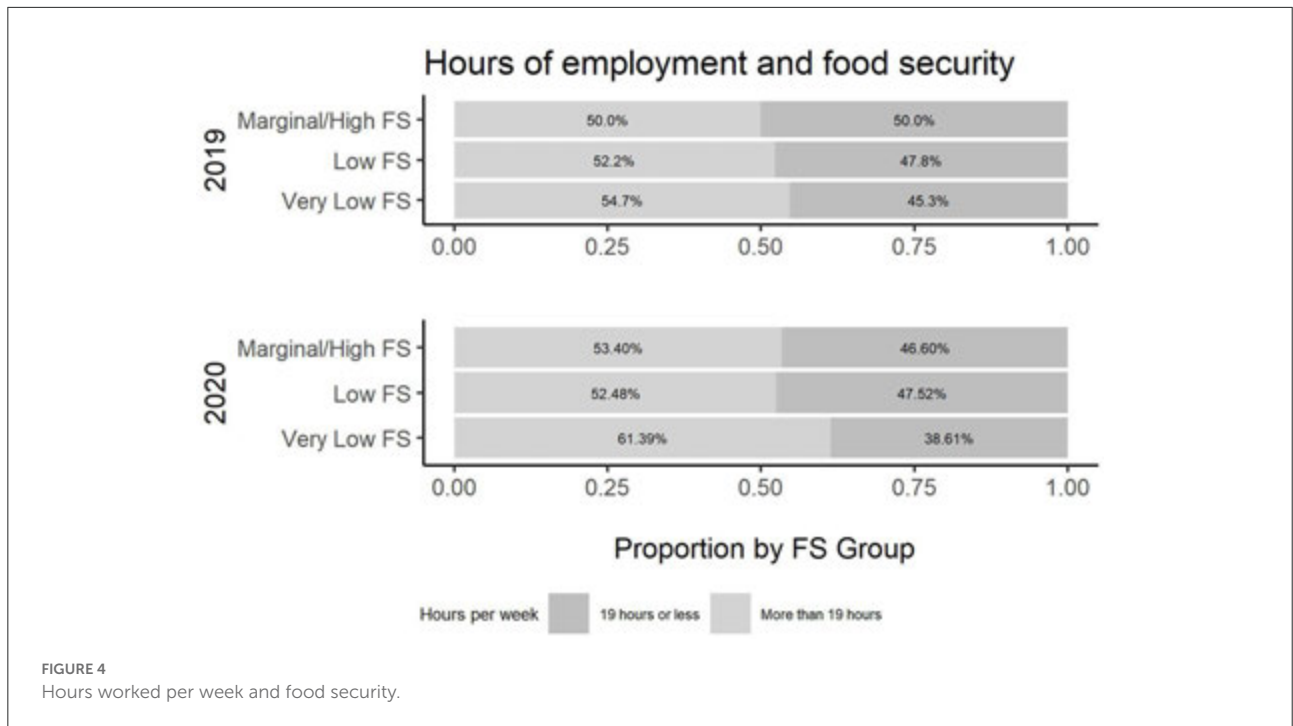
suggest that educational and higher education institutions need to shift to providing more employment opportunities to students on campus when possible and consider that many students are still struggling to adjust to the end of CARES funding and will need additional income generating opportunities.

It is important to emphasize that the student population at an HSI is not monolithic: key differences in food and housing security exist across subgroups. For example, regarding housing security, it is evident that Hispanic students experienced a decreased access to permanent housing. Pre-pandemic, 84% of Hispanic students had access to permanent

FIGURE 6
Number of dependents and food security.

FIGURE 7
Employment status and housing security.
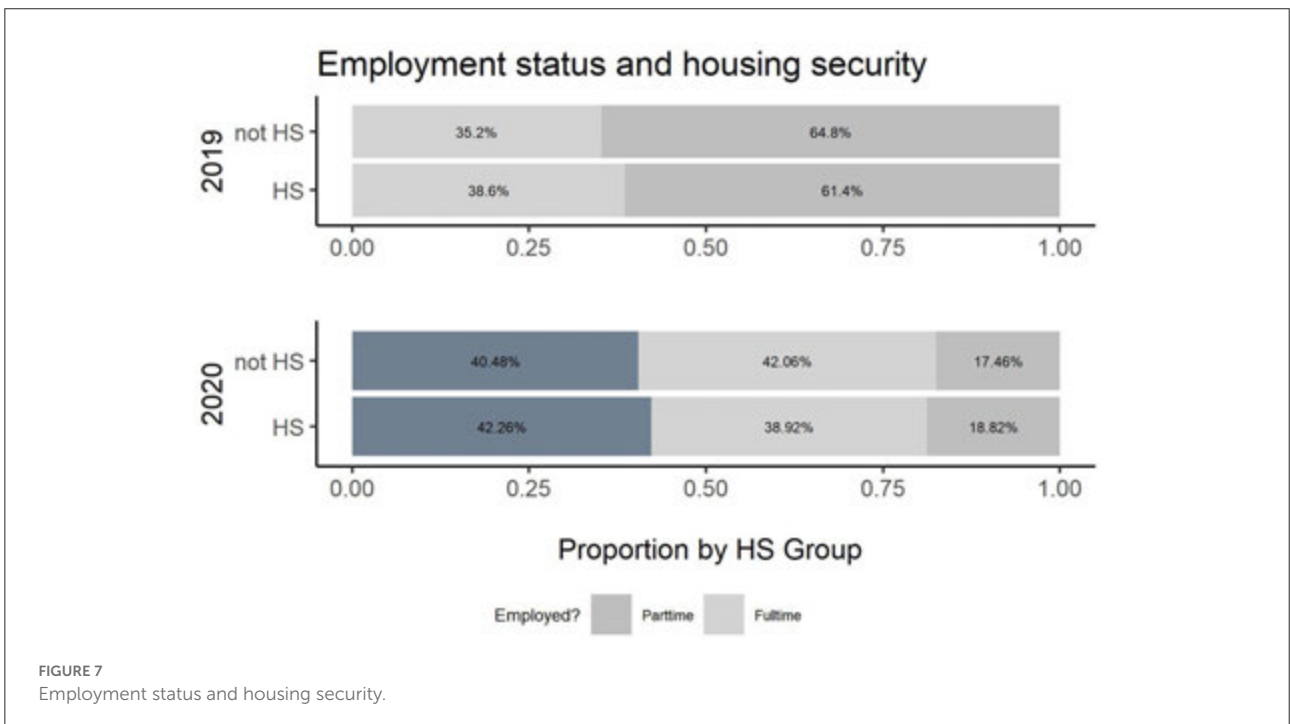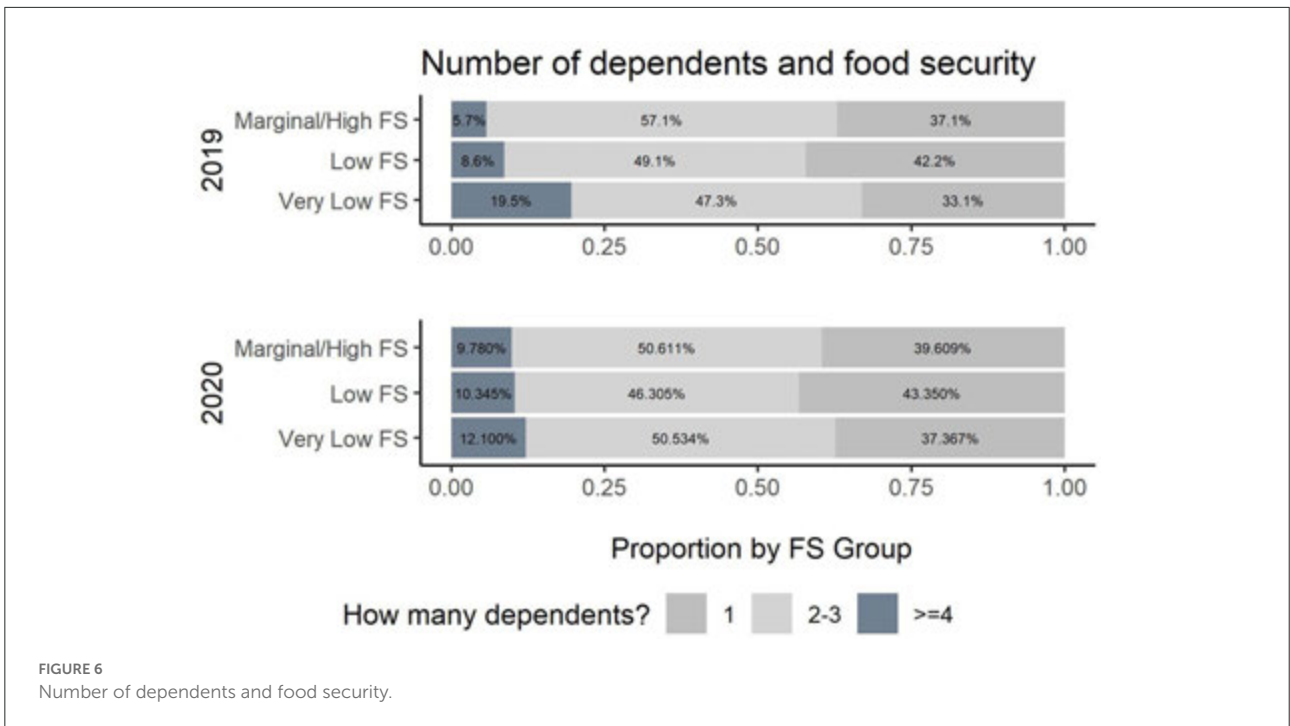
housing and during the pandemic it decreased to 77%. This presents an opportunity for higher education and educational institutions to address this change by providing support services centered on locating affordable housing on and off campus. Considering this evidence, it is recommended that educational institutions be flexible and responsive regarding

needs for affordable and accessible housing, and University leaders may want to target information campaigns to vulnerable student groups.

Overall, the article has some important strengths. Food and housing security is assessed among students at an HSI. Previous studies often have low percentages of Hispanic

FIGURE 8
Ethnicity and housing security.
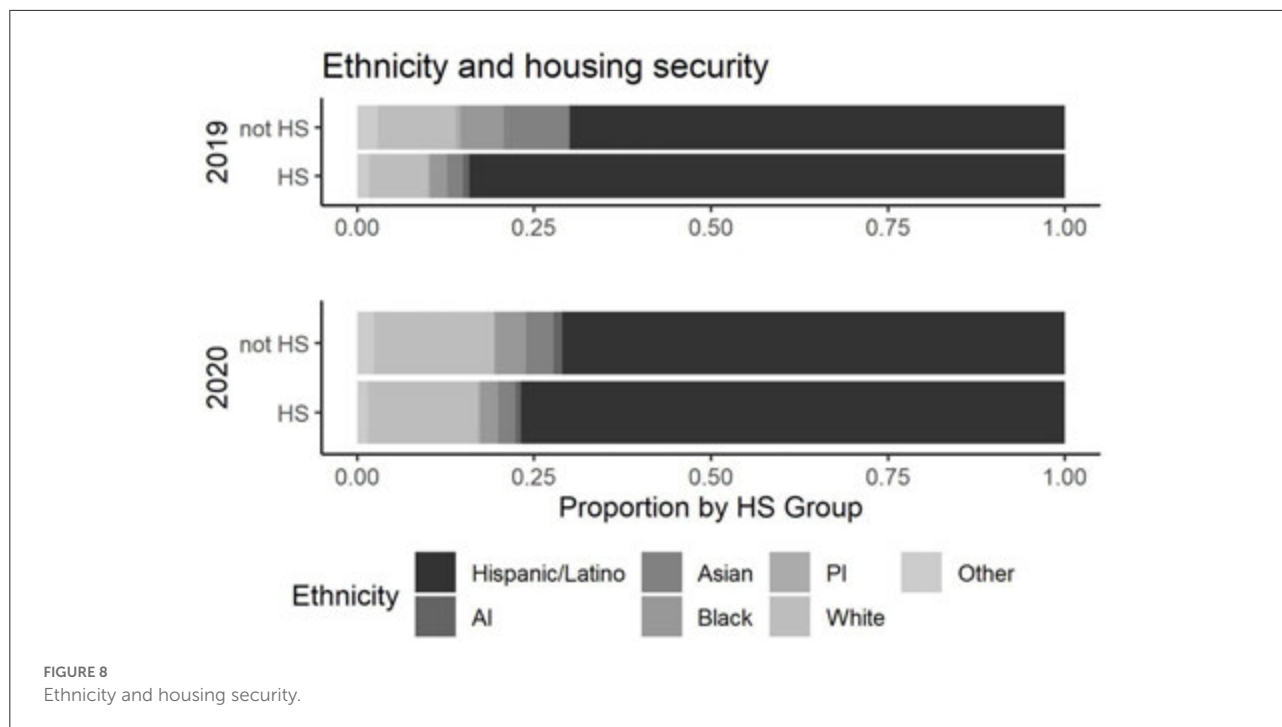
students, so the results fill a key gap in our understanding of food and housing security in higher education. In addition, the article presents food and housing security data both before and during the pandemic. By assessing food and housing security in two different time periods, the article improves our understanding of how food and housing security changed after the start of the pandemic. Furthermore, the study has high survey response rates. The high response rates by students may be due to the use of a trusted online survey platform and convenient email distribution methods.

Recommendations

Along with other forms of social assistance, University interventions can play an important role in addressing basic needs and inequities among HSI higher education students. Given the bio-psycho-social-economic factors and stressors associated with the COVID-19 pandemic, it is imperative to provide students with continued financial, psychological and support services to mitigate the medium- and long-term effects of the pandemic. Government tuition and relief support programs are needed to help students in their education, to provide nutrition and housing to struggling students, and to improve the quality of life of the community.

Tailored interventions are needed (1) to address stigma associated with accessing psychological, counseling, food and housing support services, and (2) to meet student's cultural

and linguistic realities. To assist with student retention and academic success, it is key to reduce barriers, such as chronic hunger and sustained risk of unstable housing. Food distribution centers on campus are key environments to assist students in acquiring enough nutrient-dense food to overcome dietary limitations and reduce health disparities. It is important to orient students on public assistance and other campus and community resources to increase FS and HS, including the existence and eligibility of the Supplemental Nutrition Assistance Program (SNAP); Special Supplemental Nutrition for Women, Infants, and Children (WIC); Medicaid; Children's Health Insurance Program (CHIP); and local food banks and hunger relief centers. In the informational campaigns, a special emphasis should be placed on reaching vulnerable student subgroups, including those who work, are head of household, have children, receive health and human services, and have limited or no transportation. Instructors can provide information on assistance resources in the course syllabus, program/department web pages and social media pages. The establishment and promotion of campus-based programs and services through no-questions-asked food distribution and assistance venues for students is necessary. It also is essential to develop and implement food, housing and financial security tools for higher education students, so that the University can provide programming on campus to promote a secure campus environment with visual appeal, a comprehensive safety net, and culturally and linguistically responsive services (36).

Based on the study results and the reviewed literature, we conclude that it is important to bring access and excellence

TABLE 3 Factors by year and housing security group.

Characteristic	2019			2020		
	Yes, N = 2,331[a]	No, N = 281[a]	p-value[b]	Yes, N = 4,766[a]	No, N = 252[a]	p-value[b]
Enrollment			0.030			0.080
Full-time	1,983 (85%)	252 (90%)		3,977 (83%)	221 (88%)	
Part-time	347 (15%)	28 (10%)		789 (17%)	31 (12%)	
Employed?			0.3			0.6
Full-time	1,432 (61%)	182 (65%)		897 (19%)	44 (17%)	
Part-time	899 (39%)	99 (35%)		1,855 (39%)	106 (42%)	
No				2,014 (42%)	102 (40%)	
Consistently working?			0.6			0.11
On campus	563 (39%)	76 (42%)		447 (16%)	32 (21%)	
Off campus	866 (61%)	106 (58%)		2,305 (84%)	118 (79%)	
Hours per week			0.4			0.9
19 h or more	691 (48%)	82 (45%)		1,236 (45%)	66 (44%)	
Less than 19 h	739 (52%)	100 (55%)		1,516 (55%)	84 (56%)	
Age			0.003			0.014
< 18	4 (0.2%)	1 (0.4%)		28 (0.6%)	1 (0.4%)	
19–24	1,633 (70%)	187 (67%)		3,244 (68%)	189 (75%)	
25–34	438 (19%)	76 (27%)		1,010 (21%)	53 (21%)	
35–44	179 (7.7%)	9 (3.2%)		310 (6.5%)	7 (2.8%)	
45–64	74 (3.2%)	8 (2.8%)		163 (3.4%)	2 (0.8%)	
>65	1 (<0.1%)	0 (0%)		3 (<0.1%)	0 (0%)	
Family income			<0.001			<0.001
< $50,000	1,854 (80%)	261 (94%)		3,373 (71%)	221 (88%)	
>= $50,000	461 (20%)	17 (6.1%)		1,393 (29%)	31 (12%)	
Academic level			0.10			0.3
Freshman	328 (14%)	40 (14%)		642 (13%)	41 (16%)	
Sophomore	339 (15%)	42 (15%)		674 (14%)	39 (15%)	
Junior	596 (26%)	71 (25%)		1,163 (24%)	66 (26%)	
Senior	689 (30%)	66 (23%)		1,527 (32%)	65 (26%)	
Masters	275 (12%)	41 (15%)		517 (11%)	25 (9.9%)	
Doctoral	99 (4.2%)	21 (7.5%)		225 (4.7%)	16 (6.3%)	
Professional	5 (0.2%)	0 (0%)		18 (0.4%)	0 (0%)	
Commute mode			<0.001			<0.001
Missing	79 (3.4%)	16 (5.7%)		284 (6.0%)	11 (4.4%)	
Car (alone)	1,484 (64%)	136 (49%)		3,127 (66%)	150 (60%)	
Carpool	234 (10%)	22 (7.9%)		546 (11%)	25 (9.9%)	
Bus/public	124 (5.3%)	9 (3.2%)		195 (4.1%)	10 (4.0%)	
Bike	237 (10%)	48 (17%)		363 (7.6%)	16 (6.3%)	
Trolley	19 (0.8%)	8 (2.9%)		27 (0.6%)	2 (0.8%)	
Walk	102 (4.4%)	35 (12%)		116 (2.4%)	26 (10%)	
Other	42 (1.8%)	6 (2.1%)		107 (2.2%)	11 (4.4%)	
Reliability of transportation			0.003			<0.001
Not reliable	18 (0.8%)	1 (0.4%)		103 (2.2%)	9 (3.6%)	
Somewhat reliable	185 (8.0%)	33 (12%)		397 (8.3%)	42 (17%)	
Fairly reliable	709 (31%)	106 (38%)		1,563 (33%)	102 (40%)	

(Continued)

TABLE 3 Continued

Characteristic	2019			2020		
	Yes, N = 2,331[a]	No, N = 281[a]	p-value[b]	Yes, N = 4,766[a]	No, N = 252[a]	p-value[b]
Very reliable	1,408 (61%)	141 (50%)		2,703 (57%)	99 (39%)	
Live alone?			<0.001			<0.001
Yes	204 (8.8%)	63 (22%)		361 (7.6%)	61 (24%)	
No	2,126 (91%)	218 (78%)		4,405 (92%)	191 (76%)	
Dependents?			>0.9			>0.9
Yes	417 (20%)	42 (19%)		857 (19%)	36 (19%)	
No	1,708 (80%)	176 (81%)		3,548 (81%)	155 (81%)	
How many?			0.015			0.036
1	147 (35%)	23 (55%)		336 (39%)	19 (53%)	
2–3	218 (52%)	18 (43%)		426 (50%)	17 (47%)	
4 or more	52 (12%)	1 (2.4%)		95 (11%)	0 (0%)	
Head of household			<0.001			<0.001
Yes	501 (22%)	115 (41%)		1,029 (22%)	97 (38%)	
No	1,826 (78%)	166 (59%)		3,737 (78%)	155 (62%)	
Current living situation			<0.001			<0.001
On campus	117 (5.0%)	43 (15%)		113 (2.4%)	18 (7.1%)	
Off campus with family	1,744 (75%)	86 (31%)		3,920 (82%)	116 (46%)	
Off campus no family	444 (19%)	145 (52%)		690 (14%)	114 (45%)	
Other	21 (0.9%)	7 (2.5%)		43 (0.9%)	4 (1.6%)	
Know of student homelessness			0.6			0.011
Yes	626 (27%)	80 (29%)		894 (19%)	64 (25%)	
No	1,704 (73%)	200 (71%)		3,872 (81%)	188 (75%)	
USDA rating			<0.001			<0.001
Very low FS	698 (30%)	150 (53%)		1,065 (22%)	109 (43%)	
Low FS	555 (24%)	61 (22%)		1,047 (22%)	60 (24%)	
High or marginal FS	1,078 (46%)	70 (25%)		2,654 (56%)	83 (33%)	
(Missing)	0 (0%)	0 (0%)		0 (0%)	0 (0%)	
Ethnicity			<0.001			0.13
Hispanic/Latino	1,960 (84%)	196 (70%)		3,664 (77%)	179 (71%)	
AI	19 (0.8%)	0 (0%)		35 (0.7%)	3 (1.2%)	
Asian	54 (2.3%)	26 (9.3%)		118 (2.5%)	10 (4.0%)	
Black	56 (2.4%)	17 (6.1%)		120 (2.5%)	11 (4.4%)	
PI	5 (0.2%)	2 (0.7%)		17 (0.4%)	0 (0%)	
White	195 (8.4%)	31 (11%)		740 (16%)	43 (17%)	
Other	39 (1.7%)	8 (2.9%)		72 (1.5%)	6 (2.4%)	
Gender (pronouns)			0.011			0.090
He/Him	682 (29%)	97 (35%)		1,412 (30%)	73 (29%)	
She/Her	1,617 (69%)	177 (63%)		3,210 (67%)	166 (66%)	
They/Them	9 (0.4%)	5 (1.8%)		66 (1.4%)	4 (1.6%)	
Other	22 (0.9%)	2 (0.7%)		25 (0.5%)	5 (2.0%)	
Prefer no answer				53 (1.1%)	4 (1.6%)	
College			0.022			0.023
Business administration	250 (11%)	26 (9.3%)		527 (11%)	32 (13%)	
Education	179 (7.7%)	16 (5.7%)		457 (9.6%)	10 (4.0%)	
Engineering	366 (16%)	58 (21%)		784 (16%)	31 (12%)	

(Continued)

TABLE 3 Continued

Characteristic	2019			2020		
	Yes, $N = 2,331^a$	No, $N = 281^a$	p-value[b]	Yes, $N = 4,766^a$	No, $N = 252^a$	p-value[b]
Health sciences	332 (14%)	32 (11%)		536 (11%)	32 (13%)	
Liberal arts	607 (26%)	88 (31%)		1,188 (25%)	70 (28%)	
Science	418 (18%)	52 (19%)		776 (16%)	52 (21%)	
Nursing	143 (6.1%)	7 (2.5%)		403 (8.5%)	20 (7.9%)	
Pharmacy	14 (0.6%)	0 (0%)		38 (0.8%)	3 (1.2%)	
Other	22 (0.9%)	2 (0.7%)		57 (1.2%)	2 (0.8%)	

[a]n (%).
[b]Fisher's exact test for count data; Fisher's exact test for count data with simulated p-value (Based on 2,000 replicates).

TABLE 4 University model to address food and housing insecurity.

Pre-COVID pandemic food and housing support services	Changes to the food and housing support services influenced by COVID
University Food Pantry established in 2014, operated first out of a modest closet, and expanded in 2018 to an office inside a gymnasium facility and across from student dormitories with convenient parking to support students. Efforts centered on providing emergency food assistance *via* pantry and emergency support for foster students and students experiencing homelessness. Food pantry referred students to the local food bank, pantries and health and human service organizations. Pantry offerings consisted of packaged grains, cereals, fruit, tuna, chicken, and toiletries (32, 33).	The magnitude of FI and HI among students in 2019 and 2020, along with the associations across years, were influenced by the efforts of the University. University shifted to provide a range of financial assistance and support services. Pantry was one of the few sites that remained operational due to the essential service it provided. Campus pantry adapted its model to seek donations through social media and a digital platform, where donors could browse, purchase and send non-perishable items delivered directly to campus. Additional investments in the pantry by the University to help meet growing student needs and expanded its efforts by providing grocery store gift cards and donating additional holiday gift baskets to ensure that students had sufficient food during long holidays (32).
In addition, the Foster, Homeless, and Adopted Resources (FHAR) Program provided financial and other support services for students with severe housing insecurity (33).	University used federal COVID Relief funds to provide housing grants for on-campus housing expenses. Opened dormitories for emergency housing and offered support services to connect students to more permanent housing off campus. Increased investments in the FHAR Program (33). Introduced diverse emergency financial assistance to serve as safety net to pay for food and rent. Raised private contributions to create emergency aid fund. Over $71 million of federal funds were for tuition grants. Short-term emergency loans to assist with basic needs (34, 35). Increased awareness of resources available and encouraged use. Faculty shared resources with students in class, syllabus, and encouraged them to utilize resources. Counseling and psychological services expanded services and shifted to a combination of in-person and telehealth services (36).

to pantry models of emergency food assistance. For this reason, we propose a new model, where the academy works across disciplines and implements policies to increase access, mitigate stigma, ensure nutritional education and launch integrated eligibility for public assistance and other valuable support services for students. These

innovations will provide students with needed protections from food and housing insecurity, advance discovery of public value, and positively impact the education, economy, health, and culture of the community. A proposed model to improve food and housing security on campus is found in Table 5.

TABLE 5 Call to action.

Ensure that nutritious food options are activated and utilized	Generate a meal-sharing program, in which students, faculty or staff can donate food credits or swipes.
	Pantries with perishable, frozen and non-perishable items of high nutritional value, with online and pick up options.
	Open an integrated eligibility office to enroll in SNAP and other public benefits.
	Offer nutrition and health promotion education through professionals to orient on nutrients and meal preparation.
	Collaborate up with campus food services, food banks, and community-based organizations to bring hot meal kitchen services to campus.
Inform of external food distribution centers and housing assistance sites	Generate and disseminate directories of housing, food, transportation, health and human services online and hard copies.
	Identify and participate in health fairs and community events to promote food and housing security. Post event announcements on the online and bulletin boards, campus venues and student health centers.
Reduce stigma surrounding use support services	Ensure that course syllabus includes resource links to food, housing, transportation and other support services and encourage faculty to promote access.
	Offer regular tours to faculty, staff and student advisors of the university food pantry and Foster Homeless and Adopted Resources and promote access.
	Motivate faculty, staff and students to visit the support services on campus to demystify and mitigate stigma.
	Secure grants, financial or in-kind support from private and public donors and funders to increase the food bank's nutritious options and make campus food services affordable to students.
	Rename campus food pantry based on student input to make to more inclusive.
	Conduct ongoing food and housing security assessments to inform campus leadership on way to address social and political determinants.
Create opportunities for community-engaged scholarship	Engage faculty, staff and students in the development and implementation of a food and housing security strategy.
	Designate student ambassadors or advisors in Campus Colleges and Schools to promote food, housing and transportation security.
Institutionalize support services	Generate policies to secure and expand nutritional food services and improve access to affordable housing, transportation, and health services.
	Develop a food, housing and financial security toolkit to guide programming on campus.
	Ensure adequate space, equipment, and personnel for food storage and distribution.
	Include the food pantry and student support services in university interactive maps and expand h of operation evenings and weekends to meet the needs of working students.

Study limitations

The study contains some key limitations. The cross-sectional study design limits our ability to make causal inferences regarding key factors and food and housing security. Also, the self-reported instrument relies primarily on subjective responses from students, which may be biased. Furthermore, food- and housing-insecure students may be less likely to respond to a survey, which will overestimate food and housing security levels. Despite these limitations, the findings from this study have several important implications for research, practice and policy.

Conclusion

The current study contributes to the literature on food and housing security in higher education by focusing on college students—both before and during a pandemic—at an HSI. Higher education plays an important role in the generation of social capital, mobility, and health. To ensure that university students thrive academically, succeed socially and ultimately graduate, it is necessary to ensure that education institutions secure food and housing assistance for marginalized and vulnerable populations.

Designing programs and policies with input from students is essential if we want to increase the utilization of assistance and prevent hunger and homelessness. Being responsive to changes in food or housing security also is crucial and requires concerted work to achieve. Multidisciplinary and collaborative work is required to mitigate food insecurity on campus, advance health and academic outcomes, improve the on-campus food and housing environments, and provide subsidized food options to facilitate equitable access to food. These efforts require guidance from health professionals, including nutritionists to assist students with meal preparation and budgeting skills. Ensuring equitable access to healthy food and affordable housing on campus is essential. Future research can evaluate the use and effectiveness of campus resources in improving food and housing security of university students.

The challenges of the pandemic create an opportunity for universities to strengthen food and housing security among students. Economic and health crises do not guarantee increased levels of basic needs insecurity. Instead, higher education institutions can shift to a new, more comprehensive model of food and housing assistance. The model shift will improve student basic needs security and academic outcomes, increase opportunities for higher education and upward social mobility, and create stronger and more successful communities.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Ethics statement

The studies involving human participants were reviewed and approved by University of Texas at El Paso (IRB number 1470143). The patients/participants provided their written informed consent to participate in this study.

Author contributions

Conceptualization, writing—review and editing, and writing—original draft preparation: EM, AW, GS, and SC-B. Methodology: EM, AW, and GS. Analysis: AW. Investigation: EM, GS, and JA. Visualization: AW and PD. Project administration: EM and JA. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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COVID-19 testing, infection, and vaccination among deported Mexican migrants: Results from a survey on the Mexico-U.S. border

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Background: Migrants detained and held in immigration and other detention settings in the U.S. have faced increased risk of COVID-19 infection, but data on this population is scarce. This study sought to estimate rates of COVID-19 testing, infection, care seeking, and vaccination among Mexican migrants detained by U.S. immigration authorities and forcibly returned to Mexico.

Methods: We conducted a cross-sectional probability survey of Mexican migrants deported from the U.S. to three Mexican border cities: Tijuana, Ciudad Juárez, and Matamoros ($N = 306$). Deported migrants were recruited at Mexican migration facilities after being processed and cleared for departure. A two-stage sampling strategy was used. Within each city, a selection of days and shifts were selected during the operating hours of these deportation facilities. The probability of selection was proportional to the volume of migrants deported on each day of the month and during each time period. During the selected survey shifts, migrants were consecutively approached, screened for eligibility, and invited to participate in the survey. Survey measures included self-reported history of COVID-19 testing, infection, care seeking, vaccination, intentions to vaccinate, and other prevention and risk factors. Weighted data were used to estimate population-level prevalence rates. Bivariate tests and adjusted logistic regression models were estimated to identify associations between these COVID-19 outcomes and demographic, migration, and contextual factors.

Results: About 84.1% of migrants were tested for COVID-19, close to a third were estimated to have been infected, and, among them, 63% had sought care for COVID-19. An estimated 70.1% had been vaccinated against COVID-19 and, among those not yet vaccinated, 32.5% intended to get vaccinated. Close to half (44.3%) of respondents had experienced crowdedness while in detention in the U.S. Socio-demographic (e.g. age, education, English fluency) and migration-related (e.g. type of detention facility and time in detention)

variables were significantly associated with COVID-19 testing, infection, care seeking, and vaccination history. Age, English fluency, and length of detention were positively associated with testing and vaccination history, whereas detention in an immigration center and length of time living in the U.S. were negatively related to testing, infection, and vaccination history. Survey city and survey quarter also showed adjusted associations with testing, infection, and vaccination history, reflecting potential variations in access to services across geographic regions and over time as the pandemic unfolded.

Conclusion: These findings are evidence of increased risk of COVID-19 infection, insufficient access to testing and treatment, and missed opportunities for vaccination among Mexican migrants detained in and deported from the U.S. Deportee receiving stations can be leveraged to reduce disparities in testing and vaccination for deported migrants. In addition, decarceration of migrants and other measures informed by public health principles must be implemented to reduce COVID-19 risk and increase access to prevention, diagnostic, and treatment services among this underserved population.

Introduction

According to the 2021 Census, 18% of the United States (U.S.) population is Latino/Hispanic, and one of every three Latinos is foreign-born (1). Migration status constitutes a social determinant of health (2, 3) because of its relation to stigma, language (4), lower social and economic status, cultural barriers (5, 6), and legal status. Among Latino immigrants, two in three are not U.S. citizens and around eight million are unauthorized immigrants (7). Furthermore, 64% are not proficient in English (8). Data from around the world has shown a disproportionate impact of the COVID-19 pandemic on migrants (9). In the U.S., while availability of disaggregated data by nativity has been limited (10), there is mounting evidence that foreign-born Latinos have borne a heavy burden of the COVID-19 pandemic and have experienced significant barriers to testing and treatment (2, 10, 11).

For Latino immigrants, increased COVID-19 risk is related to social and structural determinants of health (12–15). These include occupational profile (2, 10), such as inability to work remotely, lack of sustainable and safe working conditions (10, 16), overrepresentation in "essential" frontline jobs (2, 10, 17), lack of paid leave if they get sick, (16) lack of flexible working hours, lack of leisure time (12), lack of health insurance or healthcare through work, (10, 18) and/or ability to miss work (19). Other risk factors are limited healthcare access and insurance rates (20, 21), overcrowding, (11, 22, 23) immigration enforcement (3, 10, 11, 24–26), and lack of legal protections (27).

Latino immigrants in essential occupations had the highest risk of excess death during the pandemic among the working-age group (10, 17).

A central mechanism of both increased exposure to COVID-19 and COVID-19 infection among Latino immigrants is the U.S.' persecution, detention, and deportation system, which is reinforced by anti-immigration policies, institutional rhetoric and racial profiling. Between 2015 and 2018, migrant detentions and deportations increased by over 30 and 13%, respectively (24). Males from Mexico, Guatemala, El Salvador and Honduras account for 84–89% of Immigration and Customs Enforcement's (ICE) detentions (24) and 90–94% of deportations. Mexicans, in particular, account for the highest proportion of yearly deportations. The Trump administration used the pandemic as an excuse to infringe further upon the rights of immigrants in the U.S. (28) and enforce indiscriminate detention and deportation policies. (29, 30) Throughout the pandemic, ICE has deported detainees who have tested positive for COVID-19 in detention centers in hotspot states like Texas, Arizona, California, and Florida to Mexico, Honduras, Guatemala, and El Salvador (2). According to Reuters, through December 2021, Guatemalan migrants alone were deported on at least 184 flights (31). There is also some evidence that U.S. deportation policies have resulted in the spread of COVID-19 among migrant sending countries including Mexico, Central America, and Haiti (32).

Detention and deportation centers pose significant risk of exposure and transmission of COVID-19 for migrants

because they are forced to be in close proximity to others, they are confined to enclosed spaces and they have limited access to testing (33). Evidence drawing from ICE detention center data found that, during the pandemic, between 70 and 90% of all detainees had a risk of becoming infected due to the conditions in which they were held (34). ICE has publicly confirmed that testing and releases based on pre-existing health conditions have been rare. (33) Despite these alarming data, there has been insufficient research on COVID-19 risk, infection rates, and access to vaccination among foreign-born Latinos in the U.S., including those in detention or deported to their countries of origin. Evidence that suggests that COVID-19 has disproportionately impacted migrant, ethnic, and racial minorities in the U.S. has rarely been disaggregated by nativity and has seldom explored the association between sociodemographic, migration, and other contextual characteristics and COVID-19 related outcomes. There is a lack of data available for undocumented foreign-born Latinos because they are hardly included in research or public health surveillance and, when they are included, their legal status is not known (25, 35).

This study addresses this research gap by examining COVID-19 testing, infection, treatment and vaccination rates among Mexican migrants deported from the U.S. Using data from Project Migrante, we estimate COVID-19 testing, infection, treatment, and vaccination rates among Mexican immigrants deported from the U.S. We also explore demographic, migration, and contextual factors associated with differential rates of infection and access to services among this vulnerable population.

Materials and methods

Study design

This study uses data from Project Migrante, an observatory on migrant health on the Mexico – U.S. border. Since 2009, Migrante has conducted a series of cross-sectional health surveys of Mexican migrant flows traveling through this region. The surveys for this study were administered in the Mexican border cities of Tijuana, Matamoros, and Ciudad Juárez. These cities were selected because their locations in the Western, Central, and Eastern regions of the Mexico-U.S. border and transportation infrastructure uniquely position them to receive flows from and to a variety of sending and receiving regions in the U.S., Mexico, and other Latin American countries. Moreover, they receive the flows of Central American 'returnee' migrants that are either sent back to Mexico to wait for review of their refugee applications under Title 42 or are simply expelled from the United States.

Migrante relies on a two-stage sampling design with two dimensions (time and space) to sample Mexican migrants from

three different migration flows: Southbound migrants traveling from the Mexican border to other areas of Mexico after a stay in the U.S. or the Mexican border region; Northbound migrants arriving at the Mexican border as their final destination or in transit to the U.S.; and migrants deported by U.S. migration authorities and released at the Mexican border by the National Migration Institute of Mexico (INM, per its acronym in Spanish). The sample for this study comes from a Migrante survey that sampled migrants from the deported migrant flow between August 2020 and July 2021. Data was collected in Tijuana from August 26th, 2020 through June 28th, 2021, in Matamoros from November 6th, 2020 to July 30th, 2021, and in Ciudad Juárez from February 9th, 2021 to April 27th, 2021. For the sampling of deported migrants, we used a two-stage probability sampling strategy to estimate the characteristics of the individuals returned to Mexico through the study repatriation points. A sampling frame was elaborated considering two axes: time and space. The time axis was defined as the number of calendar days in the month that can be 28, 30 and 31, or even less because there are days in which there was no flow (i.e., US Holidays); in addition, each day was divided into shifts, according to the particular dynamics of the deportation station of each city. The second axis -space- was defined based on the location of Mexican immigration authorities' offices where migrants are repatriated by their US counterparts. Project Migrante selected Tijuana, Ciudad Juárez and Matamoros, as these cities account for a significant proportion of the repatriations of Mexican migrants (between January and April 2022, these three cities concentrated 47% of total repatriations, according to data from the Mexican Migration Institute). The combination of all possible sampling places and times represents the entire sampling frame from which specific sampling shifts were selected. The first stage of the sampling process consisted of determining the time and place of the survey shifts for the next observation period (i.e., usually the next month). The number of survey shifts for each month was selected a priori based on budgetary considerations as well as knowledge about the behavior of the flow. The next step was to assign the number of sampling shifts to each of the strata (i.e., days and shifts) in which it was known that there would be repatriations of Mexican migrants during the next sampling period. The assignment was conducted according to the weight represented by each shift within the day.

The second stage of sampling pertained to the selection of the specific units of observation (i.e. migrants) during the selected survey shifts. For the deported flow, the survey was conducted in the hallways through which deportees exit the deportation stations of each of the study cities. As they were cleared for departure by Mexican migration authorities, migrants were consecutively approached by trained Mexican research assistants and screened for eligibility to determine if they belonged into the target population. Eligibility criteria included being an adult age 18 or older, being fluent in Spanish,

and having just been deported from the U.S. and processed by Mexican migration authorities at the sampling point. By design, all migrants deported through these stations were Mexican nationals. Persons who were unable to answer questions due to mental or physical limitations were also excluded from the study. Eligible individuals were invited to provide informed consent to participate in the survey. Consenting individuals completed a questionnaire designed to characterize their health and access to health services. No names or identifying information were collected from survey participants (36).

Study measures

Migrante surveys consist of an interviewer-administered questionnaire and several biometric tests. The questionnaire collects information on demographics, socio-ecological health determinants, and a detailed migration and deportation history. There are also questions on health outcomes and healthcare access related to the different focus areas of each survey wave (e.g. HIV and other sexually transmitted infections, non-communicable chronic disease, etc.). Biometric rapid tests are used to screen for infectious diseases (e.g., HIV, syphilis, etc.), risk factors for cardiovascular disease (e.g., blood glucose, cholesterol levels, etc.), or stress levels (i.e., cortisol), depending on the survey wave.

Starting in August of 2020, questions about COVID-19 were added to the Migrante questionnaires.

COVID-19 questions queried about having ever been tested for COVID-19 (yes/no), having tested positive for COVID-19, having been told by a doctor or other health care provider they had COVID-19, or believing they had been infected with COVID-19. A positive response to any of these last three questions was used as an indication of COVID-19 infection history. Those with a positive test, doctor diagnosis, or a belief they had been infected with COVID were further asked whether they had sought treatment for COVID-19 (yes/no). Additional questions queried about COVID-19 vaccination history (yes/no), intentions to get vaccinated in the future among those not yet vaccinated (yes/no/don't know), reasons for not intending to get vaccinated among those unsure or not planning to get vaccinated (e.g. fear of side effects, not knowing where to obtain a vaccine, not believing in vaccines, etc.). A final set of questions asked about other preventive and risk behaviors, including mask wearing, hand washing, staying home, ability to work from home, and exposure to crowded conditions while in detention in the U.S. (yes/no). Questions regarding country where testing, infection, treatment, and vaccination took place were also included in this study.

Socio-demographic measures included age (in years), gender, indigenous ethnic identity (whether the respondent self-identified as member of an indigenous Mexican population), marital status (recoded as married/living with a partner vs.

other), and education level (recoded as less than high school vs. high school or higher level). English fluency level was assessed with a four-point Likert-scale from Not speaking English at all to Speaking English Very Well.

Migration measures included previous history of migration to the U.S. (yes/no), last country of residence (the U.S., Mexico, other), length of residence in the U.S. (in years), previous history of deportation (yes/no), time spent in detention in the U.S. (in days), type of detention facility where participants were held in the U.S. (recoded as immigration detention center versus other type of detention facility), and most recent immigration status in the U.S. (recoded as unauthorized vs. other).

Contextual variables included city in which the respondent was recruited (Tijuana, Ciudad Juárez, or Matamoros) and quarter during which they completed the survey. Because migrants detained in different regions may have been held in different detention facilities and deported through different border cities, the recruitment city was thought of as potential proxy for geographic variations in COVID-19 risk and access to testing and vaccination. Infection rates and availability of testing and vaccination varied throughout the pandemic. Survey quarter was used to capture these potential time variations.

Statistical analyses

Survey weights (i.e. expansion factors) were computed for each observation to obtain parameter estimates for the deported migrant flow. Our weighting procedures were modeled after those used in previous Migrante Project phases (36). The formula for the calculation of the expansion factors relied on the notion that the final survey shifts were selected from the universe of strata defined from the combination of the components of the temporal and spatial axes. Each of the components of these axes has a probability of selection based on the sampling frame. In the case of the temporal axis, there was the number of days of the month in which it was known that there would be a flow of repatriated migrants, as well as the weight represented by each of the shifts in which a day was divided. In the case of the spatial axis, there was only one repatriation point per city (which are independent) and within these cities there was only one exit door, so the weight of each city was equal to one. In addition, we knew the specific size of the flow of repatriated migrants through the study cities during the survey period, since the immigration authorities keep a record of that number. Thus, the expansion factor for each stratum was calculated from:

$$W_{jk} = \frac{\frac{P_{ij}}{S_{jk}} * D_k}{Q_{jk}}$$

where

W_{jk} is the statistical weight to estimate the total number of migrants in the jth stratum of the kth month

P_{ij} is the number of migrants repatriated during S_k of the jth stratum (this information is obtained from Mexican migration authorities)

S_{jk} is the number of days assigned to the jth stratum and worked during the kth month

D_k is the number of days available to select during the kth month

Q_{jk} is the number of migrants with a complete questionnaire in the jth stratum during the kth month

After weighting the data with the expansion factors obtained from the formula above, we estimated descriptive statistics of socio-demographic characteristics, migration history, and contextual variables. Descriptive statistics were also run to estimate prevalence of COVID-19 testing, infection history, treatment, vaccination and other preventive and risk factors.

Using unweighted data, we also examined bivariate associations between COVID-19 outcomes and socio-demographics, migration, and contextual variables. In addition, we estimated adjusted logistic regression models to examine independent associations between each demographic, migration, and contextual variable, on the one hand, and COVID-19 testing, infection, care, and vaccination status, on the other, adjusted for age, gender, education, ethnicity, and marital status.

Results

Population characteristics

The target sample size was 300 deported migrants, 100 from each study site. Sample size and statistical power calculations were based on sexual and reproductive health outcomes (e.g., multiple sex partners, lifetime sexually transmitted infections), which represented the main focus of the survey when it was designed, prior to the pandemic. The final survey sample included 306 deported migrants (response rate =76%), including 127 from Tijuana, 155 from Matamoros, and 24 from Ciudad Juarez. Changes in both the volume of migrants deported through Ciudad Juarez and in the times during which the deportation station in this city was operating made it impossible for our team to achieve the desired sample size of 100. As a result, we oversampled participants in Tijuana and Matamoros to reach our target sample size of 300. Among the final sample, 34 participants identified as females and 272 as males. A comparison of participants who completed the survey vs. eligible individuals who did not complete the survey indicated that the two groups did not differ significantly in terms of their gender, marital status, education, race/ethnicity, or country of residence. However, survey respondents were slightly

younger (average age was 38.3 vs. 39.7 years, Odds Ratio [OR] = 0.97, $p = 0.006$), less likely to be deported through Tijuana (OR = 0.46, $p = 0.001$) or Ciudad Juarez (OR = 0.24, $p = 0.001$), and more likely to be deported through Matamoros (OR = 7.01, $p = 0.001$), compared to non-respondents.

Based on the calculated expansion factors and the information supplied by the Mexican Migration Institute, survey participants (N = 306) represented a total weighted population of 14,841 Mexican migrants deported through Tijuana, Ciudad Juarez, and Matamoros during the survey period. The weighted distribution by city was as follows: 73.9% deported through Tijuana, 22.4% through Matamoros, and 3.7% through Ciudad Juárez (Table 1). Weighted descriptive analyses indicated that deported migrants were 38-years-old on average (standard deviation [SD] = 10.5). Most (92%) were male. Less than a quarter (22.2%) had completed high school. Approximately 5.4% identified as members of an indigenous community. In terms of migration history, 92.1% had a history of migration to the U.S. and 85.8% reported the U.S. was their most recent country of residence. Average time living in the U.S. was 17.3 years (SD = 12.0) and, within the last 12 months, the average deported migrant had spent 9.7 months in the U.S. (SD = 4.5). More than half of the migrants had a previous history of deportation (57.2%), and the majority (87.4%) had an unauthorized immigration status in the U.S. Even so, the majority was employed (63% full time and 16.8% part time) or self-employed (5.9%).

COVID-19 testing

Most deported migrants (84.1%) had been tested for COVID-19 at least once since the start of the pandemic, with the majority of them reporting testing in the U.S. (94.3%; Table 2). For those tested in the U.S., 79.1% were tested in an immigration detention center or prison; 16.9% were tested outside in the community by a healthcare provider; 2.1% in urgent care; 1.0% in a hospital or emergency room; and 0.9% in a local health department testing site. In contrast, those tested in Mexico were tested mostly at a health center or hospital (93.1%) and 45.7% were tested in other settings. Testing locations were not mutually exclusive.

Results from bivariate analyses indicated that testing varied significantly by marital status, self-reported indigenous identity, and level of English fluency. In general, testing was more likely to be reported by non-married migrants (Chi square = 16.74, $p < 0.001$), migrants who did not identify as members of an indigenous group (Chi square =4.79, $p = 0.029$), and those with higher levels of English fluency (Linear-by-Linear Association =6.394, $p = 0.011$). Based on migration history, migrants with a history of U.S. migration (Chi square =24.89, $p < 0.001$), those whose residence was in the U.S. (Chi square =76.5, $p < 0.001$), and migrants who had never before been deported (Chi square

TABLE 1 Descriptive statistics of selected socio-demographics characteristics and migration history for migrants deported from the U.S. to Tijuana, Matamoros and Ciudad Juárez, Mexico, between August 2020 and July 2021 (weighted population=14,841).

	%	Mean	SD
Socio-demographics			
Age (years)		38.3	10.5
Gender (male)	91.9		
Education level (high school or more)	22.2		
Marital status (married or living with a partner)	36.7		
Ethnic or racial minority[1]	5.4		
English fluency			
Not at all	11.9		
Not very well	42.1		
Well	22.4		
Very well	23.6		
Migration history			
Previous history of migration to U.S.	92.1		
Most recent country of residence is the U.S.	85.8		
Lifetime length of residence in the U.S. (years)[2]		17.3	12.0
History of deportation (1+ times before the most recent event)	57.2		
Unauthorized immigration status in the U.S.[3]	87.4		
Length of detention in the U.S. (months)		17.2	40.0
Survey context			
Survey location			
Tijuana	73.9		
Matamoros	22.4		
Ciudad Juárez	3.7		
Survey quarter			
First quarter (Aug '20 - Oct '20)	17.2		
Second quarter (Nov '20 - Jan '21)	20.7		
Third quarter (Feb '21 - Apr '21)	7.2		
Fourth quarter (May '21 - Jul '21)	54.9		

[1]Combined variable for anyone who described themselves as indigenous and/or of African descent.
[2]Only asked to participants who reported U.S. migration experience.
[3]Only asked to people who were in the U.S. for at least 30 days in last 12 months and were not detained for the entirety of their time in the U.S.

=5.93, $p = 0.015$) were more likely to report testing experience. In general, testing rates and time in the U.S. showed a U-shape association (Chi square = 37.6, $p < 0.001$), with higher rates among new migrants (0–2 years in the U.S.) and those who had been in the U.S. for 21 years or more. Testing rates were lower for migrants detained in immigration facilities (Chi square =33.69, $p < 0.001$) and, in general, increased by length of time in detention (Linear-by-linear association = 69.2, $p < 0.001$).

Bivariate analyses showed that testing rates also varied significantly by survey site, with the highest testing rates estimated for migrants deported through Ciudad Juárez (Chi square = 23.33, $p < 0.001$), and increasing by quarter (Linear-by-linear association =22.67, $p < 0.001$) (Table 3).

TABLE 2 Descriptive statistics of prevalence of COVID-19 testing, diagnosis, infection, treatment, and vaccination among migrants deported from the U.S. to Tijuana, Matamoros and Ciudad Juárez, Mexico, between August 2020 and July 2021 (weighted population=14,841).

	%
COVID-19 lifetime testing	
Ever tested for COVID-19	84.1
Testing location (among those tested)[1]	
U.S.	94.3
Mexico	5.2
Other country	0.2
COVID-19 lifetime prevalence[1]	
Ever had a positive COVID-19 test result	12.1
Ever diagnosed with COVID-19 by a health care professional	5.5
Think they have ever had COVID-19	16.2
Overall COVID lifetime prevalence[2]	30.4
COVID-19 diagnosis and care	
Diagnosis location[1]	
U.S.	94.3
Mexico	5.7
Care sought for COVID-19 care (among those who had COVID-19)	63.0
Care location[1]	
U.S.	98.7
Mexico	7.3
Type of location - U.S.[1]	
Immigration detention center or prison	79.1
Primary care or doctor's office	16.9
Urgent care facility	2.1
Hospital or emergency room	1.0
Local health department	0.9
Type of location – Mexico[1]	
SSA Health center or hospital	93.1
Other	45.7
COVID-19 vaccination[3]	
Vaccinated (at least one dose)	70.1
Vaccination location (among those vaccinated)[1]	
U.S.	99.9
Mexico	0.2
Intends to get vaccinated (among those not vaccinated)	
Yes	32.5
No	41.0
Don't know	26.5
Reasons for vaccine hesitancy[3,4]	
Concern about side effects	74.0
Don't know where to get vaccinated	13.0
Don't believe in vaccines	4.8
Concern about data collected at vaccine sites	2.0

(Continued)

	%
Mistrust of doctors	0.6
Other	2.4
Don't know/refuse to answer	3.2
Prevalence of other preventive and risk factors[1,3]	
Mask wearing (last 7 days)	98.1
Frequent hand washing or sanitizing (last 7 days)	96.3
Staying home most of the time (last 7 days)	62.6
Ability to work from home (last 7 days)	0.4
Experienced crowdedness while in detention in the U.S.	44.3

[1] Answers are not mutually exclusive.
[2] Combining positive result, diagnosis by a healthcare provider, and/or think they have had COVID-19.
[3] Weighted population for questions about vaccination is 9,285 because they were not added to the survey until January 29th, 2020.
[4] Asked to participants who said they would not get vaccinated or they didn't know if they would get vaccinated.

These variations by study site and survey quarter may reflect geographic and time variations in availability of testing services.

After adjusting for gender, age, ethnic identity, education, and marital status, most variables remained significantly associated with testing history, including age (i.e., being older than 45 vs. 18–29), marital status, English fluency, having a history of migration to the U.S., having a residence in the U.S., length of residence in the U.S., time in detention, type of facility where migrants were detained, survey city, and survey quarter (Table 4).

COVID-19 infection

An estimated 12.1% of migrants who had ever tested for COVID-19 had a positive result, which indicated COVID-19 infection. In addition, regardless of testing history, 16.2% thought they had been infected with COVID-19 and 5.5% had a doctor diagnosis. Combining these three different indicators, we estimated that 30.4% of deported migrants had a history of COVID-19 infection (Table 2). Among migrants diagnosed with COVID-19, 94.3% were diagnosed in the U.S. and 5.7% in Mexico. Based on bivariate analyses, rates of COVID-19 infection history (i.e. based on a positive test result, a doctor diagnosis, and/or their belief that they had had COVID-19) varied by demographic, migration, and survey variables. In general, infection rates were higher for migrants who had graduated from high school (Chi square $=4.12$, $p = 0.042$), migrants with higher levels of English fluency (Linear-by-linear association $=4.85$, $p = 0.028$), migrants with shorter lengths of residence in the U.S. (0–2 years in the U.S., Likelihood Ratio $=8.33$, $p = 0.04$), migrants with longer periods spent in detention (Linear-by-linear association $=7.04$, $p = 0.008$),

migrants detained in facilities other than immigration centers (Chi square $=6.94$, $p = 0.008$), and authorized migrants (Chi square $=25.6$, $p < 0.001$). Infection rates also varied significantly by survey location (Likelihood Ratio $=25.6$, $p < 0.001$) and increased over the course of the survey (Linear-by-linear association $=4.91$, $p = 0.027$; Table 3).

After adjustment for age, gender, ethnic identity, marital status, and education, the variables that remained significantly associated with infection history in regression models were level of education, time living in the U.S., time spent in detention, type of detention facility, unauthorized status, survey city, and survey quarter (Table 4).

COVID-19 care seeking

An estimated 27.0% of all deported migrants had sought care for COVID-19 at some point; this percent increased to 63.0% when restricted to those who had tested positive, been told by a doctor, and/or believed they had had COVID-19. Among migrants who sought care for COVID-19, 98.7% did so in the U.S. and 7.3% did so in Mexico. In the U.S., migrants sought care most frequently in immigration or other detention centers (79.1%), followed by doctors' offices (16.9%). About 2.1% sought care in an urgent care center and 1% in a hospital or emergency room. In Mexico, migrants sought care most frequently at a health center or hospital (93.1%). Country and location of care were not mutually exclusive, and some migrants sought care in more than one country and/or location within the country (Table 2).

Bivariate analyses showed only age was significantly associated with COVID-19 care-seeking (Likelihood Ratio $=12.56$, $p = 0.006$). Care-seeking rates increased by age group until age 45 and were lowest for migrants over 45 years old. In addition, we found marginally significant associations between care-seeking and time in detention (Linear-by-linear Association $=3.04$, $p = 0.081$), suggesting care-seeking increased as time detained increased. We also found marginally significant associations between care-seeking and survey quarter (Likelihood Ratio $=7.18$, $p = 0.066$), with the highest levels of care-seeking being observed for February through April 2021 and the lowest for November 2020 through January 2021 (Table 3).

Given the small size of the subsample with a history of COVID-19, we were not able to run adjusted regression models to identify factors independently associated with having sought care for COVID-19.

COVID-19 vaccination

Vaccine questions were added to the survey in late January 2021. Overall, 70.1% of migrants had received at least one dose of vaccine against COVID-19. Among them, 99.9% reported

TABLE 3 Bivariate associations between COVID-19 outcomes and demographic, migration, and contextual variables among migrants deported from the U.S. to Tijuana, Matamoros and Ciudad Juárez, Mexico, between August 2020 and July 2021 (weighted population=14,841).

	Tested for COVID-19			COVID-19 infection			Care-seeking			Vaccinated		
	Yes %	No %	$p^\star$	Yes %	No %	$p^\star$	Yes %	No %	$p^\star$	Yes %	No %	$p^\star$
Age (yrs)			0.284			0.807			**0.006**			**0.017**
18–29	69.0	31.0		10.3	89.7		44.4	55.6		30.4	69.6	
30–36	76.9	23.1		8.9	91.1		57.1	42.9		41.4	58.6	
37–45	74.7	25.3		1.2	98.8		90	10.0		61.9	38.1	
>45	82.8	17.2		13.8	86.2		12.5	87.5		60.9	39.1	
Gender			0.824			0.397			1.00			0.717
Male	75.3	24.7		11.8	88.2		53.1	46.9		48.9	51.1	
Female	73.5	26.5		5.9	94.1		50.0	50.0		37.5	62.5	
Education			0.194			**0.042**			0.429			0.649
Less than high school	73.3	26.7		9.1	90.9		47.6	52.4		49.3	50.7	
High school or more	80.8	19.2		17.6	82.4		61.5	38.5		44.0	56.0	0.629
Marital status			**<0.001**			0.817			0.774			
Married	62.5	37.5		11.7	88.3		50.0	50.0		45.0	55.0	1.00
Single/never married/other	83.2	16.8		10.8	89.2		55.0	45.0		50.0	50.0	
Ethnic or racial minority			**0.029**			0.297			1.00			
Yes	56.5	43.5		17.4	82.6		50.0	50.0		40.0	60.0	
No	77.0	23.0		10.4	89.6		51.7	48.3		48.4	51.6	
English fluency			**0.011**			**0.028**						**0.037**
Not at all	81.4	18.6		5.7	94.3		100	0.0	0.028	45.0	55.0	
Not very well	86.7	13.3		14.7	85.3		27.3	72.7		48.1	51.9	
Well	92.6	7.4		14.8	85.2		50.0	50.0		40.9	59.1	
Very well	97.1	2.9		20.0	80.0		71.4	28.6		82.4	17.6	
Previous history of migration to U.S.			**<0.001**			0.28			1.00			1.00
No	42.1	57.9		5.3	94.7		50.0	50.0		0.0	100	
Yes	79.6	20.4		12.0	88.0		53.1	46.9		100	0.0	
Time in the U.S. (yrs)			**<0.001**			**0.04**			0.317			**<0.001**
0–2	84.8	15.2		20.0	80.0		37.5	62.5		80.0	20.0	
3–10	50.0	50.0		6.6	93.4		60.0	40.0		11.8	88.2	
11–21	73.9	26.1		7.2	92.8		80.0	20.0		40.0	60.0	
>21	89.5	10.5		10.5	89.5		62.5	37.5		46.9	53.1	

(Continued)

TABLE 3 Continued

	Tested for COVID-19			COVID-19 infection			Care-seeking			Vaccinated		
	Yes %	No %	p^*	Yes %	No %	p^*	Yes %	No %	p^*	Yes %	No %	p^*
Most recent residence was U.S.			**<0.001**			0.434			0.681			0.074
No	38.8	61.2		8.8	91.2		42.9	57.1		23.1	76.9	
Yes	88.0	12.0		11.9	91.2		55.6	44.4		51.8	48.2	
Previous history of deportation			**0.015**			0.637			0.755			0.216
No	84.7	15.3		11.4	88.6		31.3	68.7		55.3	44.7	
Yes	72.4	27.6		13.3	86.7		21.9	78.1		42.6	57.4	
Time detained (days)			**<0.001**			**0.008**			**0.081**			**0.014**
0–3	39.5	60.5		10.5	89.5		33.3	66.7		29.4	70.6	
4–62	84.0	16.0		2.7	97.3		0.0	100		43.8	56.2	
63–365	92.2	7.8		7.8	92.2		17.6	82.4		33.3	66.7	
>365	95.8	4.2		23.6	76.4		64.7	35.3		63.6	36.4	
Detention facility			**<0.001**			**0.008**			0.429			**0.026**
Other	94.1	5.9		17.6	82.4		47.6	52.4		58.8	41.2	
Immigration center	64.9	35.1		7.6	92.4		61.5	38.5		35.7	64.3	
Unauthorized immigration status			0.31			**<0.001**			1.00			**0.049**
No	88.0	12.0		34.6	65.4		55.6	44.4		73.3	26.7	
Yes	77.3	22.7		9.8	90.2		52.0	48.0		43.8	56.2	
Survey location			**<0.001**			**<0.001**			0.534			**0.002**
Tijuana	61.9	38.1		18.1	81.9		47.8	52.2		73.7	26.3	
Matamoros	82.6	17.4		2.6	97.4		50.0	50.0		50.9	49.1	
Ciudad Juárez	95.8	4.2		29.2	70.8		71.4	28.6		20.8	79.2	
Survey quarter			**<0.001**			**0.027**			**0.066**			**<0.001**
First quarter (Aug '20 - Oct '20)	56.2	43.8		12.2	87.8		54.4	45.6		NA	NA	
Second quarter (Nov '20 - Jan '21)	77.8	22.2		3.2	96.8		0.0	100		0.0	100	
Third quarter (Feb '21 - Apr '21)	92.9	7.1		25.0	75.0		71.4	28.6		17.9	82.1	
Fourth quarter (May '21 - Jul '21)	88.7	11.3		19.4	80.6		58.3	41.7		67.2	32.8	

* p-values based on bivariate Chi-square tests.

NA, Not applicable. Vaccination questions were added in the second quarter of the survey.

Bold values indicate *p* value was less than 0.05.

TABLE 4 Adjusted associations between COVID-19 outcomes[1] and demographic, migration, and contextual variables among migrants deported from the U.S. to Tijuana, Matamoros and Ciudad Juárez, Mexico, between August 2020 and July 2021 (weighted population=14,841).

	Tested for COVID-19		COVID-19 infection		Vaccinated	
	AOR[2]	p	AOR[2]	p	AOR[2]	p
Age (yrs)						
18–29	1		1		1	
30–36	1.57	0.225	0.88	0.806	1.75	0.355
37–45	1.39	0.367	1.12	0.827	3.92	**0.035**
>45	2.87	**0.021**	1.7	0.323	4.07	**0.03**
Gender						
Male	1		1		1	
Female	0.711	0.443	0.417	0.251	0.631	0.565
Education						
Less than high school	1		1		1	
High school or more	1.83	0.087	2.53	**0.02**	0.919	0.867
Marital status						
Married	1		1		1	
Single/never married/other	2.99	**<0.001**	0.924	0.838	1.23	0.649
Ethnic or racial minority[1]						
No	1		1		1	
Yes	0.413	0.064	1.53	0.484	0.507	0.5
English fluency						
Not at all	1		1		1	
Not very well	1.39	0.495	2.5	0.148	1.23	0.764
Well	2.43	0.161	2.22	0.242	1.06	0.942
Very well	7.82	0.057	3.69	0.061	6.59	**0.027**
Previous history of migration to U.S.						
No	1		1		NE	
Yes	4.4	**<0.001**	2.42	0.265		
Time in the U.S. (yrs)						
0–2	1		1		1	
3–10	0.2	**<0.001**	0.32	**0.049**	0.022	**<0.001**
11–21	0.616	0.296	0.395	0.113	0.14	**0.022**
>21	1.59	0.376	0.61	0.333	0.146	**0.025**
Most recent residence - U.S.						
No	1		1		1	
Yes	10.52	**<0.001**	1.53	0.375	3.28	0.109
Previous history of deportation						
No	1		1		1	
Yes	0.548	0.08	1.14	0.74	0.438	0.08
Time detained (days)						
0–3	1		1		1	
4–62	7.24	**<0.001**	0.24	0.081	1.53	0.595
63–365	15.69	**<0.001**	0.51	0.300	1.37	0.681
>365	32.42	**<0.001**	3.04	**0.028**	3.89	**0.044**
Detention facility						
Other facility	1		1		1	
Immigration center	0.118	**<0.001**	0.396	**0.019**	0.264	**0.01**
Unauthorized immigration status[3]						

(Continued)

TABLE 4 Continued

	Tested for COVID-19		COVID-19 infection		Vaccinated	
	AOR[2]	*p*	AOR[2]	p	AOR[2]	*p*
No	1		1		1	
Yes	0.341	0.121	0.148	**<0.001**	0.379	0.174
Survey location						
Tijuana	1		1		1	
Matamoros	2.51	**0.003**	0.1	**<0.001**	0.653	0.514
Ciudad Juárez	15.41	**0.011**	2.24	0.137	0.076	**0.001**
Survey quarter						
First quarter (Aug '20 - Oct '20)	1		1		NE	NE
Second quarter (Nov '20 - Jan '21)	2.3	**0.012**	0.246	**0.027**		
Third quarter (Feb '21 - Apr '21)	11.02	**0.002**	2.79	**0.077**		
Fourth quarter (May '21 - Jul '21)	5.45	**<0.001**	1.83	0.226		

[1] Adjusted regression models could not be estimated for care seeking due to the small number of migrants for whom this question was applicable.

[2] Adjusted odds ratios (AOR) based on logistic regression models adjusted for age, gender, education, marital status, ethnic identity.

NE, Not estimated. Adjusted associations could not be calculated because of small size of subsample or lack of variation within some categories.

Bold values indicated *p* values were less than 0.05.

having received the vaccine in the U.S. and 0.2% in Mexico. Bivariate analyses revealed significant associations between the likelihood of having received the vaccine and older age (Linear-by-linear Association = 5.71, $p = 0.017$), English fluency (Likelihood Ratio =8.52, $p = 0.037$), time in the U.S. (Likelihood Ratio =21.65, $p < 0.001$), greater time in detention (Linear-by-linear Association =6.00, $p = 0.014$), being detained in a place other than an immigration detention center (Chi square =4.93, $p = 0.026$), immigration status (Fisher's Exact Test, $p = 0.049$), survey location (Likelihood Ratio =12.99, $p = 0.002$), and survey quarter (Likelihood Ratio =24.11, $p < 0.001$).

After adjusting for demographics, age, English Fluency, time living in the U.S., time in detention, type of detention facility, and survey city remained significantly associated with vaccine receipt. No regression models could be estimated for history of migration to the U.S. or survey quarter due to the lack of variation in vaccination status for some categories of these independent variables (Table 4).

Among the 29.9% of migrants who had not yet been vaccinated, 41% reported no intention of getting vaccinated, 32.5% intended to take the vaccine, and 26.5% did not know if they would get vaccinated. Reasons for vaccine hesitancy among those who did not intend to get vaccinated or did not know if they would included concern about potential side effects of the vaccine (74.0%), not knowing where to obtain the vaccine (13.0%), not believing in the efficacy of the vaccine (4.8%), concern about data collected at vaccine sites (2.0%), mistrust of doctors (0.6%), and other (not specified) reasons (2.4%). Over time, the percent of unvaccinated migrants who intended to get vaccinated decreased from 71.4% in the second quarter of the survey to 62.0% in the third quarter and 14.2% in the last quarter

of the survey. Inversely, from the second to the last quarter, the percent of migrants who did not plan to get vaccinated increased from 28.6 to 44.5%, and the percent who did not know if they would get vaccinated increased from 0 to 41.3% throughout this period (Figure 1).

Other preventive and risk factors

Regarding other preventive measures, 98.1% of migrants reported wearing masks and 96.3% washing or sanitizing hands frequently. In contrast, 62.6% reported staying home most of the time and a mere 0.4% were able to work from home. Importantly, an estimated 44.3% of migrants reported having been confined in crowded or small spaces with too many other detainees while in detention in the U.S. (Table 2).

Discussion

This study sought to reduce the gap in knowledge regarding the impact of the COVID-19 pandemic on migrant populations and, more specifically, on deported Mexican migrants. The findings indicate that although most migrants had been tested for COVID-19, about 15% of them had not been screened for the infection before they were deported by U.S. immigration authorities at the border or before they were released by Mexican immigration authorities to the larger community in the Mexican border region. This figure is consistent with previous media reports denouncing that migrants in Border Patrol custody were not tested unless they showed symptoms (37). However, those

FIGURE 1
Intentions to get vaccinated against COVID-19 among non-vaccinated deported migrants by survey quarter (%).
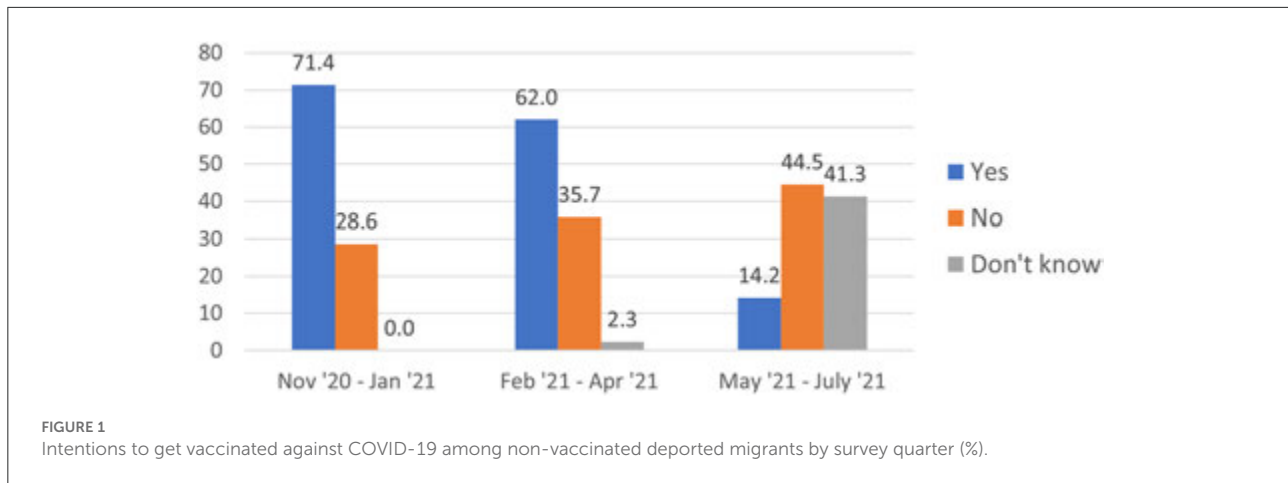
reports also indicated that "all [migrants] are tested when they leave Border Patrol custody," a claim that stands in stark contrast to results from our survey, which indicate that a sizable subset of this population had not been tested at any point since the start of the pandemic. Testing rates improved over the course of our survey, probably owing to improvement in availability of testing supplies and services as the pandemic evolved. Yet, the suboptimal testing levels among this transnational population, who are subject to detention in congregate settings, illustrates some of the mechanisms through which immigration enforcement policies can facilitate transmission of COVID-19 across international borders: migrants are arrested, kept in crowded detention facilities, and deported without first being screened for COVID-19.

This study also found that about one in three migrants had been diagnosed with, tested positive for, or suspected they had had COVID-19 infection, with prevalence rates increasing over time. In the context of insufficient testing and low levels of access to healthcare, this figure is likely an underestimate of the true burden of the pandemic on this population. It is important to note that the risk of infection was associated with migration-related experiences. Migrants detained for over a year or detained in prisons or jails had a higher risk of infection than those detained for brief periods of time or in immigration centers. It is well-established that congregate settings where large numbers of people are gathered in close proximity or for extended periods of time can facilitate transmission of respiratory infections, including COVID-19. Prisons and immigration detention centers present limited options for practicing COVID-19 preventive measures, such as social distancing (38, 39). Our survey reveals that over 44% of deported migrants were held in crowded spaces while in detention in the U.S. Together, these findings suggest that detention for long periods of time in the U.S. contributed significantly to COVID-19 exposure and transmission among deported Mexican migrants, especially those detained in prisons or jails

vs. immigration detention centers. This study also indicates that insufficient measures were put in place to protect detained migrants from COVID-19 in detention facilities. Surprisingly, authorized migrants and those with higher education were more likely to report a history of COVID-19 than their unauthorized or less educated counterparts. This could reflect true higher infection rates among these groups, but these associations may also be indicative of authorized and more educated migrants facing fewer barriers to accessing testing and diagnostic services. Over time, the odds of having a COVID-19 infection history changed significantly and independently from other factors, with a marked decreased in infection odds from November 2020 through January 2021 and a spike from February to April 2021, compared to the first quarter of the survey. These variations may be related to changes in pandemic-related travel restrictions and other control measures imposed by U.S. and Mexican authorities at different points during the pandemic.

One of the most striking findings from this study is the fact that more than one in three migrants diagnosed with or suspected of having COVID-19 never sought medical attention for a disease that can be potentially deadly. While the small sample size precluded estimation of adjusted regression models, our bivariate analyses suggest greater odds of seeking COVID-19 treatment among deported migrants who were detained for longer periods of time compared to those who were in detention for less time. This is consistent with other surveys of unauthorized Latino immigrants that have found that, in general, this population's access to COVID-19 testing and treatment (40) in the U.S. is severely restricted. Fear of deportation (11, 41), concerns regarding future regularization, limited English fluency, lack of health insurance, and lack of knowledge regarding where to obtain health care services have been extensively documented as barriers to health care services among Latino migrants. Considering that U.S. prisons are known to have inadequate prevention and treatment services for incarcerated persons (42), this result is even more troubling

and calls for implementation of efforts to improve access to COVID-19 treatment and adequate health care, among migrants both in detention facilities and in the community at-large.

Vaccination rates, at about 70%, were higher than expected among this population and they increased over time as the survey progressed. Shortly after the completion of our survey, by September of 2021, the CDC was reporting that 74.4% of U.S. adults had received at least one dose of the COVID-19 vaccine, including 71.5% of all Latinos. Despite the frequent allusions to vaccine hesitancy as a driving factor for low vaccination levels among racial and ethnic minorities in the U.S. (43), research indicates that language barriers, fear of deportation, and lack of access to vaccination sites are more important barriers to vaccination among migrants in the U.S (44). The relatively high immunization rates found by our survey and the sizable fraction of migrants not yet vaccinated who intended to seek a vaccine, are further evidence that when given the chance, most migrants will accept the opportunity to get vaccinated to reduce their risk of COVID-19. These better-than-expected vaccination levels are also consistent with trends observed for Latinos in the U.S., who have achieved higher vaccination levels than their non-Hispanic counterparts, despite having had a slower uptake during the initial phases of the vaccine roll-out (45). As it was the case for testing, the odds of vaccination were also lower among migrants detained in immigration centers compared to migrants detained in other types of facilities, which underscores a missed opportunity to provide these underserved populations with preventive services while in ICE-operated detention settings. For the subset of deported migrants who did not plan to get vaccinated, our findings show that concern about side effects and not knowing were to obtain the vaccine were the most frequent barriers. This data calls for deployment of outreach and education programs addressing these barriers to further augment Latino migrants' immunization levels.

Our analyses also revealed that other demographic and migration variables were significant, independent determinants of COVID-19 testing, infection, care seeking, and vaccination among deported migrants. For example, older migrants were more likely to be tested and vaccinated, possibly due to greater perceived severity of COVID-19 infection and earlier eligibility for vaccination among older individuals compared to their younger counterparts. Not married migrants were more likely to be tested, an intriguing finding that merits more research in the future. As expected, English fluency was an independent predictor of COVID-19 testing and vaccination. This finding is consistent with other research regarding language as a barrier to preventive services in migrant and refugee populations (44). History of migration showed an inconsistent pattern of associations with testing, infection, and vaccination. On the one hand, migrants with a history of migration to the U.S. and those who considered the U.S. their country of residence had higher adjusted odds of being tested than those who had never migrated to the U.S. or still called Mexico their home. However, length of

time in the U.S. did not increase the odds of testing, infection, or vaccination rates. In fact, compared to new migrants <2 years of time in the U.S., migrants with 3–10 years of residence in the U.S. showed significantly lower odds of testing, infection, and vaccination, and migrants with 11 or more years in the U.S. also had lower odds of vaccination than newer migrants. These findings could be related to increased acculturative stress with longer time spent in the U.S. (46) and call for additional research to understand the nature of these associations. Our study also revealed significant associations between contextual variables and COVID-19 outcomes. The odds of COVID-19 testing were greater among migrants deported through Matamoros and Ciudad Juarez, perhaps reflecting greater availability in the community and detention settings in the regions that deport migrants through these cities. In contrast, compared to migrants deported through Tijuana, care-seeking and vaccination were less likely to be reported among migrants deported through Matamoros and Ciudad Juarez, respectively. The reasons behind these findings need to be elucidated, but they call for interventions to improve access to testing, care, and vaccination for migrants in catchment areas that fare worse in these domains.

Limitations

This study has several limitations, including the cross-sectional design that impedes testing for causal associations, an imperfect response rate that creates the potential for self-selection bias, and some age and geographic differences between respondents and non-respondents. In addition, our exclusive reliance on self-reported data creates the potential for recall and social desirability biases. Our findings showed that COVID-19 outcomes among deported migrants varied significantly depending on the city through which they were deported, even after controlling for socio-demographic characteristics. These differences may reflect different levels of risk and access to services for detained migrants across different U.S. regions. Our survey was implemented only in Tijuana, Ciudad Juárez, and Matamoros, and the percent of migrants sampled in Ciudad Juárez was very small compared to the other two cities. Hence, our overall estimates of COVID-19 outcomes may be more representative of migrants deported through Tijuana and Matamoros and less accurate for individuals who are deported through other Mexican border points. We acknowledge that analyzing the samples from the three cities together can complicate interpretation of findings. However, the sample size within each city was small (especially in Ciudad Juárez) and stratified analyses for each city would have yielded even smaller cell counts and less precise estimates. The small sample size and combination of data from three different cities call for caution when interpreting the findings. Finally, the deported population is

largely composed of male migrants and, consequently, most of our sample was male. It is important to bear in mind that the findings from this study may be more reflective of the experiences of male migrants than those of their female counterparts. Future research must aim to include larger samples of female deportees.

Implications for public health practice and research

Overall, the findings from this study underscore the role of detention and deportation as structural risk factors for COVID-19 infection among Latino migrants. They also provide evidence of the failure to deliver effective prevention, testing, and treatment of COVID-19 for this population in both the U.S. and Mexico. Increased risk for COVID-19 adds to the myriad mental and physical health impacts of the civil and human rights abuses experienced by detained migrants in the U.S., the country with the largest immigration detention system (47) in the world. In general, our results resonate with calls from other scholars for decarceration of migrant detainees, suspension of deportations, and the need to identify alternative immigration enforcement practices informed by public health and human rights principles. (48). They also demand a better response by the Mexican government to reduce undiagnosed infection and improve vaccination rates among migrants forcibly returned to Mexico by U.S. immigration authorities, as well as other in-transit migrants and asylum seekers (49). For example, every year, over 100,000 Mexican nationals deported from the U.S. are subject to mandatory processing by Mexican migration authorities at deportation stations along the Mexican border. This system creates a unique opportunity to offer this sizable migrant flow COVID-19 rapid testing, triage for care of infected individuals, and vaccination at the point of return to Mexico, prior to migrants' release into the community. This practice would reduce the risk of undiagnosed disease transmission across borders, increase access to proper care among infected deported migrants, and reduce these migrants' risk of suffering severe COVID-19 infection outcomes.

The pandemic is far from over. We are likely to continue seeing new variants of the COVID-19 virus, including potentially more transmissible and/or deadly ones. As we prepare to respond to the new phases of the pandemic, we need better policies to protect unauthorized immigrants from discriminatory policies that increase their risk of exposure to COVID-19 and limit their ability to access timely testing, obtain proper treatment, and adopt preventive measures, including social distancing, vaccination, and booster vaccination. Although our survey did not collect information on receipt of boosters, current CDC data, not disaggregated by

nativity, shows that among fully vaccinated people, only 41.3 of Latinos vs. 58.7% of non-Hispanic whites have received a booster dose. Programs that train and involve Latino community members to provide COVID-19 information in Spanish or an indigenous language can improve trust and uptake of these preventive measures (6, 10, 11, 25). These programs should target both urban and rural areas, where resources for migrant populations are often even more scarce (25). Better workplace conditions, financial supports, healthcare coverage, and vaccine distribution are also necessary to mitigate the impact of future phases of the pandemic on this population (10, 17).

This study includes data collected relatively early in the pandemic. Since then, access to testing, treatment, and vaccines have evolved in the U.S. and Mexico. The findings could be different if more recent data were included. Future research must continue to examine COVID-19 outcomes among deportees and other migrants and identify and address barriers to preventive and treatment services among this population, including reasons for vaccine hesitancy.

Moving forward, it is also critical to improve our surveillance systems to safely collect information that allows for disaggregation of COVID-19 indicators by native vs. foreign-born status. These systems should also evaluate risk stratification at work to allow us to better estimate disparities in the burden of COVID-19 shouldered by migrant and immigrant groups and characterize the drivers of these disparities. During the first year of the pandemic, only 28 U.S. states were reporting COVID-19 mortality by race and ethnicity (2) and, to our knowledge, no state reported cases or vaccination figures by nativity. The limited availability of data impedes formulation of evidence-based policies and programs that could mitigate the impact and spread of COVID-19 (35).

Conclusion

This study provides insights into the extent of COVID-19 testing, infection, care, and vaccination among Mexican migrants deported from the U.S., an underserved and understudied migrant population. The results show that at least a third had a history of diagnosed or suspected infection, and over 44% were held in crowded conditions. The study also demonstrates insufficient access to testing and care for COVID-19, but higher-than-expected levels of vaccination and willingness to get vaccinated among those not yet immunized. As we prepare for future waves of the pandemic and potentially more transmissible and/or deadly variants, decarceration and other measures aimed at reducing COVID-19 risk and increasing access to preventive services

and treatment among detained migrants must be planned and implemented.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Drexel University Institutional Review Board. The participants provided their written informed consent to participate in this study.

Author contributions

APM-D conceived, designed the study, obtained research funding, and directed the implementation of the study with support from co-investigators JG-F, EP, AA-G, ML, XZ, and MR. LB helped to coordinate the study, programmed the study surveys, monitored the data quality, and conducted the data analyses under the supervision of APM-D. CC-S assisted with human subjects protocols, personnel training, and review of the literature. APM-D and CC-S led the writing of the first draft of the manuscript. All authors contributed to the article and approved the submitted version.

Author disclaimer

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Thinking on your feet: Beauty and auto small businesses maneuver the risks of the COVID-19 pandemic

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On March 11, 2020, the World Health Organization officially declared SARS-CoV-2 a pandemic, and governments and health institutions enacted various public health measures to decrease its transmission rate. The COVID-19 pandemic made occupational health disparities for small businesses more visible and created an unprecedented financial burden, particularly for those located in communities of color. In part, communities of color experienced disproportionate mortality and morbidity rates from COVID-19 due to their increased exposure. The COVID-19 pandemic has prompted the public to reflect on risks daily. Risk perception is a critical factor influencing how risk gets communicated and perceived by individuals, groups, and communities. This study explores competing risk perceptions regarding COVID-19, economic impacts, vaccination, and disinfectant exposures of workers at beauty salons and auto shops in Tucson, Arizona, using a perceived risk score measured on a scale of 1−10, with higher scores indicating more perceived risk. The primary differences between respondents at beauty salons and auto shops regarding their perceived risks of COVID-19 vaccination were between the vaccinated and unvaccinated. For every group except the unvaccinated, the perceived risk score of getting the COVID-19 vaccine was low, and the score of not getting the COVID-19 vaccine was high. Study participants in different demographic groups ranked economic risk the highest compared to the other five categories: getting the COVID-19 vaccine, not getting the COVID-19 vaccine, COVID-19, disinfection, and general. A meaningful increase of four points in the perceived risk score of not getting the COVID-19 vaccine was associated with a 227% (95% CI: 27%, 740%) increase in the odds of being vaccinated. Analyzing these data collected during the coronavirus pandemic may provide insight into how to promote the health-protective behavior of

high-risk workers and employers in the service sector during times of new novel threats (such as a future pandemic or crisis) and how they process competing risks.

Introduction

"There is a big difference between those who take risks and those who are victimized by risks others take." —Ulrich Beck (*Risk Society*, 1986).

On March 11, 2020, the World Health Organization officially declared SARS-CoV-2 a pandemic (1). By August 2020, the spread of the virus had resulted in 20 million cases and 700,000 deaths worldwide (1). Governments and health institutions enacted various public health measures to decrease the rate of transmission. In the United States (U.S.), this resulted in business shutdowns due to social distancing and shelter-in-place guidelines (2–4). Individuals in many service industries are frontline workers because they physically report to work (often working within six feet of others) and are more likely to be exposed to the COVID-19 disease whether they are officially defined as such (5).

Previous studies suggest the service industry is more likely to employ workers of low socioeconomic status and people of color (6, 7). Occupational health disparities attributable to contaminant exposures in these work environments have led to the overrepresentation of historically neglected populations in this sector. Owners and employees often lack access to resources and monetary funds to implement recommended costly interventions (e.g., industrial hygiene consultants, ventilation systems) (8, 9). The COVID-19 pandemic added new burdens as business owners and employees had to use their already limited resources to purchase additional equipment and products to protect themselves and their clients (e.g., surgical masks, disinfection products, air purifiers) while working in person and many times near others, even when recommendations from government agencies were constantly changing. Trust in government and public health organizations influence an individual's willingness to be vaccinated and use other interventions (10). At the initiation of the pandemic, officials were scrambling to establish facts about this novel virus. Thus risk communication was impacted as it changed constantly and often contradicted public health messaging. Initial risk messaging from government leaders contributed to the confusion because the pandemic took on a political

association and was less based on fast-changing facts (10, 11). These workers relied on their knowledge and self-efficacy to navigate and interpret competing risks.

The COVID-19 pandemic made occupational health disparities for small businesses more visible and created an unprecedented financial burden, particularly for those located in communities of color (2). Significant impacts on the supply chain worldwide, plus border closures, added to market fluctuations and economic impacts (12). In this study, we define small businesses as those with <100 employees and have even focused on microbusinesses with much fewer employees. Small businesses are considered important economic drivers in the U.S. (13). Before the pandemic, small business owners found themselves in a precarious financial situation, with this event further exposing the disproportionate effects on economics and health of these businesses (14). Small businesses have had to weigh the constantly changing risks of workplace SARS-CoV-2 transmission against financial burdens and social costs caused by business closure or reduced number of staff and clients. The use of face masks, changes to disinfection practices, vaccine requirements, and more are the responsibility of business owners and workers.

While acknowledging structural conditions that manifest in health disparities, understanding risk perception is one approach to help determine health-protective behaviors that could mitigate health effects (15). Douglas and Wildavsky (16) propose a cultural risk perception model suggesting risk is a "social process," emphasizing that risk cannot be calculated with precision. A cultural approach to risk can highlight how a community relates "natural dangers to moral defects" (16). The key is to determine what characteristics of "social life" result in an individual's "typical risk portfolio." In other words, the social structure we individually belong to strongly contributes to the risks we are willing to accept. "To alter risk selection and risk perception, then, would depend on changing the social organization" (16). Because a universal concept of risk that encompasses the "social life" of everyone is nonexistent, there is also no singular interpretation. Yet, characteristics that may influence risk perception can include knowledge, personality, economics, politics, and culture (17).

Subjective risk describes a person's perceived chance that something harmful will happen. A personal assessment of their

vulnerability to the threat is not based on a mathematical formula characterizing the type of risk (18, 19). A person's perspective may make some risks appear more alarming than others. Subjective risk is higher in an individual if involuntary, catastrophic, unequal, unfamiliar, or complex (20). Usually, decisions about risk are less influenced by information regarding the risk itself (21). Therefore, the risk perception of an emerging hazard may be more emotionally-based (11). Outrage (response) and the nature of the hazard (number of people exposed, infected, ill), as well as cultural and economic factors, determine risk perception and response to public health messages such as that of COVID-19 (11). For example, in the COVID-19 pandemic, masks evolved into a political issue even though they are an effective intervention against airborne viruses. The politicization of face masks resulted in their varying use throughout the U.S.

The COVID-19 pandemic has prompted small businesses to reflect on risks daily. In a systematic review, "educational initiatives, proper communication, and timely information" at the community levels were found to promote the successful implementation of public health strategies and decrease misinformation (22). Yet, there is a limited capacity from workplace organizations like the Occupational Safety and Health Administration or the Small Business Administration to help guide many extant businesses. During the pandemic, business owners simultaneously had to keep their employees healthy and their businesses profitable while increasing clientele confidence about safety from COVID-19 transmission. The latter was particularly difficult for industries that did not have viable options for transitioning away from in-person services within 1.83 meters, like beauty salons. Clear and consistent guidance from local, state, and federal authorities, including governments and health organizations, are needed to direct these industries better (23). The COVID-19 vaccine was an added competing interest for individuals working in these businesses. Understanding personal hesitancy toward the vaccine and other interventions is critical to limiting the spread of the disease and mutations and protecting frontline workers.

Risk perception is a critical factor influencing how risk gets communicated by individuals, groups, and communities. It is also a positive driver of the public's acceptance of official measures and recommendations (10, 11). For example, an Italian study concluded that willingness to get vaccinated was shaped by various factors with risk perception being of importance (24). As risk perception increased in participants, so did their willingness to get vaccinated (24). This study explores competing risk perceptions regarding COVID-19, economic impacts, vaccination, and disinfectant exposures of workers at beauty salons and auto shops in Tucson, Arizona, as part of a more extensive study to reduce workplace environmental exposures. A cross-sectional survey was developed and implemented to understand the small business impacts associated with the COVID-19 pandemic.

Materials and methods

In 2017, researchers established the principal study to understand if applying an industrial-hygiene enhanced community health worker (CHW) intervention can decrease exposures to volatile organic compounds (VOCs) routinely found in beauty and auto small businesses. Individuals from the University of Arizona Mel and Enid Zuckerman College of Public Health (MEZCOPH), Sonoran Environmental Research Institute, Inc. (SERI), and El Rio Health collaborated. With the onset of the COVID-19 pandemic, the study expanded its focus from measuring air concentrations of VOCs to understanding the impacts of the pandemic on the study's population. Activities shifted to designing resources about the novel COVID-19 virus and guidance, with the benefit of maintaining communication and providing support during a demanding period for these small businesses. A cross-sectional survey was developed and implemented as part of this ongoing community-engaged research to understand how the pandemic was impacting businesses and changing their work practices. The survey also included a section to assess the competing risk perceptions regarding viral transmissions, financial hardships, vaccination status, and disinfection exposures. It provides a novel perspective on the impacts of COVID-19 on small businesses in Tucson. It was also an opportunity to better understand the perceptions of workers/managers and employees from small businesses following a catastrophic event that may have influenced workplace decision-making processes.

Study population and recruitment

Race and ethnicity are socially constructed categories that have real-life implications regarding health disparities (e.g., chronic disease, premature death) (25). Health inequities in the U.S. have been brought to the surface during the COVID-19 pandemic, with Tucson, Arizona being no exception. The Tucson zip codes that are part of the study area contain high poverty rates, urban stress, and lower education attainment (26). They also include the Mexican and Mexican American neighborhoods that are Spanish-speaking in the city. The study area also has among the highest rates of COVID-19 cases and death in the region. This area is already at an increased risk for VOC exposure, and the pandemic may increase chemicals in workplace air due to increased disinfection.

The study targeted small business beauty salons and auto shop owners, managers, and employees in Tucson who were at least 18 years old and spoke either Spanish or English. Recruitment of participants was *via* social media, phone calls, mailed flyers, and poster advertisements. Contact information for the businesses was compiled based on internet searches, social media presence, and driving through targeted

TABLE 1 Survey respondents were asked to rate the following specific activities from 1 = very low risk to 10 = extremely risky; individual activities have been grouped into broader risk categories for assessment of these more general categories of risk.

Broad risk categories	COVID-19 vaccination risk	COVID-19 risk	Disinfection risk	Economic risk	General risk
Specific activities	Getting the COVID vaccine	Eating a meal indoors with people who don't live in my home	Using alcohol to disinfect surfaces	Betting a day's income at the casino	Driving a car
	Not getting the COVID vaccine	Eating lunch with coworkers at work—indoors	Using Clorox$^®$ wipes to disinfect surfaces	Investing 10% of my annual income in a new business	Drinking and driving
		Eating lunch with coworkers at work—outdoors	Using liquid bleach to disinfect surfaces	Quitting my job or shutting down my business	Firing a gun
		Spending time with family or friends without a face mask	Using Lysol$^®$ to disinfect surfaces	Continuing to reduce my work hours or the open hours of my business	Riding a motorcycle
		Being at the grocery store without a face mask	Using Pine-sol$^®$ to disinfect surfaces		Listening to loud music
		Being at work without a face mask	Using disinfectant sprays in my workspace		Riding in a car without a seatbelt
			Using disinfectant wipes in my workspace		Smoking
					Playing soccer
					Exposure to pesticides Using Raid$^®$

neighborhoods. Honan et al. provide detailed recruitment methods (23).

Workers in beauty and auto small businesses responded to the survey between June 8, 2021, and January 25, 2022. The questions were either self-administered online or over the phone to owners, managers, and workers of auto repair shops and beauty salons in Tucson, Arizona. This survey also collected demographic information. A total of 67 individuals representing owners, managers, and employees participated. Individuals who completed the survey received a $25 gift card as compensation for their time and effort.

Survey

The development of the COVID-19 small business survey has been described previously (23). An interdisciplinary team from the University of Arizona and SERI designed the survey instrument. This questionnaire captured the perceived risks of the novel COVID-19, COVID-19 vaccination, disinfection activities, economic impacts, and non-occupational health hazards.

The COVID-19 small business risk perception section of the survey was adapted from a previous study (24). Respondents

evaluated the risk of activities posed from their perspective. They rated activities using a 10-point Likert scale, with one being something they consider very low risk and 10 being something they consider extremely risky. Table 1 displays individual survey items about perceived risk of specific activities, grouped into broader risk categories. The survey was designed to be succinct and typically completed in 30 min. The survey was submitted to and approved by the University of Arizona Human Subject Protection Program.

Data analysis

Survey responses were de-identified before data analysis. The survey data was downloaded from the REDCap (Research Electronic Data Capture) platform available through the University of Arizona Health Sciences. Data were read into the R statistical computing software Mac version 4.1.2 (25) R Core Team Vienna, Austria), cleaned and combined. Additional R packages used included the R tidyverse package for manipulating data (26) and the DescTools package to calculate multiplicity-adjusted p-values using Dunnett's test (27). As part of the data cleaning process, data from two participants who had selected "other type of shop" with the text "Automotive headlight

restoration and light-duty mechanical work" and "RV and boat repair" were changed to auto shops. Any questionnaires not filled out by someone working at an auto shop or beauty salon or where the participant did not complete the survey were removed.

We tested how perceptions about risk vary across different groups using a longitudinal survey's baseline cross-sectional survey data. First, we tested if vaccination status was related to various demographic variables using Pearson's chi-squared test for categorical variables and linear model analysis of

TABLE 2 Descriptive statistics of demographics by vaccination status for our cross-sectional survey of 64 individuals (survey of 67 individuals, three of whom declined to state their vaccination status) between June 8, 2021 and January 25, 2022 who worked at beauty salons and auto shops in Tucson, AZ, were at least 18 years old, and spoke either Spanish or English.

	Vaccinated (N = 53)	Not vaccinated (N = 11)	Total (N = 64)	p value
Shop type				
Auto	23 (43.4%)	6 (54.5%)	29 (45.3%)	0.50[a]
Beauty	30 (56.6%)	5 (45.5%)	35 (54.7%)	
Gender				
Female	34 (64.2%)	4 (36.4%)	38 (59.4%)	0.09[a]
Male	19 (35.8%)	7 (63.6%)	26 (40.6%)	
Ethnicity				
Hispanic	30 (56.6%)	4 (36.4%)	34 (53.1%)	0.22[a]
Not Hispanic	23 (43.4%)	7 (63.6%)	30 (46.9%)	
Race				
Indigenous/American Indian/Alaska Native	2 (4.2%)	0 (0.0%)	2 (3.4%)	0.78[a]
Asian	1 (2.1%)	0 (0.0%)	1 (1.7%)	
Black or African American	3 (6.2%)	1 (10.0%)	4 (6.9%)	
White	38 (79.2%)	9 (90.0%)	47 (81.0%)	
More than one race	4 (8.3%)	0 (0.0%)	4 (6.9%)	
Education				
Some high school	1 (1.9%)	0 (0.0%)	1 (1.6%)	0.73[a]
Completed high school	16 (30.2%)	1 (9.1%)	17 (26.6%)	
Some trade school	1 (1.9%)	0 (0.0%)	1 (1.6%)	
Completed trade school	13 (24.5%)	4 (36.4%)	17 (26.6%)	
Some college	14 (26.4%)	4 (36.4%)	18 (28.1%)	
Completed college or graduate school	8 (15.1%)	2 (18.2%)	10 (15.6%)	
Working as much as would like?				
Yes (have enough work)	39 (81.2%)	9 (90.0%)	48 (82.8%)	0.51[a]
No (looking for more work)	9 (18.8%)	1 (10.0%)	10 (17.2%)	
Employee type				
Employee	25 (49.0%)	4 (36.4%)	29 (46.8%)	0.61[a]
Manager	8 (15.7%)	3 (27.3%)	11 (17.7%)	
Owner	18 (35.3%)	4 (36.4%)	22 (35.5%)	
Number employed at shop				
Mean	6.3	4.1	5.9	0.28[b]
Standard deviation	6.4	2.0	5.9	
Range	0.0–35.0	1.0–8.0	0.0–35.0	
Age (years)				
Mean	42.4	37.1	41.4	0.29[b]
Standard deviation	15.1	5.7	14.0	
Range	21.0–71.0	30.0–47.0	21.0–71.0	

[a]Pearson's Chi-squared test.
[b]Linear Model ANOVA.

variance (ANOVA) for continuous variables. Next, for each respondent, their average perceived risk score was calculated for the following categories: general risk (average of 10 statements), economic risk (average of four statements), disinfection risk (average of seven statements), COVID-19 risk (average of six statements) (Table 1). We then compared the risk perception of COVID-19 to other activities; Dunnett's test was performed to identify which activities had statistically significantly different mean risk scores compared to COVID-19 risk (28). Additionally, average perceived risk scores for categories of risk, along with perceived risk scores of getting and not getting the COVID-19 vaccine, were ranked for the following demographic groups: vaccinated/not; auto/beauty; employee/manager or owner; Hispanic/not; and Hispanic female, Hispanic male, non-Hispanic female, non-Hispanic male. Finally, we ran a logistic regression model of vaccination status on the perceived risk score of not getting the COVID-19 vaccine, gender, ethnicity, and the gender by ethnicity interaction. An α level of 0.05 was used for all tests of statistical significance.

Results

Table 2 displays the descriptive statistics of demographic information obtained from cross-sectional survey responses from June 8, 2021, through January 25, 2022 by vaccine status. Sixty-four cross-sectional surveys were analyzed (46.8% employees, 17.7% managers, and 35.5% owners). Originally 67 individuals participated, with three declining to state their vaccination status, and therefore were excluded from the analysis. A mean of six employees worked at each auto shop or beauty salon. Most workers at auto shops were male (72.4%), while most workers at beauty salons were female (86.8%). Approximately half of the workers were of Hispanic ethnicity (53.1%), and a little less than half were non-Hispanic (46.9%). Workers were also White (81.0%), Black or African American (6.9%), more than one race (6.9%), Indigenous/American Indian/Alaskan Native (3.4%), and Asian (1.7%). For the most part, individuals completed trade school (26.6%) or some college (28.1%). Most individuals (82.8%) believed they had enough work and were not currently looking for more or different employment opportunities. The respondents had a mean age of 41 years (SD = 14, range: 21–71).

These small business respondents had high vaccination rates, with 83% reporting they had at least one dose of the COVID-19 vaccine. Gender was the demographic characteristic most strongly associated with vaccination status (p-value = 0.09), with women more likely to be vaccinated than men (Table 2). Ethnicity was the next most strongly associated with it (p-value = 0.22), with Hispanics being slightly more likely to be vaccinated than non-Hispanics. However, none of these differences were statistically significant at the level of α = 0.05.

TABLE 3 Summary of perceived risk score of COVID (average of six statements) relative to other activities on a Likert scale from 1 (very low risk) to 10 (extremely risky).

Activity	Mean	SD	*Mean difference	p value
General Categories	5.5	2.3		
COVID-19 (average of six statements)				
Disinfection (average of seven statements)	3.2	2.2	−2.2	<0.001
Economic (average of four statements)	6.7	1.8	1.2	0.099
Specific activities	3.3	2.9	−2.2	<0.001
Getting the COVID-19 vaccine				
Playing soccer	3.4	2.4	−2.0	<0.001
Listening to loud music	4.7	2.5	−0.8	0.629
Using Raid	4.9	2.9	−0.6	0.903
Driving a car	5.0	2.5	−0.5	0.966
Firing a gun	5.9	3.2	0.5	0.974
Exposure to pesticides	6.7	2.9	1.3	0.077
Riding a motorcycle	6.9	3.1	1.4	0.032
Not getting the COVID-19 vaccine	7.1	3.4	1.6	0.009
Smoking	7.9	2.7	2.4	<0.001
Riding in a car without a seatbelt	8.3	2.5	2.9	<0.001
Drinking and driving	8.7	2.7	3.2	<0.001

*The significance of the mean difference of score for each activity compared to that of the reference activity of COVID-19 (average of six statements) was assessed using Dunnett's test, which accounts for these many-to-one comparisons.

Table 3 summarizes the perceived risk score of COVID-19 relative to general risk categories as well as specific activities. Participants regarded activities related to exposure to COVID-19 as a moderate risk, similarly risky to driving a car or firing a gun. Activities perceived as significantly less risky than COVID-19 were disinfection, getting the COVID-19 vaccine, and playing soccer (all with $p < 0.001$) (Table 3). Activities perceived as significantly riskier than COVID-19 included riding a motorcycle ($p = 0.032$), not getting the COVID-19 vaccine ($p = 0.009$), smoking cigarettes, riding in a car without a seatbelt, and drinking and driving (all with $p < 0.001$). Economic risks have a similar mean perceived risk score as exposure to COVID-19 ($p = 0.099$).

The most significant differences in relative perceived risk rankings (1–6; where one is low perceived risk and six is high perceived risk relative to the other categories) based on the mean perceived risk scores are between the vaccinated and unvaccinated (Table 4). For every group except the unvaccinated, the perceived risk score of getting the COVID-19 vaccine was low (1–2), and the score of not

TABLE 4 Perceived risk rankings for various demographic groups, based on the mean perceived risk scores presented in Table A.1 in the Appendix. These rankings range from 1−6 for the six categories listed in the six right-most columns in the table, where 1 is low perceived risk and 6 is high perceived risk relative to the other categories.

Demographic group	Getting the COVID-19 vaccine	Not getting the COVID-19 vaccine	COVID-19	Disinfection	Economic	General
All	2	6	3	1	5	4
Vaccinated	2	6	3	1	5	4
Not vaccinated	3	1	2	4	6	5
Unknown vacc. status	1	6	5	2	4	3
Auto	2	4	3	1	6	5
Beauty	1	6	3	2	5	4
Employee	2	6	3	1	5	4
Manager or owner	2	4	3	1	6	5
Unknown employee type	1	6	5	2	4	3
Hispanic	1	6	3	2	5	4
Not Hispanic	2	6	3	1	5	4
Hispanic female	1	6	3	2	4	5
Hispanic male	2	6	3	1	5	4
Not Hispanic female	1	6	3	2	5	4
Not Hispanic male	2	4	3	1	6	5

getting the COVID-19 vaccine was high (4–6). Respondents with an unknown vaccination status scored like those vaccinated or more conservatively regarding COVID-19 risks. The perceived risk ranking of not getting the COVID-19 vaccine was at the extreme between vaccination status, whereas the ranking of the perceived risk of COVID-19 was generally considered moderate (2–3) and similar between the two. Disinfection risk had low rank (1) for the vaccinated, whereas it had higher rank (4) for the unvaccinated. Generally, regardless of vaccination status, economic risks were scored high (4–6, with the average rank from all survey respondents 5).

To determine the relative importance of the perceived risk score of not getting the COVID-19 vaccine and demographic variables in association with vaccination status, we ran a logistic regression model of vaccination status on the perceived risk score of not getting the COVID-19 vaccine and the two demographic variables with the strongest associations with vaccination status in this study (gender and ethnicity), along with their interaction. The logistic regression results are shown in Table 5. The perceived risk score of not getting the COVID-19 vaccine was more strongly associated with vaccination status ($p = 0.01$) than either gender, ethnicity, or their interaction, all of which were not statistically significant. A meaningful change in the perceived risk score of not getting the COVID-19 vaccine was four points, because that is the difference in points between the first quartile (score $= 5$) and median (score $= 9$) in our sample. A four-point increase in the perceived risk score of not getting the COVID-19 vaccine

TABLE 5 Logistic regression model results for COVID-19 vaccination status (not vaccinated = 0; vaccinated = 1) on the perceived risk score of not getting the COVID-19 vaccine (range: 1–10), gender (0 = female; 1 = male), ethnicity (0 = Hispanic; 1 = Not Hispanic), and the gender by ethnicity interaction. $N = 61$ (survey of 67 individuals, six observations were omitted because of missing information).

Term	Coefficient Estimate	SE[*]	Z statistic	p-value
Intercept	0.78	0.90	0.87	0.39
Perceived risk score of not getting the COVID-19 vaccine	0.30	0.12	2.46	0.01
Gender	−1.10	1.41	−0.78	0.44
Ethnicity	−0.56	1.37	−0.41	0.68
Gender * Ethnicity	0.07	1.94	0.04	0.97

[*]SE = Standard Error.
The multiplicative increase in the odds ratio (OR) of being vaccinated associated with a Δ-point increase in the perceived risk score of not getting the COVID-19 vaccine is calculated as $\exp(0.30 ^* \Delta)$, where 0.30 is the coefficient estimate given in the table below.

corresponded to an increase in the odds ratio (OR) of being vaccinated by a factor of 3.27 (95% CI: 1.27, 8.40). As a concrete example from our model, for the lowest vaccinated group in our sample (i.e., non-Hispanic males), a change in the perceived risk score of not getting the COVID-19 vaccine from 5 to 9 corresponded to a change in the probability of being vaccinated from 66% (95% CI: 39%, 86%) to 86% (95% CI: 57%, 97%).

Discussion

Analyzing data collected during the COVID-19 pandemic may provide insight into how to promote the health-protective behavior of vulnerable workers and employers during times of new novel threats (such as future pandemics or crises) and insight into how such workers and employers process competing risks. In this study, the primary differences between respondents at beauty salons and auto shops regarding their perceived risks of COVID-19 vaccination are between the vaccinated and unvaccinated. Unvaccinated participants' perceived risk of not getting the COVID-19 vaccine was the lowest, suggesting little fear or worry about the disease and higher anxiety and worry about the vaccine. Previous studies showed that the perceived risk of the disease a vaccine protects against is the main factor influencing vaccination status (29–31). The vaccine's safety is also an influencing factor that can help explain racial and ethnic differences in status (31). Lower vaccine acceptability for individuals identifying as non-Latinx African American, of low income, lacking health insurance, and conservative-leaning have been documented (32), which may typify the unvaccinated respondents of this investigation.

In this analysis, the perceived risk of not getting the COVID-19 vaccine is a more meaningful indicator of vaccination status than gender, ethnicity, or other demographic characteristics typically associated with vaccination status. A previous investigation has shown that using only demographic factors limits explanatory models of why individuals are hesitant to get the COVID-19 vaccination, whereas identifying drivers of and barriers to vaccination is a more informative approach (33). An individual's perceived risk is determined by a combination of factors that include technically and socially derived information (34). Sandman originated the concept of outrage, which refers to the public's collective factors when considering if exposure to a hazard (risk) is acceptable (35). Outrage factors that may contribute to respondents' perceived risk of not getting the COVID-19 vaccine may include voluntariness (assume risk is voluntary), control (can prevent or control), fairness (no greater risk than others), and diffusion in time and space (spread over a large population or concentrated) (36). Because a barrier to vaccination success is public hesitancy, a longitudinal understanding of the perceived risks of COVID-19 and vaccines will be crucial to adjusting the scientific communication about the vaccine.

Our results demonstrate that participating workers in small service-industry businesses highly accepted the COVID-19 vaccine (83% of the respondents in this study reported at least receiving one dose). Vaccination rates were between 52 and 80% across Pima County (first dose) during the study period (37). Vaccinated respondents may also feel safer in situations that may expose them to COVID-19, which may explain why the vaccinated and the unvaccinated in this study have similar rankings of COVID-19 risks and thus likely similar levels of fear

about the COVID-19 disease. The timing of the cross-sectional study overlaps with when individuals were receiving vaccine second doses and starting booster shots, a period during the pandemic when confidence was high. This public confidence in the first dose vaccine may have influenced the responses of the vaccinated individuals.

Respondents scored the perceived risk of disinfection significantly lower than that of COVID-19. This result could translate to more frequent use of disinfection products to decrease COVID-19 exposure and increase client confidence regarding the safety of visiting a business. The intensification of hygiene efforts could subsequently increase worker exposure to VOCs, as many disinfectants contain these chemicals. Before the pandemic, we measured VOC exposures to be high among workers during cleaning activities in this study. A U.S. EPA study concluded that exposure to airborne pollutants is high when using VOC-containing products, and air concentrations can persist "long after the activity is completed" (38).

Additionally, the health effects of exposure to VOCs vary greatly and can result in asthma and cardiovascular disease, which are risk factors for COVID-19 complications (39). Continued monitoring of these compounds will be essential to ascertain the pandemic's impact on VOC levels in beauty and auto small businesses. The perceived risk ranking of disinfection was moderately risky for unvaccinated respondents but low risk for vaccinated ones (minor difference). A possible explanation for the former might be a wariness of disinfection chemicals. For example, a spike in disinfectant poisonings due to confusion about public messaging resulted in a jump in calls to poison control centers during the pandemic (40). Salvadori and Lauriola concluded in their study that promoting hygiene and cleaning was due to the "negative affective attitude toward the COVID-19 and meditated by an affective appraisal of risk" (15). Interestingly, the vaccinated group did not have a high-risk perception of disinfection, which may indicate a lack of public awareness about the COVID-19-related poisonings or the VOCs contained in the products.

Study participants ranked economic risk among the highest (5/6) among the following six categories: getting the COVID-19 vaccine, not getting the COVID-19 vaccine, COVID-19, disinfection, economic, and general (Table 4). For small businesses, economic impacts during the COVID-19 pandemic were high because of social distancing and shelter-in-place guidelines (2). Also, small businesses had higher financial and health disparities before the onset of the COVID-19 pandemic, making it difficult to respond to and recover from the disruptions associated with COVID-19 (3). Bartik et al. concluded that 43% of the small businesses surveyed were temporarily closed, and employment fell by 40% while dealing with expenses through cuts, debt, or bankruptcy (2). Perceived economic risk is high because of the lived experiences of workers

at small businesses and the precarious nature of their business even before the COVID-19 pandemic.

Questions on general risk were incorporated into the cross-sectional survey to understand how individuals ranked these risks compared to COVID-19. General risk was moderate to high between the vaccinated and unvaccinated, respectively. It suggests that respondents' risk perception toward everyday activities may be typical. General risks were scored higher than COVID-19 disinfection and COVID-19 risk.

A limitation of the study is its small sample size, which can impact the statistical power of the analysis. Also, data collected in the survey was self-reported behavior and not actual behavior observed. During data collection, risk perceptions about COVID-19 and associated vaccines may have become more positive as vaccination rates nationwide also improved. This study did not include a survey of individuals before vaccines were widely available. Although vaccines were widely available during the study period, participants experienced waves of COVID-19 variants (Delta, Omicron) that may have also influenced health behavior and COVID-19 risk perception. Additionally, vaccinated individuals may be more likely to respond to the cross-sectional survey, biasing survey results.

On a broader scale, the results of this study add to the growing literature about small business beauty salons and auto shops impacted during the COVID-19 pandemic. These businesses shifted into survival mode, maneuvering economics, interventions, and COVID-19. Understanding the risk perception of these worker populations can also strengthen national efforts to communicate actionable steps during a public health crisis that can help reduce anxiety and fear by increasing the sense of agency of these individuals.

Conclusion

This study documented workers' risk perceptions from beauty salon and auto shop small businesses located in Tucson, Arizona, during the COVID-19 pandemic. These less visible and disproportionally frontline workers from service industries had higher vaccination rates than the general population. Future messaging targeting these small businesses should focus on vaccine-hesitant individuals to increase their perceived risk of not getting the COVID-19 vaccine (disease saliency). Vaccines are a crucial line of defense for workers considered frontline or essential. Messaging about vaccination should address safety concerns, provide actionable steps, and impact emotion. This is even more important as a Center for Disease Control recent study revealed that only about half of the people eligible for a booster vaccine have not received one (41). For example, because the virus that causes COVID-19 is novel, researchers are still trying to understand the long-term impacts on human

health. Communicating the long hauler effects of the COVID-19 disease such as fatigue, cognitive problems, rapid heartbeat, and shortness of breath may help (42).

Additionally, an unintentional increase in exposure to disinfectants is possible during the study period. Understanding these exposures is necessary to build trust and communicate solutions. In the future, it will be essential to continue monitoring workers at small businesses and their associated changes in perception of risk of COVID-19, because the pandemic is not over. Also, expanding the study to other areas that were not as impacted by the pandemic will help determine which disparities increased during this public health crisis and how they directly impacted these industries. Future results on this topic should also be translated to policymakers to make further recommendations to safeguard worker health.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation in compliance with the study's human subjects protocol.

Ethics statement

The studies involving human participants were reviewed and approved by University of Arizona Human Subject Protection Program. The patients/participants provided their written informed consent to participate in this study.

Author contributions

DM interpreted the quantitative data and wrote the original draft of this manuscript. SG analyzed and interpreted the data and contributed to the writing of the manuscript. JH developed the RedCAP to collect survey responses and contributed to the editing and writing of the manuscript. CQ managed the field study, translated study materials, collected survey responses, and contributed to the editing of the manuscript. MC collected survey responses and contributed to the editing of the manuscript. SS contributed to the editing of the manuscript. FS directed engagement for the project and managed recruitment for the study. SC designed the study and contributed to the editing and writing of the manuscript. MI assisted with creating the survey, training on survey administration and contributed to the editing of the manuscript. RS designed the recruitment material. DB designed the quantitative methodology, interpreted the quantitative data, and contributed to the writing of the manuscript. PB conceptualized the study, co-created the survey, interpreted the quantitative data, reviewed the manuscript in detail, and contributed to the writing of the manuscript.

All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.921704/full#supplementary-material

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COVID-19 vaccine uptake among people who inject drugs in Tijuana Mexico

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Background: SARS-CoV-2 prevalence is elevated among people who inject drugs (PWID). In Tijuana, Mexico, COVID-19 vaccines became available to the general population in June 2021, but uptake among PWID was <10%. We studied COVID-19 vaccine uptake among PWID in Tijuana following implementation of a pop-up vaccination clinic.

Methods: Beginning in October, 2020, PWID in Tijuana aged ≥18 years were enrolled into a longitudinal cohort study. At baseline and semi-annually, participants underwent interviewer-administered interviews on health behaviors and COVID-19 exposures through April 5, 2022. From June 21—September 20, 2021, staff referred PWID to a temporary COVID-19 vaccine pop-up clinic that was coincidentally established near the study office. Participants attending the clinic completed a short interview on barriers to vaccination and were offered facilitated access to free Janssen® COVID-19 vaccine. All participants were reimbursed $5 for this interview, regardless of whether or not they chose to be vaccinated. Poisson regression was used to evaluate the effect of the pop-up clinic on COVID-19 vaccination uptake, controlling forpotential confounders.

Results: Of 344 participants, 136 (39.5%) reported having received at least one COVID-19 vaccine dose during the 10 months follow-up period, of whom 113 (83.1%) received vaccine at the pop-up clinic and 23 (16.9%) elsewhere. One third of those receiving COVID-19 vaccine during the pop-up clinic were previously vaccine hesitant. Attending the pop-up clinic was independently associated with higher rates of COVID-19 vaccination Adjusted Rate Ratio (AdjRR: 9.15; 95% CI: 5.68−14.74).

Conclusions: We observed a significant increase in COVID-19 vaccine uptake associated with attending a temporary pop-up vaccine clinic in Tijuana suggesting that efforts to improve vaccination in this vulnerable population should include convenient locations and staff who have experience working with substance using populations. Since COVID-19 vaccination rates remain sub-optimal, sustained interventions to increase uptake are needed.

Introduction

Individuals with a diagnosis of substance use disorder, including opioid use disorder, have significantly higher risk of acquiring SARS-CoV-2 and worse clinical outcomes than other COVID-19 patients (1). In a previous study of people who inject drugs (PWID) in Tijuana and San Diego, SARS-CoV-2 prevalence was 37.5%, which was higher than the general population in both cities (2). PWID may experience severe COVID-19 illness due to comorbid conditions, including chronic kidney, liver and lung diseases (1, 3–5). Additionally, PWID have limited access to health care services and often experience stigma and discrimination that perpetuates medical mistrust, contributing to poor health care utilization (6, 7). Due to the high COVID-19 burden among PWID, there is a need to expand COVID-19 vaccination efforts for this population (2, 8, 9).

In Mexico, SARS-CoV-2 has caused over 5.5 million cases of COVID-19 (10). Mexico developed five stages for vaccination rollout (11). In Stage 1, Mexico vaccinated 100% of their healthcare personnel (1.25 million people) between December 2020 and February 2021 (12). In Stage 2 (February to May 2021), vaccination efforts were prioritized to municipalities with concentrated COVID-19 mortality, starting with those 60 years old and older (11, 13). Efforts expanded with Stage 3 (May to June 2021) prioritizing pregnant women in the second or third trimester and persons 50 years or older. Stage 4 (June to July 2021) expanded to persons 40 years or older, and finally, Stage 5 vaccinating the general population beginning in July 2021 (12). In Tijuana, Baja California, Mexico's most northwestern state abutting California, United States, COVID-19 vaccines became available according to the above schedule at mass vaccination sites throughout the city, where SinoVac-CoronaVac®, Oxford-AstraZeneca®, and J&J/Janssen® vaccines were offered (14).

By June 25, 2021, Baja California reported being close to becoming the first state in Mexico to achieve full vaccination for most of its adult residents (15, 16) following a donation of J&J/Janssen vaccine from the United States; however, vaccine uptake was lower in some marginalized populations (17). As in other Mexican cities, individuals in Tijuana seeking COVID-19 vaccination were required to register online and enter their CURP (*Clave Única de Registro de Población*; Mexican official unique identifier) to obtain an appointment and were asked to print the appointment card or present their CURP to verify their identity (18), which has been shown to be a barrier to health services in other settings (19). For low income residents such as most PWID, this may have represented a financial burden since those lacking computer or smartphone access were required to pay for computer time and printouts. Additionally, some COVID-19 vaccine queues were very long. People without reliable transportation may have faced additional barriers to access.

An earlier study conducted by our binational team found that only 7.6% of PWID living on either side of the San Diego-Tijuana border reported having had at least one COVID-19 vaccine dose by September 2021, and nearly one-third reported being vaccine hesitant (17). There was no difference in COVID-19 vaccine hesitancy between PWID residing in San Diego vs. Tijuana or by race/ethnicity but younger PWID and those who endorsed COVID-19 disinformation were more vaccine hesitant (17). Disinformation has been described as the deliberate spread of false information, as opposed to misinformation, which is spread without malicious intent (2, 20).

In an effort to increase COVID-19 vaccination among marginalized populations, a temporary pop-up vaccination clinic was set up in Tijuana's Zona Norte that offered assistance to access free COVID-19 vaccination. We studied predictors of COVID-19 vaccine uptake clinic among PWID, hypothesizing that PWID who attended the pop-up clinic would be more likely to be vaccinated. We also postulated that those endorsing more COVID disinformation beliefs would be less likely to become vaccinated.

Methods

Participants and eligibility

Between October 28, 2020 and September 10, 2021, adults aged ≥18 or older who injected drugs within the last month and lived in San Diego County or Tijuana were recruited into a longitudinal cohort study, as previously described (2). Recruitment took place using street outreach whereby potential participants were approached in various locations, such as on the street, parks, bars, shelters, motels, river canyons and vacant lots. The current analysis was restricted to the 344 participants who were recruited in Tijuana, had not received a COVID-19 vaccination prior to the opening of the pop-up clinic and who underwent the necessary interviews to collect data on COVID-19 vaccination history. The study was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki). Informed consent was obtained from all participants and the protocol was approved by institutional review board at Xochicalco University in Tijuana.

Baseline and follow-up survey measures

After providing written informed consent, participants were provided with a photo ID with the study's logo and contact information. All underwent face-to-face interviewer-administered surveys using computer assisted personal interviews in the study office, which was located in the Zona Norte neighborhood in Tijuana. Surveys assessed socio-demographics, chronic health conditions (e.g., diabetes, asthma,

hypertension), and potential experiences in their lifetime and during the last 6 months such as homelessness, number of hours spent on the street, injection and non-injection use of specific drugs, food insecurity (21), if they had been enrolled in a substance use treatment program, had been incarcerated or used a syringe services program (SSP).

To reduce participant burden, some survey items, including COVID-19 related beliefs, exposures and vaccination uptake were administered at a supplemental interview approximately 1 week following the baseline visit. We also asked participants about various COVID-19 related experiences (negative income impact, food insecurity, knows someone who died from COVID-19), potential exposures to COVID-19 and protective behaviors (e.g., social distancing, masking, COVID-19 testing). Perceived threat of COVID-19 was assessed by asking participants how worried they were about getting COVID-19 (or getting it again) on a 10 point scale (22).

We asked participants if they had ever received one or more doses of COVID-19 vaccine, and if so, to specify the date and location. To assess COVID-19 misinformation, we presented participants with seven statements about SARS-CoV-2 transmission, severity, immunity, symptoms, treatments and vaccines and asked them to classify each statement as "True", "False," or "Unsure" (17). These included the following: (1) COVID-19 cannot be easily spread from one person to another; (2) many thousands of people have not died from COVID-19; (3) most people are immune to COVID-19; (4) you can tell someone has COVID-19 from looking at them; (5) there are treatments that can cure COVID-19; (6) COVID-19 is about as dangerous as having the flu; and (7) COVID-19 vaccines are not safe for pregnant women. We then created a binary variable for each statement indicating whether the participant was misinformed or not, grouping "unsure" responses with responses that clearly indicated having endorsed misinformation.

COVID-19 disinformation was assessed through a six-item scale including conspiracy theory items as previously described (23). These included "COVID-19 was created by the pharmaceutical industry" or "the Chinese government", "childhood vaccines cause autism" (24), as well as three additional items: "COVID-19 vaccines include a tracking device", "alter DNA", and "COVID-19 vaccines offered to 'people like me' are not as safe". We dichotomized responses to indicate endorsement of disinformation ("True" and "Unsure") or not ("False") and summed them into a total score ranging from 0–6. The mean inter-item correlation value was 0.31, which indicates optimal internal consistency (25). We also assessed COVID-19 vaccine hesitancy as Yes versus No or Unsure.

Follow-up visits were conducted every 6 months where the above measures, including COVID-19 vaccine uptake was re-assessed. Participants were compensated $20 USD for the baseline and follow-up surveys and $10 for the supplemental survey.

SARS-CoV-2 antibody detection

Blood samples were collected by venipuncture. Sera were batched and tested weekly by Genalyte® (San Diego, CA), using their Maverick™ Multi-Antigen Serology Panel (26) that detects IgG and IgM antibodies to five SARS-CoV-2 antigens.

SARS-CoV-2 RNA detection

Participants were shown how to self-collect anterior nasal swabs in the presence of study staff. Swabs which were placed in 3 mL of viral transport media for temporary storage, before being shipped for testing at the San Diego Center for AIDS Research laboratory. RT-PCR was conducted using a pooling approach based on the Fluxergy system® (Irvine, CA) to detect SARS-CoV-2 RNA.

HIV and HCV serology

Rapid HIV and HCV tests were conducted using MedMira's Miriad Rapid HIV/HCV Antibody Test (Halifax, Nova Scottia, CA). Reactive and indeterminate tests underwent a second rapid test with Oraquick® HIV or Oraquick® HCV, respectively (Orasure, Bethlehem, PA) and were confirmed by Western Blot at the UC San Diego Centers for AIDS Research.

Participant referrals

Following the interview and specimen collection, participants were referred to available resources depending on their responses and stated needs (e.g., treatment for HIV, substance use). From June 21—September 20, 2021, participants who indicated that they had not had a prior COVID-19 vaccine were referred to a pop-up COVID-19 vaccine clinic, which was located nearby the study office in a neighborhood known for its high level of drug use and where sex work is quasi-legal.

Pop-up clinic procedures

Participants who attended the pop-up clinic were permitted to show their photo ID from our study as proof of identification and were provided with assistance obtaining their CURP if needed by clinic staff, all of whom had extensive experience with substance users. Participants were also invited to undergo a short interviewer-administered survey which included reasons why they had not yet received a COVID-19 vaccine. At the end of the survey they were reimbursed $5 USD and were offered facilitated access to free single-dose Janssen® COVID-19 vaccine by a licensed medical provider with pre- and post-test counseling.

Monetary reimbursement was not contingent upon participants' decision to receive the vaccine.

Statistical analysis

All eligible participants who were not vaccinated prior to establishment of the pop-up clinic (i.e., June 21st, 2021) were included in this analysis. Participants were followed up until April 5th, 2022 and the outcome (i.e., whether they received a vaccine or not by the end of follow-up period) was assessed.

Characteristics of participants who were and were not COVID-19 vaccinated were summarized by generating frequencies and percentages for binary variables and means and standard deviations for continuous variables. The two groups were compared using Mann-Whitney U tests for continuous variables and Chi-square or Fisher's Exact tests for categorical variables. Since our primary objective was to assess whether the exposure to an intervention (visiting the pop-up clinic) was successful at increasing vaccination uptake, we undertook the following analytical approach. First, as suggested by VanderWeele (2019) (27), we selected a series of variables to further examine and determine potential confounders to control for in a multivariable model to estimate the intervention effect on the outcome. Initially, all the variables listed in Table 2 were selected based on subject-matter knowledge and the assumption that any could played a causal role on the outcome (vaccine uptake), primary exposure (visiting the pop-up clinic), or both.

Next, we regressed each individual variable listed in Table 2 on the vaccine uptake outcome by conducting univariate Poisson regressions with robust standard error estimations *via* generalized estimating equations (GEE) (28, 29). Whether a participant got vaccinated between June 21st, 2021 and April 5th, 2022 in conjunction with the natural logarithm of time spent "at risk" facilitated the estimation of the vaccine incidence rate. For those who got vaccinated, time spent "at risk" was calculated as the number of days between the dates when COVID-19 vaccination was first offered to the date of self-reported vaccination, whereas for those unvaccinated it was calculated as the number of days between when COVID-19 vaccination was first offered to the date when the participant was last seen. The estimates from the aforementioned regressions are listed in Table 2.

To identify variables that might play a causal role on the exposure, we regressed all of the variables listed in Table 2 on the exposure variable (i.e., attended the pop-up clinic) by conducting univariate logistic regressions with robust standard error estimation *via* GEE (results not shown).Next, considering each variable's effect size on the outcome or exposure, in conjunction with a level of statistical significance of 0.10 which is in an acceptable range supported in the literature (28), we narrowed down the candidates for inclusion in a multivariable model. Last, we created the final multivariable

model by using the "purposeful selection of variables" strategy of Hosmer and Lemeshaw (1999, 2000) (30, 31), where subject matter significance, relationships among the independent variables (e.g., correlations, confounding, and interactions) and statistical significance were taken into consideration. In the final multivariable model, only covariates that maintained a significance level <0.10 were retained. All possible confounding interactions were assessed and ruled out. Multi-collinearity was ruled out based on appropriate values of the largest condition index and VIFs.

All statistical analyses were conducted using SAS, version 9.4.

Results

Sample characteristics

A total of 344 cohort participants reported not having received any COVID-19 vaccine before June 21, 2021 and completed questions on COVID-19 vaccination during the study period ending April 5, 2021, and hence were eligible for this analysis. The majority were male (74.4%), Mexican (91.0%) and mean age was 43 years (SD = 9.6).

COVID-19 vaccine hesitancy and vaccine uptake

Of the 344 participants, 324 (94.2%) completed the supplemental survey which included questions on COVID-19 vaccine hesitancy. Of these, 62 (19.1%) reported that they were not interested in receiving the vaccine, 55 (17.0%) were unsure and 207 (63.9%) reported that they were willing to be vaccinated. Over nearly 10 months of follow-up, 136 (39.5%) reported having received at least one COVID-19 vaccine dose, of whom 113 (83.1%) received vaccine at the pop-up clinic and 23 (16.9%) received it elsewhere. Of 105 participants who received COVID-19 vaccine at the pop-up clinic and had previously answered questions on vaccine hesitancy, 36 (34.3%) had previously expressed being unwilling or unsure about being vaccinated against COVID-19.

Factors associated with COVID-19 vaccine uptake in univariate regression

Factors associated with receiving at least one dose of COVID-19 vaccine during the 10 month follow-up period are shown in Tables 1, 2. We observed no sociodemographic factors that predicted COVID-19 vaccine uptake. Considering behavioral characteristics, participants who reported engaging in sex work in the last 6 months were marginally more likely

TABLE 1 Characteristics Associated with COVID-19 Vaccination among PWID in Tijuana, Mexico (*n* = 344).

Baseline characteristics	Vaccinated $N = 136$	Not vaccinated $N = 208$	Total $N = 344$	P
Socio-demographics				
Male	98 (72.1%)	158 (76.0%)	256 (74.4%)	0.45
Mean Age [standard deviation (SD)]	43.5 (9.6)	43.3 (9.7)	43.4 (9.6)	0.91
Hispanic/Latinx/Mexican	121 (89.0%)	192 (92.3%)	313 (91.0%)	0.34
Speaks English	132 (97.1%)	195 (93.8%)	327 (95.1%)	0.21
Speaks Spanish	78 (57.4%)	111 (53.4%)	189 (54.9%)	0.51
Born in Mexico	108 (79.4%)	156 (75.0%)	264 (76.7%)	0.36
Primary residence in Tijuana	78 (57.4%)	114 (54.8%)	192 (55.8%)	0.66
Mean years of school completed (SD)	8.4 (3.1)	8.7 (3.4)	8.6 (3.3)	0.38
Married or common law	39 (28.7%)	47 (22.6%)	86 (25.0%)	0.21
Average monthly income <500 USD	94 (69.1%)	143 (68.8%)	237 (68.9%)	1.0
Impact/Exposures related to COVID-19				
Homeless*	42 (30.9%)	66 (31.7%)	108 (31.4%)	0.91
Incarcerated*	8 (5.9%)	14 (6.7%)	22 (6.4%)	0.82
Mean # of people in the same household (SD)*	5.8 (11.6)	6.3 (12.5)	6.1 (12.2)	0.62
Engaged in sex work*	29 (21.3%)	29 (13.9%)	58 (16.9%)	0.08
Client of sex worker*	8 (5.9%)	15 (7.2%)	23 (6.7%)	0.67
Income worse since COVID began[Y]	112 (83.0%)	156 (75.4%)	268 (78.4%)	0.11
Low/very low food security since COVID began	115 (84.6%)	177 (85.1%)	292 (84.9%)	0.88
Substance use				
Smokes cigarettes	117 (86.0%)	184 (88.5%)	301 (87.5%)	0.51
Smoked or vaped marijuana*	61 (44.9%)	112 (53.8%)	173 (50.3%)	0.12
Smoked/snorted/inhaled/vaped methamphetamine*	65 (47.8%)	113 (54.3%)	178 (51.7%)	0.27
Smoked/snorted/inhaled crack or powder cocaine*	3 (2.2%)	16 (7.7%)	19 (5.5%)	0.03
Smoked/snorted/inhaled/vaped either heroin or fentanyl*	23 (16.9%)	42 (20.2%)	65 (18.9%)	0.48
Injected methamphetamine*	52 (38.2%)	82 (39.4%)	134 (39.0%)	0.91
Injected cocaine*	6 (4.4%)	14 (6.7%)	20 (5.8%)	0.48
Injected either heroin or fentanyl*	125 (91.9%)	193 (92.8%)	318 (92.4%)	0.84
Mean # of years of injection drug use (SD)	21.0 (11.5)	21.0 (11.5)	21.0 (11.5)	0.93
Mean # of times injected drugs per day*(SD)	2.4 (1.6)	2.6 (1.6)	2.5 (1.6)	0.29
Visited shooting galleries*	46 (33.8%)	64 (30.8%)	110 (32.0%)	0.56
Receptive needle sharing*	71 (52.2%)	121 (58.2%)	192 (55.8%)	0.32
Health conditions				
Tested HIV+	19 (14.0%)	27 (13.0%)	46 (13.4%)	0.87
Tested HCV+	55 (40.4%)	82 (39.4%)	137 (39.8%)	0.91
Mean # of chronic conditions (excluding seasonal allergies and acne/skin problems) (SD)	0.5 (0.9)	0.7 (1.2)	0.6 (1.1)	0.25
Has at least one chronic illness	39 (28.7%)	69 (33.2%)	108 (31.4%)	0.41
Protective behaviors during the COVID-19 pandemic				
Social Distancing	9 (6.6%)	7 (3.4%)	16 (4.7%)	0.19
Isolated or quarantined themselves	2 (1.5%)	3 (1.4%)	5 (1.5%)	1.0
Wore face mask	111 (81.6%)	157 (75.5%)	268 (77.9%)	0.19
Increased handwashing/sanitizer	15 (11.0%)	8 (3.8%)	23 (6.7%)	0.01
Engaged in at least one protective behavior	119 (87.5%)	178 (85.6%)	297 (86.3%)	0.63

(Continued)

TABLE 1 (Continued)

Baseline characteristics	Vaccinated N = 136	Not vaccinated N = 208	Total N = 344	P
COVID-19-related disinformation				
Thinks that the pharmaceutical industry created the COVID-19 virus	36 (26.5%)	49 (23.6%)	85 (24.7%)	0.61
Thinks that the coronavirus was created by the Chinese government as a biological weapon	43 (31.6%)	63 (30.3%)	106 (30.8%)	0.81
Thinks that vaccines given to children for diseases like measles and mumps cause autism	90 (66.2%)	112 (53.8%)	202 (58.7%)	0.03
Thinks that COVID-19 vaccines being offered to 'people like me' are not as safe as other COVID-19 vaccines	17 (12.5%)	27 (13.0%)	44 (12.8%)	1.0
Thinks that COVID-19 vaccines include a tracking device	16 (11.8%)	33 (15.9%)	49 (14.2%)	0.34
Thinks that some COVID vaccines could change their DNA	18 (13.2%)	25 (12.0%)	43 (12.5%)	0.74
Endorses at least one conspiracy theory	101 (74.3%)	128 (61.5%)	229 (66.6%)	0.01
COVID-19-related misinformation				
Does not think that the virus that causes COVID-19 can be easily spread from one person to another	29 (21.3%)	44 (21.2%)	73 (21.2%)	1.0
Does not think that many thousands of people have died from COVID-19	25 (18.4%)	34 (16.3%)	59 (17.2%)	0.66
Thinks that most people already have immunity to COVID-19	98 (72.1%)	133 (63.9%)	231 (67.2%)	0.13
Thinks that you can tell someone has COVID-19 by looking at them	24 (17.6%)	30 (14.4%)	54 (15.7%)	0.45
Thinks that having COVID-19 is about as dangerous as having the flu	47 (34.6%)	70 (33.7%)	117 (34.0%)	0.91
Does not think that COVID-19 vaccines are safe for pregnant women	54 (39.7%)	91 (43.8%)	145 (42.2%)	0.50
Most important source of COVID-19-related				
Information				
Friends	80 (58.8%)	129 (62.0%)	209 (60.8%)	0.57
Doctors/health professionals	3 (2.2%)	1 (0.5%)	4 (1.2%)	0.30
Social media	11 (8.1%)	20 (9.6%)	31 (9.0%)	0.70
Conservative TV/radio	38 (27.9%)	52 (25.0%)	90 (26.2%)	0.62
Liberal TV/radio	4 (2.9%)	6 (2.9%)	10 (2.9%)	1.0
Additional COVID-19-related experiences				
Visited pop-up COVID-19 vaccine clinic	117 (86.0%)	63 (30.3%)	180 (52.3%)	<.001
COVID-19 Vaccine hesitancy (yes vs. no/unsure)[Y2]	32 (24.1%)	64 (30.8%)	96 (28.2%)	0.22
Knows someone who died from COVID-19	27 (19.9%)	39 (18.8%)	66 (19.2%)	0.89
Mean for: On a scale of 1 (low) to 10 (very), how worried are you of getting COVID-19 or getting it again (SD)	5.7 (2.8)	5.7 (2.6)	5.7 (2.7)	0.89
Knows someone who was vaccinated for COVID-19	93 (68.4%)	113 (54.3%)	206 (59.9%)	0.01
Thinks they had COVID-19	5 (3.7%)	21 (10.1%)	26 (7.6%)	0.04
Has been tested for COVID-19 outside the study	24 (17.6%)	30 (14.4%)	54 (15.7%)	0.45
Was exposed to somebody who tested positive for COVID-19	7 (5.1%)	12 (5.8%)	19 (5.5%)	1.0
Had at least one COVID-19 symptom on day of interview	37 (27.2%)	58 (27.9%)	95 (27.6%)	0.90
Tested SARS-CoV-2 seropositive	33 (24.3%)	60 (28.8%)	93 (27.0%)	0.09
Tested SARS-CoV-2 RNA positive	0 (0%)	3 (1.4%)	3 (0.9%)	0.28
Ever had a flu vaccine	31 (22.8%)	45 (21.6%)	76 (22.1%)	0.79

*Past 6 months; Missing values, [Y] n = 2 [Y2] n = 20.

Between group differences were determined using Mann-Whitney U tests for continuous variables and Chi-square or Fisher's Exact tests for categorical variables.

to receive COVID-19 vaccination (Table 1). Participants who reported using crack cocaine were less likely to have been vaccinated compared to those who did not report use of crack (2.2% vs. 7.7%, $p = 0.03$). Also, participants who reported increasing their handwashing or use of hand sanitizers were more likely to have been vaccinated compared to those who did not (11.0% vs. 3.8%, $p = 0.01$), but no other protective or health-related factors were predictive of vaccine uptake.

TABLE 2 Factors Associated with COVID-19 Vaccination among PWID in Tijuana, Mexico.

Baseline characteristics	Univariate RR (95% CI)	Multivariate Adj RR (95%CI)**
Socio-demographics		
Male	0.89 (0.67–1.18)	
Age[¥]	1.00 (0.99–1.02)	
Hispanic/Latinx/Mexican	0.80 (0.54–1.18)	
Speaks English	1.72 (0.72–4.08)	
Speaks Spanish	1.10 (0.85–1.44)	
Born in Mexico	1.17 (0.84–1.63)	
Highest year of school completed[¥]	0.98 (0.95–1.02)	
Married or common law	1.21 (0.91–1.60)	
Monthly income <500 USD	1.01 (0.76–1.34)	
Potential COVID-19 exposures		
Homeless*	0.98 (0.74–1.30)	
Incarcerated*	0.91 (0.52–1.62)	
Engaged in sex work*[P]	1.34 (0.99–1.80)	1.61 (1.01–2.55)[c]
Client of sex worker*	0.87 (0.49–1.55)	
Income worse since COVID began[Y2]	1.34 (0.93–1.94)	
Low/very low food security since COVID began	0.98 (0.68–1.40)	
Substance use		
Smokes cigarettes	0.88 (0.61–1.27)	
Smoked or vaped marijuana*	0.80 (0.62–1.05)	
Smoked/snorted/inhaled/vaped methamphetamine*	0.85 (0.66–1.11)	
Smoked/snorted/inhaled crack or powder cocaine*[P]	0.39 (0.14–1.10)	
Smoked/snorted/inhaled/vaped either heroin or fentanyl*	0.87 (0.61–1.25)	
Injected methamphetamine*	0.97 (0.74–1.27)	
Injected cocaine*	0.75 (0.38–1.48)	
Injected either heroin or fentanyl*	0.93 (0.58–1.49)	
# of times injected drugs per day[¥] *	0.96 (0.89–1.04)	
Health conditions		
Tested HIV+	1.05 (0.72–1.53)	
Tested HCV+	1.03 (0.79–1.34)	
Has at least one chronic illness	0.88 (0.65–1.18)	
Protective behaviors during the COVID-19 pandemic		
Social Distancing	1.45 (0.92–2.29)	
Isolated or quarantined themselves	1.01 (0.34–2.98)	
Wore face mask	1.26 (0.89–1.79)	
Increased handwashing/sanitizer[P]	1.73 (1.24–2.41)	
Engaged in at least one protective behavior	1.11 (0.74–1.66)	
COVID-19-related disinformation (i.e., endorsement of conspiracy theories)		
Thinks that the pharmaceutical industry created the COVID-19 virus	1.10 (0.82–1.47)	
Thinks that the coronavirus was created by the Chinese government as a biological weapon	1.04 (0.78–1.37)	
Thinks that vaccines given to children for diseases like measles and mumps cause autism	1.38 (1.04–1.83)	
Thinks that COVID-19 vaccines being offered to 'people like me' are not as safe as other COVID-19 vaccines	0.97 (0.65–1.45)	

(Continued)

TABLE 2 (Continued)

Baseline characteristics	Univariate RR (95% CI)	Multivariate Adj RR (95%CI)**
Thinks that COVID-19 vaccines include a tracking device	0.80 (0.52–1.23)	
Thinks that some COVID vaccines could change their DNA	1.07 (0.73–1.56)	
# of conspiracies they believe (out of 6)[¥]	1.03 (0.96–1.10)	
COVID-19-related misinformation (i.e., incorrect knowledge items)		
Does not think that the virus that causes COVID-19 can be easily spread from one person to another	1.01 (0.73–1.38)	
Does not think that many thousands of people have died from COVID-19	1.09 (0.78–1.52)	
Thinks that most people already have immunity to COVID-19	1.26 (0.94–1.70)	
Thinks that you can tell someone has COVID-19 by looking at them	1.15 (0.83–1.60)	
Thinks that having COVID-19 is about as dangerous as having the flu	1.02 (0.78–1.35)	
Does not think that COVID-19 vaccines are safe for pregnant women	0.90 (0.69–1.18)	
Most important source of COVID-19-related Information		
Friends	0.92 (0.71–1.20)	
Doctors/health professionals[P]	1.92 (1.07–3.43)	1.92 (1.28–2.86)[c]
Social media	0.89 (0.54–1.46)	
Conservative TV/radio	1.09 (0.82–1.46)	
Liberal TV/radio	1.01 (0.47–2.19)	
Additional COVID-19-related experiences		
Visited pop-up COVID-19 vaccine clinic[P]	5.61 (3.63–8.68)	9.15 (5.68–14.74)
COVID-19 Vaccine hesitancy[Y2]	0.81 (0.59–1.11)	
Knows someone who died from COVID-19	1.04 (0.75–1.44)	
On a scale of 1 (low) to 10 (very), how worried are you of getting COVID-19 or getting it again[¥]	1.00 (0.95–1.05)	
Knows someone who was vaccinated for COVID-19[P]	1.45 (1.08–1.94)	1.45 (0.97–2.18)[c]
Thinks they had COVID-19[P]	0.47 (0.21–1.04)	0.36 (0.13–1.01)[c]
Has been tested for COVID-19 outside of our study	1.15 (0.83–1.60)	
Has been exposed to somebody with a positive COVID-19 test result	0.93 (0.51–1.70)	
Had at least one COVID-19 symptom on day of interview	0.98 (0.73–1.32)	
Tested SARS-CoV-2 seropositive	0.82 (0.6–1.13)	
Tested SARS-CoV- RNA positive***	N/A	
Ever had a flu vaccine	1.04 (0.76–1.42)	

*past 6 months; Missing values, [Y]n = 2; [Y2]n = 20; [¥] Per one unit increase; [P]P-value < 0.10; **corresponding estimates were adjusted for all the variables included in the multivariable model. ***N/A due to zero cell for vaccinated persons. [c]Should be interpreted with caution as this variable was included as a confounder and may not be associated with the outcome.

Surprisingly, participants who received COVID-19 vaccination were more likely to believe that childhood vaccines caused autism (66.2% vs. 53.8%, $p = 0.03$); however, no other COVID-19 disinformation measures were associated with COVID-19 vaccination. Similarly, we found no associations between COVID-19 vaccination and endorsing statements that reflect COVID-19 misinformation. COVID-19 vaccine hesitancy was not significantly associated with vaccine uptake.

The strongest predictor of COVID-19 vaccination was visiting the pop-up COVID-19 vaccine clinic after receiving a referral. Of those who received the COVID-19 vaccine, 86% visited the pop-up clinic, whereas only 30.3% of those unvaccinated visited the clinic ($p < 0.001$), which corresponded to a Rate Ratio [RR] of 5.61 95% Confidence Interval (CI): 3.63–8.68; Table 2.

Knowing someone who had received COVID-19 was significantly associated with getting vaccinated, (RR: 1.45; 95% CI: 1.08–1.94) but participants who believed they had already had COVID-19 were less likely to get vaccinated (RR: 0.47; 95%CI: 0.21–1.04). Testing positive for SARS-CoV-2 antibodies

or RNA was not associated with vaccination. Association between Pop-Up Clinic Attendance on COVID-19 Vaccine Uptake 3.5.Adjusting for Confounders

Of variables included in Table 2, obtaining most of their COVID−19 information from health providers, having had COVID-19, knowing more people who had received COVID-19 vaccines and engaging in sex work were identified as potential confounders. After adjusting for these variables, attending the pop-up clinic became even more strongly associated with COVID-19 vaccination in the multivariate model [Adjusted Rate Ratio (AdjRR: 9.15; 95% CI: 5.68–14.74), Adjustment for sociodemographic factors such as age and sex did not alter parameter estimates. No significant interactions were observed.

Discussion

In this prospective study of PWID living in Tijuana during the COVID-19 epidemic, we found that attending a temporary pop-up vaccine clinic was independently associated with greater uptake of COVID-19 vaccination. Before this clinic was established, <10% of PWID in our study had received at least one COVID-19 vaccine dose (17), which is similar to a study of PWID in Oregon, USA (32). By the end of the 10 months follow-up period, the proportion of participants who had received at least one COVID-19 vaccine dose had increased to 39.5%. Although this level of vaccine coverage remains grossly sub-optimal, it is encouraging that at least one third of the study participants who were vaccinated during the pop-up clinic had previously reported being vaccine hesitant, suggesting that attendance at the clinic was influential in their decision to receive COIVID-19 vaccine.

Our findings should be interpreted cautiously due to the observational nature of our cohort study. Due to time constraints and the public health imperative to increase COVID-19 vaccination in this highly vulnerable population, we did not randomize participants to receive pop-up clinic referrals in a clinical trial design, which would have been more rigorous. Our study may have under-estimated the impact of the pop-up COVID-19 vaccination clinic since the clinic only operated during the first two months of the follow-up period and low statistical power may have attenuated the magnitude of some associations. Also, while we created a single multivariable model to assess the effect of the intervention on the outcome and adjusted for potential confounders which is common practice, some authors (33) suggest caution when trying to interpret the effects of the confounders on the outcome as they may not have the same interpretation as that of a "primary effect" on the outcome. We therefore limit our discussion to the potential effect of the pop-up clinic on COVID-19 vaccine uptake.

It is possible that some participants accepted the referral to the pop-up clinic because they were more interested in the $5 monetary reimbursement for completing the supplemental

survey, rather than receiving COVID-19 vaccine. Indeed, a review of 11 clinical studies showed that financial incentives were associated with a seven-fold increase in adherence to the vaccine schedule for Hepatitis B virus, leading some researchers to advocate for contingency management to increase COVID-19 vaccine uptake (8, 34). In a study of PWID in Oregon, contingency management was associated with a significant increase in SARS-CoV-2 testing (35). However, financial incentives are not able to compensate for broad vaccination barriers (36), and some studies have shown that small compensations may not increase COVID-19 vaccination rates (37, 38). Therefore, it may not be realistic to expect that lower and middle-income countries could provide large enough financial incentives to significantly increase COVID-19 vaccination given limited resources and competing health priorities.

Despite the limitations of our study design and relatively short follow-up period, our findings have implications for improved COVID-19 vaccine uptake in this marginalized population. Greater uptake of COVID-19 vaccination associated with the pop-up clinic could have been due to its convenient location in the Zona Norte, the clinic staff's experience and familiarity with the issues facing people living with addiction, the ability of participants to use their photo ID from the study as proof of identification, or the assistance some participants received from clinic staff in obtaining their CURP. Since our observational study design was unable to determine which of these or other factors may have been most influential in the participants' decisions to receive vaccination, additional studies are required to examine client preferences to appropriately tailor services to their needs.

Although we did not find COVID-19 disinformation, misinformation or vaccine hesitancy to be significantly associated with lower vaccine uptake as we had hypothesized, it is noteworthy that two-thirds of our cohort endorsed at least one COVID-19 conspiracy theory, one third felt that COVID-19 was "no worse than the flu", and close to 50% believed that COVID-19 vaccines are not safe for pregnant women. Apart from system-level barriers, widespread COVID-19 disinformation and government criticism was prevalent on both sides of the US-Mexico border (39) making it harder for people to discern false information from evidence-based sources. Based on these findings, additional interventions to address medical mistrust are needed.

In summary, our prospective evaluation found a significant increase in COVID-19 vaccine uptake associated with attending a pop-up vaccine clinic in Tijuana. Despite our encouraging findings, < 50% of PWID in our study had received at least one COVID-19 vaccine dose. Sustained efforts to improve COVID-19 vaccination in this population should focus on removing logistical and structural barriers to ensure that their health and that of the general population are protected.

Data availability statement

Ethics statement

The studies involving human participants were reviewed and approved by Institutional Review Board at Xochicalco University and the Office of IRB Administration at the University of California San Diego. The patients/participants provided their written informed consent to participate in this study.

Author contributions

AH-V, SM, MR, and CR were responsible for participant referrals and data collection. DA and IA were responsible for data management and analysis. SS conceived the study design and oversaw the analysis. SS, AH-V, and DA interpreted the findings. MM, SS, AH-V, IA, and SM wrote the manuscript. AH-V, SM, IA, DA, MM, CR, SA, and MR reviewed and edited the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Check for updates

COVID-19, science, vaccines and family in a multi origin Latinx population in South Florida

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During the Spring of 2021 in Miami-Dade County, four virtual focus groups were held with 31 participants from four diverse local Latinx communities as part of the Florida Community Engagement Alliance (FL-CEAL) Against COVID-19 Disparities project. The main objective was to explore attitudes about COVID-19 information and prevention strategies among South Florida's diverse Latinx populations, across a broad geographical area. The study used a semi-structured focus group qualitative design and chose participants from four well established Latinx neighborhoods. Participants were mostly women, diversity was strong with birth regions including the Caribbean, North, Central and South America. Though a third ($n = 11$) were born in the United States, almost all ($n = 28$) reported speaking Spanish at home. Three themes and six subthemes were identified to underscore Latinx attitudes toward COVID-19 vaccine uptake or hesitancy. These were: (1) Attitudes regarding vaccine intake; (2) Sources of Information; and (3) Science Education. The degree to which each of these themes exercised influence on vaccine intake or hesitancy varied. The multi origin Latinx participation in the focus groups strengthened findings by broadening representation and discussion. In the end and despite the various national origins, all participants indicated receiving most of their information on COVID-19 related topics from their family, physicians, social networks, and some form of media.

Introduction

Yo creo en la ciencia y creo que puede haber la capacidad de desarrollar una vacuna en muy poco tiempo. Sin embargo, han sido tantas las noticias que hemos escuchado, la información que nos bombardean y nos tienen confundidos… pero aún no estoy convencida que sea lo mejor y que esté completamente probado que es lo que debemos hacer. Yo todavía no estoy a punto de convencida de que debemos colocarnos la vacuna (Angela[1], focus group participant, Central Miami-Dade County, FL).

I believe in science and believe the means exist to develop a vaccine quickly. However, we've had such an overdose of information that all this bombardment of information has caused us to be confused… this is why I am not convinced that we should get it [vaccine], and that everything has been validated correctly, and that this is what we must do. I am not yet at the point of being convinced that we should get the vaccine (Angela, focus group participant, Central Miami-Dade County, FL).

At the time that Angela expressed the views above, COVID-19 related deaths in the United States (US) had surpassed 483,000 with 27,600,000 confirmed cases of infection (1) and < 2 months had passed since the first COVID-19 vaccine was administered in Florida (2). Yet, despite the development of a groundbreaking vaccine to combat the rising trajectory in both rates and mortality, vaccine hesitancy and fears plagued local communities throughout the US and became strong barriers to vaccine uptake (3). In fact, at the time of this writing, COVID-19 deaths have surpassed one million, and infections rates have reached nearly 89,000,000 cases in the US alone (1). Still, < 67% of individuals residing in the US have been fully vaccinated; this contrasts the higher rates of fully vaccinated individuals in other countries, including the United Arab Emirates (∼98%), Portugal (∼92%), and Cuba (∼87%) (1).

Similar to US national rates, only 68% of Florida residents are reported as having full vaccinations, compared to more than 93% in the District of Columbia (4). In Miami-Dade County (MDC), FL, the peninsula's southernmost county, and site of the current study, Latinxs compose over 69% of the population (5). Compared to non-Latinx White individuals, Latinxs are 200% more likely to die, and 250% more likely to be hospitalized—due to COVID-19 (6). In fact, several studies have shown that the COVID-19 pandemic has disproportionately impacted marginalized minority communities (7–9) and Latinx communities in MDC are no exception.

During the Spring of 2021 in MDC, four virtual focus groups were held with 31 participants from four diverse Latinx communities as part of the Florida Community Engagement Alliance (FL-CEAL) Against COVID-19 Disparities project (10).

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1 All names for participants throughout the manuscripts are pseudonyms that have been assigned to protect participant privacy.

TABLE 1 Characteristics of participants.

	n	%
Gender		
Female	21	70.0
Male	8	25.8
Transgender	1	6.7
Language spoken at home		
English	2	6.7
Spanish	28	93.3
Region of birth		
Caribbean	4	13.3
Central America	10	33.3
North America	12	40.0
South America	4	13.3
Race		
Black or African-American	2	6.7
White	19	63.3
White, American Indian or Alaska Native (Biracial)	1	3.3
White, Black or African-American (Biracial)	1	3.3
Prefer not to answer	7	23.3
Household income		
Less than $15,000	2	6.7
$15,000–$19,999	1	3.3
$20,000–$24,999	2	6.7
$25,000–$34,999	4	13.3
$35,000–$49,999	7	23.3
$50,000–$74,999	11	36.7
$100,000 and above	3	10.0
Education		
Some high school	1	3.3
High school graduate or GED	3	10.0
Associate's or technical degree	8	26.7
Bachelor's degree	15	50.0
Graduate degree	3	10.0
Age (in years) *M* = 44.4, *SD* = 13.7		
20–29	5	16.7
30–39	8	26.7
40–49	5	16.7
50–59	8	26.7
60–69	4	13.3

Median age = 40.5.

The groups were conducted to explore attitudes about COVID-19 information and prevention strategies among South Florida's diverse Latinx populations.

At the start of the FL-CEAL project, the only CDC recommended prevention approaches based on research consisted of mitigation strategies such as social distancing, wearing masks, washing hands regularly, and isolation when

or if infected (11). During this time, much was still unknown about the epidemiology of COVID-19; hence, misinformation and fearmongering quickly became widespread across social and mass media outlets regarding the origins of COVID-19, its effects, infection rates, and mortality (3). Simultaneously, scientists were working to understand the new virus, while health care providers risked their personal health and safety in overwhelmed and understaffed hospitals (12). Concurrently, the US government became divided on how to address the pandemic, causing division among citizens as well (3). On December 11, 2020, the United States Food and Drug Administration (FDA) issued an Emergency Use Authorization (EUA) for the first COVID-19 vaccine (Pfizer-BioNTech) (13). One week later, the FDA issued another EUA for a second vaccine (Moderna) (13). Two months after the second vaccine was issued, the FDA issued the third EUA (Janssen) (13); full FDA approval for COVID-19 vaccines were the fastest in FDA history (14), but sparked widespread misinformation, misconceptions, and conspiracy theories about the vaccine itself (3).

It was in this highly politicized context regarding the COVID-19 pandemic and vaccine that we held focus groups and community observations in MDC, Florida, in early Spring 2021. The purpose was to explore how diverse Latinx residents—of various national origins, socio-economic status, political beliefs, and sexual orientation—viewed the COVID-19 pandemic and recently developed vaccines, while also identifying potential barriers or motivators to receiving the vaccine and promoting it to family members and friends.

Design

The current study used a semi-structured focus group qualitative design. Four virtual focus groups ($N = 31$ overall) were conducted throughout Miami-Dade County (MDC) from January 21 to February 15, 2021. Participants were recruited from high density, multi-origin Latinx communities—specifically, North Miami-Dade County (North-MDC) ($N = 8$), Central Miami-Dade County (Central-MDC) ($N = 8$), South Miami-Dade County (South-MDC) ($N = 8$), and an additional county-wide sexual gender minority group (SGM) ($N = 7$). Participants were recruited by an outreach worker and are active community residents with no formal roles in the agencies that facilitated their recruitment. Outreach protocols established by (FL-CEAL) and the Center for Latino Health Research Opportunities (CLaRO) (a Florida International University and University of Miami collaborative research center) were instrumental in obtaining community support to remotely contact and recruit participants. Specifically, the study utilized the protocols directing community health workers to target minority communities with outreach focused on education and information regarding COVID-19 research and prevention

efforts. The design leveraged South Florida's multi-origin Latinx population to conduct outreach and recruit diverse Latinx participants.

Methods

Community selection and recruitment

Recruitment began on January 10, 2021, and was conducted in collaboration with various social service agencies strategically located throughout MDC, FL. A Latinx community outreach worker contacted local agencies to explain the research study and participation criteria. In designing the recruitment plan, agencies were selected on the basis of their Latinx client volume and their commitment to community participatory research with our academic institutions.

To obtain broad geographical inclusion, participants were chosen from four Latinx communities within MDC. These included: (1) North-MDC where Latinx populations compose 29.5% of the population; (2) Central-MDC, including the neighborhoods of Allapattah, composed of over 76% Latinxs, predominantly of Dominican Republic origin and Little Havana, composed of 95% Latinxs, historically of Cuban descent; however, in recent years the area has become more diverse and home to immigrants of Mexico, Central America, South America, and the Caribbean (15, 16). Finally, (3) South-MDC centered on the town of Homestead, predominantly a farm working community, which is composed of 68% Latinxs with higher rates of foreign-born residents (36%) compared to the rest of Florida (20.7%) (17). Given the study's inclusion goal, a fourth focus group was conducted to include representation from the large Latinx sexual and gender minority (SGM) population in MDC. Purposeful sampling, widely used in qualitative research, was used to identify, and select the most information-rich individuals, this approach was particularly helpful when working with limited resources and time, suggested by Patton (18, 19). Sampling recruitment procedures yielded a study population inclusive of the broad Latinx community within MDC, that was knowledgeable about the respective targeted communities. Participants in the four focus groups included active community members, expected to relate broad perspectives, opinions, and concerns regarding the COVID-19 vaccine in their respective communities and, specifically, their personal, family, friends, providers and neighbors' attitudes and behaviors regarding the newly developed vaccine.

Participants

For all focus groups, the following inclusion criteria were used: being (i) an adult aged 18 years or older, who is (ii)

a leader or active member of the target community that (iii) consented to complete a one-on-one pre- and post-survey and (iv) consented to attend a 90-min Zoom focus group and was (v) able to understand and effectively communicate in English or Spanish. Although measures were taken to ensure a diverse range of ages and genders, participants in the three community focus groups consisted of nearly 88% females for all three geographic groups (North-MDC, Central-MDC, South-MDC), while the sexual and gender minority group (SGM) consisted of six males and one transgender female (See Tables 1, 2). Data generated from these groups contributed an additional and diverse perspective on COVID-19 vaccine knowledge and opinions, given their distinct national origins, diverse experiences, and past and current involvements in their respective communities. It is noteworthy that one member of the SGM group remarked: "this is not the first epidemic my community has experienced."

Data collection

Focus groups were chosen as the primary mode of data collection to gain insight and explore knowledge, perceptions, and opinions regarding COVID-19 and rejection or acceptance of the vaccine. Focus groups were conducted virtually (*via* the Zoom online conferencing platform) during separate days for each neighborhood and the SGM group. All focus groups were held within a 3-week period to limit participants' exposure to media messages and frequently changing sources of information. Groups were conducted in the early evening to accommodate participants' schedules and help facilitate participation. Before each focus group started, participants completed a short demographic survey. Each ~90-min focus group was facilitated by a study co-investigator and assisted by a co-facilitator. Whenever clarity was needed during the course of the focus group, the moderator rephrased the question or asked from a different point of view, as suggested by Krueger and Casey (20).

The community focus groups were conducted primarily in Spanish and facilitated by the same team and using the same focus group guide to maintain contextual consistency. The SGM was the only bilingual (English and Spanish) group in which both languages were used, as needed. While developing the focus group guide and preparing for the focus groups, the first author watched local Spanish language daily television news to gain insight into the community's exposure to the COVID-19 related information provided by these outlets. Concurrently and in an effort to contextualize place, fieldwork observations were conducted at retail pharmacies and food markets located in targeted neighborhoods.

As indicated in this paper's opening quotation—and supported by our research team's fieldwork observations—confusion about the development of the vaccine and its possible deleterious effects was extensive in these communities at the

time focus groups were conducted. Spanish media focusing on COVID-19 and vaccine-related information, varied according to the different audiences to which it reached. For example, most radio programs in Spanish were guided by countries of origins, political orientations, and most frequently, religious affiliations. The media's influence on the Latinx community's response to the vaccine was notable at the time focus groups were held because local media broadcasts transmitted widely different rumors and stories. For example, popular during late Fall 2020 and early 2021—immediately preceding and concurrent with our focus groups—were media stories about a pastor at one of the largest Spanish language mega-churches in MDC who discouraged uptake of the vaccine and instead urged "taking believe in divine immunity" (21). Media and field observations were instrumental in developing focus group questions and probes.

Data analysis

Focus groups were recorded using Zoom platform and collected audio/visual recordings were watched independently by the first and second authors, each doing a line-by-line analysis to identify major themes. Whenever questions emerged, one additional author was asked to review parts of completed recordings for further discussion and clarification. Transcript-based analysis was employed, following Krueger and Casey (20). Transcripts were submitted to four comprehensive reviews using original recordings and field notes. Transcripts from the three community focus groups were first discussed and analyzed between the first two authors, who were present at all community focus groups. The audio/video recording of the SGM focus group was watched and reviewed for topics and consistency five times by the first author, followed by five additional views and reviews, conducted jointly by the first, second and third authors, including a careful line-by-line comparison between the transcript and the actual recording.

Data analysis was performed in the language participants used with Spanish being the prominent language; therefore, the line-by-line analysis was performed in Spanish to avoid a third level of data interpretation. Translations were performed only for the purpose of reporting results. Several constructs from Social Cognitive Theory (22) primarily, self-efficacy, outcome expectancies, reinforcement, and behavioral capability guided the data collection and analysis.

Results

Major theme and subtheme selection came about as an iterative and collaborative process among the authors. The first and second authors independently read each of the transcripts and identified the themes presented in each focus group. Once themes were identified for all four focus groups, the first two authors and a third reader who had not coded the transcripts

TABLE 2 Individual characteristics.

Fictitious name	Education	Age	Gender	Country of origin	Household income (1,000 s)
South Miami-Dade County (SMDC)					
Elena	BA	52	Female	Colombia	15–25
Antonina	BA	58	Female	Mexico	25–35
Maria	MA	41	Female	United States	50–75
Victoria	HS	34	Female	Nicaragua	100 and above
Angela	BA	59	Female	Colombia	50–75
Sofia	AA	60	Female	Colombia	25–35
Rosa	HS	47	Female	Panama	50–75
Diana	AA	62	Female	Nicaragua	15–25
Central Miami-Dade County (CMDC)					
Martina	AA	30	Female	United States	25–35
Mercedes	AA	58	Female	Guatemala	35–50
Gabriela	BA	49	Female	Nicaragua	50–75
Julieta	BA	61	Female	Nicaragua	35–50
Carlos	BA	65	Male	Honduras	15–25
Nina	BA	40	Female	Nicaragua	100 and above
Natalia	BA	55	Female	Nicaragua	25–35
Raul	AA	22	Male	United States	35–50
North Miami-Dade County (NMDC)					
Luis	HS	40	Male	Argentina	50–75
Elsa	HS	39	Female	Cuba	50–75
Barbara	MA	29	Female	United States	50–75
Ana Maria	MA	56	Female	Cuba	35–50
Rebeca	BA	37	Female	Cuba	35–50
Teresa	AA	20	Female	United States	50–75
Carmen	BA	37	Female	Dominican Republic	35–50
Cecilia	BA	38	Female	United States	35–50
Sexual Gender Minority (SGM)					
Camille	AA	57	Transgender	USA	< 15
Jesus	BA	33	Male	USA	50–75
Fernando	AA	26	Male	Honduras	50–75
Jorge	BA	35	Male	USA	100 and above
Miguel	SHS	-	-	-	-
Daniel	HS	67	Male	USA	50–75
Christian	BA	26	Male	USA	50–75

$N = 31$.

identified the salient themes and agreed on their overarching structure. The study authors met to review the transcripts and selected themes and agreed on the findings.

Major themes and subthemes

Theme 1: Attitudes regarding vaccine intake

Analysis of data from late 2021 suggest that participants' attitudes toward the vaccine were similar among the four communities of Miami-Dade County. Participants in all groups offered similar arguments to explain and support their hesitancy toward COVID-19 vaccination, but each group included individuals who trusted the vaccine and did so for similar reasons.

Subtheme 1: "A wait and see"

The most frequent theme regarding COVID-19 vaccine hesitancy, mentioned on 32 different occasions by participants, was a "wait-and-see" approach, mainly stemming from beliefs

that the vaccine "was developed too quickly." For example, one woman participant expressed her concern over the development timeline, by stating:

> …when checking the Internet, in previous years, how long does it take for a vaccine to hit the market? Often, two, three, even four, or five years, and this one [was done] in a matter of months... when "they" (here assumed scientists) still don't even understand well what Coronavirus is. (Carmen, NMDC)

In the above comments, Carmen shares knowledge about vaccine development, which informs her behavioral capability and subsequent exercise of self-efficacy when deciding on whether to get vaccinated or not. Alternatively, others expressed hesitancy because of fears of side effects. Amelia from Central-MDC suggested: "I think it's best to maintain good health and wait… to see what's going to happen to those people with horrible side effects." Similarly, one participant from the South-MDC farm workers focus group reminded fellow participants that all medications have side effects and continued by noting, "If it [the vaccine] affects other organs, it may protect you, but it's affecting something else. So, I think we have to wait a little longer to see what the effects of the vaccine are."

Vaccine hesitancy was common even among participants who expressed support of science. One such participant, as presented in the opening quotation of this paper, expressed reluctance resulting from overwhelming media information:

> …so, the more news you listen to, the more questions arise with less answers. I believe in science; I believe in the companies that develop it [vaccine], and I believe it can be a good thing, but I'm still not convinced that it's the best thing for us at this time, and that it has been completely proven that it's what we should do… I'm still not at the point where I'm convinced that we should get the vaccine. (CMDC)

Similar to the participant above, Jesus, a participant from the SGM group indicated: "What you most hear in the community is the uncertainty, or that, 'I don't know what can happen, rather than it's good or bad.'"

Those who expressed hesitancy unanimously expressed their concern for the speed at which the vaccine was developed—similar to findings reported from a recent study by Bateman et al. (23). Though levels of mistrust were high at the time the focus groups were conducted, it was generally related to vaccine quality and effectiveness. Others who manifested mistrust for the vaccine also indicated a wider skepticism for the structure and practice of medicine in the US, suggesting wariness of medicine in the US as a for-profit business, as expressed by a North-MDC participant and agreed by most participants present at that focus groups.

Participants' statements frequently revealed fears rooted in past events and confusion by what they considered overwhelming daily information from multiple sources, such as television news coverage, radio talk shows, internet and social media, and word of mouth. Fernando, a participant from the SGM group, indicated that media messaging surrounding the vaccine "lacked transparency and fueled issues of mistrust and hesitancy."

> …I didn't look up more details, but I remember... the Florida doctor, that he took the vaccine, and then 16 days later, he died. And then, in the news, the wife said that 'Oh. It's due to the vaccine.' And Pfizer … said, 'No. It has nothing to do with the vaccine.' But then... the CDC is investigating the case. So, what I don't like is how the media will blast the whole article... kind of to put fear into the people about the vaccine.

Subtheme 2: "Sometime in the future, not saying never"

Vaccine hesitancy and vaccine acceptance are not mutually exclusive and participants comments reflect both. Indeed, this was the case for Fernando. In response to the facilitator's probe on whether he perceived any personal consequences to receiving the vaccine, he responded: "Oh, yeah, I have no cons against it, for sure. When it is available for me, I'm the first person to go." Unlike the above participant, others admitted they were "not ready" or "still searching" to receive the vaccine. However, they were not opposed to it, indicating their willingness to receive it at a later time when the vaccine had been more adequately tested, or when more was known about its side effects. Some made exceptions, however, to their "wait-and-see" opinion. One participant in the SMDC group, who was told that it could be required to travel to a foreign country, almost immediately modified her earlier "wait-and-see" approach to the vaccine and expressed that she would get the vaccine within "a moment's notice," if required to travel abroad to visit her loved ones. A woman of Central American origin from the same group added, "if for international travel the vaccine is mandated, then I will get it immediately to visit my family." Others who had expressed hesitancy earlier agreed to vaccination, if necessary to travel, almost immediately modifying their earlier position resulting from the recently received information.

Among those who said that they would get vaccinated were several participants in the SGM group who acknowledged that their motivations were related to their comorbidities, which increased their risk and fear of infecting others. These included references to living with an older family member, attending a social event, being a "vector" of the virus to others or a desire to return to "normal".

Additionally, one participant in the SGM focus group, Camille, drew a parallel between the COVID-19 pandemic and the experience of the SGM community with the HIV

epidemic. She ended her comment by advising others to get the vaccine:

> I want to say I came through another epidemic a long, long, long time ago. So, yes, there was a lot of stigmas, probably just as much stigma as is going on with the pandemic today, but I educated not only me, but I educated other people, and that helped diffuse the fear a lot. I've seen that epidemic progress. I'm talking about way from '80s, I've seen the epidemic progress. So, when it comes to this pandemic, I can't emphasize how important it is to educate them people. Me, personally, if they're in a category that are a lot of—I think I heard people say underlying conditions—that they need to be vaccinated, my advice would be to get it.

Moreover, while there were many who expressed hesitancy, of the 31 focus group participants, only three gave an adamant "never." Interestingly, among the three who expressed the most hesitancy, two, soon after, received the first dose and shared the news with the outreach coordinator. Despite earlier discussions on hesitancy, mistrust, and other concerns, over one-third of participants expressed willingness to get vaccinated "as soon as possible"—not finding it necessary to wait for additional information on the vaccine and indicating strong efficacy. A woman from South-MDC expressed satisfaction about receiving the vaccine as early as mid-January 2021, during a time when the majority of the US population had not been vaccinated. She said:

> Well, I called my primary physician, I also have several other specialists, since I have a chronic health condition that requires frequent medical visits, and my physician told me that his practice was recommending intake of the vaccine. I went ahead and got it. A day later, I heard my daughter say, "the person I most wanted to get vaccinated was my mother, and she already got it." When I heard her say this, I felt so much better. I already have my appointment for my second shot.

The above woman shared that her daughter, a nurse, had been heavily involved with COVID-19 patients and at "the center of the crisis." Another participant from the same community indicated that she would get vaccinated as soon as she could make an appointment, even when questions remained about possible side effects. Still, referring to a well-known Spanish proverb, she shared, "it is always easier to prevent rather than to treat."

In general, most participants who expressed hesitancy also observed that it was not whether they will get it or not, but rather when they would feel or think "sufficiently secured

getting it." Only three participants appeared reticent at the time, and one said that "it would take a lot of information [from those she most trusted] for me to be ready for the vaccine," illustrating constructs, such as expectations, expectancies, and expanding her behavioral capability. While some ignored the negative comments and were ready to be vaccinated, as a participant from Central-MDC (Little Havana) said, "the sooner the better." Others, who expressed hesitancy in terms of a "wait-and-see" attitude, also acknowledged the possibility of getting "the vaccine sometime in the future." When carefully analyzing the data line-by-line, two groups were identified: one group who said they were ready for the vaccine, and a second group that professed a "wait-and-see" attitude, with most noting that, "not getting it now, does not mean we will never get it." This second group expressed dissatisfaction with the information being received at the time from mass media, indicating that "at a future time when more scientific information became available and when the numbers of the vaccinated increased, they were more likely to get it."

Theme 2: The media and other sources of information

Subtheme 1: "We have a cocktail of information"

Beginning with the first focus group, sources of information emerged as a significant theme in participants' narratives, and several participants found the source to be of utmost importance when making decisions about COVID-19 exposure, mitigation practices, or vaccination. A participant from the N-MDC focus group referred to the CDC as a "most trusted source of information on COVID and the vaccine." Data analysis revealed that participants from all targeted MDC communities unanimously trusted information from their physicians, immediate family, or both. Those who gave higher priorities to trust in their physicians, were those who also indicated having chronic conditions that required long term relationships with their physicians. Fernando, a participant in the SGM group made a particularly strong reference to his physician as the person most trusted when stating: "I suffer from chronic conditions, diabetes, asthma, among others… I trust my physician." Similarly, a woman with chronic conditions from South-MDC indicated that she had consulted with her physicians and, following their advice, she elected to be vaccinated. Others, not reporting major chronic conditions, were more likely to indicate close family members as their most trusted sources, especially when the relative was in the health field. Ranked close to their physicians and family members, were other health professionals (such as pharmacists), and reputable websites (e.g., American Medical Association) and university websites (e.g., the Cornell University website was mentioned directly by Rebeca, a North-MDC participant). Over half of all community participants indicated that reputable and university websites were also

important resources; the latter was frequently mentioned (5+ times) during focus group sessions when participants sought to justify their various positions by citing sources of information and informants beyond their close friends and family members.

More distant, yet important, sources of information frequently reported by participants were media personalities (e.g., television hosts) and recognized television networks, such as US CNN, FOX News, and local and Spanish language broadcasting networks. For example, Ana Maria, a participant from North-MDC, whose daughter lives in Spain, was adamant in her opinion that Spain's major national television network, TVE (Television Española), was her preferred source of COVID-19 media coverage. Ana Maria noted, "I watch TVE regularly and their hosts are very clear when speaking about COVID." When asked why she prefers TVE for COVID-19 news and information, rather than US networks, she noted, "they are more trustworthy, they provide clarity to the topic, their presenters stay away from politics; actually, they refer to science not politics when conveying news and mitigation practices."

Participants were also frequent users of online sources of information, among which YouTube was the most frequently cited. Angela from Central-MDC observed:

Well, I have membership in various channels, and in a YouTube channel, there is a host called Gary Burg who is a medical doctor and also very young, he is fabulous because he explains all illnesses very detailed, and he tells us what needs to be done in order to eat better, live better, the connection between mind and body, how to sustain stable health. I also watch Dr. Hyman who has a clinic in New York... [and] there are lots of good medical doctors on television that present programs that help with health that are free and these are the programs that I follow and help me in making my health decisions.

Within the broad topic of media as a source of COVID-19 information, participants in the North-MDC focus group observed that US media messages appeared contradictory and confusing. When asked, "What comes to mind when you listen to COVID-19 news, read about COVID-19 (online, newspapers), or talk about it to your friends and family?" Ana Maria, a Central-MDC participant noted: "Listening to contradictory "things" (cosas in Spanish). Here, "things" (cosas) was a word frequently mentioned during focus groups when participants were referring to the information they heard and watched on COVID-19 news. When further probed about the meaning of "things," there was hesitation from Ana Maria and those in the group who agreed with her; participants then explained that, when referring to news broadcasts, "things" indicated noise, such as information not to be taken seriously or trusted, whether from television, radio, or print. When referring to "things," Ana Maria clarified, "I speak about mistrust in terms

of local media coverage of COVID news and information, I am cynical about all the "things" that I listen on a daily basis." She adds:

My personal opinion is that health, in this country, is a business; that is how I see it. It is all about profit and COVID is all about inducing panic. [She continues], so when I say all those "things", I mean all the irrelevant and redundant comments that people bring up that lead to panic, or denial. I say that management of COVID information has been very poor. I have had multiple negative experiences.

Similarly, but from a different ideological position, Carlos from Central-MDC indicated:

We have been manipulated for a long time by 24-hour news and now with COVID, one media source says, "one thing," while the other says another, an expert offers an explanation and another says the opposite, the media promoted a situation of uncertainty and doubtfulness. Media channels and the government need to monitor what is said about COVID and the information that constantly circulates. Otherwise, we get the mess we are in.

An older woman from Central-MDC, Nina, responded by noting:

I am very much in agreement. I believe that we have a cocktail of information, lots of very bad information. "Things" are said without proof or verification, creating fear in society. I believe every person has the capacity to decide.

Diana, from the South-MDC farmworkers community, further adds to this theme by suggesting:

In order to trust the vaccine, the media need to be exact and precise in circulating news about the vaccine. They should not lie, not say this or that, but to be precise in their messages, not to say one thing one day, and the next reverse it. For me this is very important because most of us are constantly watching the news, I watch news all day and rely on what I hear. I have heard that many are dead in other countries, in Germany and Norway, I don't remember all the places, because they received the vaccine, so that makes me think twice on when I should get it. Perhaps wait longer to make sure.

Participants from the SGM group also expressed dissatisfaction with media coverage of the vaccine, and the influence that it has on individuals who rely on it as a source of information. Specifically, Christian said:

I do feel like a lot of the dividing opinions have also come of where people choose to get their news from misinformation just for the sake of selling clicks and selling

advertisements. And as long as it makes a good headline, they'll post whatever. I also think a lot of that of looking around in Facebook and, now online, you have the option to cherry pick whichever news you want [. . .] I do feel like the media has created a lot of confusion.

Subtheme 2: "My biggest fear is my family, my grandmother." Information and support across generations

Comments pointing to family and relatives among the most trusted sources of information were common among all focus group participants. These were reinforced when the children of participants, or other relatives, worked in the health field. Participants who reported being vaccinated, or scheduled to be vaccinated, alluded to recommendations received from their physicians and/or their children or close relative in health fields. In fact, children, particularly those in the health field were the ones with the most influence on decisions to vaccinate, followed by physicians. Additionally, trusted dyads, such as mothers and daughters, were particularly important in all instances where the parent's health was concerned. It was notable that references to children, or close relatives, in the health field were heard in all community focus groups.

The current Information and Support Across Generations theme was also evidenced by a mother from South-MDC who indicated that she had been vaccinated, following advice she received from her adult daughter, a nurse. Data from all focus groups support findings suggesting that younger family members are more likely to keep up with broader cultural messaging than older family members. Such was the situation discussed by younger participants of the SGM group, born in the US (five out of seven), who indicated that they played a role in informing, advising, and sharing a sense of responsibility for older family members. For example, Fernando notes:

My biggest fear especially with my family was right before Thanksgiving when my partner got COVID 19, and I feared for my grandmother. So luckily, she was not living with me, but if she needs my help, or anything, I try to limit my exposure to her. So, she got the vaccine now. . . . then obviously when I get it (the vaccine) it eliminates the fear of like Oh, I can potentially give it to her.

Fernando, further indicated: "For example, my grandmother, the second I heard about the elderly people getting the vaccine, I already had her phone number, I was willing to do the appointment for her, but she had an appointment already."

Another participant from the SGM group, Jesus, also noted that when asked about the vaccine by his mother-in-law, his suggestion was: ". . . go for it. . . . that was my suggestion because

that happened to be my mother-in-law." The above comments indicate that this younger group, plays the role of informers and advisors partaking in culture and guiding their older family members.

Theme 3: Science and education
Subtheme 1: "We need to keep super informed:" Trust in science

Participants' views on science, scientific information and scientists emerged as a third major theme in focus groups discussions. At the time focus groups were conducted, while the pandemic was at its height, most participants, across all focus groups, expressed trusting views of science and scientists. References to scientific information, knowledge, and scientists were common throughout all focus groups. As in the opening quotation, most participants acknowledged respect for science, frequently referring to the CDC website and to "Dr. Fauci," who most, if not all, knew from the various news outlets they watched.

Upon concluding a second line-by-line review of focus group data, no refutations of science were found in the transcripts; even when expressing hesitancy about the vaccine, no participant openly or directly expressed a disbelief in science or scientific methods. When vaccine hesitancy was expressed, it was in relation to doubts about the methods of science not being appropriately or sufficiently applied during development and testing. For example, a participant from South-MDC noted: "I keep reiterating to friends and family that we need to be super informed of the latest scientific information, this virus is all over the world; in the months ahead, we will learn a lot more about it."

When referring to scientists, a woman also from South-MDC, Victoria, complained by saying:

The problem is, they first said it was an unknown virus. . . then suddenly they make a vaccine. How can they make a vaccine for a virus they don't know? . . .in other words, so much has been said that not even they [scientists] really understand the virus, yet they already have a vaccine for a virus they don't understand? . . .I will not be convinced.

In response, participant Maria added, "When she travels, then she'll have to take it," but Victoria replied with, "Not even, I'm willing to not travel..."

When asked, when was "the right moment to get the vaccine," Maria from South-MDC, responded:

When scientists produce a medical journal that says: "People who were vaccinated have become immunologically protected, they are now immune to the virus"; because I want to know, who are these people participating in vaccine trials? Is it a Puerto Rican, a Colombian? A US born Colombian or a foreign-born Colombian? A Puerto Rican

like myself? born there… or here? You know what I mean? So… when I hear that they did trials with a group like *me*, then I'll get it (vaccine).

Jesus from the SGM focus group shared his trust in science, noting:

> What you mostly hear in the community is the uncertainty, or that "I don't know what can happen," … But it seems like everything is running fine and I trust science. There was research before, so that's it, Thank you.

Rebeca from North-MDC repeatedly said that she never watches the news; however, she followed, "… what they [scientists] say especially in scientific journals which are peer reviewed. If I find the articles interesting, I read it; if not, I pass."

Finally, only three participants made references to alternative health choices: two participants described the YouTube doctors they watch regularly, who endorse a holistic curative approach to illness through nutrition; the third participant, a woman, shared her observations about an Asian couple who used herbal teas to treat COVID-19. Others in all groups demonstrated strong support and respect for science, scientists, and health professionals, despite reservations about the vaccine rollout.

Subtheme 2: "Getting Educated." Education, studying, and following mitigation recommendations

Participants felt strongly about education, and phrases such as "getting educated" and "becoming educated" were expressed frequently during focus group discussions, especially when referring to following CDC recommended mitigation practices or choosing to ignore them.

Angela from the South-MDC group made a case for education.

> I want to share with the group that above everything else there is education [Pause]. I think that the community needs to be educated on a daily basis and addressed with a great deal of sensibility. I believe that first we need education to make people aware that despite whatever our needs, we should not be out shopping without protection, especially those with COVID symptoms should not go to public spaces without being tested first, that, when necessary, they follow mitigation practices.

A respondent from the same group agreed:

> I think that education is a fundamental part. We must strengthen education programs in our communities, make people more aware, conscientize the community, so they engage in mitigation behaviors.

Rosa added:

> I believe that as time goes by, we will see this illness developing and further infecting others in large scale. This is the time when we are going to have to run and gain confidence on the vaccine and learn how to educate families, like mine.

Cecilia from North-MDC observed, "people need to make educated decisions, to share information." Alicia, also from North-MDC, followed: "people need to read, share information, search databases, so they become more educated." Susana agreed: "studying is important, community leaders should educate the community and provide information."

Participants in the SGM focus group also felt strongly about education. Camille emphasized the need for education when speaking on the vaccine, noting: "education is the key to a lot of things. Find out as much as you can about the vaccine, and don't go at it just because it's fear of something." Similarly, another participant—when referring to the absence of mitigation practices among sex workers—commented: "…so there might be another way to allow them to access education, or to access the workforce, education, to get more dignifying degrees, then there is a greater sense of worth." Another participant, also from the SGM group, added that "education decreases the stigma associated with partner violence in our communities."

Discussion

Three themes and six subthemes were identified to underscore Latinx attitudes toward COVID-19 vaccine uptake or hesitancy. The three major themes that emerged were: (1) Attitudes Regarding Vaccine Intake**,** with two subthemes: (a) vaccine hesitancy and (b) vaccine acceptance; (2) Sources of Information, with two subthemes, (a) the media and other sources of public information, and (b) information and support across generations; and (3) Science and Education, with two subthemes: (a) trust in science and (b) education, studying, and following mitigation recommendations. The degree to which each of these themes exercised influence on vaccine intake or hesitancy varied.

Data analysis from the four focus groups provided the opportunity to reach, identify, and report on multi-origin Latinx participants' attitudes toward the vaccine, including themes on science and medicine while also highlighting reasons for vaccine hesitancy. We expect findings from these groups to assist in establishing the foundation for an improved and wider understanding of Latinx vaccine behaviors in general and their openness to vaccination.

Within the theme of "valued sources of information," participants from all focus groups viewed their physicians, immediate family, or both as their major and trusted source of vaccine information and inclination. Physicians and families, whether nuclear or semi extended, or both, were their major and

most frequently solicited source of information on all aspects of the vaccine, including not only recommendations or rejections, but also information and discussion on the scientific merits of the vaccine and/or getting vaccinated. Participants expressed less engagement with neighbors or distant family members, even when in close neighborhood proximity.

Findings suggest that participants held strong views on science. They were often eager to find evidence in support or rejection of vaccine intake based on their access to the readily available scientific information. Those participants frequently searched through online sources or local media. All participants were familiar with using virtual modes of communication and demonstrated familiarity and reliance on websites that promoted different vaccines perspectives.

Findings presented here have to be interpreted within the multi-origin, broadly diverse Latinx population of Miami Dade County, not only diverse in national origin but also in socio-economic characteristics. However, above findings provide a preliminary outline of the groups' attitudes and behaviors on the vaccine, as well as their views on science and respected sources of information. Participants acknowledged respect for science, professional expertise, and information. However, vertical networks of family members in health professions and horizontal networks of friends and neighbors were also important sources of information. Vertical family networks were valued sources of information and support. Preferably, advice and information were sought from family members who were health professionals (e.g., nurses, pharmacists, physician assistants or other health professionals, including physicians). Some participants in the SGM group who acknowledged close proximity to physicians and other health workers, many in second generation vertical family dyads, advised and encouraged other family members, most often a grandmother or mother-in-law, to become vaccinated. Current findings are similar to studies that have shown Latinxs are likely to get their health information from sources such as physicians, family, friends, and social networks, and some form of media (24). In a more recent study, the Pew Research Center reported that although Latinxs have used radio and newspapers as sources of information historically, television and the Internet are more widely used now. In fact, the Pew study also found that, among Latinx individuals, there were significant declines in use of radio and newspapers as news sources between 2006 and 2016; even television, as a source of information, declined during that same period (25).

In contrast, between 2006 and 2016, there was a 37% increase (74%) of Latinxs reported use of the Internet (including social media and smartphones), of which 66% of those used it to search for health information. Moreover, 41% reported their decisions to treat health conditions were influenced by what they saw in media (25). As such, these studies suggest that the internet is increasingly becoming a main source of information for Latinxs, as is also suggested from the current research findings.

Finally, fear-of-deportation due to undocumented status, though recently reported by Bateman et al. (23) as a hurdle to vaccine uptake among Latinx individuals in Jefferson County, Alabama, did not emerge as a theme in any of the four focus groups with multi origin Latinx populations in MDC. We explain the absence of this topic in our focus group discussions by noting that a third of participants were US born ($n =$ 10) and obviously not affected. Second, the demographics of Miami-Dade County (MDC), where 54% of the population is foreign born (5), provide a positive receiving context for all Latinx immigrant populations which we suggest account for the absence of the fear-of-deportation topic among those who were foreign born. However, agency involvement, particularly when encouraging participants to volunteer for the focus group, could have resulted in that those most community active were probably more likely to have formalized their immigration status.

Strengths and limitations

We find the multi-origin Latinx representation among focus group participants in Miami-Dade County strengthens the findings presented here. Results contribute to the literature on the Latinx perspective on the COVID-19 pandemic and consequent vaccine attitudes that cut across Latinx groups from diverse national origins. Multi origin Latinx populations are increasingly becoming part of the demographic profile of the largest metropolitan counties in the US and thus important for research. Focus group topics aimed to identify shared factors underlying participants' reasons for accepting or rejecting the COVID-19 vaccine while promoting an open environment for participants to share their hesitancy or their vaccine acceptance.

By delving into participants' reasons for vaccine hesitancy or acceptance in a multi-origin Latinx population, findings yielded by this study can be useful in designing health promotion and prevention initiatives that address COVID-19 related fears among these subgroups. Results may also be extended beyond the targeted aims to include different health related issues and concerns. Outreach messaging to these communities should be anchored by scientific support, the authenticity of the messenger, or preferably both. Focus group data presented here suggest that vaccine messaging and endorsements are best received when coming from a trained health professional or a grown child or close relative, especially when the latter are trained in the health professions. Study findings have the potential to contribute to designing interventions aimed at multi-origin Latinx groups. To that end, findings from this study guided the development of a short intervention where tailored COVID-19 public health messages, sourced from National Institutes of Health and Centers for Disease Control and Prevention, were sent to focus group participants *via* WhatsApp. We find that focus groups results from the multi-origin Latinx presence in

this study facilitated a broad outreach to diverse Latinx origin groups in Miami Dade County.

Furthermore, the research team strove to promote an open environment for participants to share their hesitancy and their acceptance. Notwithstanding the strengths, this study had several limitations in the recruitment of the sample through well-established community agencies. Though fostering an inviting environment where they expressed their opinions openly, agencies may have selected participants and/or promoted the study to those community members who displayed involvement and support of their programs and activities. Hence, participants may have been more engaged, more educated, and more likely to express opinions than perhaps members of the same communities less acquainted with these agencies, or less likely to be community leaders. Despite these limitations, the results presented here contribute to the literature on vaccines in general and present a broader perspective on vaccine attitudes in multi-origin Latinx populations.

Findings and results presented here on multi origin Latinx groups in South Florida while strongly supportive of findings obtained with more homogeneous Latinx groups (26, 27) such as those centering around misinformation and distrust of health information sources also differed in that insecurity in the form of fears of loss of employment and deportation were not salient among our multi origin Latinx participants. On the other hand, themes of family-related stress from changes in the home dynamic due to increased utilization of shared space and concerns of social isolation due to changes in support systems emerged.

Conclusion

Study findings provide useful contextual information in reaching out to the Latinx community in general—whether designing strategies to prevent or control infectious diseases, inform on chronic disease prevention, or design broad health promotion and prevention programs. Drawing on data presented here, references to science and scientists are likely to strengthen the legitimation of health messages and intervention programs aimed to reach broad Latinx communities. Study participants welcomed science-based information, whether from online sources, radio and television media, or health professionals. Though about half were not fluent in English, the absence of English proficiency is not an indicator of their level of education or even exposure to science. Most had some science education in their home countries and, hence, had a basic level of expectation for the quality of the information they received, especially if in Spanish. This may partially explain why some participants sought information from international Spanish speaking media, as shared by the woman who preferred TVE, the national television network in Spain. Second and important to health promotion and intervention programs, study participants were, to a greater or lesser extent, receptive to new information

and messaging, especially if scientifically supported; and that effective communication can bring about some behavioral modification, even among those expressing strong reluctance. Such was the earlier situation when a participant expressed strong resistance to the vaccine yet became vaccinated soon after her participation in the focus group. Finally, we suggest that health messaging for Latinx populations should incorporate a multi-generational approach to deliver more expeditious sources of transmission across generations, where the flow is multidirectional across the various age strata.

Outreach messaging to these communities should be anchored by scientific support, the authenticity of the messenger, or preferably both. Focus group data presented here suggest that vaccine messaging and endorsements are best received when coming from a trained health professional or a grown child or close relative, especially when the latter are trained in the health professions. Findings presented here have the potential for designing interventions aimed at multi-origin Latinx groups to inform this population on broad themes related to health in general and focused health issues, such as vaccine development and uptake. We find that the multi-origin Latinx presence in this study facilitated a broad outreach to diverse Latinx origin groups, thus widening our exposure not only to similarities and differences, but also, and more importantly, expanding and widening our outreach to these groups.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by IRB Committee Florida International University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

All authors reviewed the study design and methods and edited the article. All authors approved this version of the article.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships

that could be construed as a potential conflict of interest.

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Health knowledge and livelihood experiences with COVID-19 amongst Arizona residents

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The Coronavirus disease 2019 (COVID-19) pandemic is an ongoing public health concern that is rapidly evolving and has impacted individuals and communities differently. We analyzed deidentified survey datasets to evaluate the perceptions, experiences, and impacts of COVID-19 among Arizona residents. The survey included 1,472 eligible Spanish-speaking participants in Southern (Pima, Santa Cruz, Cochise, Yuma County) and Central Arizona (Maricopa County). Eighteen questions which included participants' health and socio-economic status, source of information on COVID-19, preventive measures, the impact of COVID-19 on household income, and vaccination status were administered to the survey respondents. The analyzed data showed an unequal proportion of the reported source of COVID-19 information between Southern and Central Arizona participants. More male respondents ($n = 833$, 57%) participated in the study than did the female respondents ($n = 638$, 43%). Of the 1,472 total participants in both regions, 1,011 (68.7%) participants represented Southern Arizona while 461 (31.3%) participants represented Central Arizona. Of the 461 participants in Central Arizona, the majority reported television (56%) and social media (20%) as their primary source of information. Whereas, of the 1,011 participants in Southern Arizona, the majority reported social media (37%) and television (32%) as their major source of information on COVID-19. Overall, 82% of the participants were vaccinated, with a statistically significant difference between the proportion of vaccinated individuals in the Southern and Central Arizona (chi-square p-value of 0.00139). More individuals in Southern Arizona participated in the survey than in Central Arizona across both genders, with 58% of women reporting loss of jobs due to COVID-19. This study demonstrated that the COVID-19 pandemic profoundly had a more socio-economic impact on women than men, particularly Hispanic women in this subset.

KEYWORDS

COVID-19, health disparities, Hispanic, marginalized communities, Arizona

Introduction

The impact of Coronavirus disease 2019 (COVID-19) on health and well-being varies across communities. COVID-19 has exacerbated existing structural and social inequalities, with particularly undesirable health outcomes for those already disadvantaged in the society (1). After nearly 3 years, many individuals and families still face persisting limitations to secure means of livelihood, as a result of the pandemic. Specific groups are striving for basic amenities and medical treatment (2), this contributes to the feelings of inequality, discrimination, and isolation among marginalized communities (3). The knowledge of COVID-19 is evolving daily, consequently, society encounters diverse forms of contradictory information, incomplete information, and sometimes outright misinformation (4). People still tend to prefer informal source like social media or family and friends as their primary source of information, therefore, it is now more imperative than ever to evaluate the basic health knowledge of the public on COVID-19 (5).

Health literacy improves health and well-being, addresses health inequalities, and builds individual and community resilience, allowing individuals to make better health decisions and have a stronger commitment and higher levels of efficiency (6). Since the onset of the COVID-19 pandemic, there have been numerous publicly available data from legitimate and illegitimate source (7), this overflow of information gathering makes it difficult for the public to decipher the accurate information from misleading information, resulting in misconceptions and wrong beliefs. The internet has been associated with lower literacy levels (8) due to the amount of fake information disseminated without technical review and appraisal (9). Although young adults may have high digital health literacy about COVID-19, discerning the reliability of this online health information may be challenging. Online communication channels are especially vulnerable to the spread of incorrect information making people adopt wrong behaviors against COVID-19 (5). However, online communication channels have also been a central resource for reliable health information throughout the pandemic.

Numerous pre-pandemic disparities unfolded during COVID-19 with communities of color suffering disproportionately (10). Before the pandemic, many families, especially those with lower incomes, faced significant difficulty in their economic, physical, and mental well-being. In addition, the COVID-19 pandemic has led to an immense economic and public health disruption, amplifying previously existing economic inequalities; and disproportionately affecting Black and Hispanic workers, women, young adults, and people with low incomes. Some communities can withstand the impact of economic downturns due to more favorable economic and social factors protecting residents from adversity. However, other communities are experiencing the effect of rising unemployment and financial troubles during the time of COVID-19. The loss of income and livelihood has further led to drops in wages, pressuring more people into poverty, which simultaneously impacts community health (11).

Obtaining a health coverage plays a major role in determining access to health care amongst People of Color (12). There were early reports of racial disparities when the COVID-19 vaccines were in short supply relative to its demand (13). Despite the COVID-19 vaccines supply exceeded demand at the time of this study, racial disparities in vaccination were still apparent. Upstream social determinants of health are accounting for the vaccine disparity, including disproportionate access to vaccines in low-income neighborhoods, inability to skip work to receive a vaccine, lack of access to culturally and linguistically tailored information, and fear of deportation among some immigrant groups (14–17). These upstream social determinants are evident in previous vaccination programs, where racial and ethnic minority groups experienced persistent low annual influenza vaccination rates compared to White persons (18).

The ease of restrictions and returns to normalcy can be attributed to the increase in the number of vaccinated populations. While innovative and useful research continues to emerge, additional information and analysis of robust data source will help policymakers better understand how the pandemic has disproportionately affected populations that have historically faced barriers to accessing health services (19). In Arizona, persons living in poverty are disproportionately American Indians, Hispanic, and Black, with Hispanic persons more often reporting lack of healthcare coverage or not visiting a doctor because of costs (20). We attempt to fill this gap by focusing the Mobile Health Unit (MHU) vaccination and survey questions to the hardly reached populations in Arizona, represented by ethnic minorities, migrant farmworkers, the elderly, people without homes, undocumented immigrants amongst others. To evaluate the perception, experiences, and impacts of COVID-19, we analyzed deidentified survey datasets with inquiries about participants' primary source of information, change in employment status, and access to COVID-19 vaccination among Arizona residents.

Methodology

The Mobile Outreach Vaccination & Education for Underserved Populations-Mobile Health Units (MOVE-UP MHUs) provide vaccination, free preventative health screenings, health education, and other health-related services to vulnerable, hard-to-reach populations across Southern and Central Arizona. However, from March-April 2020 during the initial lockdown and business closure due to the COVID-19 pandemic, the MHU did not provide on-site services and instead initiated a call-back campaign to previous users. In the

late fall of 2020, the MHUs carefully reinitiated on-site visits and shortly after, the MOVE-UP project commenced. The MHU staff provided credible health information regarding COVID-19, emotional support, and serve as a link to community resources during a difficult time. The method was later synchronized and used by the Mexican Section of the U.S.-Mexico Border Health Commission across all 11 mobile health units (21) and 50 Ventanillas de Salud (VDS) and (Health Windows (HW) inside Mexico's Consular Network across the United States (22). Due to the high-need responses during the call-back campaign, the MHU staff provided mobile unit users with a paper version of the "COVID-19 call-back survey." The MOVE-UP project was later created to help increase COVID-19 vaccination rates in Arizona with an emphasis among vulnerable populations. The project allowed for the MHU to expand its reach and go directly to areas with low vaccination or low access to points of COVID-19 vaccine distribution.

The survey included 1,472 eligible Spanish-speaking participants in Southern (Pima, Santa Cruz, Cochise, Yuma County) and Central Arizona (Maricopa County). In the southern area of study, Pima is a large county classified as a medium metro area, Santa Cruz is a small county classified as a micropolitan or large rural area, Cochise and Yuma are both medium counties classified as small metro area. While Maricopa is the largest county classified as a large central metro area; according to the National Center for Health Statistics Urban-Rural Classification ("Arizona Health Workforce Profile")[1]. The Central (urban) and Southern (rural) Arizona regions are of significance to this study due to the significant gap between numbers of health professionals in the urban and the rural areas of Arizona ("Arizona Health Workforce Profile")[1]. In addition to the southern region having more rural areas, it is also closer to the border than the central region. Moreso, the "mobile health units" are primarily housed in these two regions. The mobile health units were strategically placed in target cities based on the concentration of Hispanic population determined by the network of consular offices in the U.S. and the Mexico Section of the U.S. Mexico Border Health Commission (USMBHC). The Arizona health workforce profile shows that health care infrastructure and workforce are more concentrated in metro areas of Arizona than the rural areas (23).

The administered survey focused on questions pertaining to participants' socio-economic and health status, primary source of information on COVID-19, implemented preventive measures, the impact of COVID-19 on household income, and current vaccination status (Appendix 1). Gender in this study is an important variable that was measured from the respondents' responses, each participant self-identified to one of the three gender options: male, female, or transgender. The authors used de-identified data from a database system

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1 https://crh.arizona.edu/sites/default/files/2022-03/20210420_CriticalCareWorkforceBrief.pdf

called the Continuous Information System and Health Reports of Mexicans in the United States (SICRESAL-MX [acronym in Spanish]) to perform this secondary analysis. SICRESAL-MX is a computer-based system developed by the Mexican Section of the USMBHC, specifically to confidentially maintain information provided by users in the HW and MHU's. The use of secondary data for this analysis was not deemed human subjects research, therefore, did not require IRB approval. This study excluded incomplete data from phone or in-person survey responses.

Statistical analysis

The results collected from the questionnaires were analyzed using RStudio "Prairie Trillium" Release with R version 4.1.3, and the graphs were generated with the ggplot2, ggpubr, and ggsci packages. The chi-square test was conducted with the chisq.test function within R. We removed questionnaires with blank entries pertinent to the test before generating the summary statistics and chi-square tests. Overall, the observed numbers of missing data can be attributed to the design of the study being a voluntary survey, where participants can consent to partake in the study with the will to answer or omit any question, without affecting their participation in the survey. For the bivariate analyses, we investigated how female and male respondents in the Central and Southern Arizona responded to questions such as "Have you received the first dose of COVID-19 vaccine?," "Did you lose your job during the pandemic?," and "Do you know any family member who had experienced job loss during the pandemic?." The R script and data used to generate the results to this publication are available upon request.

Result

A total of 1,472 eligible respondents participated in the survey, male respondents represented the higher proportion (n = 833, 57%) with an average age of 39 ($\pm$18) years old across both genders, while female respondents represented 43% (n = 638) of the participants. A larger sum of the participants (59%) identified as Mexicans, as opposed to 10% identifying as United States nationalities. This can be attributed to why more participants (805) omitted the responses to the English fluency question compared to the Spanish fluency question (302). The distribution of the sample analysis is shown in Table 1.

There were more participants across both genders in Southern Arizona (69%) (Pima, Santa Cruz, Cochise, Yuma) than in Central Arizona (31%) (Maricopa). Since the survey administration, 82% of the participants in the study had received a COVID-19 vaccine (Figure 1A), with a statistically significant difference between the proportion of vaccinated individuals in the Southern Arizona (Figure 1B) and Central Arizona

TABLE 1 Social and demographic characteristics of respondents.

Variable	Subgroups	Frequency (%)
Age (years)*	< 18	61 (4.1)
Mean ± SD: 39 ± 18	18–24	146 (9.9)
Median: 39 IQR: 17		
	25–44	795 (54.0)
	45–64	408 (27.7)
	> 65	62 (4.2)
Gender	Female	638 (43.0)
	Male	833 (57.0)
	Transgender	1 (0.0)
English fluency	Not at all	117 (6.9)
	Not well	82 (4.8)
	Well	60 (3.5)
	Very well	629 (37.2)
	Missing data	805 (47.6)
Spanish fluency	Not at all	7 (1.5)
	Well	17 (3.7)
	Very well	135 (29.2)
	Missing data	302 (65.5)
Birth country	United States	46 (9.9)
	Mexico	273 (59.2)
	Guatemala	27 (5.9)
	Nicaragua	1 (0.2)
	El Salvador	3 (0.6)
	Venezuela	1 (0.2)
	Chile	1 (0.2)
	Peru	1 (0.2)
	Cuba	2 (0.4)
	Honduras	2 (0.4)
	Missing data	104 (22.6)
State region of participants	Southern Arizona	1,011 (68.7)
	Central Arizona	461 (31.3)
Lives with family	Yes	251 (54.4)
	No	210 (45.6)
Medical insurance	Yes	95 (20.6)
	No	366 (79.3)
Educational status	None	11 (2.4)
	Elementary school (5th grade)	10 (2.2)
	Middle school (6th—8th grade)	31 (6.7)
	High school (9th—12th grade)	80 (17.4)
	Some years of university	13 (2.8)
	Finished University	11 (2.4)
	Postgraduate	1 (0.2)
	Missing data	304 (65.9)
Total household income	Does not know	14 (3.0)
	Less than 1,000 USD	60 (13.0)

(Continued)

TABLE 1 (Continued)

Variable	Subgroups	Frequency (%)
	Between 1,000 USD and $3,000 USD	78 (16.9)
	Between 3,001 USD and $5,000 USD	1 (0.2)
	Refused	4 (0.8)
	Missing data	304 (65.9)

*MEPS age grouping.

([Figure 1C](#)) (chi-square p-value of 0.00139). We investigated the rate of vaccination and found that residing in Central Arizona (Maricopa County) was associated with a significantly higher proportion of vaccination among MHU users (chi-sq =10.8, p < 0.05), when compared to the Southern Arizona cohort.

There was an unequal proportion of the reported source of COVID-19 information between Southern Arizona and Central Arizona ([Figure 2](#)). Upon further investigation, we found that of the 461 (31%) participants in Maricopa County, 56% of the respondents reported a higher proportion of television as their primary source of information when compared to the Southern Arizona cohort with a higher proportion reporting social media (37%) as the primary source of information.

A significantly higher proportion of female respondents (86%) received at least one dose of the COVID-19 vaccine compared to males (80%, $x^2 = 7.66$, $p < 0.05$). Furthermore, a significantly higher proportion of female respondents (58%) reported job loss during the pandemic than male respondents (42%, $x^2 = 6.54$, $p < 0.05$). More female respondents (17%) also recorded having a family member who had experienced job loss during the pandemic than male respondents (11%, $x^2 = 7.48$, $p < 0.05$). This study demonstrated that the COVID-19 pandemic had a more profound socio-economic impact on women than men, particularly Hispanic women.

Discussion

During the COVID-19 pandemic, a vast amount of information has been readily available through the media, internet, social networks, and many other sources ([5](#)). The way people access information has changed over the last decade, with younger generations tending to rely on the internet as their preferred source of information. Overall, the majority of the participants in this survey were in the age group of 19–40 years and most specified television and social media as their primary source of information, with a

FIGURE 1
Proportions of vaccination per region of the study area. **(A)** Combined region vaccination rate. **(B)** Southern Arizona vaccination rate. **(C)** Central Arizona vaccination rate.

FIGURE 2
COVID-19 information source. **(A)** Combined region information source. **(B)** Central Arizona information source. **(C)** Southern Arizona information source.
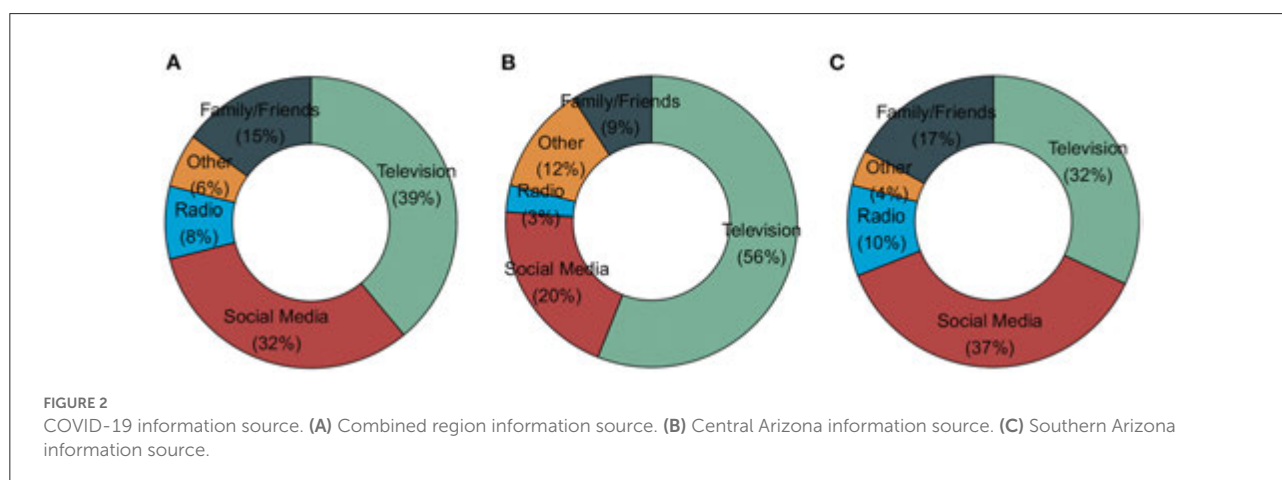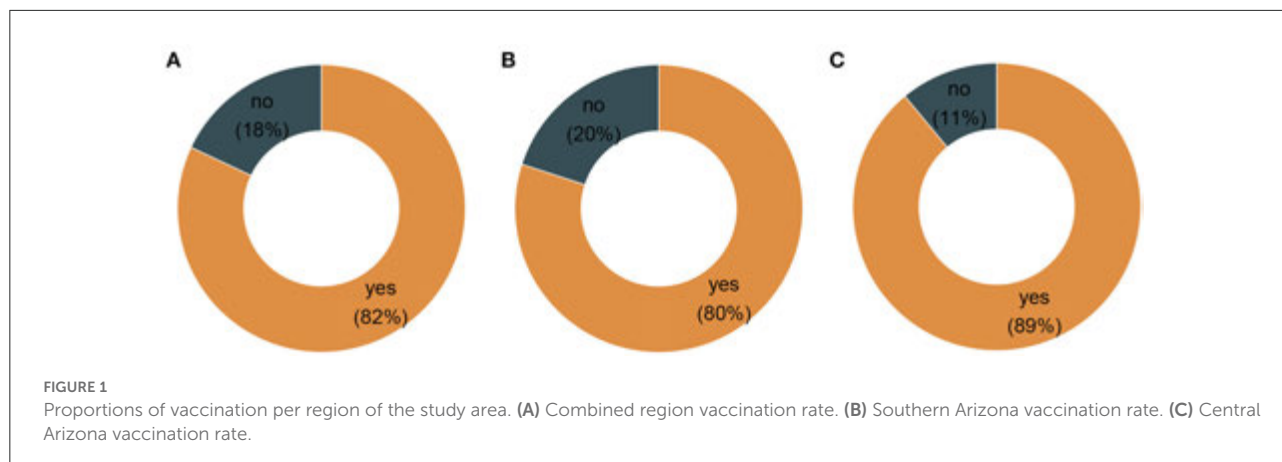
preference for television (56%) over social media (20%) from the central/metro region. Health literacy and knowledge has been shown to influence preventive behavior among chronic disease patients (24), as improvements in health literacy are likely to result in improved utilization of preventive services, medical adherence, and involvement in health decision-making (25).

Although the southern region specified television and social media as well, they preferred social media (37%) over television (32%). The southern region consists more of counties classified as rural areas (Yuma, Cochise, Santa Cruz), with the exception of Pima county which also expands into areas close to the US-Mexico border. On account of income and poverty rate, these factors may be a contributing influence on why those in urban areas may be more socially advantaged to afford a television than the rural populations. Phoenix in central Arizona for instance has a lower poverty rate of 16.2%, a median household income of $60,914 and an employed population of about 822,717; whereas, Tucson in Southern Arizona has a higher poverty rate 20.8%; a lower median household income of $45,227 and a lower employed

population of 249,855 relative to the metro central Arizona (SVI CDC)[2].

In spite of the central region having some rural areas, it is predominantly an urban area. The social vulnerability index (SVI) is another factor that could account for why the central region (Maricopa SVI of 0.6354 which denotes moderate vulnerability) seem to be more socially advantaged than the southern region: Yuma SVI of 0.9895, Cochise SVI of 0.9064, Pima SVI of 0.8828 and Santa Cruz SVI of 0.9318, all indicating a high level of vulnerability (26). The greatest impact of COVID-19 was in rural areas where residents tend to be older (23), and workers are mostly essential workers that are unable to work from home (27). Report findings showed that there are fewer health providers per 100,000 population in rural than urban areas of Arizona with County health departments reporting difficulties providing services due to budget cuts and problems with hiring and retaining health staff primarily due to uncompetitive wages (27).

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2   https://svi.cdc.gov/map.html

Our study revealed that a higher proportion of the respondents (82%), with the help from the MOVE-UP project had received a COVID-19 vaccination when this survey was conducted, which further reiterated the success of this vaccination program. In this study, women reported more vaccination tendencies than men, and these findings resonate with a survey that identified gender differences in health and the use of health services to be a long-standing concern for the U.S. medical system. Such differences have been documented in physician and home care use, hospital service, outpatient surgery, and preventive services (28). A study investigating COVID-19 vaccine hesitancy across geographic patterns in the United States found that men (36%) were more likely than women (22%) to cite personal reasons for not taking a vaccine (29). This coincides with another study that showed that women constitute the majority of Medicare beneficiaries (28).

Majority of the vaccinated participants in this study received their COVID-19 vaccines through the Mobile Outreach Vaccination & Education for Underserved Populations (MOVE-UP) in Arizona -an initiative developed to expedite vaccinations to vulnerable, hard-to-reach individuals within the state (30); as predicted, that access to healthcare service may be difficult for racial and ethnic minorities. Community efforts such as this led to improved results in the early days of COVID-19 vaccination. A CDC report found that Arizona was as at the time of its report one of only two states (Arizona and Montana) that had greater COVID-19 vaccination coverage in its counties with high social vulnerability than its counties with low social vulnerability across all metrics, according to the social vulnerability index (31). Current research findings show that Hispanic and Black households report disproportionate loss of income from the pandemic, with approximately 70% of Hispanic households reporting an income shock during the pandemic as of July 2020, compared to 60% of Black households and 50% of non-Hispanic White households (32). Without sufficient support, families of color stand at risk of experiencing significant percentage declines in wealth due to the COVID-19 recession, as they did as a result of the Great Recession (33).

Notably, women and people of color, specifically Black and Hispanic workers, are overrepresented in the low-wage workforce (34). In this study, female respondents reported a more socio-economic impact during the pandemic by reporting higher job loss than male respondents. Efforts to address the long-term impacts of the COVID-19 pandemic on economic well-being should prioritize an equitable recovery (19). Community engagement and targeted interventions can help identify and lessen the root causes of the disparities, such as the social determinants of health and pre-existing comorbidities (35). The immediate disproportionate impact of the COVID-19 pandemic on racial and ethnic minority groups with insufficient resources is receiving more awareness (36). However, insufficient funding, or the lack thereof, to support the research or interventions of under-represented minority

groups often leads research investigators to change research interests and channel their research focus to other competitive topics, away from health disparities in minority groups. Many scientists from under-represented minority groups focus their research on projects that address the needs of their communities, which may not be well aligned with the strategic priorities of their institutions or funding agencies, urging grant reviewers to question the significance of focusing research on minority populations, if the health disparities are not glaringly obvious (37). Therefore, it is pertinent to reexamine policy interventions in order to redress the disproportionate burdens and lack of resources for ethnic minority groups.

The outcomes of this study present some of the socio-economic impacts of the COVID-19 pandemic and the persistent disparities among minority populations. A more inclusive access begins with the availability of accurate information for all. Therefore, to reduce some common barriers to effective communication in a pandemic, one of the inching steps implied by these findings; is for academia, public health experts, healthcare institutions, clinicians, and federal government agencies to re-examine current programs. Such that the dissemination of updated information with reference to the public is not limited to white papers, scientific papers published in journals and other similar scholarly articles, but also channeled through informal digital platforms such as television and social media which are more easily accessible for minority groups, as shown from participants' responses in this study.

This article has two main limitations. First is selection bias, due to the ease of data collection, geographical proximity, availability, and willingness to participate in the study during mobile unit visits, the participants were recruited through convenience sampling, however this may not be representative of the population of interest. Secondly, there was a huge amount of missing data for important variables such as education, income, language, and nationality as responses to any and all questions was to the discretion of the participant. Despite these limitations, this study yielded several useful insights about the population-specific health disparities experienced during the COVID-19 pandemic, as well as elucidated the disproportionate socio-economic impact COVID-19 had on residents across the study area in Arizona. This survey presents valuable information for policy makers such as Arizona Public Health Association, Arizona Department of Health Services, Arizona Medical Association Advocacy, and other community healthcare service providers. This result can be used as a basis to realign current programs and outreach in an effort to incorporate equity into the many health policy decisions made yearly, enhancing the health professions training pipeline to include training in rural areas, addressing scope of practice regulations to promote practice in rural areas (27). Such successful models can then be replicated and modified in other states, and among local government agencies and non-profit organizations, which will

aid a gradual ease of the burden of health inequalities and disparities amongst populations of diverse groups, toward a near-equitable positioning in a future pandemic.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

CR contributed to the conception and design of the study. SS organized the database and proofread sections of the manuscript with corrections. LC performed the statistical analysis. TF wrote the first draft of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.939154/full#supplementary-material

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A narrative-based approach to understand the impact of COVID-19 on the mental health of stranded immigrants in four border cities in Mexico

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Objective: This paper describes the impact that the different COVID-19 related restrictions have had on the mental health and wellbeing of 57 Central American and Caribbean immigrants stranded in Mexico due to the pandemic.

Methods: Ethnographic data was obtained through the application of in-depth interviews centered on topics such as migration history, personal experience with COVID-19 and beliefs about the pandemic. This information was further analyzed through a narrative approach and Atlas Ti.

Main findings: US Title 42 and the Migrant Protection Protocols (MPP) have stranded thousands of individuals in the US-Mexico border region, a situation that has overcrowded the available shelters in the area and forced many of the immigrants to live on the streets and in improvised encampments. Thus, exposing them to a higher risk of contagion. Furthermore, the majority of the interviewed Central American and Caribbean immigrants consider that Mexico is more lenient when it comes to the enforcement of sanitary measures, especially when compared to their countries of origin. Finally, vaccination hesitancy was low among the interviewees, mainly due to the operative aspects of the vaccination effort in Mexico and the fear of ruining their chances to attain asylum in the US. These findings are backed up by the discovery of five recurring narratives among the interviewees regarding: (1) The pandemic's psychological impact. (2) The uncertainty of being stranded in Mexico and the long wait. (3) Their fear of violence over the fear of contagion. (4) The perceived leniency of Mexico with the pandemic when compared to their countries of origin, and (5) their beliefs about the pandemic and vaccines.

Key finding: The mental health of stranded Central American and Caribbean immigrants in Mexico during the COVID-19 pandemic is mostly affected by their inability to make it across the US-Mexico border using legal means.

Introduction

The COVID-19 pandemic has shown that there are socio-economic and cultural differences not only when it comes to frequency, hospitalization and mortality (1), but also when it comes to vaccination hesitancy (2) and mental health (3). Other factors such as the lack of civil infrastructure have contributed to increased risks of contagion. An example of how cultural and socio-economic factors have contributed to the experience of the pandemic occurred among the Otomí-Tepehua peoples in central Mexico, as they had to go out on the streets to resist a sanitary perimeter established around their communities without any previous notice, thus exposing themselves to the virus (4).

The different restrictions that Mexico and the United States have implemented on migration both before and during the COVID-19 outbreak have increased the exposure of the migrant population stranded in Mexico, mainly due to their vulnerable situation, vagrancy and overcrowded shelters.

In this paper, we aim to determine how the different COVID-19 related restrictions have impacted the mental health and wellbeing of Central American and Caribbean immigrants stranded in Mexico, using a narrative approach centered on their migration history, their experience with the virus and their personal beliefs on the pandemic and the vaccination efforts. Using this approach will help us understand how cultural and economic differences come into play when experiencing the pandemic on a day to day basis, which leads to a more precise contextualization of the sanitary contingency and its consequences through the personal narratives and experiences of those immigrants in transit. This strategy also highlights the factors that have a direct impact on their mental health, as per their testimonies, which provides us with a chance to better understand their situation (5).

Immigration and COVID-19 in Mexico

Central American and Caribbean immigrants in Mexico have experienced COVID-19 through the intersection of economic inequality, cultural differences, their status as outsiders and the migratory policies on both sides of the US-Mexico border (6). During our ethnographic work, some of the interviewed individuals expressed how their journey across Mexico was mired with risks and dangers associated with being outsiders, poor, sick, indigenous, black, female, unaccompanied or all of them at the same time.

Some of the specific instances that were mentioned by the interviewees were: the presence of illegal checkpoints along the routes used to travel to the US-Mexico border, manned by organized crime groups with the intent of ransoming those with relatives in the US. The rapes and attacks committed on women

and unaccompanied minors, abusive migratory authorities and xenophobic demonstrations in different Mexican cities (7, 8).

Furthermore, the restrictions placed by both governments to fight the spread of the virus have affected the mental, social and economic health of the migrant population (9). Studies in Canada and the US have already shown the asymmetrical impact of the pandemic among immigrants and racialized populations, considering that COVID-19 is most likely to affect those in vulnerable situations such as overcrowded shelters, encampments and on the streets (10).

Most of the immigrants in-transit through Mexico are living in overcrowded shelters and on the streets, where they lack access to services such as plumbing facilities, potable water, hand sanitizer, face masks and other methods that were used by the general population to fight the pandemic. Nonetheless, this paper will show that even though the day-to-day material and social conditions that our interviewees had to face did, in fact, increase their chances of contagion given the viral properties of COVID-19, the main factor that impacted their mental health had to do with the uncertainty of making it across the border and into the US.

Migrant mental health and COVID-19

Most available COVID-19 literature has focused on the quantitative aspects of the pandemic, especially when it comes to data related to spread patterns, contagion, and deaths (11). While there are studies that have addressed the psychological impacts that COVID-19 has had among different demographic groups in countries such as Iran, China and the United States, most of them have used methods such as online and telephonic surveys to conduct their analysis (12–15). Although this approach has allowed for the identification of mental health risks and disorders in the face of COVID-19, qualitative efforts to understand the mental consequences of the coronavirus, particularly those that delve into the narrative and experiential aspects of them, have just begun to emerge, especially among first responders, hospital staff and older adults (16–19).

When it comes to immigrants at the border, and according to data provided by the *Instituto Nacional de Estadística y Geografía* and the *Consejo Nacional de Población*, immigrants in Mexico tend to congregate in the states of Baja California, Chihuahua, Tamaulipas, and Chiapas (20, 21). While there has always been a continuous influx of foreign migration due to Mexico's geographical position as the gateway to the United States, the rate in which immigrants arrive to the country has increased since 2018, driven mainly by the social, economic, and political unrest that has persisted throughout Central America and the Caribbean (22). Perhaps one of the most visible consequences of this phenomenon took place in November 2018, when there were several attempts to cross into

TABLE 1 Migratory and COVID-19 record of the interviewees.

Interview	Gender	Country	Age	MPP	Has/had COVID-19	Vaccinated	Willingness to be vaccinated	Temporary/permanent residency	Refugee status	Completely undocumented
TJ-01-F	F	Colombia	38	No	Yes	No	Yes	Yes	No	No
TJ-02-F	F	Venezuela	75	No	No	Yes	Yes	Yes	No	No
TJ-03-M	M	Venezuela	71	No	No	Yes	Yes	Yes	No	No
TJ-04-M	M	Honduras	47	No	No	Yes	Yes	Yes	No	No
TJ-05-M	M	Nicaragua	31	Yes	No	No	Yes	No	No	No
TJ-06-M	M	Honduras	35	No	Yes	No	Yes	No	No	Yes
TJ-07-M	M	Honduras	34	No	No	Yes	No	No	Yes	No
TJ-08-M	M	Honduras	44	No	No	No	Yes	No	Yes	No
TJ-09-M	M	Honduras	32	No	No	Yes	Yes	No	No	Yes
TJ-10-M	M	Guatemala	68	No	No	Yes	Yes	Yes	No	No
TJ-11-M	M	Mexico	22	No	No	Yes	Yes	Yes	No	No
TJ-12-M	M	Honduras	35	Yes	No	No	Yes	No	No	Yes
JZ-01-M	M	Cuba	41	Yes	No	No	Yes	No	No	No
JZ-02-F	F	Mexico	48	No	Yes	No	Yes	Yes	Yes	No
JZ-03-F	F	Honduras	25	Yes	No	No	No	No	No	No
JZ-04-F	F	Honduras	26	Yes	Yes	No	Yes	No	No	No
JZ-05-M	M	Nicaragua	28	Yes	Yes	No	Yes	No	No	No
JZ-06-F	F	Guatemala	26	Yes	Yes	No	No	No	No	No
JZ-07-F	F	Guatemala	28	No	No	No	Yes	No	No	No
JZ-08-F	F	Guatemala	39	No	No	No	Yes	No	No	Yes
JZ-09-M	M	Guatemala	28	No	Yes	No	Yes	No	No	Yes
JZ-10-F	F	El salvador	28	Yes	No	No	Yes	No	No	No
JZ-11-F	F	Guatemala	31	No	No	No	Yes	No	No	Yes
JZ-12-M	M	Honduras	33	Yes	No	No	Yes	No	No	No
JZ-13-F	F	El salvador	28	Yes	No	No	No	No	No	No
JZ-14-F	F	El salvador	33	No	Yes	No	Yes	No	No	No
MT-01-F	F	El salvador	25	Yes	No	No	Yes	No	No	No
MT-02-F	F	El salvador	31	No	No	No	Yes	No	Yes	No
MT-03-M	M	Honduras	30	No	No	No	Yes	Yes	Yes	No
MT-04-M	M	Nicaragua	35	Yes	No	No	Yes	No	No	No
MT-05-M	M	Haiti	40	Yes	No	No	Yes	No	No	No
MT-06-F	F	Honduras	32	Yes	Yes	No	No	No	No	No
MT-07-F	F	Honduras	23	No	No	No	Yes	No	No	No
MT-08-M	M	Haiti	24	No	No	No	No	No	No	No
MT-09-M	M	Haiti	25	No	No	No	Yes	No	No	No
MT-10-F	F	Honduras	21	Yes	No	No	No	No	No	No
MT-11-F	F	El salvador	33	Yes	No	No	Yes	No	No	No
MT-12-F	F	Haiti	37	Yes	No	No	Yes	No	No	No
MT-13-F	F	Honduras	35	No	Yes	No	Yes	Yes	Yes	No
MT-14-M	M	Honduras	57	No	No	No	No	Yes	No	No
MT-15-M	M	Guatemala	39	No	No	No	No	No	No	No
MT-16-M	M	Haiti	28	No	No	No	Yes	Yes	No	No
TP-01-M	M	Cuba	58	No	No	No	No	Yes	No	No
TP-02-M	M	El salvador	72	No	No	No	Yes	Yes	No	No
TP-03-F	F	Guatemala	31	No	Yes	Yes	Yes	Yes	No	No

*(Continued)*

TABLE 1 (Continued)

Interview	Gender	Country	Age	MPP	Has/had COVID-19	Vaccinated	Willingness to be vaccinated	Temporary/permanent residency	Refugee status	Completely undocumented
TP-04-F	F	Guatemala	37	No	No	No	Yes	Yes	No	No
TP-05-M	M	Honduras	21	No	No	No	No	Yes	No	No
TP-06-M	M	Honduras	42	No	No	No	No	Yes	No	No
TP-07-F	F	Honduras	25	No	No	No	Yes	Yes	No	No
TP-08-F	F	Honduras	30	No	No	No	No	Yes	Yes	No
TP-09-F	F	El salvador	27	No	No	No	No	No	No	No
TP-10-F	F	Honduras	31	No	Yes	No	Yes	Yes	Yes	No
TP-11-M	M	Guatemala	29	No	No	No	Yes	Yes	Yes	No
TP-12-F	F	Honduras	19	No	No	No	Yes	No	No	No
TP-13-F	F	El salvador	32	No	Yes	No	Yes	Yes	Yes	No
TP-14-F	F	Honduras	20	No	No	No	Yes	Yes	Yes	No
TP-15-M	M	Guatemala	29	No	No	No	Yes	Yes	No	No

Source: COVID-19 differential Impact on Indigenous Peoples and Newcomers: A socioeconomic analysis of Canada, US and Mexico, 2021.

FIGURE 1

Narrative workflow during each interview. Solid arrows symbolize the expected workflow. Dotted arrows represent how most interviews actually went (Source: COVID-19 differential Impact on Indigenous and Newcomers: A socioeconomic analysis of Canada, US and Mexico, 2021).
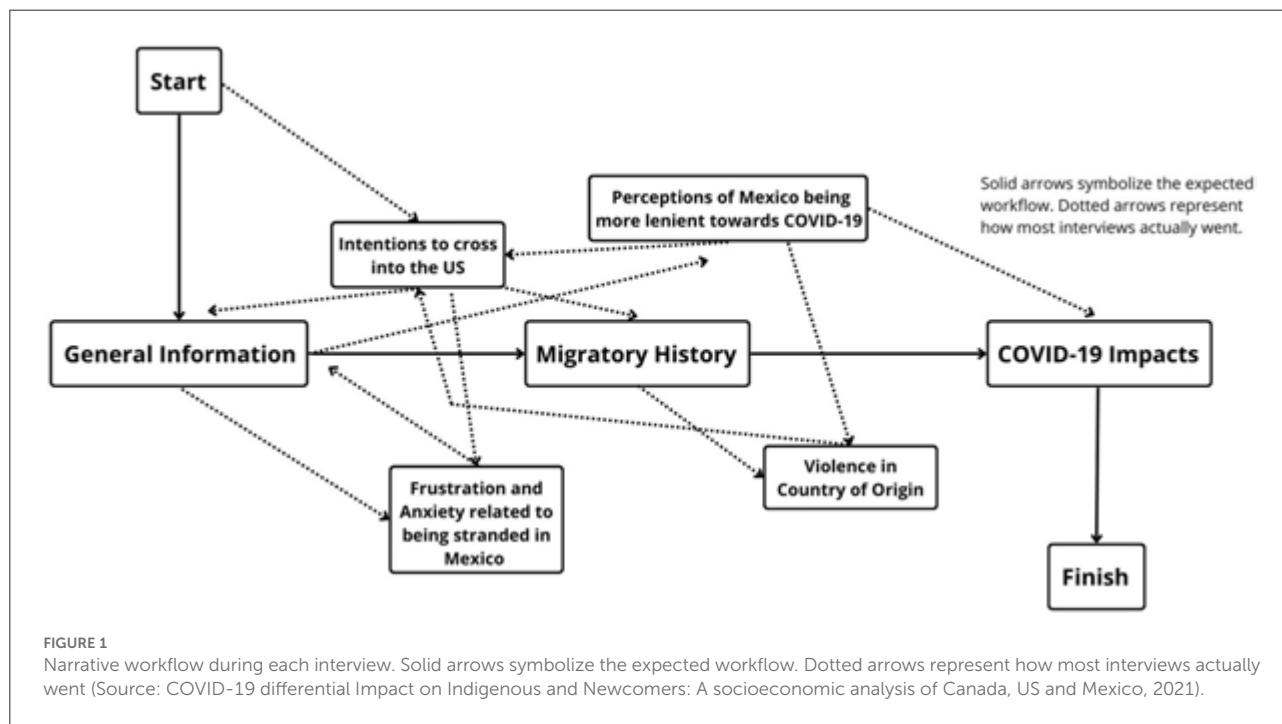
the US by organized groups of Central American immigrants; their clash with US Border and Customs authorities was widely reported, with some of the most conservative news outlets in the US fearing a mass invasion of undocumented migrants (23, 24).

It is important to consider that migrant caravans are a direct response to the high levels of violence that migrants have to experience during their journey, more so if we take into account

that Mexico has become one of the most violent countries (25). Caravans are but a method that increases the chances of survival by finding strength in numbers (23). An unintended effect of these caravans, however, has to do not only with how easy it has been for the authorities to identify them and deport those without migratory documentation, but for criminal groups to exploit their vulnerability and for some xenophobic groups to harass and target them (26).

FIGURE 2
Most referred topics during the qualitative interviews (Source: COVID-19 differential Impact on Indigenous Peoples and Newcomers: A socioeconomic analysis of Canada, US and Mexico, 2021).

When COVID-19 hit the US and Mexico, most immigrants in-transit were already stranded at the border due to the restrictions placed on migration by the Trump administration and upheld by the Biden administration. These Migrant Protection Protocols (MPP) directly affected those seeking asylum in the US, as they were expected to remain in Mexico and wait until they were instructed to return to a specific port of entry, at a specific date, for their next court hearing, thus stranding them in Mexico and exposing them to physical assault, psychological abuse, violence against family/friends, sexual violence and psychological stress (27).

Up until 2021 the implementation of the MPP had returned more than 70 thousand asylum seekers into Mexico (28), further complicating the situation amidst the COVID-19 pandemic and its ensuing restrictions (29). Prior to this, asylum seekers who passed a "credible fear interview" at a US port of entry could ask to be released on parole in the US.

While the Biden administration did temporarily suspend MPP, this policy was formally reinstated on December 6, 2021. At the same time, in March 2020, the US implemented a public health regulation called Title 42 in response to COVID-19. This policy resulted in the quick deportation of asylum seekers who present themselves at the US border without due process, although exceptions were made for unaccompanied minors and, in some cases, victims of torture, parents with newborns, pregnant women and/or those with special needs (30).

Structural determinants of health among immigrants stranded in Mexico

Regarding the structural determinants of health among Central American and Caribbean immigrants in Mexico, it is worth noting that few of them have access to healthcare, as this is something that is dependent on whether they are staying at a shelter that can provide such services (31). If they are staying at an encampment instead, their only chance at healthcare is to be present when an NGO makes a visit to provide aid. In some cases, a limited number of immigrants have managed to obtain refuge status in Mexico, allowing them to officially apply for jobs and thus making them eligible to get healthcare as per Mexico's laws (32).

If the agentic capacities of a given community are a reflection of the interaction between power and control (33), the agency of those that we interviewed, and the health behaviors enacted by them, constitute another structural determinant of health. These agentic capacities are, in turn, relegated to the power dynamics operating in the border region and in their specific living spaces. By this, we refer to the fact that all of the interviewees mentioned how they were willing to obey every single sanitary measure intended to fight COVID-19, including vaccination efforts, even if they were personally against it, as they did not want to risk their chances at making it across the US-Mexico border. This explains how,

for instance, there was no virtually no hesitancy toward vaccination (34).

Migration and mental health

As for migration and mental health, it is common for those migrating across Mexico with the intent to make it into the US to experience increased levels of anxiety, chronic fatigue and pain (35, 36). Other migrant stressors are related to traumatic events, discrimination, stressful migration experiences and the uncertainty of fulfilling their migratory objectives, and can lead to an increased propensity for depression, anxiety and post-traumatic stress disorder (37, 38). These conditions, coupled with the increased securitization of the US-Mexico border, the implementation of the MPP and US Title 42, and the psychological effects of the pandemic have created a complex panorama for the thousands of Central American and Caribbean immigrants stranded in Mexico.

Methods

The primary source of data were 57 semi-structured, in-depth, face-to-face interviews, funded by the Canadian Institutes of Health Research (CIHR) through the University of Manitoba. As such, the entire research process and the interview guide were approved by the University of Manitoba's Institutional Review Board. All data was kept confidential by the primary authors using password protected systems.

Taking into account INEGI's (21) and CONAPO's (20) data, our ethnographic efforts focused on four cities: Tijuana, Juarez, and Matamoros, in the US-Mexico border, and Chiapas in the Mexico-Guatemala border. Although most of the immigrants stranded in these cities originate from Central America, there is a visible trend when it comes to Haitians and Cubans, as the former tend to move toward Tijuana, while the latter usually move to Juarez and Matamoros (39).

While our original intention was to focus on the specific nationalities shown by these trends, COVID-19 lockdowns and safe distance protocols prevented us from deploying our ethnographic operation in full, which was dependent on gaining access to a series of shelters among the aforementioned locations. This situation pushed us not only to disregard our intention to interview an equal number of individuals from specific countries, but to adapt our overall fieldwork strategy in order to maximize the number of successful interviews. In the end, our criteria to select potential interviewees was based on two aspects: they had to be foreigners and they had to have arrived in Mexico no later than 6 months from the start of our interviews in April 2021. This timeframe allowed us to choose individuals who had experienced the brunt of the pandemic during their journey into and across Mexico.

Initially, and considering the severity of the pandemic and the safe distance protocols, interviews were to be carried out remotely. This was soon deemed unreasonable, as most of our target group lacked access to a computer or a mobile phone with enough data to waste on an interview with a group of strangers. Additionally, shelters that could have accommodated for long-distance interviews were in full lockdown and lacked the resources to divert their attention to our requests.

This situation led us to rely on snowball sampling and visiting public areas and/or improvised encampments where immigrants were known to dwell. We learned the areas, walking them for several weeks, asking around and sampling potential candidates. Once a person agreed for an interview, we arranged for a session at a nearby cafe or restaurant, although sometimes a bench did the trick. A written consent agreement was signed, where each interviewee was informed that their information was to be treated anonymously. Being free from the gaze of institutional authorities made for a more comfortable situation for our interviewees. We had already learned from a past mistake, in which conducting interviews in the premises of the Instituto Nacional de Migración made many of them uneasy and careful with their answers, as they feared that they could deter their asylum request process.

Given that we had limited time with each potential collaborator due to the safe distancing protocols and other COVID-19 related restrictions, our interview guide (Appendix A) was designed to tackle specific topics, with the intention of priming our interviewees to share their experiences on the pandemic and their migratory trajectories; as such, this guide was divided into three sections: (a) basic information and background, (b) migratory history, and (c) COVID-19 impacts; some of the topics addressed by this last section were taken from the surveys that were being conducted by the quantitative team that was part of the CIHR funded project.

Once the interviews were completed, each audio file was transcribed in Spanish, resulting in roughly 741 single-spaced pages which were later translated as needed. Data was coded using Atlas Ti, which allowed us to spot the convergences between common mental stressors, particularly those related to their intentions to make it into the US.

It is important to mention that two of the 57 interviews were conducted with Mexican nationals who were living in an improvised encampment that was established next to the Chaparral Pedestrian Crossing between Tijuana and San Diego (Table 1). We decided to keep their stories because they had experienced a similar journey across the pandemic-ridden Mexico and they had been living in the same encampment, so they could attest to some of the dynamics within and among its inhabitants.

Finally, and despite the fact that our original plan to interview an equal number of immigrants from each Central American and Caribbean country was thwarted by the different

restrictions that we faced while on field, we managed to keep close to a 50/50 proportion when it came to gender, as we interviewed 29 women and 28 men. As previously stated, we had originally planned to emphasize certain nationalities depending on whether it was Tijuana, Juarez, Matamoros, or Tapachula, but the restrictions imposed by the pandemic made it difficult for us to maintain this objective. As such, the majority of the interviews were conducted with immigrants in-transit from Honduras, Guatemala, El Salvador, Haiti, Nicaragua, Venezuela, Cuba, and the two Mexican cases who were inhabiting shelters for foreigners.

Data analysis

Our analysis gravitated around the idea of identifying pivotal themes (40) regarding mental health and the different struggles faced by foreign immigrants in Mexico during the pandemic. Both during their journey to and across Mexico, and during their stranding in one of the border cities in which they were interviewed. In this regard, our focus was on the narrative content of each interview.

The advantage of using a narrative approach lies in the fact that it gave each one of the interviewees the necessary freedom to recount their experiences with little input from the interviewer, whose role was restricted to guiding the conversation to the topics established in the interview guide. It also allowed for discourse to be properly contextualized and nuanced, which would have been difficult if we had used a quantitative methodology. Validity issues were not considered, as it is not directly applicable to narrative research (40).

While our guide was designed to address the psychological impacts of the pandemic (Appendix A), most interviews followed the pattern seen on Figure 1, where it shows how most of the interviewees were constantly referencing their desire to make it into the US rather than staying in Mexico. This recurring theme was central to their outlook on life and it was completely inseparable from other topics and themes, be it the pandemic or even the violent contexts that they were fleeing from.

Once the transcriptions were completed, we proceeded with a thematic categorization on each interview. Figure 2 contains the number of times that an interviewee talked about that specific topic. The coding process was the result of a three phase process: (1) The interview itself, which allowed us to get a rough idea on what each individual was emphasizing in their narrative. (2) The listening of each recording, which allowed us to confirm the existence of common narrative themes, and (3) The transcription of each interview, which confirmed, through the use of codes, the common narratives and the priority of specific themes within them.

As we were focused on narrative content, our aim was to narrow down the experiences that each interviewee was referencing, this led us to generate the codes seen in Figure 2.

Themes such as *COVID-19 in Mexico*, *Beliefs about COVID-19*, *COVID-19 in Country of Birth*, *Measures* (against COVID-19), *Gang Violence*, *Employment/Survival*, *Frustration*, *Vaccination*, and *Expectations after COVID* were the most numerous and yet, the recurring nature of their *Intentions to cross into the US* and their *Arrival* (to Mexico), coupled with the *Frustration* and the *Depression* associated with becoming stranded at the border were bits of data that we were not expecting to see in such numbers, especially in a context where COVID-19 was still a clear and present threat.

The rest of the codes, although fewer in number, allowed us to cross-reference the instances in which explicit mental states, such as fear, uncertainty, isolation, hopelessness, paranoia, anxiety, anger, misery, and stress were directly linked to the pandemic or to their intentions to cross into the US. This approach allowed us to pinpoint five recurring narratives that will be further addressed in the results section.

Results

After coding each of the 57 interview transcripts in Atlas Ti, most of the information gravitated toward their experience of COVID-19 in Mexican territory, which was to be expected considering the nature of our talking points. In spite of this, most of the narratives always shifted toward the intention to cross into the US, with this being the second most frequent topic across all of the interviews, and a very important hint for us, as we later found out that this was at the root of most of our interviewees' stressors. By this we mean that the highest priority for our interviewees always was reaching the US, and any element that contributed against their chances of making it across the border affected them in a more profound way than the fear of contagion or even death by COVID-19.

The third most frequent iteration across all interviews had to do with their arrival in Mexico during the pandemic, followed by their personal beliefs on the virus, the effects of the disease in their countries of birth, the preventive measures taken both individually and collectively to fight the coronavirus and their means of survival. Only then we started to see the narrative aspects surrounding the mental and psychological impacts of the pandemic itself, with frustration being the prevailing feeling among them (Figure 2).

As previously stated, we were able to identify five recurring narratives that allowed us to infer how COVID-19 affected the mental health of the Central American and Caribbean immigrants that we were able to interview: (1) The pandemic's psychological impact, referring to those cases in which the sanitary contingency was directly related to their mental health. (2) The uncertainty of being stranded in Mexico and the long wait. (3) Fear of violence over fear of contagion. (4) The perceived leniency of Mexico with the pandemic when

compared to their countries of origin, and (5) Beliefs about the pandemic and vaccines.

In the following paragraphs we will use excerpts from the transcripts, organized into one of the five recurring narratives, to show how our interviewees were mostly concerned with the border closure and the consequences of it all in regard to their objective of making it into the US. These excerpts will also show how COVID-19 restrictions were perceived to be more lenient in Mexico when compared to their countries of origin and how the coronavirus was perceived as a lesser threat to their mental wellbeing when compared with the prospect of returning to their countries or getting stranded in Mexico.

In an effort to maintain confidentiality and to better organize our data, each of our collaborator was assigned a code in the following manner: TJ-01-F, which stands for the city in which the interview was conducted (TJ for Tijuana, JZ for Juarez, MT for Matamoros, and TP for Tapachula. The number refers to the interview number for that particular city; M or F refer to Male or Female).

The pandemic's psychological impact

The pandemic impacted the mental health of migrants in several ways: the cost of the journey toward the US increased, border security measures in every country became harsher, the sanitary filters made it more difficult for them to freely move within each city and life within shelters became stricter.

It is important to mention that this recurring narrative, along with the one regarding personal beliefs, were the only instances in which we explicitly steered each interview in order to get insights. When compared to the other three recurring narratives, this one becomes relatively unimportant. Most of the fears regarding COVID-19 had to do with the isolation that could come because of contagion and the thwarting of their plans because of it. Table 3 contains all of the quotations on this and the other four recurring themes, nonetheless, these are some of the most representative instances for this particular one.

TJ-06-M mentioned how frustrating it was for him to live in a shelter and how he had to abandon it due to how overcrowded it was: "They gave us access to medicine, facemasks and whatnot, but we were so many, using only one bathroom, life was tough in there so I left it" (Interview, TJ-06-M, April 2021).

TJ-09-M left a shelter to live in an improvised migrant encampment due to the highly restrictive policies that the former had during the pandemic:

> They have so many measures in place because of the pandemic, they have strict schedules and very harsh rules, and you have no other choice than to comply, because you're

in a foreign country (…) if it weren't for the pandemic we wouldn't be suffering like this, waiting in this encampment (Interview, TJ-09-M).

MT-02-F was very paranoid even after agreeing to the interview; considering that her priority was to get into the US, she seemed to fear retaliation for providing what she thought were wrong answers. She did emphasize how COVID-19 restrictions made things harder for her:

> You have no idea how the pandemic closed doors for us, especially from the migratory authorities; they abandoned us (…) we have to get tested every 15 or 20 days because they ask us to fulfill that requirement, just to have the right to be here at the shelter (Interview, MT-02-F, May 2021).

The uncertainty of being stranded in Mexico and the long wait

While many of the interviewees had experienced COVID-19 in their home countries and even along their journeys, realizing that their entry into the US was not going to be as easy as they had thought, coupled with their unexpected stranding in Mexico, allowed us to identify these type of situations as mental stressors that surpassed their fear of contagion and/or death due to the virus.

JZ-03-F fled Honduras due to gang violence, she got stranded at the border due to the Migrant Protection Protocols; she missed her court date because of the pandemic:

> (…) things are difficult, especially when you have to share a shelter with so many people; I could find someplace to rent, but I'm afraid something's gonna happen to me if I do so (…) most of my relatives in Honduras got infected, luckily nobody died, up here I haven't had it yet, but I'm not as afraid of it as I once was (…) I just keep using my facemask and disinfectant (…) I'm really desperate about being stuck here (Interview, JZ-03-F, April 2021).

JZ-04-F was extorted by a gang and is seeking asylum in the US, as she has relatives in that country, when talking about her worse experience in Mexico during the pandemic, she mentioned the long wait and the uncertainty:

> I've been here longer that I had expected (…) I haven't been able to attend my court hearing because of the border closure and I'm fearful that my case will be discarded (…) during the time that I've been here I've suffered with depression and anxiety, I even got bladder stones because of it (…) what's eating me is the uncertainty, I don't

know the current status of my asylum request because of the pandemic, nobody is answering (Interview, JZ-04-F, May 2021).

JZ-05-M left Nicaragua because he experienced political persecution (…) he crossed into the US but was deported as per the Migrant Protection Protocols, he's been waiting ever since:

> The border closure due to COVID-19 has been really tough for me, I wasn't able to get my baby girl to be born in the US, me and my wife got deported and stranded in here, they changed my baby's life forever because of it (…) during my time here, I've caught COVID-19 twice, luckily I haven't died (…) psychologically it's been tough, physically not so much, I'm just desperate for my situation to get solved (Interview, JZ-05-M, May 2021).

JZ-06-F is from Guatemala and is also waiting for her asylum request application to go through, she also cited a missed opportunity regarding giving birth in the US because of the pandemic:

> They denied me my chance for my daughter to be born in the US, they told me that I had to wait here in Mexico, even though I was almost ready to give birth (…) if they hadn't closed the border, I'd be already up there, trying to build a better life (…) stupid pandemic put everything on pause, every procedure, everything related with the government, it really is depressing (Interview, JZ-06-F, May 2021).

JZ-13-F came from El Salvador, trying to make her case at the US Courts, due to MPP she was taken back to Mexico and made to wait:

> Next week they will come for us, for our next appointment on the asylum request, the wait gets very frustrating, I've been here for 5 months; not being able to cross the border is unnerving (…) we were under the impression that it would take less time but it seems that the pandemic has delayed everything (…) we've been like this for five months (…) being stuck in place is harsh (…) I'm not planning on getting the vaccine, but being isolated has taken a toll on my mind (Interview, JZ-13-F, May 2021).

Fear of violence over fear of contagion

Most Central American and Caribbean immigrants are fleeing from contexts of high-violence related to gang activity, weakened governments or the aftermath of natural disasters (7). In addition, their journey toward the US remains a high-risk

activity, as Mexico is plagued with cartel-related violence associated with kidnappings, rapes and murders (41). Taking this into account, it was relatively common for our interviewees to express their fear of violence rather than their fear COVID-19.

TJ-05-M experienced violent encounters on his way toward the US-Mexico border:

> I can't stay in Mexico, back in the outskirts of Tecun, Chiapas, I was assaulted with a machete, they were trying to kidnap me (…) I actually wanted to request asylum in Mexico, but after experiencing that kind of situation I decided to leave Tapachula and try to reach the US, that's how I ended up here" (Interview, TJ-05-M, April 2021).

TJ-10-M is from Guatemala, he was deported from the US and decided to make the trip across Mexico once more in order to contest his deportation. He mentioned how his biggest fear was getting stopped by a cartel or by the Mexican authorities: "The scariest part about traversing the country isn't the virus, but the police and the military. You never know if a road checkpoint is legit or belongs to a cartel" (Interview, TJ-10-M, April 2021).

MT-04-M, from Nicaragua, expressed how he was constantly in fear of smugglers and kidnappers, not the virus:

> I try not to pass as a foreigner as much as possible, I know that people in shelters and encampments are easy targets, not just for the virus but for criminal groups and policemen trying to extort those of us who have relatives in the US, or even back home (Interview, MT-04-M, May 2021).

JZ-11-F's sentimental partner was killed by gang members and she's also requesting asylum in the US:

> I got jumped in Tapachula and lost what little money I had with me, almost 1,500 quetzales (…) I did make it across the US but they sent me back to Mexico because of COVID-19, they told me I had to wait for my turn here (…) the border closure is getting to me, and border agents are getting more aggressive by the minute, maybe they're on the edge due to the virus (Interview, JZ-11-F, May 2021).

MT-02-F shared how she thinks that "things are as severe down in El Salvador and in Mexico, but not because of the virus, but due to the high levels of violence; I got mugged both in El Salvador and In Mexico" (Interview, MT-02-F, May 2021).

MT-16-M, from Haiti claimed that he is more worried about how violent Mexico is, rather than how dangerous the pandemic could be: "a group of thugs attacked me, they took my backpack, my passport, my money" (Interview, MT-16-M, May 2021).

The perceived leniency of Mexico with the pandemic when compared to their countries of origin

Another narrative circulating among our interviewees had to do with how they perceived Mexico to be more lenient regarding the different COVID-19 related restrictions, as this country lacked the curfews and the policing that was common in places like Honduras, El Salvador and Nicaragua (Oliva Franco Cabrera, 2021).

TJ-05-M talked about how he perceived Mexico to be less restrictive on pandemic-related restrictions.

> Nicaragua is undergoing a pretty awful political crisis, I was beaten several times down there by the authorities (…) things got even worse when COVID hit (…) when I compare it with Mexico, is almost as if the virus didn't exist here, people are on the streets just going about their lives (Interview, TJ-05-M, April 2021).

TJ-07-M also expressed how Mexico is more relaxed than Honduras:

> I feel pandemic related restrictions are almost the same between Mexico and Honduras, although it does feel more relaxed here without curfews (…) I wasn't sure about getting the vaccine, I know many people in Honduras who died because of it, when we got to the encampment though, they said that we all had to get it (…) they said that it wasn't compulsory, but that we had to get it if we wanted to avoid trouble with US authorities on the other side (Interview, TJ-07-M, April 2021).

JZ-01-M expressed how Cuba is more severe with its COVID-19 restrictions:

> (…) things are pretty bad in Cuba, there is no work, and when you find some, it is poorly paid (…) I lost all my documents here, I was robbed and left without a penny, that's when I started living in a shelter (…) I haven't gotten the virus yet but a friend of mine caught it, he got well after a week or so (…) I try to follow the sanitary measures but it is very different from Cuba (…) in there you get huge fines for not wearing a facemask (Interview, JZ-01-M, April 2021).

According to JZ-05-M: "compared to Nicaragua, Mexico almost looks as if there weren't any restrictions, not a lot of people seem to care out here on the streets" (Interview, JZ-05-M, May 2021).

JZ-11-F claimed that "Mexican authorities don't seem to care that much about the virus, all they seem to care about is to extort as much money as they can" (Interview, JZ-11-F, May 2021).

MT-03-M complained about how they were being asked for COVID-19 tests in Honduras, just to let them leave the country: "The cop told me to sign and pay a fine for not presenting a negative COVID-19 test, they told me to get tested and I had to pay for it, they even threatened me, saying that I was a risk for everybody else, and that I was contaminated" (Interview, MT-03-M, May 2021).

Tapachula interviewees were more specific in their comparisons regarding COVID-19 between Mexico and their countries of origin.

> Crossing from Nicaragua into Honduras was very difficult, 80 percent of the times that people attempted to make it across, border authorities would just deport you (…) I could have arrived earlier but it was impossible due to the heavy restrictions, lots of checkpoints and plain abuse from the authorities (…) in Tapachula a lot of things changed, they become more human, although it depended on the person that interacted with you (…) back in my home country, my family is completely isolated, they even developed pneumonia (…) they have offered us the vaccine here in Tapachula, but I still have my doubts and I don't know if I will get it (Interview, TP-01-M, May 2021).

TP-07-F complained about how people could not leave their homes while in Honduras:

> We had a full lockdown, you couldn't even go outside to get water or food, unless you were selected by the government based on your ID number (…) things got worse because the gangs started to notice that people were stuck in place, and they were able to pick on you directly at home, this is why I left my country (Interview, TP-07-F, June 2021).

Beliefs about the pandemic and the vaccines

Overall, most interviewees were willing to put aside their personal beliefs when it came to vaccination, as their status as outsiders and their position as asylum seekers leaves them vulnerable to the whims of the migratory authorities in both Mexico and the US. An example of this is TJ-06-M's case, as he will get the vaccine but only because he feels that it is mandatory, even when it is not: "I'm waiting on the vaccine because I wasn't here in the encampment when they came to apply it (…) I don't want to get it but I don't really have a choice" (Interview, TJ-06-M, April 2021).

TJ-10-M recalled how he decided to get the vaccine just to avoid any inconvenience in the future: "I got the dose here in the encampment, they told us that it was up to us if we wanted to get vaccinated, but I didn't want to run into any issues later on" (Interview, TJ-10-M, April 2021).

JZ-09-M told us how he "already got COVID-19 right after I crossed into Mexico, but I made it, I only had to rest and take paracetamol (…) I don't want the vaccine, but if it is required of me I will comply (Interview, JZ-09-M, May 2021).

JZ-10-F spoke about how she is "scared of the vaccine and its effects, I haven't taken it but I'm guessing that they're gonna make it mandatory for us" (Interview, JZ-10-F, May 2021).

JZ-14-F mentioned that she has not "been vaccinated but I will have to get it. I fear that if I don't, my asylum application will be revoked" (Interview JZ-14-F, May 2021).

MT-01-F is waiting for a court date to continue her asylum application; while her narrative also showed how her priority never ceased to be her entry into the US, she did mention how the believes that the vaccine is a requirement rather than a decision: "I wish I could get the vaccine, but it seems like they're only applying it to important people, like doctors and nurses (…) I want to be vaccinated because I'm pregnant, but also because it is required by US authorities" (Interview, MT-01-F, May 2021).

MT-14-M claimed that COVID-19, while real, is not enough of a threat for him to avoid going out and trying to seek a better life: "To be honest, I've worked all this time, I trust God (…) the thing that's killing people right now has to do with mental psychosis, fear; the thing is, I'm more fearful of someone coming and killing me (…) I really hope God allows me to get into the US" (Interview, MT-14-M, May 2021).

Discussion

Our narrative approach allowed us to identify five recurring narratives around mental health and each of the interviewee's personal struggles, both throughout their entire migratory experience and during their stranding in one of the border cities in which they were interviewed. The results that we were able to obtain suggest that there is a particular way in which the pandemic has been experienced by the Central American and Caribbean immigrants in transit through Mexico.

Literature shows that the most common stressors and social determinants of health among immigrants in transit are not just directly related to the violent and unstable contexts in their home countries, but also to the many dangers and perils during their journey (7, 32, 35). The COVID-19 pandemic added additional elements such as the fear of contagion and the anxiety and depression brought about by the sanitary measures and the isolation produced by them (42).

Our research shows, however, that these factors are secondary to their fear of not being able to make it into the US and becoming stranded in Mexico, followed by the fear of becoming homeless, returning to their home countries and/or getting abused by the authorities or cartel members. Let us not forget that, for many of them, getting back to Honduras, El Salvador, Guatemala or Nicaragua implies a violent, if not fatal,

TABLE 2 Quotations during the interviews regarding mental health.

	Tijuana	Juarez	Matamoros	Tapachula
Anger	0	1	0	1
Annoyance	0	0	1	0
Anxiety	0	0	0	4
Cluelessness	0	0	1	0
Depression	6	9	8	7
Easiness	4	2	0	7
Fear	5	9	3	9
Frustration	23	15	8	6
Hopelessness	0	10	3	0
Isolation	1	10	3	9
Misery	0	0	2	1
Paranoia	0	1	1	3
Patience	1	1	1	0
Uncertainty	9	7	7	1

Source: COVID-19 differential Impact on Indigenous Peoples and Newcomers: A socioeconomic analysis of Canada, US and Mexico, 2021.

outcome. Nonetheless, fear of contagion remains present, but it varies depending on whether the person is inhabiting a shelter or living in an encampment (43).

As the excerpts within the psychological impact of the pandemic theme show in the results section, individuals who experienced the pandemic in a shelter have a different outlook on the contagiousness of the virus. While both shelters and encampments are always in a constant struggle to maintain hygiene and fight overcrowding, the enclosed nature of the former makes it difficult to comply with hygiene and other social distancing measures (44), which in turn increases the chances of contagion and the fear expressed by our interviewees who had the chance to inhabit a shelter. Encampments, on the other hand, generate the impression that COVID-19 is less of a risk. This situation, coupled with the fact that most of our interviewees were living at encampments or on the streets, supports the notion that most of their psychological distress was caused by their inability to make it into the US and the uncertainty associated with the partial closure of the US-Mexico border due to the pandemic.

An interesting aspect in the narratives of our interviewees has to do with how they differ depending on which part of their journey they currently were. Table 2 contains the instances in which psychological aspects were mentioned by each of our interviewees, divided by city. Those who expressed the most frustration were located in Tijuana, Juarez and Matamoros on the US-Mexico border, especially when talking about how their journey had come to a complete stop due to the Migrant Protection Protocols and the partial closure of the border due to the virus. The same pattern repeats itself when it comes

TABLE 3 Quotations regarding each of the five recurring themes within each narrative.

(1) The pandemic's psychological impact	(2) The uncertainty of being stranded in Mexico and the long wait	(3) Fear of violence over fear of contagion	(4) The perceived leniency of Mexico with the pandemic when compared to their Countries of Origin	(5) Beliefs about COVID-19 and vaccination
I feel very relaxed, I know that I can get COVID again but It doesn't scare me anymore, I'm more fearful of becoming isolated (…) what frustrates me the most is the downtime, you start thinking 'wait a moment, this is not right," and I just feel how everyone is just fed up and how we are all burdened because you are stuck and there is no way to let off all this steam, there are no chances or spaces to live humanly, you just lose it (…) I guess I'm not being as careful as I once was, I try not to care that much about the virus anymore (Interview, TJ-01-F, April 2021)	I have seen three Honduran and four Guatemalan women die because of COVID-19, right here in the encampment, once that happens an ambulance just comes by and picks them up (…) nobody has the mindset to dwell on it, everybody is just waiting for a chance to get into the US, plus most of us have been vaccinated already (…) a group of people came with the vaccines, most people accepted right away (Interview, TJ-11-M, April 2021).	I can't stay in Mexico, back in the outskirts of Tecun, Chiapas, I was assaulted with a machete, they were trying to kidnap me (…) I actually wanted to request asylum in Mexico, but after experiencing that kind of situation I decided to leave Tapachula and try to reach the US, that's how I ended up here" (Interview, TJ-05-M, April 2021)	I got vaccinated as soon as I arrived in Tijuana, people from the shelter commanded me to do so; I didn't get any secondary effects (…) they were clear about vaccination being voluntary, but I didn't want to risk it with migration (…) I can't say that I've been affected by the pandemic while being here, I guess that the most bothersome thing is having to constantly wash our hands and use facemasks, but other than that, I don't feel depressed or anything, if only you know what we had to go through in Honduras (…) my country is badly run and it was really bad down there, we couldn't even leave our homes and we had no food nor medical care (…) I have even heard rumors about how people that are getting vaccinated in Honduras are dying because of the vaccine, but not here (…) I was expecting Mexico to be more rigid but I didn't encounter a lot of trouble (…) the waiting is what's killing us, other people traveling with me lost it when we got here and were told that the border was closed because of COVID. I have seen people who have lost it and taken drastic measures, such as venturing with a smuggler or even doing drugs just to pass time (Interview, TJ-04-M, April 2021).	"I'm waiting on the vaccine because I wasn't here in the encampment when they came to apply it (…) I don't want to get it but I don't really have a choice" (Interview, TJ-06-M, April 2021)

(Continued)

TABLE 3 (Continued)

(1) The pandemic's psychological impact	(2) The uncertainty of being stranded in Mexico and the long wait	(3) Fear of violence over fear of contagion	(4) The perceived leniency of Mexico with the pandemic when compared to their Countries of Origin	(5) Beliefs about COVID-19 and vaccination
We were panicked about getting intubated but also afraid of the vaccine; a nephew of mine got the vaccine and didn't take it very well, he got severely sick, with fever and pain; we thought that he was going to die but thank God nothing else happened (…) when we got the vaccine we didn't get no after effects so I'm grateful for that (…) they need to finish with the vaccination effort, we all need to be vaccinated, only then they will open the border again (Interview, TJ-02-F; TJ-03-F, April 2021).	(…) things are difficult, especially when you have to share a shelter with so many people; I could find someplace to rent, but I'm afraid something's gonna happen to me if I do so (…) most of my relatives in Honduras got infected, luckily nobody died, up here I haven't had it yet, but I'm not as afraid of it as I once was (…) I just keep using my facemask and disinfectant (…) I'm really desperate about being stuck here (Interview, JZ-03-F, April 2021).	"The scariest part about traversing the country isn't the virus, but the police and the military; you never know if a road checkpoint is legit or belongs to a cartel" (Interview, TJ-10-M, April 2021).	Nicaragua is undergoing a pretty awful political crisis, I was beaten several times down there by the authorities (…) things got even worse when COVID hit (…) when I compare it with Mexico, is almost as if the virus didn't exist here, people are on the streets just going about their lives (Interview, TJ-05-M, April 2021)	"I haven't received the vaccine but I will get it as soon as they come to apply it" (Interview, TJ-08-M, April 2021).
"They gave us access to medicine, facemasks and whatnot, but we were so many, using only one bathroom, life was tough in there so I left it" (Interview, TJ-06-M, April 2021).	I've been here longer that I had expected (…) I haven't been able to attend my court hearing because of the border closure and I'm fearful that my case will be discarded (…) during the time that I've been here I've suffered with depression and anxiety, I even got bladder stones because of it (…) what's eating me is the uncertainty, I don't know the current status of my asylum request because of the pandemic, nobody is answering (Interview, JZ-04-F, May 2021).	"I am fearful of getting kidnapped, I've heard numerous stories about it, so I try not to leave this place at all" (Interview, JZ-07-F, May 2021).	I feel pandemic related restrictions are almost the same between Mexico and Honduras, although it does feel more relaxed here without curfews (…) I wasn't sure about getting the vaccine, I know many people in Honduras who died because of it, when we got to the encampment though, they said that we all had to get it (…) they said that it wasn't compulsory, but that we had to get it if we wanted to avoid trouble with US authorities on the other side (Interview, TJ-07-M, April 2021).	"I got the dose here in the encampment, they told us that it was up to us if we wanted to get vaccinated, but I didn't want to run into any issues later on" (Interview, TJ-10-M, April 2021)
They have so many measures in place because of the pandemic, they have strict schedules and very harsh rules, and you have no other choice than to comply,	The border closure due to COVID-19 has been really tough for me, I wasn't able to get my baby girl to be born in the US, me and my wife got deported and stranded	"We were stopped and robbed near Nuevo Laredo, we lost everything, documents, money (…) the virus is nothing compared to what we	"I have talked to my mom, and things seem to be better down in Honduras because of the curfews; nobody is	"I'm not sure about getting the vaccine but I might have to get it just to avoid more trouble with the

(Continued)

TABLE 3 (Continued)

(1) The pandemic's psychological impact	(2) The uncertainty of being stranded in Mexico and the long wait	(3) Fear of violence over fear of contagion	(4) The perceived leniency of Mexico with the pandemic when compared to their Countries of Origin	(5) Beliefs about COVID-19 and vaccination
because you're in a foreign country (…) if it weren't for the pandemic we wouldn't be suffering like this, waiting in this encampment (Interview, TJ-09-M).	in here, they changed my baby's life forever because of it (…) during my time here, I've caught COVID-19 twice, luckily I haven't died (…) psychologically it's been tough, physically not so much, I'm just desperate for my situation to get solved (Interview, JZ-05-M, May 2021).	have to endure just to have a chance to get into the US" (Interview, MT-03-M, May 2021).	allowed outside that easily, unlike here (Interview, TJ-08-M, April 2021).	US authorities" (Interview, JZ-03-F, April 2021).
Everything has been exasperating, I just heard that my mother died because of the virus and I can't do anything about it from here (…) my friends in the US send me money every now and then (…) I already catched COVID-19 a few months ago, and the shelter took care of me (…) I know that my asylum request will go through, it just hasn't because of the situation (…) even though the shelter has provided support, Mexican authorities don't care about my situation (…) I will get the vaccine as soon as I can, even if I already have had the virus (Interview, JZ-02-F, April 2021).	They denied me my chance for my daughter to be born in the US, they told me that I had to wait here in Mexico, even though I was almost ready to give birth (…) if they hadn't closed the border, I'd be already up there, trying to build a better life (…) stupid pandemic put everything on pause, every procedure, everything related with the government, it really is depressing (Interview, JZ-06-F, May 2021).	I try not to pass as a foreigner as much as possible, I know that people in shelters and encampments are easy targets, not just for the virus but for criminal groups and policemen trying to extort those of us who have relatives in the US, or even back home (Interview, MT-04-M, May 2021).	(…) things are pretty bad in Cuba, there is no work, and when you find some, it is poorly paid (…) I lost all my documents here, I was robbed and left without a penny, that's when I started living in a shelter (…) I haven't gotten the virus yet but a friend of mine caught it, he got well after a week or so (…) I try to follow the sanitary measures but it is very different from Cuba (…) in there you get huge fines for not wearing a facemask (Interview, JZ-01-M, April 2021).	"I don't want to get the vaccine but I know that I will have to eventually, I feel that it's an experiment, that they're just experimenting with us" (Interview, JZ-06-F, May 2021).
I know a lot of people who have died in Honduras because of COVID-19, three aunts among them; it has been hard but the most difficult thing is knowing that there is nothing that you can do about it (…) I just keep using my facemask and disinfectant	"I'm just waiting for them to open the border, that's all I care about (Interview, JZ-07-F, May 2021).	In the past we didn't have to wear a mask during our trip up north, and we weren't fearful of this virus that can be lethal, or so they say (…) lucky me, I've been everywhere, I've interacted with lots of people and I haven't had any major issues;	"compared to Nicaragua, Mexico almost looks as if there weren't any restrictions, not a lot of people seem to care out here on the streets" (Interview, JZ-05-M, May 2021).	"I'm not sure about getting the vaccine, but I guess we'll all have to do it" (Interview, JZ-07-F, May 2021).

(Continued)

TABLE 3 (Continued)

(1) The pandemic's psychological impact	(2) The uncertainty of being stranded in Mexico and the long wait	(3) Fear of violence over fear of contagion	(4) The perceived leniency of Mexico with the pandemic when compared to their Countries of Origin	(5) Beliefs about COVID-19 and vaccination
whenever possible (Interview, JZ-12-M, May 2021).		I did get infected, but it was like a flu and that was it (Interview, MT-06-F, May 2021).		
You have no idea how the pandemic closed doors for us, especially from the migratory authorities; they abandoned us (…) we have to get tested every 15 or 20 days because they ask us to fulfill that requirement, just to have the right to be here at the shelter (Interview, MT-02-F, May 2021).	I had hoped for this to go faster, but now we're stuck here, without being able or allowed to move freely (…) I'm stressed about having to go back to my country, I can't go back and if my request is denied, what am I going to do? I don't really care about the virus or the pandemic, or the vaccine, I just want for this to be over (Interview, JZ-08-F, May 2021).	I got jumped in Tapachula and lost what little money I had with me, almost 1,500 quetzales (…) I did make it across the US but they sent me back to Mexico because of COVID-19, they told me I had to wait for my turn here (…) the border closure is getting to me, and border agents are getting more aggressive by the minute, maybe they're on the edge due to the virus (Interview, JZ-11-F, May 2021).	"Mexican authorities don't seem to care that much about the virus, all they seem to care about is to extort as much money as they can" (Interview, JZ-11-F, May 2021).	"I might get it [the vaccine] if it makes everything easier, but I'm not sure yet" (Interview, JZ-08-F, May 2021).
Seeing all those dead on TV scared us a lot, when we had to move out and realized that no one really cared about the virus, it became less relevant, we were more worried about fleeing our country (…) we will all get vaccinated as soon as it is our turn (…) when I was in Guatemala and COVID-19 hit, I did get very depressed, because it changed everything for the worse; when we had to flee our country well, you put things into perspective and you stop caring about the disease (Interview, TP-03-F, May 2021).	I don't want to stay here in Mexico, I need to make it into the US and fulfill what they call the American Dream, I have cousins and uncles there (…) I don't really think if there is a pandemic or not, you just grab whatever belongings you can carry and make a run for it (…) yes, you do get depressed, especially after walking for hours under the sun, but you have to take it and be patient (Interview, JZ-09-M, May 2021).	"things are as severe down in El Salvador and in Mexico, but not because of the virus, but due to the high levels of violence; I got mugged both in El Salvador and In Mexico" (Interview, MT-02-F, May 2021).	"The cop told me to sign and pay a fine for not presenting a negative COVID-19 test, they told me to get tested and I had to pay for it, they even threatened me, saying that I was a risk for everybody else, and that I was contaminated" (Interview, MT-03-M, May 2021).	"I already got COVID-19 right after I crossed into Mexico, but I made it, I only had to rest and take paracetamol (…) I don't want the vaccine, but if it is required of me I will comply (Interview, JZ-09-M, May 2021).
"got infected and sent to a hospital, I thought I was going to die; almost two weeks in (…) the headaches and the	Because of the pandemic there are roadblocks and checkpoints everywhere and everytime they're looking for a bribe or something in return	"When I got into Mexico, I was never required to get tested for COVID-19; this was not the case for Guatemala	Crossing from Nicaragua into Honduras was very difficult, 80 percent of the times that people attempted to make it	"I'm scared of the vaccine and its effects, I haven't taken it but I'm guessing that they're

(Continued)

TABLE 3 (Continued)

(1) The pandemic's psychological impact	(2) The uncertainty of being stranded in Mexico and the long wait	(3) Fear of violence over fear of contagion	(4) The perceived leniency of Mexico with the pandemic when compared to their Countries of Origin	(5) Beliefs about COVID-19 and vaccination
dizziness never left me (…) I tried to keep my distance after this experience, even with my children, this affected me deeply" (Interview, TP-10-F, June 2021).	(…) I left El Salvador with 600 dollars and they were gone in a matter of days (…) if everything is halted because of the pandemic I don't know what I'm gonna do, we can't go on like this, I wasn't expecting a wait this long (…) Mexican authorities have been really mean to us immigrants, they always asked for a special medical tax and that's how they take advantage of us all, it's gotten to the point in which I'm scared of leaving this place (Interview, JZ-10-F, May 2021).	(…) things were really harsh in Honduras, we needed to be careful no just from the gangs, but also from the government" (Interview, MT-10-F, May 2021).	across, border authorities would just deport you (…) I could have arrived earlier but it was impossible due to the heavy restrictions, lots of checkpoints and plain abuse from the authorities (…) in Tapachula a lot of things changed, they become more human, although it depended on the person that interacted with you (…) back in my home country, my family is completely isolated, they even developed pneumonia (…) they have offered us the vaccine here in Tapachula, but I still have my doubts and I don't know if I will get it (Interview, TP-01-M, May 2021).	gonna make it mandatory for us" (Interview, JZ-10-F, May 2021).
	"feeling isolated is one of the most awful feelings that one can experience, that and the uncertainty of not knowing if you're gonna be allowed into the US or not" (Interview, JZ-12-M, May 2021).	"a group of thugs attacked me, they took my backpack, my passport, my money" (Interview, MT-16-M, May 2021).	I couldn't get to work, only certain people were allowed to break the curfew, based on a random number assigned by the government. I wasn't selected so I was completely isolated, it became unbearable (…) I haven't had that sort of trouble in Mexico, I can move around freely as long as I wear a face mask (Interview, TP-05-M, May 2021).	"I know we have to get vaccinated but I haven't done it yet" (Interview, JZ-11-F, May 2021).
	Next week they will come for us, for our next appointment on the asylum request, the wait gets very frustrating, I've been here for 5 months; not being able to cross the border is unnerving (…) we were under the impression that it would take less time but it	Due to the pandemic I lost my job and I was being extorted by local gang members (…) arriving in Mexico with nothing in your possession, literally starting out from zero, you stop thinking about the virus (…) I don't care if I can't make it into the US,	I had to pay 1,200 pesos just to get through a checkpoint in the outskirts of Tapachula, that was most of our money but at least they didn't nag anymore (…) we did keep using sanitizing gel and face masks, but other than that, we	"I don't want to get the vaccine because of everything that people have been saying about them, if it comes to it, I will get the shot, but not because I want it" (Interview, JZ-12-M, May 2021).

(Continued)

TABLE 3 (Continued)

(1) The pandemic's psychological impact	(2) The uncertainty of being stranded in Mexico and the long wait	(3) Fear of violence over fear of contagion	(4) The perceived leniency of Mexico with the pandemic when compared to their Countries of Origin	(5) Beliefs about COVID-19 and vaccination
	seems that the pandemic has delayed everything (…) we've been like this for 5 months (…) being stuck in place is harsh (…) I'm not planning on getting the vaccine, but being isolated has taken a toll on my mind (Interview, JZ-13-F, May 2021). My plan was never to remain in Mexico (…) I've been to three court hearings so far but they demanded for me to bring a lawyer with me, otherwise I wouldn't be able to continue my process (…) It has been really tough to be stranded here, living in a shelter and following all of the restrictions and sanitary precautions (Interview JZ-14-F, May 2021). "MPP and I've been waiting since December (…) I live on the streets, sometimes I am able to visit some shelters just to get something to eat". (Interview, MT-04-M, May 2021).	I am willing to request asylum in Mexico as well (…) I will get the vaccine if it's required of me (Interview, TP-04-F, May 2021).	didn't run into any major issues (…) things get worse when you check in in a shelter, as they do require you to use your face mask constantly, and you get to be really isolated, even though it's overcrowded (Interview, TP-06-M, June 2021). We had a full lockdown, you couldn't even go outside to get water or food, unless you were selected by the government based on your ID number (…) things got worse because the gangs started to notice that people were stuck in place, and they were able to pick on you directly at home, this is why I left my country (Interview, TP-07-F, June 2021). "things are starting to relax here in Mexico, I don't know if it's been like this the whole time, but it feels more relaxed than in Honduras" (Interview, TP-08-F, June 2021).	"I have not been vaccinated but I will have to get it. I fear that if I don't, my asylum application will be revoked" (Interview JZ-14-F, May 2021). "I wish I could get the vaccine, but it seems like they're only applying it to important people, like doctors and nurses (…) I want to be vaccinated because I'm pregnant, but also because it is required by US authorities" (Interview, MT-01-F, May 2021).
	"I'm trapped here, COVID kicked my ass, they didn't let me through because of stupid COVID, I've tried three times already" (Interview, MT-15-M, May 2021). When I heard that the border was closed I didn't know what to do. Luckily, a couple told me about the possibility		"in Mexico, I didn't see any other measures or anyone enforcing the safe distance protocols" (Interview, TP-10-F, June 2021). There are three big checkpoints in Guatemala, every non-Guatemalan gets sent back, if you're a national,	"I will get the vaccine just because the US requires it for us to get it" (Interview, MT-06-F, May 2021). "To be honest, I've worked all this time, I trust God (…) the thing that's killing people right now has to do with mental

(Continued)

TABLE 3 (Continued)

(1) The pandemic's psychological impact	(2) The uncertainty of being stranded in Mexico and the long wait	(3) Fear of violence over fear of contagion	(4) The perceived leniency of Mexico with the pandemic when compared to their Countries of Origin	(5) Beliefs about COVID-19 and vaccination
	of requesting asylum here, and that's what I've been doing (…) I try keeping my distance just to lower the chance of contagion (…) a lot of acquaintances have died because of the virus, but I try not to think that much about it (Interview, TP-08-F, June 2021).		they ask you for a negative test, if you don't have it with you, they sent you back for one or you can get away with it if you give out a bribe (…) when you arrive in Mexico, a Red Cross checkpoint asks you if you want a test, free of charge (…) the worst thing about my experience was how badly we were treated by the migratory authorities in Mexico (…) I will get the vaccine if necessary, I don't want to have an additional target on my back (Interview, TP-11-M, June 2021). Normally we couldn't go out, because of the curfews lots of jobs were lost (…) I couldn't believe that there weren't any restrictions like those here in Mexico, even when we passed the Honduras-Guatemala border, Guatemalan officers were very tough when it came to enforcing their pandemic restrictions (Interview, TP-12-F, June 2021).	psychosis, fear; the thing is, I'm more fearful of someone coming and killing me (…) I really hope God allows me to get into the US" (Interview, MT-14-M, May 2021). We have done a lot to fight the virus, everywhere, but we haven't achieved anything because it is God's will, it was written (…) I will get the vaccine because the Bible also says that we must obey our rulers, but so far they haven't said anything about it (…) Mexico is very passive when it comes to fighting the pandemic, whereas in other places that I've been, they even arrest you for not wearing a facemask (Interview, TP-02-M, May 2021). "all of this is a scam so that pharmaceutical companies can get rich off us (…) I haven't been vaccinated but I guess I would do it" (Interview, JZ-05-M, May 2021).

to uncertainty and hopelessness. Fear and depression remains constant across all four cities.

A key finding that we want to emphasize is how the status of 'outsider' becomes the most important social determinant of mental health, as it is associated with the consequences of the implementation of the Migrant Protection Protocols during the Trump Administration, and the use of US Title 42 to prevent immigrants from accessing the US due to health concerns. Being an outsider, along with the stigma and restrictions that such a label carries in a foreign country has a more significant impact among those stranded in Mexico, to a point in which the fear of contagion becomes secondary.

Figure 2, Table 3 support the above, as they showcase the thematic and symbolic relevance that "making it into the US" has on the narratives that each interviewee shared with us. Even after our interview guide was designed to lead every conversation toward their experience of the pandemic in Mexico (Appendix A), the 108 instances in which our collaborators talked about COVID-19 are due to our efforts in pushing the narrative so that they could talk about the virus. At 94 instances, their intentions to cross into the US were always at the center of each interview, even when we insisted on COVID-19 related questions.

Our results regarding Migration and Mental Health are in line with the literature review that was conducted prior to our ethnographic efforts, although the different factors associated with stressful migratory experiences (37, 38) varied by city, as most instances of frustration and depression occurred among those interviewed in Tijuana, Juarez, and Matamoros, and they were more likely to experience situations of anger, annoyance, anxiety, depression, fear, frustration, hopelessness, isolation, misery, paranoia and uncertainty. The reasoning behind this is that their journey through Mexico had come to a stop and they had to face the reality that their entry into the US might not go as they had expected. We also noticed that fear levels were constant across all four locations, which is consistent with the high levels of violence within the country (Table 2).

Regarding the beliefs about the pandemic and the vaccines, most interviewees were aware that they were subject to the whims of the different authorities both in Mexico and the US, and they expressed how they were in no position to refuse vaccination or any other sanitary measures if it meant that it would endanger their chances of making it across the US-Mexico border. Our data shows that this has to do with two factors: (1) As a strategy to increase their chances of successfully obtaining asylum in the US by decreasing the chances of them being questioned about not being vaccinated, and (2) The fact that most migrant shelters and encampments in Mexico have been visited by the medical brigades of the Mexican Department of Health in order to administer any of the available vaccines (45). Even though our interviewees mentioned that the vaccination was not mandatory, they felt compelled to do so out of fear of

getting in trouble with the Mexican authorities and/or the other inhabitants of the encampment.

When it comes to the perceived leniency of Mexico with the pandemic, our results show the mixed perceptions regarding the severity of the lockdowns in Mexico, as those coming from countries like Honduras, El Salvador and Nicaragua mentioned how their own governments had implemented strict measures that did not compare to those present in Mexico, such as curfews, police raids and fines.

Finally, we must address the fact that in very rare cases, staying in Mexico becomes an actual alternative, due to the vast differences in quality of life and the high levels of narco-related violence in the country. We also want to emphasize that these results are not enough evidence to claim that our interviewees were unaffected by the virus, or that immigrants in Mexico do not consider the pandemic to be serious enough to care or be directly affected.

Our results show how the pandemic was experienced by each interviewee based on each person's history, context and intersections. Nonetheless, we must not forget that even when many of the psychological impacts expressed by our collaborators seem to suggest that COVID-19 did not affect them as much when compared to their migratory situation, the reasons given in each interview are, in the end, related to the pandemic itself, as the partial border closure and the implementation of Title 42 were, indeed, caused by the arrival of COVID-19.

Limitations

This particular study has severe limitations associated with an exploratory enterprise, but it provides solid ground for future ventures. It must be said, however, that our unsuccessful efforts to gain access to actual enclosed shelters due to the lockdowns also means that we were not able to interview immigrants who might have expressed a heightened fear of contagion despite their migratory status and the implications of the border closure, as other studies have shown, particularly when it comes to somatic manifestations such as headaches, sleep disorders, fatigue, loss of reason, suffocating sensations, and gastrointestinal disorders due to fear of the pandemic (98). Even so, such studies have also implied that COVID-19 has been a threat to the migratory efforts of their subjects, rather than to their physical health (98, 2116).

Another limitation has to do with the fact that we were not able to interview an equal number of immigrants for each Central American and Caribbean country, as we had to mostly rely on snowball sampling and the type of person present at the improvised encampments on the streets.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Research and Ethics Compliance, University of Manitoba, Canada. The patients/participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

RC and CI: study conception and design, data collection, analysis and interpretation of results, and draft manuscript preparation. All authors reviewed the results and approved the final version of the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.982389/full#supplementary-material

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Ventanillas de Salud (VDS) and Mobile Health Units (MHU): A binational collaborative models

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Over the years, the Mexican population in the United States has faced high prevalence of health-related inequalities and disadvantages and represents one of the most vulnerable migrant groups in the country. To help reduce the gaps in health care for the Mexican population, the Mexican government, in collaboration with strategic allies from various sectors, launched the Ventanillas de Salud (VDS) strategy, which was subsequently reinforced through the Mobile Health Units (MHU) care model. Both the VDS strategy and the MHU care model are intended to contribute to the development of initiatives, projects, and actions in health that will benefit the Mexican community living in the United States, which lacks or has difficulty accessing health services. This article provides a descriptive, analytical analysis of the VDS strategy and the MHU care model, as unique collaborative models, which can be replicated, and have achieved a positive impact on the health of Mexican and other Hispanic communities in the United States, at both the individual and community level.

KEYWORDS

migration, health, Ventanillas de Salud, Mobile Health Units, binational collaboration

Introduction

According to data from the Current Population Survey 2020, the Hispanic population in the United States (62.1 million people) represents 18.6% of the total population (331 million), while the community of Mexican origin (38.5 million) accounts for 11.5%. Within this Hispanic community, the majority have American citizenship (80.2% Hispanics and 81.2% Mexicans), either by birth or naturalization; one in 10 obtained Legal Permanent Resident status and one in 10 lacks documents for their legal stay in the United States. In absolute numbers, 10.8 million of all Hispanics lack medical coverage, of which 7.2 million are of Mexican origin (1). The lack of access to

medical services, coupled with poor financial conditions and limited English proficiency, which are common barriers to accessing medical care for the immigrant population, have a negative impact on the quality of life and poor health status of Mexicans in the United States.

Given this outlook, and in response to needs, in 2001, a collaborative project was implemented between Mexico and the United States called Binational Health Week (BHW). This annual event takes place in October when health is promoted and access to various medical services and prevention activities is facilitated (2).

Based on the experience of the BHW, and as a result of pressure from community leaders and local organizations requesting the continuity of the services provided, in 2003, the Ventanillas de Salud (VDS) strategy was implemented as a pilot project in the Mexican Consulates in San Diego and Los Angeles, California, with the support of the United States-Mexico Border Health Commission (USMCB), the United States-Mexico Health Initiative (currently the Health Initiative of the Americas), the University of California and The California Endowment [(3), p. 19]. In 2004, the VDS strategy was formalized and extended to other consulates. Subsequently, in 2016, as part of a strategy to strengthen the VDS, the Mexican Section of the United States-Mexico Border Health Commission implemented the Mobile Health Units (MHU) care model (4).

The VDS strategy and the MHU care model are designed to facilitate access to health services and contribute to fostering a culture of self-care among the Mexican population living in the United States, and to promote disease prevention and control [(4), p. 7–14]. However, even though the programmatic goal of VDS is to serve the Mexican population living in the United States, VDS also served other Hispanic populations living in the same communities. Therefore, we use the term "Hispanic" throughout this article to refer to the population served.

Methodology

Secondary data sources with lack of personally identifiable information were reviewed. First, the database of the Current Population Survey 2020 (1) of the United States Census Bureau, which contains a representative sample of the Hispanic community in the United States, was analyzed to determine the typical characteristics of the population (5).

The database of the System of Continuous Information and Health Reports of Mexicans in the United States (SICRESAL-MX) was consulted. This technological tool was developed by the Mexican Section of the USMBHC, which has a record of the people served, and preventive services provided by both the VDS and the MHU. This document includes the analysis of 6.4 million records of people who received twenty million services during the period from 2019–2021. The analysis was

descriptive, based on simple frequencies, and cross-referenced basic sociodemographic variables.

No personally identifiable information was included in the analysis thereby avoiding the need for the participation of human subjects and the approval of ethics committees.

Results

Contents of the VDS strategy and the MHU care model

Ventanillas de Salud (VDS) is a Mexican Government Strategy, undertaken by the Ministry of Health (SS) and the Ministry of Foreign Affairs (SRE), through the Institute of Mexicans Abroad (IME). It is implemented in the Mexican Consular Network in the United States and operated by local agencies, with the support of strategic allies in that country, such as government organizations, civil society and private organizations and academic institutions (6).

The mission of VDS is to improve access to basic and preventive health services, increase public health insurance coverage, and establish a medical home, through counseling, education, timely detection, and referrals to quality health facilities, in a safe environment. Fifty-one VDS currently operate in the Mexican consular network in the US, as shown in Map 1.

VDS serves Hispanics in a situation of vulnerability who live in the United States, by promoting a sense of responsibility to improve their own health and quality of life and the acquisition of accurate health-related information. VDS facilitates access to preventive health services and fosters a culture of self-care, including active participation in health matters.

VDS has the following characteristics:

1) Services are based on the conditions that most affect the Mexican population;
2) By focusing on the individual needs of each user, they create a relationship of trust and empathy with the population served;
3) They have specialized, culturally appropriate materials to provide information in the source language;
4) They are operated by personnel trained in disease prevention and control and provide resources and options for access to health services in collaboration with community health centers and institutions, and
5) They work to improve the physical and mental health conditions of the Mexican population in the United States, and to maintain a healthy environment based on local and binational collaboration [(4), p. 8].

To fulfill its mission, VDS has over six hundred allies which include health institutions such as hospitals and federal health centers, community clinics, government organizations

Map 1
Geographical location of Ventanillas de Salud in the United States. Source: Mexican section of the Mexico-United States Border Health Commission, 2020.
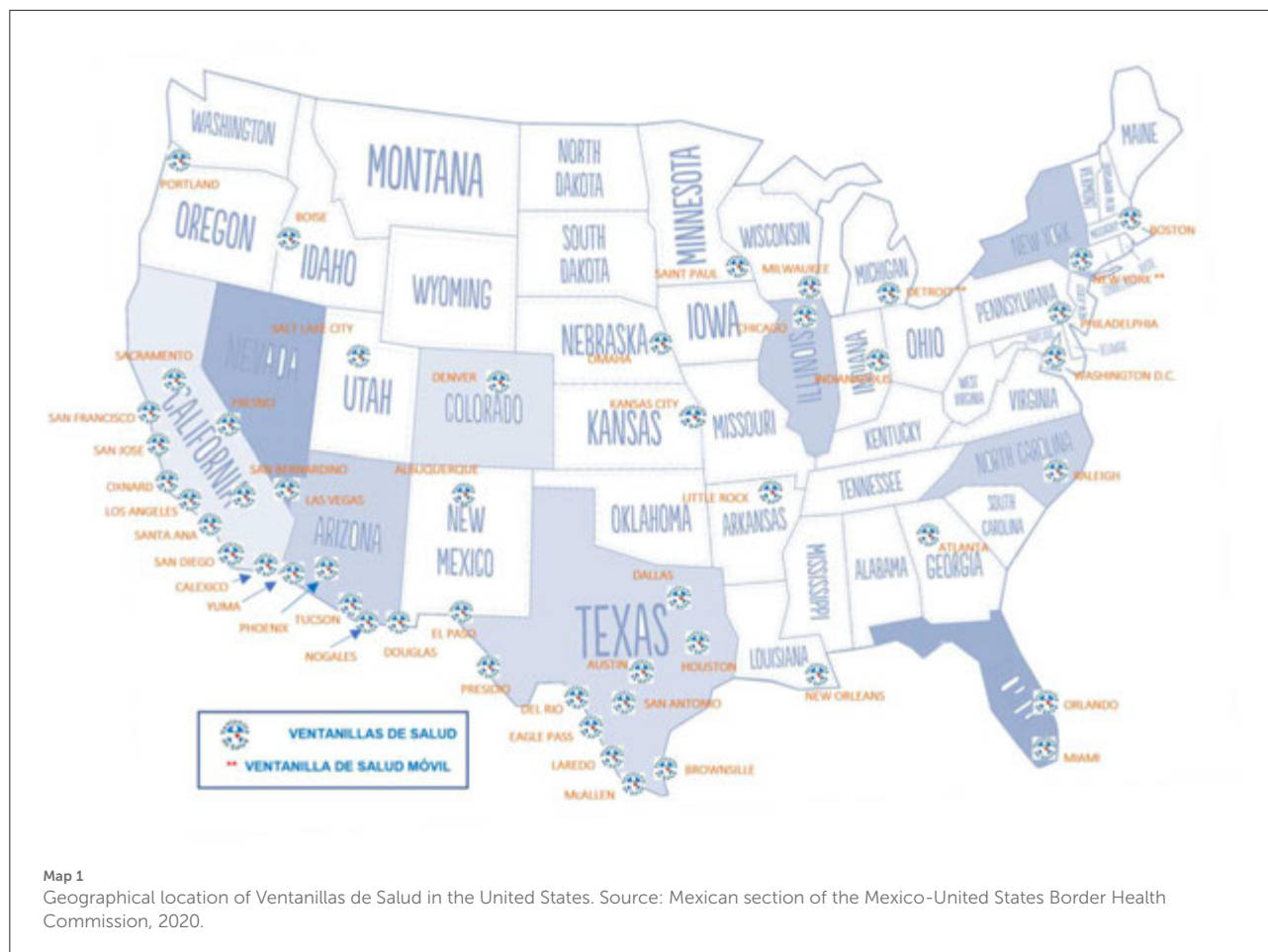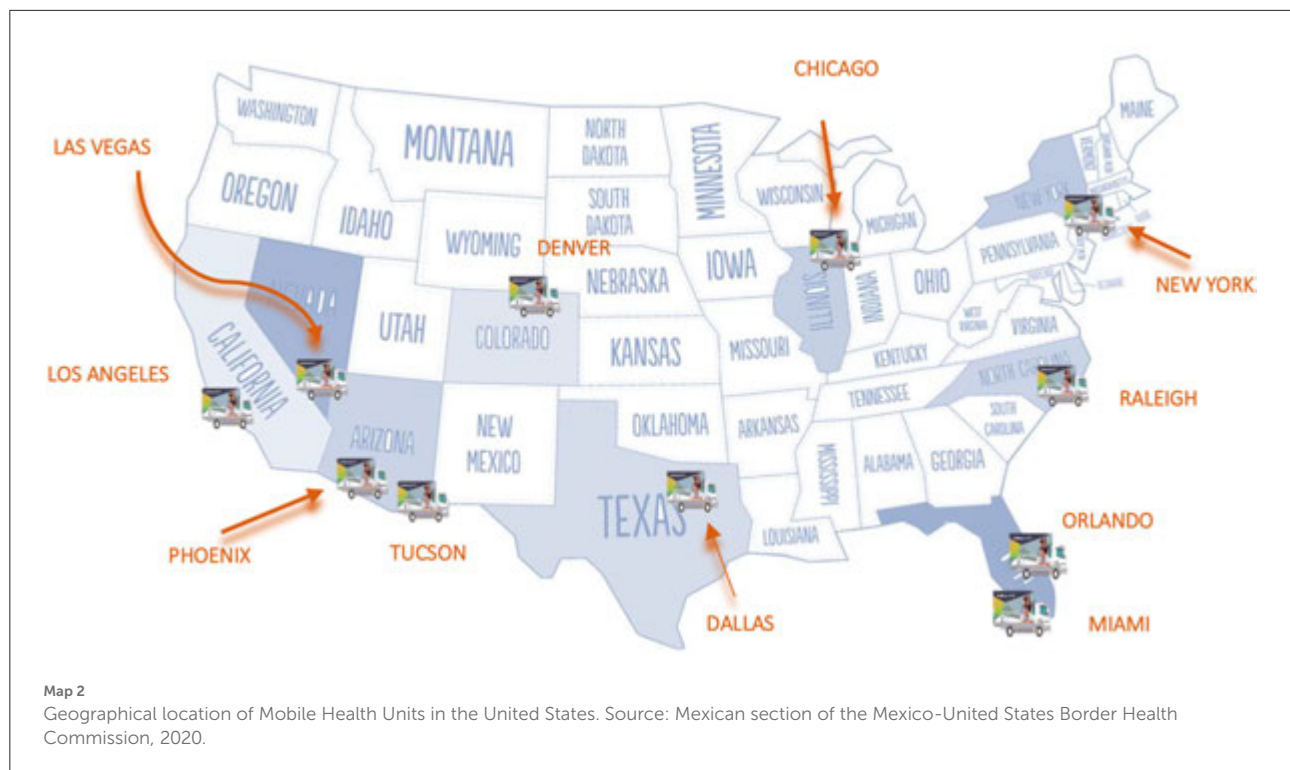
and educational institutions, which contribute to providing screening services, delivery of printed educational material, and help with navigating the health system in the United States, among others. These collaborative partners comprise a broad and valuable network that provides comprehensive preventive health services including health education, screening, and referrals.

To strengthen the VDS, the Mobile Health Units's (MHU) care model was created to provide preventive health services to remote communities with difficult access to health services. Eleven MHU currently operate in cities with a large concentration of Hispanic populations: Chicago, Dallas, Denver, Las Vegas, Los Angeles, Miami, New York, Orlando, Phoenix, Raleigh, and Tucson (Map 2).

Background

The VDS strategy was initiated in response to the success of the Binational Health Week and its acceptance

by the community. During this event, preventive and health promotion services are offered annually to Hispanics who typically experience barriers to accessing such services in the United States. Such improved access and acceptance led community leaders and local organizations to request long term continuity of these services. In 2003, the VDS strategy was implemented as a pilot project at the Mexican Consulates in San Diego and Los Angeles, California, with the support of the United States-Mexico Border Health Commission and the United States-Mexico Health initiative (known as the Health Initiative of the Americas), from the University of California and The California Endowment. In 2004, the VDS strategy was formally launched and extended to other consulates. With the aim of strengthening and expanding the coverage of preventive health services for the Mexican community in the United States to remote communities unable to access health services, in 2016, the first phase of the MHU care model was implemented in Dallas, Los Angeles, New York, Phoenix and Chicago. Its services were subsequently extended to Denver, Las Vegas, Raleigh, Orlando, Miami, and Tucson (7).

Map 2

Geographical location of Mobile Health Units in the United States. Source: Mexican section of the Mexico-United States Border Health Commission, 2020.

VDS Strategy Characteristics

The VDS strategy is an example of government and institutional collaboration with strategic allies in Mexico and the United States. The resources, both monetary and in kind, required to provide basic preventive services, are contributed by the following actors:

- Mexican goverment
  - Seed money
  - Institutional collaboration
- Consular network
  - Space on their premises
  - Technology and support office
  - Alliances
  - Training
- Lead agencies
  - Manage and operate the VDS
  - Select and hire staff
  - Generate intervention projects
  - Organize fairs and events
- Network of associated agencies
  - Provide specialied personnel
  - Perform screening tests and administration fof vaccines
  - Carry out workshops and deliver educational materials and workshops
  - Participate in health fairs and training

The VDS strategy has an advisory board comprised of nine members, including leaders in the health and migrant assistance sectors, who represent different sectors: government, academia, the non-government sector, and international organizations, from Mexico and the United States. The purpose of the Advisory Board is to provide advice on management, innovation, and binational managerial strengthening processes with the various sectors to improve strategy (8).

In general, VDS and MHU focus on conditions with the highest incidence rates among the Mexican population living in the United States, grouping services into five categories:

1) **Counseling** on prevention and health promotion issues through advice on priority health issues, such as nutrition, obesity, diabetes, women's health, child health, mental health, addictions, HIV/AIDS, and access to services, among others.
2) **Timely detection** of various ailments, using measurements such as body mass index, cholesterol and glucose tests, and HIV/AIDS and COVID-19 tests.
3) **Referrals** to health services available in their locality (community clinics), related to cultural and language particularities, to receive medical care if necessary and/or establish a medical home.
4) **Administration of flu and COVID-19 vaccines** and for other illnesses.

5) **Advice** on health insurance alternatives in the United States.

Educational and technological tools

Activities undertaken by VDS and MHU are based on training health promoters in priority health issues to strengthen their skills and provide comprehensive preventive health services for users (9). During 2020 and the first semester of 2021, various training sessions and webinars were held whose main topics were COVID-19 and mental health.

In addition, these activities were supported using culturally adapted educational materials in Spanish focusing on health promotion and disease prevention. Between 2020 and the first semester of 2021, technical content was developed on various priority health topics (such as healthy lifestyle; chronic-degenerative diseases; health promotion; sexual and reproductive health; child health; mental health and COVID-19), which subsequently allowed the design of 301 educational materials. The material is disseminated in community events and through social media networks: Facebook, Twitter, Instagram, YouTube, and the VDS strategy website.

Likewise, in 2018, the Mexican Section of USMBHC launched the mental health initiative. In collaboration with the Pan American Health Organization (PAHO), it implemented training in the Mental Health Gap Action Programme (mhGAP) Intervention Guide designed to help health personnel and community health workers (promotores de salud) reduce gaps in mental health. The training covers issues such as risk factors and warning signs of mental illness and information on depression, anxiety, trauma, and psychosis either to help a person cope with the mental health problem and/or to refer them in a timely manner to professional help [(10), p. 14].

SICRESAL-MX, the data collection system previously described in the methods section, is the official mechanism for registering users of VDS and MHU services and for generating real-time quantitative data describing the sociodemographic and health conditions of users and the VDS and MHU services received by users. The database is a rich source of information with about 283 variables. Its importance lies in the fact that the capture of such data through the registration process enables its analysis through descriptive statistics for decision-making and the strengthening of preventive health services.

Impact

The VDS strategy has met the needs of their users by providing comprehensive health services through culturally adapted preventive health promotion actions, by contributing to disease control, and preventing the use of emergency service through timely detection.

The MHU care model has taken these services to remote communities that are unable to access health services, thus, reaching a sector of a vulnerable community and broadening the scope of services.

According to data from SICRESAL-MX, between 2019 and 2021, the VDS and MHU served approximately 6.4 million people and provided 20.7 million services, of which 88.2% corresponded to counseling or advice, 8.1% to screening, 3.1% to vaccination services, 0.2% to information on other issues, and 0.1% to referrals. Tables 1, 2 shows the disaggregation of services and people served by type of strategy, year, and service.

This level of care has achieved a favorable impact on the health of Hispanic VDS service community in the United States by offering preventive services that enable identifying ailments and raising health issue awareness. In addition, it contributes to disease control and prevents the use of emergency services through timely detection, service availability advice, and aiding in the establishment of a medical home. Likewise, because of the COVID-19 pandemic, services were expanded to adapt to the new context.

TABLE 1 Population served and services provided at VDS, January 2019—December 2021.

Year	Population served	Total services provided	Advice/counseling*	Information on other issues	Screening	Vaccines	Referrals
2019	1,394,159	3,918,773	3,208,957	22,203	593,655	86,055	7,903
2020	3,060,946	8,582,100	8,166,127	5,747	402,908	51,234	6,084
2021	1,319,481	5,014,824	4,132,432	5,994	490,021	382,830	7,937
Total	5,774,586	17,515,697	15,507,516	33,944	1,486,584	520,119	21,924

Source: Compiled by the author based on data from the SICRESAL-MX. *In 2020, in the face of the COVID-19 pandemic and social distancing as a preventive measure, the VDS and MHU developed a communication system through social networks to continuously provide guidance and education services. At the same time, SICRESAL-MX adapted to this need and integrated the dissemination of information through social networks, as part of VDS and MHU counseling services notably increasing the numbers reported. As of April 2021, the registration for in-person counseling services was separated from the work of disseminating information on social networks, to have clarity of the work carried out by VDS and MHU by type of service.

TABLE 2   Population served and services provided in MHU, January 2019—December 2021.

Year	Population served	Total services provided	Advice/counseling*	Information on other issues	Screening	Vaccines	Referrals
2019	28,631	164,772	96,408	7,416	54,890	4,188	1,870
2020	295,160	1,161,157	1,017,979	922	35,778	6,059	429
2021	297,918	1,858,412	1,640,099	2,300	99,143	101,444	396
Total	621,709	3,184,341	2,754,486	10,638	189,811	111,691	2,695

Source: Compiled by the author based on data from SICRESAL-MX.

*In 2020, in the face of the COVID-19 pandemic and social distancing as a preventive measure, the VDS and MHU developed a communication system through social networks to continuously provide guidance and education services. At the same time, SICRESAL-MX adapted to this need and integrated the dissemination of information through social networks, as part of VDS and MHU counseling services notably increasing the numbers reported. As of April 2021, the registration for in-person counseling services was separated from the work of disseminating information on social networks, to have clarity of the work carried out by VDS and MHU by type of service.

TABLE 3   Percentage distribution of results of anthropometric measurement and glucose, cholesterol, and blood pressure tests, of the population served at VDS and MHU, by sex and type of strategy, January 2019—December 2021[a].

(a) Ventanillas de Salud				(b) Mobile health units			
Glucose level	**Men**	**Women**	**Total**	**Glucose level**	**Men**	**Women**	**Total**
High	22%	20%	21%	High	29%	25%	26%
Low	1%	3%	2%	Low	1%	1%	1%
n = 26,118 cases				n = 10,210 cases			
Anthropometric measurements	**Men**	**Women**	**Total**	**Anthropometric measurements**	**Men**	**Women**	**Total**
Overweight/Obesity	76%	69%	72%	Overweight/Obesity	77%	75%	76%
Low weight	1%	1%	1%	Low weight	0%	1%	0%
n = 25,884 cases				n = 10,416 cases			
Cholesterol level	**Men**	**Women**	**Total**	**Cholesterol level**	**Men**	**Women**	**Total**
High	37%	29%	33%	High	24%	30%	27%
Low	5%	8%	7%	Low	2%	1%	1%
n = 5,263 cases				n = 2,421 cases			
Blood pressure level	**Men**	**Women**	**Total**	**Blood pressure level**	**Men**	**Women**	**Total**
High	53%	66%	60%	High	52%	63%	59%
Low	45%	29%	37%	Low	47%	35%	40%
n = 34,433 cases				n = 12,792 cases			

Source: Compiled by the author based on data from the SICRESAL-MX.

[a]To categorize screening results, the VDS strategy uses the following sources.

Academia Estadounidense de Médicos Familiares, en https://es.familydoctor.org/perfil-de-lipidos-en-el-analisis-de-sangre/.

Biblioteca Nacional de Medicina, Institutos Nacionales de Salud de los Estados Unidos, en https://medlineplus.gov/spanish/ency/patientinstructions/000386.htm.

Biblioteca Nacional de Medicina, Institutos Nacionales de Salud de los Estados Unidos, en https://medlineplus.gov/spanish/cholesterollevelswhatyouneedtoknow.html.

Of those receiving screening services for specific conditions at the VDS and MHU, the most important data are presented below (Table 3):

- Glucose screening showed that two out of every 10 people screened at VDS and three out of 10 at MHU displayed high levels.

- An alarming piece of data is that around three-quarters of people screened in VDS and MHU have overweight and obesity problems, especially men.
- In general, three out of 10 users attended VDS and MHU had high cholesterol levels. Once again, a higher percentage of men experienced this condition compared with women, especially among those who attended VDS.

TABLE 4 Percentage distribution (in lines and columns) of population served at VDS and MHU by age group and medical insurance status, January 2019—December 2021.

Percentage distribution in lines (by age group)	Age groups	MHU ($n = 27{,}794$)	VDS ($n = 126{,}470$)
		Uninsured	Uninsured
	Under 5	85%	98%
	5 to 9	97%	94%
	10 to 17	89%	95%
	18 to 30	88%	97%
	31 to 40	87%	98%
	41 to 50	88%	97%
	51 to 65	82%	94%
	Over 65	60%	87%

Source: Compiled by the author based on data from SICRESAL-MX.

- While six of every 10 persons had high blood pressure, women experienced a higher prevalence than men.

During the period of analysis (2019–2021), data from the SICRESAL-MX related to family history of illness of 41,000 people receiving either VDS and/or MHU services showed that 55% have a family history of diabetes and 20% have a family history of obesity. In addition, 452 mental health screenings were performed during this period indicating the prevalence of the following: depression (40%), anxiety (16%), psychosis (14%), violence (8%), sexual problems (8%), and other more rare conditions (14%).

During the period of analysis, just over 154,000 people were served at VDS and MHU and provided information on their medical coverage (Table 4). These data show that in general this is a highly vulnerable population since 94% lack any type of health coverage, and more so among VDS (96%) than MHU users (85%). Moreover, when separated by age group, people aged 65 or over have the highest percentage of medical coverage, especially among MHU users.

Discussion

The services provided by VDS and MHU in the United States are crucial for several reasons:

First, there is a large and growing size of Hispanic population living in the United States. According to data from the most recent Census conducted in 2020, the total Hispanic population living in the United States amounted to 62.1 million, of whom approximately 62% were of Mexican origin (38.5 million people).

Second, it addresses the predominant characteristics that act as barriers to medical care among this population such as their economic status, limited command of the English language, and

limited access to health services that result in them suffering from poorer health.

Third, the VDS and MHU address conditions that stem from a history of chronic-degenerative illnesses and diseases among the Mexican population, such as obesity, diabetes, and hypertension, documented both in Mexico, through the National Survey of Health and Nutrition (11), and the United States through the National Health Interview Survey (12).

Fourth, in recent years mental health has become a major concern in offering preventive and holistic care and giving it the same level of care as physical health problems receive. VDS and MHU began an initiative to approach healthcare among Mexicans in the United States to detect mental health signs and symptoms, and to refer them to access local or online services.

Fifth in the face of the COVID-19 pandemic, VDS and MHU adapted its services and system and type of care offered to continue providing in person preventive services, such as administering vaccines, also, providing remote services, showing their ability to adapt and respond to emerging needs.

Given these characteristics and based on the results of the quantitative analysis, both VDS and MHU are considered successful models in managing to detect the specific needs of their users and adapting to the context where they are implemented. They have also been strengthened over the years, thanks to their network of strategic allies in each consular district, which in turn manifests their perseverance, coordination, and institutional commitment.

Conclusion

VDS and MHU have proven to be an important model of collaboration. Through alliances with institutions from different sectors, VDS and MHU have managed to direct outreach to a vulnerable sector of the Hispanic population to reduce the gap in access to health services. It is a unique care model, serving co-nationals in another country, contributing not only to the benefit of the health and wellness of Mexicans in the United States, but also to the health and wellness of other neighboring Hispanics.

The ability of the VDS/MHU to effectively organize and manage health outreach services and to connect clients to these services, particularly in the area of COVID-19 and mental health, is a testament to the strength of its diverse network of collaborators in Mexico and the United States.

In conclusion, we would like to suggest the following actions to strengthen the VDS and MHU services and ensure the continuity of the strategy. First, VDS and MHU should identify and formalize collaborations with strategic allies to promote the supply and distribution of the COVID-19 vaccine and others vaccines to the neediest and most vulnerable migrant communities. Second, it is also important to strengthen the

mental health module. The relevancy of this module was highlighted by the COVID-19 pandemic and the detrimental impact on mental health related to social distancing and sheltering in place. Third, the VDS and MHU requires greater dissemination of the work carried out to strengthen their actions and give continuity to the strategy.

The VDS strategy has been instrumental in providing much needed health-related preventive services to hard-to-reach populations and communities which they would otherwise have been unable to obtain.

Data availability statement

The datasets generated for this study are available on reasonable request to the corresponding author.

Author contributions

IL and SS first draft and data analysis. MR, AL, AR, MC, LG, and CR revision and final draft. All authors contributed to the article and approved the submitted version.

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The reviewer KD declared a past co-authorship with the authors MG and CR to the handling editor.

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| Frontiers in **Public Health**

The impact of COVID-19 and access to health services in the Hispanic/Mexican population living in the United States

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Introduction: The United States is home to 10.5 million undocumented immigrants, of which 5 out of 10 are Mexican or Central American. Their immigration status is an obstacle to secure employment that provides labor benefits such as sick leave and health insurance. Living through the global pandemic in the U.S. had a negative impact on this vulnerable population's mental and physical health. They avoided seeking primary or hospital care fearful that they were undocumented and uninsured. The services provided by the Ventanillas de Salud (VDS) "Health Windows" mitigated this pandemic's negative impact and have become an important source to support and increase access to health services among the immigrant community.

Methods: De-identified data from a database system called the Continuous Information System and Health Reports of Mexicans in the United States (SICRESAL-MX) to perform this secondary analysis. The descriptive analysis describes socio-demographic, epidemiological, and situational characteristics of COVID-19.

Results: Between January 2020 and July 2021, the VDS and UMS provided 11.5 million individual services to just over 4.3 million people. The main health conditions are overweight and obesity, high blood pressure and elevated cholesterol and glucose levels. Between March 2020 to July 2021 a total of 2,481,834 specific services related to COVID-19 were offered.

Discussion: The Mexican migrant community in the United States is in a vulnerable situation, largely due to its immigration status which limits their access to health and human services, including primary health care services. Many of them have suffered from chronic diseases since before the pandemic, generating difficulties in monitoring the ailments and exacerbating their conditions.

KEYWORDS

COVID-19, immigrants, Mexican, health, United States, diseases

Introduction

The Hispanic immigrant population living in the United States face a series of social barriers that hinder their living conditions. Among them are the legal barriers stemming from their immigration status (1), which may result in difficult working conditions (2) and limited access to healthcare services, including basic health screens (3). Recent statistics based on data from the US Census Bureau (4), show that there are 10.5 million undocumented immigrants in the United States, of which approximately half come from Mexico and Central America.

The history of Mexican migration to the United States dates to the late 19th and early 20th centuries. At that time, the migratory dynamics were relatively unregulated, and the flow was almost natural from Mexico to the United States and vice versa. In the first decade of the 20th century, an agreement was signed between both governments for Mexican workers to work in US agriculture (5).

During World War I, the United States issued measures that sought to regulate migration in general. Under the Literacy Act, entry was conditioned to those who knew how to read and write, and could pay border crossing fees. During the economic crisis of 1929, the U.S. context showed greater hostility toward Mexican migration. Meanwhile, Mexico could not absorbed the growing demand for employment by the working-age population (5).

Beginning with World War II, the United States had a strong demand for labor in agriculture and other productive sectors due to the shortage of American workers. In 1942, the Bracero Program began, in which Mexico provided labor for agricultural production. Mexican migrant's wages were much lower and conditions more precarious than their U.S. counterparts. The program continued once the war was over until the United States ended it in 1964. From then on, migration to the United States was constant and growing, but mostly undocumented (5).

Mexican migratory flows to the United States maintained a growing trend in the 1980s and 1990s. As of 2001, due to the terrorist attacks, the context hardened through greater border control measures. The result was an increase in deportations and a large number of migrants who lost their lives trying to cross the border. By 2008, the repatriation of undocumented Mexican immigrants reached significant and alarming levels. Also, during this time, the Deferred Action for Childhood Arrivals (DACA) Program began, as a policy that serves and protects "Dreamers," a population that had come to the United States as children, allowing them a legalized manner to remain in the United States (5).

The Donald Trump administration focused on an anti-immigrant discourse with the aim of building a wall on the northern border with Mexico (5). One of the initiatives, America First, consisted of increasing immigration restrictions in the name of protecting American workers and industry (6).

The immigrant population can be considered among the most vulnerable for several reasons. For example, an undocumented status precludes authorization to work legally in the country of residence which for many results in securing jobs that subjects them to low wages, long hours, and exposure to hazardous conditions (1) such as exposure to toxins, extreme temperatures, pesticides, and chemicals. Also, they may find employment in industries such as construction, agriculture, production, shipping, and transportation which are jobs known to have higher accidents rates compared to other types of jobs (2). In addition, undocumented status contributes to a web of interrelated consequences that can prevent immigrant workers from accessing the worker protections to which they are entitled.

Most Mexican immigrants have lower rates of health insurance coverage compared to the U.S. counterparts, resulting in limited use of emergency or primary care services, or accessing lower quality health care (3). Additional barriers to accessing services are limited English language proficiency, restrictive public health access policies, fear of deportation and discrimination, which can adversely affect communities (7).

The existence of mental health problems can contribute to vulnerability. The political environment in the U.S. increased anti-immigrant discourse and sentiment, attempts to tighten immigration laws, deportation threats, family separation, and detentions (8). In this context, the immigrant population has experienced fear, stress, anxiety, and perceptions of discrimination, thereby exacerbating mental and behavioral challenges (9, 10).

Scholarly literature has shown that high stress levels among individuals leads to disease susceptibility. Thus, living and working conditions contribute to poor health outcomes such as chronic diseases, including heart disease and diabetes (7, 11, 12). The immigrant population's situation worsened during the COVID-19 pandemic. The cumulative number of COVID-19 cases and hospitalizations in this community are among the highest in the country due in part to lack of access to healthcare (8, 13).

Therefore, immigration policies and laws play a central role in the quality of life of the immigrant population by shaping the type of employment and salary, the level of access to health services, as well as populations ailments (14). Immigration laws dictate who enters and who stays out, as well as the structural vulnerability of those who enter. The policies classify the population in different categories of precariousness, from illegality to temporary stay, permanent residence, and citizenship. This results in a differentiated labor supply that produces precarious workers (15, 16). Further, immigration laws require certain skills and experience for the different categories. This places various restrictions on the freedoms of the population, their privileges, and rights of those who enter the United States, which has an impact on their labor market insertion (17).

During the pandemic, immigrants were well-known as the nation's essential workers. They continued to work despite the risk for exposure to the novel coronavirus. For example, early in the pandemic, the agricultural sector failed to protect its workers by implementing recommended mitigation measures such as social distancing, handwashing and mask wearing; prior to the development of vaccines (18–20).

In the hotel and restaurant industry, immigrant workers lost employment. Travel restrictions and quarantine measures had a negative impact on this sector with the loss of jobs and financial security. While there has been discussion and concern about how this pandemic has affected travel and the hospitality industry, there has been less concern about the impact on the millions of essential workers that lost jobs in this industry (7). Overall, in the United States, 51 million jobs were lost during 2020 because of the pandemic, an all-time record (21).

Living in this context disempowers the immigrant population from seeking healthcare services, creating a danger for all during a global pandemic (22, 23), more so when care is inaccessible. For example, 38% of Mexican immigrants in the United States do not have health insurance, while 8% of those born in the United States are uninsured (24). Moreover, the working conditions, economic status and housing conditions of this sector may increase exposure to the coronavirus, as well as transmission and spread (8).

The Ventanillas de Salud (VDS), pre-COVID-19, have been shown to be an important and trusted source of information providing access to health services for the immigrant community since 2003 (25). They were established by the Health Secretariat and the Foreign Affairs Secretariat, through the Institute of Mexicans Abroad (Instituto de los Mexicanos en el Exterior). The VDS's mission is to improve access to primary and preventive healthcare services, increase public insurance coverage, connect people to medical homes, and promote a culture of self-care among Mexicans living in the United States (26).

In addition to offering general health information, the VDS provides counseling, health education, disease prevention, and health promotion. Also, they offer preventive health screens, referral to primary healthcare services, and health insurance navigation resources. The existing 49 VDS and two mobile VDS are housed within the Mexican consular network in the United States and operated by local agencies (27).

Likewise, in 2016, the Mexican Section of the United States-Mexico Border Health Commission (USMBHC) introduced the Mobile Health Units (MHU) model of care to strengthen the VDS programs. The objective of the MHU is to outreach and bring preventive health services to remote communities with difficult access to healthcare services, reaching the most vulnerable (3). Currently there are 11 MHU located in Chicago (IL), Dallas (TX), Los Angeles (CA), Phoenix and Tucson (AZ), NYC (NY), Denver (CO), Las Vegas (NV), Miami and Orlando (FL), and Raleigh (NC) (3, 28, 29).

As part of the same strategy, the VDS and MHU serve the same target population, Mexican migrants in the United States. The difference is that the VDS are located inside the offices of the General Consulates of Mexico in 49 U.S. cities. While MHU serve the population that is hard to reach; due to distance, lack of transportation, resources, or fear due to their immigration status (30). In summary, while the VDS receives the population, the UMS goes to where the people are.

Although the VDS and MHU were initially developed to address the needs of the Mexican immigrant population, they serve all those in need, regardless of their country of origin or immigration status.

The objective of this article is to describe the socio-demographic and epidemiological characteristics of the Latino immigrant population served in the VDS and MHU living in the United States, from January 2020 to July 2021. It also seeks to describe the impact and situation of the target population in the face of the COVID-19 pandemic.

Methods

The authors used de-identified data from a database system called the Continuous Information System and Health Reports of Mexicans in the United States (SICRESAL-MX [acronym in Spanish]) to perform this secondary analysis (31). SICRESAL-MX is a computer-based system developed by the Mexican Section of the USMBHC, specifically to confidentially maintain information provided by users in the VDS and MHU. The descriptive analysis describes socio-demographic, epidemiological, and situational characteristics of COVID-19. Use of secondary data for this analysis was not deemed human subjects research, therefore, did not require IRB approval.

Results

Socio-demographic analysis

From January 2020 to July 31, 2021, the VDS and MHU provided a total of 11.5 million individual services to 4.3 million individuals. These services included counseling, education, COVID-19 and Influenza vaccination, basic health screening, and referrals (Table 1).

Sixty percent (2'5617,153) service users are female and slightly more than half (56%, 2'389,972) are between the ages of 30 and 49. Among those under 18 years of age (7%, 298,747) and older adults aged 60 years or older (9%, 384,102) use these services (Table 2). Half of the users reported attaining a middle school education (50.1%, 2,138,172) and a 34% (1,468,126) reported having attended between the ninth and twelfth grade; 7.2% (307,282) did not complete college and 6.8% (290,211) completed college.

TABLE 1 Individual services provided in VDS and UMS by type of service, January 2020–July 2021.

Variable	Frequency
Population served	**4,267,808**
Individual services provided	**11,475,047**
Guidance and education	10,429,503
Vaccination	230,437
Basic Health Screening	577,818
Referral	13,079

Source: Prepared by the authors based on SICRESAL-MX, Mexican Section of the United States-Mexico Border Health Commission. The numbers in bold are to highlight the total numbers of population served and services offered (the figures that are not in bold when added together make up the total services offered).

About 80% (3'414,246) of the users of these programs are permanent residents, having lived in the U.S. for 10 years or more. Another 10% (426,781) have lived in the U.S. 5–9 years, and an additional 10% (426,780) have recently migrated within 4 years or less.

Regarding the place of birth, 94.6% (4,037,346) of the population served is of Mexican origin. Although this population is the objective, the VDS also provided service to other nationalities of which 2.9% (123,766) are Americans and between Central America, South America and the Caribbean make up the remaining 2.5% (106,695).

The level of English proficiency declared by the population served is mostly intermediate with 50.8% (2,168,046). 35.32% (1,506,536) stated that their level of English is advanced, while the remaining 13.85% (593,225) stated that their level is basic. Regarding occupations, the three main ones are cleaning services (23.7%, 1,011,470), construction (22.1%, 943,186) and manufacturing or factories (14.1%, 601,761); which make up about 60% of the occupations of the population served. The remaining 40% (1,711,391) is made up mostly of waiters, agriculture or gardening, administrative positions, sales, and drivers.

Main conditions

The analysis of the epidemiological characteristics of the population allows us to know the main prevalence of diseases detected in the population attended in the VDS and MHU. The screenings made were about glucose, overweight and obesity, blood pressure, cholesterol, sexually transmitted infections (STI), and HIV. Although the relationship between COVID-19 and its associated conditions has not yet been examined, according to the Pan American Health Organization (32), people with chronic non-communicable diseases have a higher risk factor for complications from a COVID-19 infection.

TABLE 2 Main socio-demographic characteristics of the population served at VDS and MHU, January 2020-July 2021[*] N = 4,267,808.

Characteristics	Percent	Characteristics	Percent
Gender	100	**English level**	100
		Basic	13.9
Male	40.9	Intermediate	50.8
Female	59.0	Advanced	35.3
Transgender	0.1		
Age group	100	**Education level**	100
Under 10	3.8	None	1.5
10–14	0.7	1–6	28.8
15–19	2.0	7–9	21.3
20–29	10.8	9–12	34.4
30–39	24.9	Some years of college	7.2
40–49	31.3	University/College	6.8
50–59	17.4		
60 and more	9.1	**Occupation**	100
Birthplace	100	Cleaning services	23.7
Mexico	94.6	Construction	22.1
USA	2.9	Manufacturing/Factories	14.1
Central America	1.6	Cook/Bartender/Waiter	10.6
South America	0.7	Gardening/Agriculture	8.3
Caribbean	0.2	Administrative	8.1
Years living in the United States	100	Sales	3.4
Under 1 year	2.7	Driver	2.4
1–4 years	8.0	Other occupations	7.3
5–9 years	9.8		
10 years or more	79.5		

Source: Prepared by the authors based on SICRESAL-MX, Mexican Section of the United States-Mexico Border Health Commission.

The care provided to Mexican immigrants in the U.S. detected the main health conditions using various measurements (see Table 3). Seventy-eight percent (4,830) of the users of these services were overweight and obese. Thirty-seven percent (2,625) had high blood pressure, 31% (444) had elevated cholesterol levels, and 24.6% (1,376) elevated glucose levels. Other self-reported conditions included sexually transmitted infections (STI) at 1% (1) and <1% percent reporting HIV (Acquired Immunodeficiency Virus) infection. In addition to the health screenings, guidance and education services were provided on care and prevention of these conditions. Most notable is the high uninsured rate at 97% (4,139,774).

Situational diagnosis of COVID-19

In response to the pandemic, the VDS and MHU programs included COVID-19 in their guidance, education, health

TABLE 3   Prevalence of the main health conditions treated at the VDS and MHU, January 2020–July 2021.

Type of detection	Guidance/Education provided	Measurements performed	Elevated readings detected	Prevalence%
Glucose	10,927	5,594	1,376	25
Overweight and obesity	9,154	6,280	4,830	77
Blood Pressure	11,527	7,013	2,625	37
Cholesterol	9,154	1,430	444	31
STI	3,241	360	4	1
HIV	3,241	402	2	1

[1] Includes guidance and education on obesity/metabolic syndrome/cholesterol prevention.
[2] Includes guidance and education on HIV and STI prevention.
Source: Prepared by the authors based on SICRESAL-MX, Mexican Section of the United States-Mexico Border Health Commission.

TABLE 4   COVID-19 situational diagnosis of population served in VDS and MHU, March 2020 to July 2021[*] N = 19,929.

Variables	Percent	Variables	Percent	Variables	Percent
Gender	**100**	**Have experienced**	**100**	**Lost their job due to the COVID-19 outbreak**	**15.0**
Male	43.6	Food insecurity	47.4		
Female	56.3	Lack of hygiene products	15.1	**Have a relative unemployed due to the COVID-19 outbreak**	**20.5**
Transgender	0.1	Loss of income	28.6		
Main source of information about the pandemic	**100**	Other	8.9		
		Tested for COVID-19	**32**	**Sought assistance of a government program**	**6**
T.V.	60.7	Positive	22		
Social media	21.9	Negative	73	**Sought assistance of a food bank**	**20**
Friends/Relatives	8.1	**Symptoms experienced**	**100**		
Radio	4.6	Dry cough	13.9	**How serious do you think the current situation is?**	**100**
Other	4.7	Headache	13.4		
Level of information you have regarding the pandemic	**100**	Body pain	12.9	Very serious	38.2
		Sore throat	12.8	Serious	54.3
Very good	31.0	Fever	11.4	I don't believe it exists	0.8
Good	60.5	Other	35.6	Not serious	6.7
Regular	7.8	**With someone you know diagnosed with COVID-19**	**32**		
Uninformed	0.7				

Source: Prepared by the authors based on SICRESAL-MX, Mexican Section of the United States-Mexico Border Health Commission. The letters in bold correspond to each question asked to the population served. Those not in bold are the answers that make up the question. For example: Gender - 100%; Male - 43.6%, Female - 56.3%, Transgender - 0.1%. There are questions that have no answers, for example: Lost their job due to the COVID-19 outbreak - 15% (it means that 15% of the population served lost their job due to the pandemic).

screening, primary care referrals, and vaccination services. During the "Stay at Home" orders across the U.S., staff adapted and continued to provide services remotely from their newly created "home offices" through phone calls, e-mails and social networks. Upon lifting the shelter in place orders, staff returned to the community, adjusting their approach to implement the CDC recommendations of physical/social distancing, hand sanitizing and mask wearing. Once vaccines became available in 2021, with collaboration with local health departments, staff included COVID-19 and Influenza vaccination services.

As a result, from March 2020 to July 31, 2021, the VDS and MHU offered a total of 2,481,834 specific services related to COVID-19. The actions carried out focused on guidance and education (1.47 million), dissemination of credible and

evidenced-based information on COVID-19 on social networks (699,000), in addition to health screenings (157,000) and vaccination (156,000).

Impact of COVID-19

The following describes the social impact of the pandemic on individual users of the VDS and MHU, their families, and friends (Table 4). Of all users of the VDS and MHU during COVID-19, 56% (8,695) were women, 6 of every 10 (12,250) users were between 31 and 50 years of age. Remarkably, only 3% (605) of all services users were 60 years of age or older.

Among the immigrant population seeking advice, education and guidance, 60% (12,101) indicated their main source of information about the current pandemic was television followed by social media. The majority reported they had a "Good" or "Very Good" level of information.

At least 6% (1,164) of the users who approached the VDS or MHU reported symptoms related to COVID-19. The most common symptom dry cough, manifested in 14% (2,769), followed by headache (13%, 2,661), body aches (13%, 2,562) and sore throat (13%, 2,543), fever above 98.6°F/ 37°C (11%, 2,265), chest pain (10%, 2,015) and joint pain (9%, 1,882), among others. One out of 10 (2,192) reported they required a hospital or clinic visit due to symptoms related to COVID-19 and 32% (6,377) had been tested for coronavirus, of which 22% (1,372) tested positive.

Between January and July 2021, the VDS and MHU administered vaccinations against COVID-19. From a total of 12,913 people served, 34% (4,390) reported having received a COVID-19 vaccine, the remaining hesitated to receive the vaccine. The main reason for not receiving the vaccine was distrust in the government (28%, 2,434). For this same period, 90% (18,431) of the users considered the current pandemic as serious or very serious, yet reported not receiving the COVID-19 vaccine.

The VDS and MHU users' perception of how serious the current situation is, relates to the social impact in their own lives. For example, 32% (6,285) of the users reported a member of their family, friend, co-worker, or neighbor tested positive for COVID-19; 21% (4,088) stated a member of their family experienced a job loss due to the pandemic, and 15% (2,926) reported personal job loss. Economically, 47% (9,455) stated that during this period, they experienced food insecurity, and 29% (5,691) experienced loss of income. Consequently, 20% (3,970) of the users indicated they required food bank services, while 6% (1,197) of the total made use of one of the programs launched by the city, county, or state governments to support the community with the challenges faced.

In addition, the emotional health of users has also been affected in different ways: 29% (5,684) expressed stress, 22% (4,345) concern about their future, 21% (4,111) anxiety, 11%

(2,251) felt isolated, 11% (2,116) tired, and 7% (1,423) sadness or loneliness.

Discussion

The Mexican migrant community in the United States is in a vulnerable situation, largely due to its immigration status which limits their access to health and human services, including primary health care services. Many of them have suffered from chronic diseases since before the pandemic, generating difficulties in monitoring the ailments and exacerbating their conditions. The main conditions that affect the population studied are overweight and obesity, high blood pressure, high cholesterol, and high glucose levels while almost entirely lacking health insurance.

Social factors that hinder further access to health services are low levels of formal educations, a limited command of the English language, and precarious jobs, which translates into the quality of life of this population. In addition to the above, the COVID-19 pandemic had an impact on their vulnerability, reflected in job losses, food shortages, and income loss, leading some to request assistance from food banks or government aid while also affecting their mental health, experiencing higher levels of stress and worry about the future.

Prior to the current pandemic, the VDS and MHU were trusted voices and sources of care, providing basic health screenings, health education, and referral to primary care. Both were even more essential in enhancing the reach of local health departments in providing COVID-19 testing, mitigation guidance, and COVID-19 vaccination, when it became available. Reaching this population through the VDS and MHU is a practical option for receiving guidance and education services provided in Spanish, the native language of most. Nonetheless, outreach and primary prevention services cannot replace the much-needed primary care that many VDS and MHU users require. Therefore, the challenges to serving the migrant community require the coordination and cooperation of both Mexican and U.S. agencies.

Conclusion

Keeping the migrant community informed and aware of available resources, educating and assisting them in navigating the healthcare and public healthcare system in the U.S. is challenging under normal or non-crisis circumstances, let alone during what we have experienced globally with the current pandemic. Migrant communities are fluid and require consistent and reliable engagement, providing credible, culturally sensitive information, and cultural humility. Moreover, coordination and cooperation between and among trusted community-based organizations, community leaders, and local/state health authorities is critical in creating community well-being.

The analyzed results aim to demonstrate the action capacity of the VDS and MHU. Given the success they have had with the Latino migrant community in the United States, this strategy can be a model applicable to other organizations dedicated to the care of vulnerable groups. The strategy was able to adapt to the emergence of health emergencies and has shown that it can be part of a response protocol in the event of a health emergency, in this case, the COVID-19 pandemic. Finally, this strategy contributes to access to first level health services since these cannot influence the health strategies of the US government.

Primary health care has had a very good impact on the Latino immigrant community in the United States. Primary health care, being free regardless of immigration status, has made it possible to care for an entire population that would otherwise be very difficult or had no access. The limitations of the strategy are imposed by the various contexts and challenges they present. Each VDS and MHU, the agencies that work for them, and their allies face a variety of situations that vary from city to city.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Author contributions

SS and LO contributed to the writing and initial data analysis. MR, JA, and CR contributed to the data analysis review, discussion, and data interpretation. All the authors contributed to the article and approved the version submitted.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Consequences of COVID-19 on adolescents in Arizona: A longitudinal study protocol

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Introduction: The long-term impact of COVID-19 is unknown. We developed a 5-year prospective cohort study designed to generate actionable community-informed research about the consequences of COVID-19 on adolescents ages 12–17 years in Arizona.

Methods: The study has two primary outcomes: 1) acute and long-term outcomes of COVID-19 illness and 2) symptoms of depression and anxiety. Data is collected using an online survey with plans to integrate qualitative data collection methods. The survey is administered at baseline, 4, and 8 months in year one, and annually in years two through five. This study is informed by Intersectionality Theory, which considers the diverse identities adolescents have that are self and socially defined and the influence they have collectively and simultaneously. To this end, a sample of variables collected is race/ethnicity, language usage, generational status, co-occurring health conditions, and gender. Additional measures capture experiences in social contexts such as home (parent employment, food, and housing security), school (remote learning, type of school), and society (racism).

Results: Findings are not presented because the manuscript is a protocol designed to describe the procedure instead of report results.

Discussion: The unique contributions of the study is its focus on COVID-19 the illness and COVID-19 the socially experienced pandemic and the impact of both on adolescents.

KEYWORDS

COVID-19, adolescents, depressive symptoms, anxiety, resilience, epidemiology, intersectionality

Introduction

COVID-19 has greatly influenced the lives of adolescents in direct and indirect ways. The extent of influence is unknown, therefore longitudinal studies are imperative. Globally 464 million people and over 78 million people in the United States (U.S.) have contracted SARS-CoV-2, the virus that causes

COVID-19 (1). Among the 73 million U.S. children and adolescents, 17,095 per 100,000 have had COVID-19 (2). Cases resulting in the hospitalization of children and adolescents are 1–5% and deaths <0.02% (2). In Arizona, over two million of the state's 7,303,398 population have been infected with SARS-CoV-2 (3, 4). Twenty-one percent of the cumulative cases in the state are 19 years of age and younger, and 65 deaths (3). To prevent severe illness, hospitalizations, and death, efficacious vaccinations are available. Seventeen million or 68% of adolescents 12–17 years of age in the U.S. have had at least one dose of the COVID-19 vaccine (2). Fourteen and a half million or 58% have received two doses (2). Among Arizona adolescents 19 years of age and younger, 36% have had at least one dose (3).

Description of Arizona

Arizona is a state in the southwestern U.S. It shares state borders with Utah to the north, California and Nevada to the west, New Mexico to the east, and an international border with Mexico to the south. The international border with Mexico offers an exchange of people, culture, and goods that create unique border communities. Socially constructed classifications (5) of ethnicity and race of the Arizona population are as follows: Latinx 31%, German 17%, Irish 11%, and English 10% (6). Racial groups are Whites 77%, from another race not listed here 7%, Black or African American 5%, Native American 5%, people belonging to two or more races 4%, Asian 3%, and Native Hawaiian or Pacific Islanders <1% (6). There are 22 federally recognized Native American tribes in the state (7). Arizona has a diverse population, and expansive open spaces. By area Arizona is the sixth largest state in the U.S. (4). Pockets of rural communities are spread across the 15-county state (8). The large distances between rural and some tribal and some border communities create a challenge to access necessities such as food and healthcare. These challenges were worsened with COVID-19 by deepening economic and health inequities.

In January of 2021 people categorized as Native Americans comprised 5–9% of the Arizona population but made up 12% of COVID-19 deaths (9). Moreover, the Navajo people experienced more COVID-19 cases per capital compared to any state in the U.S. in the spring of 2020 (10). Seventy-five percent of Navajo people reside in Arizona with the Navajo Nation spanning Arizona, New Mexico, and Utah (11). The Tohono O'odham Nation had 1,748 COVID-19 cases and 69 deaths in March of 2021 for a population of 33,000 enrolled members (12). Health inequities are also among people classified as Latinx or Black. Nationally, those categorized as Latinx had 1.5 times more cases, 2.3 times more hospitalizations, and 1.8 times more deaths than those categorized as White (13). People categorized as Black had 1.1 more cases, 2.4 times more hospitalizations, and 1.7 times more deaths than those categorized as White (13). Life expectancy decreased early in the pandemic from 2019 to the

first six months of 2020, however people classified as Black and Latinx experienced disproportionately greater loss such that Blacks had a 2 year reduction (74–72 years), Latinx a 1.9 year reduction (81.8–79.9 years), and Whites a 0.8 reduction (78.8 to 78 years) (14).

Co-morbidities

Co-occurring and/or pre-existing conditions have increased the risk of SARS-CoV-2 infection and severity of the illness. Such a pattern is seen among children and adolescents with disabilities. More severe cases of COVID-19 have been found among children and adolescents compared to adults (15). Children and adolescents 17 years of age and younger with intellectual and developmental disabilities (IDD) had a case-fatality of 1.6% in comparison to children without IDD with <0.01% (15). The nature of IDD can interfere with understanding and implementation of COVID-19 mitigation strategies. For some adolescents with disabilities, the disability does not appear to increase the risk of infection, but rather the changes in service provision during the pandemic placed barriers to health system's access (16).

Inequities in basic needs

Economics contribute to the challenges posed by COVID-19. In 2020, the national poverty rate was 11% (17) and unemployment was 15% (18) still lower than that of many racial and ethnic groups in Arizona prior to the pandemic. Limited access to basic needs such as food and housing creates cascading results for adolescent development and health. In the Adolescent Behaviors and Experiences Survey conducted by the Centers for Disease Control and Prevention (CDC) from June to January 2021, 33% of high school students classified as Black reported food insecurity in their home (19). Prior to the pandemic, almost one in ten youth classified as Latinx resided in crowded housing (20). Crowding increased the risk of infection from SARS-CoV-2 among youth living in immigrant and mixed-nativity households (20). A study of 16,651 U.S. adults found 24% experienced housing inaccessibility defined as insufficient funds for rent, mortgage, or utilities or moving in with others (21). Furthermore, of these adults 77% reported worries about insufficient food, running out of food, or reducing serving sizes or skipping meals altogether. Inaccessible housing was related to no usual source of care (AOR 1.31, 95% CI 1.08–1.59), delaying care (AOR 1.84, 95% CI 1.46–2.31), and delaying medication acquisition (AOR 2.16, 95% CI 1.70–2.74) (21). Adult people of color that identified as lesbian, gay, bisexual, or transgender (LGBT; 17%) were three times more likely to experience food insecurity than White non-LGBT adults (6%) (22). The impact of stress on adolescents surrounding basic needs can be seen

in findings from a national survey where 52% reported worries about family's health, 40% about finances, 39% about education, and 30% about food, medication, and safety (23). Worries impact mental health. Shortly after the pandemic began, a study found that more than 25% of high school students in the U.S. reported emotional distress manifesting in the inability to sleep, feelings of unhappiness and constant strain, and a decrease in self-confidence (23).

Racism

Co-occurring with the pandemic, has been social injustice and striking political controversy. The events and undercurrent at points in the pandemic identify long-held racial tension that permeates the experiences of adolescents in the U.S. According to the Adolescent Behaviors and Experiences Survey, over 33% of high school adolescents reported bad or unfair treatment at school that they attributed to their race or ethnic category (19). The Weathering Hypothesis describes the negative health consequences of chronic discrimination and stress (24). Students reporting high levels of racism were in the Asian, Black, and Multiracial classifications (19). Racism negatively impacted adolescent mental health and fostered disconnectedness with school. This is particularly problematic when considering school is an important social context for adolescents to develop both socially and academically (19).

Development

Socialization has been interrupted by prolonged separation due to school closures and social distancing measures. Peer interaction is a necessary part of development particularly during adolescence as youth move toward becoming adults. As part of that development, important structural and functional changes occur in the brain (25). Research among adolescent mice suggest social isolation has negative implications on brain processes and behavior (26). The influence of the pandemic whether directly or indirectly will have implications on adolescent development and health.

Youth that identify as transgender

According to an analysis of the national Youth Risk Behavior Surveys from 2017 to 2019 by the Williams Institute, 1.4% or 300,000 youth in the U.S. ages 13–17 years identified as transgender (22). In Arizona, 1.54% or 7,300 youth ages 13–17 years identify as transgender. The age group of 13–17 years is the second largest group of people that identify as transgender in Arizona. The first is young adults ages18–24 years with 1.92% or 13,000 (22). The southwestern states of California (1.93% or 49,100), Texas (1.42% or 29,800), and New Mexico

(2.62% or 3,700) show youth ages 13–17 years are the largest group that identifies as transgender in their states. The data suggest the younger age groups in these U.S./Mexico border states have the greater percentages of transgender identifying people. The finding is informative in recording the changing gender identification landscape or potentially reflective of a growing acceptance to identifying as transgender. These data have implications for preparing to meet the needs of youth.

Resilience

Among the experiences during the pandemic, resilience is an important aspect. In a study published in 2021 of children and adolescents ($n = 2,863$) in Hong Kong ages nine to 17 years where 73% were categorized in the medium affluence group, youth reported greater awareness of health including noting signs of stress and responding by relaxing (27). In the U.S., adolescent resilience during the pandemic has yet to be quantified with validated survey tools. In a study of youth from Australia, utilizing the Connor-Davidson Resilience-10 (CD-RISC-10) survey, those between the ages of 12–18 years were found to have an average CD-RISC-10 score of 20.93 on a 0–40 scale (higher scores correlate to higher self-perceived resilience) (28). In a study of adolescents from China, resilience was found to be predictive of stress, anxiety, depression and post-traumatic stress disorder (29).

Intersectionality theory

Given the many factors involved in the impact of COVID-19 on adolescents, Intersectionality Theory has been selected as a guiding theoretical approach for the design and analysis of the study. Crenshaw is credited for introducing intersectionality theory with work dating back to the 1980s (30, 31). Intersectionality Theory focuses on the multiple interdependent categories of social groups, rather than on a singular identity (32–34). It acknowledges the ways in which age, class, sexuality, gender, disability, race, ethnicity, and other social categories become mutually constructed through powerful and often limiting systems (33). The authors acknowledge that race is a classification system. It includes societal beliefs and practices that are intricately woven into the order and operation of society that perpetuates advantage and disadvantage among groups (5). An intersectional approach focuses on the impact of social, economic, and demographic characteristics and how it shapes adolescents' daily experiences and health outcomes (34).

The study collects surveys over 5 years among youth ages 12–17 years living, working, or attending school in Arizona. The objective of the study aligns with principle three of the Principles of Action from the World Health Organization's Commission on the Social Determinants of Health (35). Principle three calls

for data to be collected to assess the problem. To that end, the purpose of the study is to (1) calculate the frequency of COVID-19 over time, (2) calculate the prevalence of symptoms of depression and anxiety over time, (3) create groups using PROGRESS-Plus (36) designed to measure inequities, (4) evaluate the interaction between the groups and COVID-19, depressive symptoms, and anxiety symptoms.

Materials and methods

Design

The CoVHORT Children and Teens Study (CATS) is a 5-year prospective cohort study. It has been developed alongside Arizona CoVHORT, an adult longitudinal study. Details about the Arizona CoVHORT protocol are in the February 10, 2021, issue of this journal (37). Adolescents eligible to participate in CATS live, work, or go to school in Arizona and are 12–17 years of age and read and write in English or Spanish. CATS is approved by the University of Arizona Human Subjects Protection Program (IRB number 2103560999) and has a Certificate of Confidentiality issued by the National Institutes of Health CC-OD-21-1467.

Investigative team

The investigators form an interdisciplinary team that features knowledge and skills in epidemiology, social work, maternal and child health (includes adolescent health and children and youth with disabilities), health behavior health promotion, data and statistical software, speech language pathology, policy, and education. Members include students, staff, and faculty. Students are undergraduates and graduate students. Staff are skilled in epidemiology. Faculty members are assistant or associate professors. Members of the team are from the University of Arizona and Arizona State University. Fifty-six percent of the team is Indigenous, Black, and/or Latinx. Ninety-three percent are women with 50% women of color and one man of color. Twenty-five percent are bilingual (English/Spanish).

Recruitment

Adolescents are recruited through partnerships, networks, outreach, and community engagement. The goal is to recruit 500 youth. Our partnership with the Arizona CoVHORT will provide the opportunity for ongoing recruitment. Our partnership with Arizona State University will focus recruitment efforts in Maricopa county in central Arizona. The study will distribute English and Spanish electronic and print flyers. Digital promotion of the study includes using various social

media platforms and the Arizona CoVHORT/CATS website. Photos will display adolescents from intersecting identities and categories. Language will be adapted for the intended audience including parents or guardians, adolescents, or service providers. Consideration for gender-inclusive language in Spanish has been implemented with the flyers. Spanish language defers to the masculine form of words such as chicos (males) and chicas (females) therefore in the absence of a single word to include all genders (such as they), we will use chicos/as.

Through the investigative teams' networks, flyers will be sent. Furthermore, targeted recruitment at youth sporting events and local street fairs are planned. Outreach to schools is planned as is partnerships with local coalitions and county health departments. Community engagement in CATS is intended to be responsive and respectful and mutually beneficial. CATS has been building a relationship with the border community of San Luis, Arizona. Discussions involve implementing qualitative research methods that will engage undergraduate students in the training of high school youth in the research method, PhotoVoice, whereby data (photographs) are created by the youth and contextualized through narrative (38).

At the time of this writing, we were not actively recruiting adolescents from tribal communities, although the youth that are members of tribes or identify as Native American/American Indian/Indigenous may self-select to participate. Engagement with tribal communities is underway through consultation with tribal councils which must approve and/or require a memorandum of agreement before recruitment can begin. The process of approval is customized to each tribe.

Consent and assent

Access to study information is at the Arizona CoVHORT study website in the "Teens" tab (www.covhort.arizona.edu/CATS). Figure 1 shows the enrollment and survey process. The welcome page provides information about the survey, eligibility criteria, and a series of questions to confirm eligibility. The website can be translated in seconds to multiple languages using Google Translate (39). Guests are first asked if they are a parent or guardian. If they are not, then they are presumed to be adolescents and are informed to secure consent to advance to enrollment. If they are a parent or guardian, then they are guided through an electronic consent process that requires a digital signature. Up to six adolescents can be enrolled per parent or guardian. For each of the adolescents consented, parents or guardians select the preferred communication contact (parent/guardian or adolescent). This person receives study reminders and survey links. For adolescents with parent or guardian communication selected, the parent or guardian is sent an email containing a custom link to their adolescent's assent and survey. If more than one

FIGURE 1
CoVHORT CATS procedural flow chart.
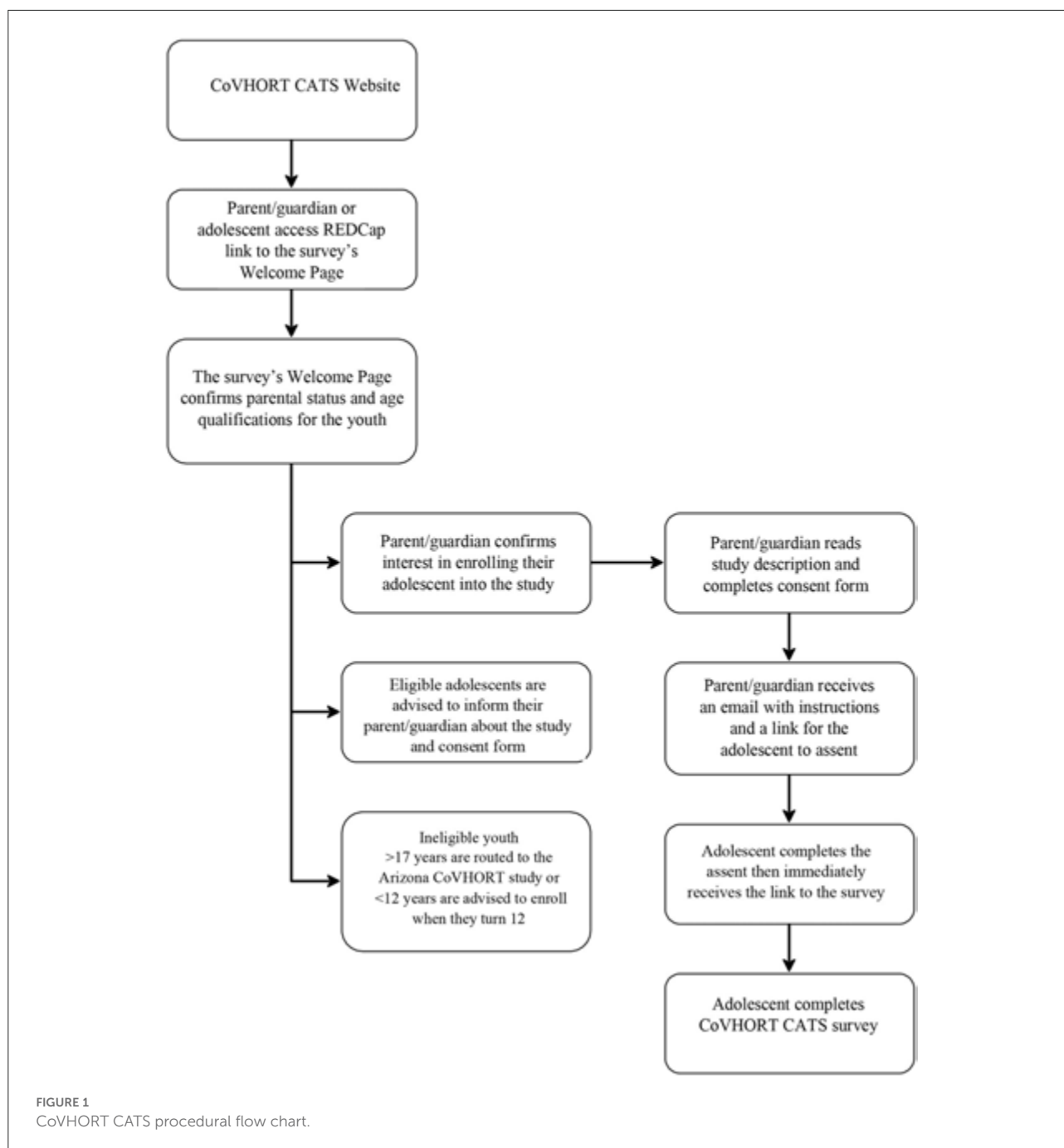
adolescent was enrolled and parent or guardian communication was selected, the parent or guardian receives instructions to have each adolescent complete the assent and baseline survey from the same device and in the same sitting. When one adolescent completes the assent and baseline survey, the parent or guardian is prompted for the next adolescent to "complete assent and survey again". For adolescents with youth communication selection, the adolescent is emailed a personalized link to complete the assent form and baseline survey.

Adolescents have 2 weeks to complete the assent and baseline survey. The assent has been developed from evidence-based methods of language analysis in the field of speech-language pathology (40). The assent is an interactive process whereby adolescents read content in sections then answer a brief question with multiple choice options. They receive immediate feedback on their response with praise for the desired response, and a reminder of the material for the undesired response. By adding the questions, the authors intend to

promote comprehension in efforts to achieve informed consent. Immediately after assent, a link is sent to the baseline survey.

Data collection

A total of seven surveys are administered over 5 years. In year one, three surveys are collected: baseline, 4, and 8-month. In years two through five, four surveys are collected: 12, 24, 48, and 60-month. Annual surveys are administered on the anniversary of the baseline survey.

Data management

Consents, assents, and the survey data are collected using the Research Electronic Data Capture (REDCap), a secure, HIPAA-compliant, web-based electronic platform that supports data capture and management in research (41). Data is stored in REDCap and de-identified data from REDCap is exported to Stata 17 for analysis (42).

Participation

The CoVHORT CATS baseline survey was officially launched July 8, 2021. Figure 2 illustrates engagement from the launch date to May 6, 2022 (302 days of the study). There have been 198 visits to the study welcome page with 133 parents or guardians expressing interest in enrolling their adolescent. At the consent stage, 75 parents or guardians have consented to enrolling their adolescent and collectively, 96 adolescents are enrolled in the study. The adolescent communication format yielded 18 adolescents who completed the assent and baseline survey. The parent or guardian communication format has yielded 47 completed assents and 42 completed surveys. In total, there are 65 completed assents and 60 completed baseline surveys as of May 6, 2022. In this timeframe 53 adolescents have been eligible for their 4-month survey; of these, 36 completed the 4-month assent and 36 completed the 4-month survey.

Measures

The baseline survey has 79 items. The follow-up surveys measure change over time. They include the baseline questions and exclude some fixed variables such place of birth. Some measures were developed based on the expertise of the investigative team (Table 1) and some from existing, validated scales. The primary outcome variables are COVID-19, depressive symptoms, and anxiety symptoms. Variables that contribute to forming groups reflecting intersecting identities and factors include gender, sexual orientation, resilience, food

FIGURE 2
CoVHORT CATS assent and completed surveys.
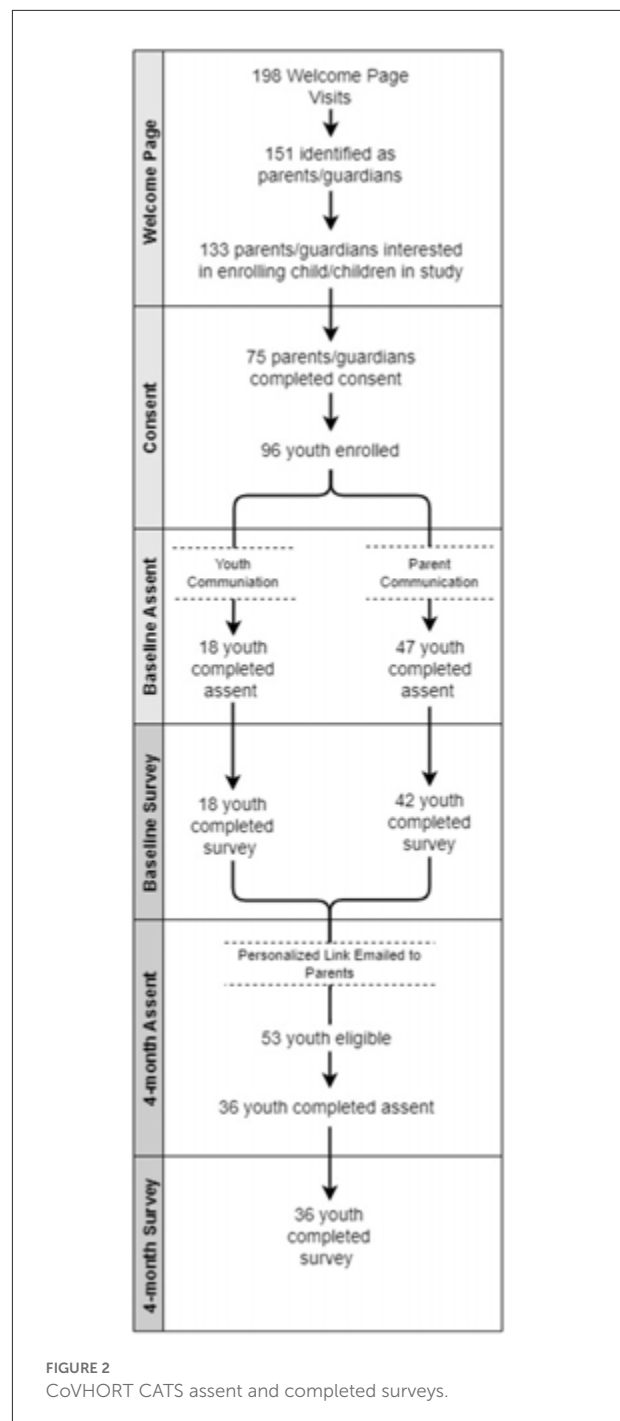
and housing accessibility, race and ethnicity, racism, disability, age, place of birth, and generational status.

The survey has one item for each of the following, race or ethnicity classification, gender identity, and sexual orientation. One item asks the adolescents about their place of birth. Six items ask about the type of school the adolescent attends and

TABLE 1　Investigative team developed survey items for the CoVHORT Children and Teens Study, participants 12–17 years of age.

Domains	Example questions
Experiences with COVID-19	
Symptoms	What, if any, symptoms did you experience?
Evaluation and Testing	Which of the following occurred as a result of your symptoms?
	Did you (or your parent/guardian) contact a physician, urgent care, or an emergency department for this illness?
Disease Progression	Did you ever start to feel better and then get worse during the course of your illness?
Household Transmission	Has anyone else living in your home had or probably had COVID-19?
Vaccination	
Vaccine Perception	How safe do you think the COVID-19 vaccine is?
Vaccine Receipt	Have you received a COVID-19 vaccine?
School	
School Type	What kind of school do you go to?
School Format	When you were last in school were you in person, hybrid, fully online?
Online School	What do you like about going to school online?
	What do you NOT like about school online?
Home and Family	
Financial	Are you or your family worried about having enough money?
Food	How worried are you about having enough food?
Housing	How worried are you about losing your home?

their experience with hybrid, online, and in-person modalities (Table 1).

COVID-19

Thirteen items ask about the adolescent's COVID-19 experience. The items are sequenced to start with whether an adolescent had COVID-19 or had been told they had COVID-19. Subsequent questions skip to items about testing, symptoms, treatment, and recovery based on previous responses. Testing questions ask if the adolescent has been tested, and if so, how such as nasal swab or blood withdrawal. Next, adolescents select all symptoms they have experienced from a list. Adolescents are then prompted to select the actions they or their caregiver took to relieve their symptoms. To capture perceived severity, adolescents are asked how sick they felt based on a scale from 0 to 10 with 0 defined as "you did not feel sick at all" and 10 as "you felt very sick". Next, adolescents indicating their illness had passed are asked if they feel as well as they did before they were sick. Finally, adolescents are asked whether anyone else in their home had had COVID-19.

Vaccination

Two items ask about vaccination. One question measures perceived safety and the other measures vaccination status. The safety question is "How safe do you think the COVID-19 vaccine is?" Response options are "extremely, very, somewhat, not too much, not at all." The vaccination status question is "Have you

received a COVID-19 vaccine?" Response options are "yes, no, I don't know."

Co-occurring conditions

Pre-existing conditions can increase the risk of COVID-19. Moreover, mental health conditions could have contributed to greater difficulty in school during stay-at-home orders. One item asks participants to select from 36 conditions commonly reported in the National Survey of Children with Special Health Care Needs (43). The first option is "none" followed by the 36 conditions. The item ends with the option to select "other" and then type in the condition.

Racism

The experience of racism can have several negative effects on the health and well-being of adolescents (44). Eleven items address racism. Two were created by the investigative team, and nine are a subset from the Adolescent Discrimination Distress Index (ADDI) (45). The ADDI measures institutional, educational, and peer discrimination experiences. Adolescents indicate if they have had a particular experience or not.

Home and family

The first set of items captures basic needs such as having sufficient income, food, and housing. Questions include "Are you or your family worried about having enough money?",

"How worried are you about having enough food?", "During this past school year, did you go to school for free breakfast or lunch?", "How worried are you about losing your home?", and "How many times in the last year have you moved?".

The next set of items ask about parent and grandparent nativity, language spoken at home, and interpretation. Close to 13% of people living in Arizona are foreign-born, with the majority from Latin America (6). Compared to other states, Arizona has the most people that speak an Indigenous language (6). Similarly, Arizona has a significant population that speaks Spanish. Among all ages, 20% of the Arizona population speaks Spanish and 24% of those 5–17 years of age speak Spanish (6). A meaningful percent of people immigrate to the U.S. with close to 13% of people born in countries other than the U.S., the majority are from Latin America (6).

Adolescents are asked "Were any of your biological parents or grandparents born in another country?" If yes, then the adolescent selects which family member(s) are foreign-born parents and/or grandparents. Adolescents are asked "What language or languages do you hear at home?" Following adolescents are asked "Have you translated/interpreted for your parents?" and "I have to help my parents by explaining how to do things in the US." Finally, adolescents are asked "Have you worried about family members having trouble with immigration (for example, getting deported, getting a green card, or getting arrested)?

Depressive symptoms

There are 27 questions to measure mental health including depression and anxiety symptoms. Depressive symptoms are measured using the Center for Epidemiological Studies Depression Scale for Children (CES-DC), a 20-item self-report inventory that asks adolescents how they felt in the past week (46). Response options are presented using a 4-point Likert scale with four of the 20 items reverse coded. Scores range from 0 to 60 with a score of 15 suggesting depressive symptoms and scores >15 indicating severe depressive symptoms (46, 47). Symptom scores can also be categorized into a group of four ranging from mild to severe (47). Studies show the CES-DC internal consistency ranges from Cronbach's $\alpha = 0.71$–0.91 (48–50) and test-retest reliability among adolescents ages 12–18 years to range from 0.70 to 0.85 (48, 50). The CES-DC has been tested and validated in other countries including India (51), Iran (49), Rwanda (52), Germany (48), and China (50).

Anxiety symptoms

Seven items measure anxiety using the Generalized Anxiety Disorder (GAD-7) scale (53). Scores range from 0 to 21 with severity cut-points at 5 for mild, 10 for moderate, and 15 for severe (54). A single cut-point of 8 is recommended and suggests the likelihood of anxiety (54, 55). Two studies, one with adolescents from Finland and the other with adolescents from China, together covered the ages of 10–18 years and found an internal consistency range from Cronbach's $\alpha = 0.91$–0.95 (56, 57). In a separate study of adolescents in Ghana the internal consistency was Cronbach's $\alpha = 0.69$ (58). The GAD-7 correlated with other scales measuring depression and mental health (58). Cultural considerations of the GAD-7 are the potential to underestimate anxiety in young adults categorized as Black/African American using the existing cut-points. In a study of undergraduates living in the US categorized as Black/African American, investigators found potential measurement bias that could result in lower anxiety scores rather than an accurate estimate of the severity of the anxiety experienced (59). The GAD-7 has been tested and validated with U.S. adolescents and adolescents from other countries such as China (57), Ghana (58), and Finland (56).

Resilience

Resilience, the ability of individuals to maintain well-being through the identification and acquisition of psychological, cultural, physical, and social resources, is an important measure for this study (60, 61). The Child and Youth Resilience Measure (CYRM-R) is a self-report scale designed to assess available resources that may improve resilience in youth ages 10 to 23 years (62). The internal consistency reliability in the CYRM-R is $\alpha = 0.82$, reporting a good fit to the Rasch model as it is unidimensional, has good fit statistics and a lack of bias and problematic local dependency (63). Additionally, the CYRM-R has shown concurrent validity with positive correlations with self-esteem ($r = 0.22$–0.53), peer support ($r = 0.53$), and social skills ($r = 0.62$) (64). The CATS survey includes 11 items addressing resilience and is scored using a 3-point Likert scale. Adolescents answer "no" or "sometimes" or "yes" for each item.

Statistical approach

The data will be analyzed for the primary outcomes of COVID-19, depressive symptoms, and anxiety symptoms. The rates of new (incident) and existing (prevalent) cases of COVID-19 infection will be calculated. Incident cases will be defined as new infection or meeting criteria for depression and anxiety since the baseline survey. The prevalence of COVID-19, depression, and anxiety will be based on each time point. Descriptive statistics will be calculated for all variables. Frequencies will be used for categorical data and means ($\pm$ standard deviation) for continuous data. For skewed continuous data we will use the median and range. Changes over time will be captured using analyses for repeated measures such as general linear modeling.

Data analysis will be informed by Intersectionality Theory. Although there is interest in the application of Intersectionality

Theory best practices for research, best practices are in development (65). We will form groups to measure inequities among outcomes using PROGRESS-Plus (36). PROGRESS-Plus has categorized individual, social, relational, and time-specific categories that have shown a relationship with inequities in health. Each letter in PROGRESS represents a category such as "S" that is for "social capital". The "Plus" portion is for experiences of discrimination (i.e., mental or physical dis/ability), features of relationships (i.e., foreign-born grandparents), and relationships that are related to a particular time period (i.e., transition from middle to high school). Once groups are formed, we can conduct bivariate analyses using the chi-square test to compare categorical data, two-sample *t*-test to compare continuous data between groups, and the correlation coefficient to compare continuous data. Non-parametric analog methods will be used when univariate data is non-parametric. After, we can conduct regression models with the groups as interaction terms. We cannot pre-specify all the statistical tests to be performed as we cannot predict the final sample size, although we are projecting enrollment to total 500 youth. The number of groups that will be created are to be determined; however, we will follow best practices in our analytical approaches and data reporting, including pre-specified analysis plans, statistically defensible methods for missing data, thoughtful sensitivity analyses, and the careful use of reporting guidelines. Data will be analyzed in alignment with Intersectionality Theory with consideration for the multiple factors and/or identities that can work simultaneously to influence health inequities (57). Multiple imputation will be used to account for missing data if appropriate, with imputation models that include variables associated with missingness. Other sensitivity analyses may center around changing definitions of cases and/or symptoms.

Results

Because the manuscript is a protocol paper, results are not presented, however, given the data suggest greater mental health needs among youth, we speculate that depressive symptoms and anxiety symptoms will be higher than estimates prior to the pandemic. We anticipate learning more about long COVID-19 symptoms and recovery as the research develops and through our data collection. We predict some challenges in forming intersectionality groups and draw from the collective knowledge within our investigative team, others, and the literature to inform our decision-making process.

Discussion

The research protocol describes a study for adolescents in Arizona to measure the frequency of COVID-19, depressive symptoms, and anxiety symptoms. Our study is unique with

the application of Intersectionality Theory to research with adolescents from a southwestern state along the U.S.-Mexico border. Another study in Arizona is the AZ HEROES Kids Study (66). It investigates the risk of infection from SARS-CoV-2 and vaccine effectiveness among children ages 4 months to 17 years. CATS is different from AZ HEROES Kids Study with our focus on COVID-19 and mental health. Nationally, studies from the CDC have examined the impact of COVID-19 and mental health with the CovEx survey among ages 13–19 years (67) and a cross-sectional study of high school students in 2021 to evaluate youth's behaviors and experiences of the pandemic (68). Globally, a systematic review identified 13 studies about the mental health impact of COVID-19 on children and adolescents (69). Of these one was conducted in each country including the U.S., Italy, India, and Canada, and nine in China. We have only begun to gather data on the impact of COVID-19 on the physical and mental health of adolescents. Our study can contribute to the practice, scientific, and policy communities in a few ways. Findings can inform interventions and contribute knowledge to inform future Healthy People objectives and Sustainable Development Goals. Results of the study may inform needed policies to address macro level factors that are creating systemic and structural barriers that contribute to inequities in health for youth.

While cases of COVID-19 have subsided, there is a need to understand the progression of long COVID-19. A systematic review and meta-analysis found a prevalence of 25% of long COVID-19 among children and adolescents (70). In some cases, children develop multisystem inflammatory syndrome (MIS-C). At present we are aware of these two continuing conditions from COVID-19, but it is too early to tell if other conditions will surface. In addition to the physical health implications of COVID-19, the elevated level of psychological distress is repeatedly stated in the literature. Warnings from global and national sources emphasize the critical need already apparent. In a national study of over 7,000 students in grades nine to 12 conducted in 2021, 37% reported negative mental health during the pandemic (71). In the year prior, 44% said they felt sad and hopeless.

The study has limitations. One is recall bias introduced by the survey format of the study. Additionally, some recruitment methods, such as recruiting from the Arizona CoVHORT study may introduce selection bias. Another limitation is recruitment. Great effort is required to reach adolescents from across the state. It requires partnerships across Arizona to engage youth, and partnerships take time to cultivate. Furthermore, partnerships should be mutually beneficial. The process of partnering and recruitment is time intensive during a period when the pandemic seems to be changing often. Delays can impact the gathering of much needed data. Another consideration with prospective cohort studies is participant retention. To bolster retention, we send email reminder notifications for survey completion. Future strategies

to promote retention include providing incentives to enroll and for completing surveys.

One component of success for this study hinges on the setup and active monitoring of the REDCap database. The REDCap workflow was constructed to ensure seamless flow from consent and assent to the baseline survey. Initially, participants had the option to select a preferred communication method: parent communication and youth communication. Through active data monitoring we discovered a lower participation rate (nearly half) among those that preferred youth communication. The communication method was changed to parent communication only. For each adolescent that enrolls, the parent/guardian receives an email with a unique personalized link for each adolescent.

Conclusion

Our study describes a longitudinal investigation of COVID-19, depressive symptoms, and anxiety symptoms. It is unique in that it applies Intersectionality Theory as a guiding framework. Results are expected to inform future practice, policy, and research.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

Conceptualization: VL, PG-F, KP-B, MJ, OD, MD, DC, and LB. Methodology: FC-M, VL, PG-F, MJ, OD, MD, DC, and LB. Analysis: NM and PG-F. Writing: VL, NM, OD, MD, KP-T, and PG-F. Supervision: VL and PG-F. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Mobile Health and Wellness Project: A binational collaboration of frontline health services to the Latino population in the United States in times of COVID-19

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Hardly reached communities in the United States greatly benefit from collective efforts and partnerships from Community Based Organizations, Health Institutions and Government Agencies, yet the effort to engage in this collaborative effort is minimal and funding to support these projects is lacking. The COVID-19 Pandemic exacerbated on a national scale what many vulnerable communities experience regularly; difficult access to basic medical care, information and support. In an effort to directly engage with community organizations and curb the infection rate of the COVID-19 virus within vulnerable communities, the US Centers for Disease Control and Prevention (CDC) launched its first targeted effort to partner directly with community based organizations. This article will highlight the first pilot year of activities and key results of COVID-19 education and vaccination efforts by the Mobile Health and Wellness project. This is a fleet of 11 Mobile Health Vehicles managed by the Mexico Section US-Mexico Border Health Commission in partnership with Alianza Americas, Latino Commission on AIDS, and the CDC, targeting Latino, Immigrant and rural communities across the US.

KEYWORDS

COVID-19, access to health care, preventive health care, Mobile Health Units, health initiative

1. Introduction

COVID-19 has exposed the challenges and vulnerabilities that health systems all around the world face. The pandemic corroborated the disparities and inequities we've known vulnerable communities have always had to overcome when trying to access health care services. In the United States, Black and Latinx communities have had to deal with some of the most harmful health and economic effects left by this contagion.

According to the Economic Policy Institute, Latinx workers have suffered greater economic hardships than their white counterparts. Even prior to the pandemic, Latinx workers faced low wages and precarious health conditions, in addition to lower access to health care (1).

Initially the impact of COVID-19 in regard to death rates for Latinx and white non-Latinx populations seem similar (39–35 deaths per 100,000). However, the results widen as age groups are considered. For example, Latinx children ages 0–14 are 3.3 times more likely to die from COVID-19 than white children from the same age group. Also, Latinx youth ages 15–24 are 6.1 times as likely to die than those considered white (1).

There are also several underlying economic factors that exacerbate the solvent effects of COVID-19 on the Latinx community, as most of these workers were economically insecure and without equal access to health care long before the pandemic even started. Most of the issues that Latin Americans face can be tracked to the structural and institutional racism in the country (2).

As the COVID-19 pandemic continues, it has become apparent the Latinx community is one of the most affected communities amongst the population. According to data from New York City -an early epicenter of the coronavirus infection-, immigrants are over-represented in the front lines of health care, transportation, agriculture, food production, and sanitation (3, 4).

A large percentage of Latinx immigrant workers are not able to work from home. Even though they tend to play essential roles in the American economy, they often lack access to personal protective equipment (PPE) and fear accessing COVID tests or medical services. The Economic Policy Institute documented that Latinx immigrants are also not able to social distance at home or at work. They lack access to viable and trusted information due to language and cultural barriers, which generates fear of being stigmatized. As a consequence, the pandemic has also exposed the lack of safety measures in the workplace (1).

This widely known, but rarely addressed, context affecting communities of color and immigrants, called for partnerships that bridged the guidance of scientific and health professionals with organizations that already established trust with communities at most risk. Thus, the Centers for Disease Control and Prevention (CDC) launched the "Improving Clinical and Public Health Outcomes through National Partnerships to Prevent and Control Emerging and Re-Emerging Infectious Disease Threats" grant opportunity, to work closely with national partners.

The Mexican section of the United States-Mexico Border Health Commission (USMBHC) in partnership with Latino Commission on AIDS (LCOA), participated in this Project led and coordinated by Alianza Americas (AA). This trio collaborate and join forces to curb the current infection rate within vulnerable communities and contribute to the improvement of national efforts to address re-emerging infectious diseases.

The Mexican Section of the USMBHC operates a fleet of Mobile Health Units (MHU). These 11 mobile vehicles launched in 2016 are located in: Chicago, Dallas, Denver, Las Vegas, Los Angeles, Miami, New York, Orlando, Phoenix, Raleigh, and Tucson. The MHU are the only model of care that offer preventive health care services on priority health issues to the Latinx population in remote communities experiencing difficult access to health and public health services. Key services provided include: orientation and counseling, basic health screenings, referrals, and vaccines. Care is culturally and linguistically adapted, free, and accessible regardless of insurance coverage or immigration status. It was within this context that the Mexican Section of the USMBHC, with the MHU, began working closely with the CDC to reduce the impact and stop the spread of COVID-19, as well as other potential disease threats (5, 6).

This article describes the efforts done by the Mobile Health Units during the first stage of this Project from February to September 2021. It aims to highlight key outcomes on COVID-19 education and vaccination efforts, as part of MHU's contribution to this Project.

1.1. Mobile Health and Wellness Project

The specific aim of the grant is to improve health promotion and response activities to limited English proficiency (LEP) Latinx essential workers, as well as their families and their communities. A key strategy of this effort includes strengthening critical partnerships with community-based organizations (CBOs). It also aims to develop culturally and linguistically tailored programs and practices to facilitate the dissemination of information, testing, contact tracing, vaccination, and the development of healthcare strategies as a direct response to health emergencies such as the COVID-19 pandemic.

The project consists of three strategic initiatives and their corresponding activities: disseminate and adopt, inform and adapt, and target and train. Each strategy proposes a series of short-term results, where it seeks to increase knowledge on COVID-19 and facilitate access to the COVID-19 vaccine, for both the target population and essential workers. They also seek to create alliances with local city and state health departments and with non-governmental organizations. The purpose is to

carry out community events such as health fairs, educational programs, and outreach.

The first strategy, *disseminate and adopt* seeks to support the CDC in the dissemination and adoption or implementation of COVID-19 guidelines to curb the infection rate. It includes vaccination readiness plans, clinical guidelines, and best practices for the prevention and control of emerging and re-emerging infectious diseases. The strategy aims to work with limited English proficiency Latinx essential workers, their families, and communities.

The activities developed for this strategy include digital dissemination of existing and adopted resources *via* social media. The information sources are original infographics, video, and audio resources in alignment with CDC guidelines, testimonials, and public radio and television spots. Other activities are the participation and organization of local community and health events, as well as the distribution of cultural and linguistically adapted printed materials. Lastly, it looks forward to establishing partnerships with local governments and agencies.

The second strategy, *inform and adapt*, seeks to inform, and support CDC in the development and adaptation of guidelines, tools, and best practices. Including collecting information and communicating effectively. The activities embrace feedback sessions on best practices and dispelling myths and addressing misinformation and disinformation. It also incorporates partnerships with state and city departments of health.

The third strategy, *target and train,* seeks to engage frontline personnel and lead training in CDC best practices for the broader workforce supporting the prevention and control of emerging and re-emerging infectious diseases. Target guidance and tools to better reach communities and populations at increased risk for infectious diseases and reduce disease spread in targeted workplaces or settings.

The activities for this strategy are the recruitment and training of community health workers, volunteers, interns, and students. Also, the promotion of important relationships with state and local health departments to support vaccination activities.

The MHU implemented these efforts as part of their core activities, many of which were already in practice. Targeted outreach, building trust, individual and personalized orientations are among the activities in action. Access to educational material and viable and trusted information that is culturally and linguistically sensitive is key to successfully providing a quality service that is informative and impactful.

1.2. Target population

Through the Mobile Health and Wellness project, community health initiatives are implemented as a first

response to the prevention of emerging and re-emerging infectious diseases, as well as non-communicable diseases, mental health initiatives, among others. The project contributes by improving access to basic health services to vulnerable Latinx communities. Significant part of this population is in a geographically hard to reach areas and with difficult access to these and other basic services.

The main characteristics of this population, includes low income, limited English proficiency, prevalent barriers to access health services, a remote or rural locations, and rampant marginalization. These represent some of the most frequent barriers to healthcare for the Latinx immigrant population in the United States, and directly affect their overall wellness (5, 7). Additionally, the most common employment for this population includes agriculture, home and office cleaning, construction, and industrial factory work. Moreover, more than 70% of this community is un-or under insured (5).

The MHW offers a vast national network and infrastructure, with the capacity to link some of the most vulnerable communities in the United States with local providers who can provide medical care, together with national public health organizations dedicated to improving access to health services and eliminating health disparities.

2. Methods: Process measure indicators

For the preparation of this article, qualitative methods were used based on reports directly related to the project, such as the project Logic Model, monthly progress reports, and the cumulative final report.

From the strategies involved in the logical model: disseminate and adopt; inform and adapt; and target and train, its components were reviewed based on the indicators of population served, preventive health services provided, development of educational material and dissemination of information, and recruitment and training. Rollout of activities based on the logic model were implemented by the MHU and tracked using newly developed reporting tools and an online database, tracking the number of individuals reached and services provided.

3. Results

The main results of the project are described below, based on the committed indicators, in each of the strategies that make up the logical model.

TABLE 1   Basic services provided by the Mobile Health Units, February–September 2021.

People receiving services	245,541
Services provided	1,535,771[a]
Orientation and information	1,442,181 (93.9%)
Health screenings conducted	38,737 (2.5%)
Vaccines given	54,625 (3.6%)
Health referrals	228 (0.01%)

[a]People could attend >1 services; therefore, number is higher than total people.
Source: MHW project, integrated logic model and cumulative report February–September 2021, extracted from database *Sistema de Información Continua y Reportes de Salud de los Mexicanos en Estados Unidos* (SICRESAL-MX), from the Mexican Section of the United States-Mexico Border Health Commission.

TABLE 2   COVID-19 specific services provided by the Mobile Health Units, February-September 2021.

Services provided	No.
COVID-19 orientation and information	68,238 (65%)
COVID-19 screenings conducted	5,740 (5.5%)
COVID-19 vaccines	31,000 (29.5%)
COVID-19 referrals	13 (0.01%)

Source: MHW project, integrated logic model and cumulative report February–September 2021, extracted from database *Sistema de Información Continua y Reportes de Salud de los Mexicanos en Estados Unidos* (SICRESAL-MX), from the Mexican Section of the United States-Mexico Border Health Commission.

3.1. Disseminate and adopt

The MHU offered a total of 1,535,771 services to 245,541 people during February–September 2021 (Table 1). The services include health orientations, basic health screenings, vaccines, and referrals to health services. They target priority health issues affecting the migrant community, highlighting COVID-19 specific services (Table 2) that provide relevant health care topics in the face of the COVID-19 pandemic.

For the most part, the MHU focused on orientations (informative talks on various health topics), which make up 93.9% (1,442,181) of the total services provided. It is followed by the application of vaccines with 3.6% (54,625) and screenings with 2.5% (38,737) of the total. Likewise, the total referrals for this period were 228 (0.01%). Regarding COVID-19 specific services, a total of 104,991 were provided: COVID-19 orientations made up 65% (68,238), COVID-19 vaccines makes up 29.5% (31,000), 5.5% (5,740) of services corresponded to COVID-19 screenings, and COVID-19 referrals reported a total of 13 (0.01%).

These numbers reflect comprehensive preventive healthcare services to the Latinx immigrant communities

in the United States, which are among the most vulnerable communities even prior to the beginning of the pandemic.

The dissemination of information included newly developed material based on guidelines and current updates from various trusted and official sources. Some of them are the CDC, Mexico's Ministry of Health, non-profit institutions, as well as the Pan American Health Organization (PAHO), and the World Health Organization (WHO). The documents include data on the early stages of the pandemic, symptoms, risk factors, preventive measures, COVID-19 testing, treatment for persons with compromised immune systems or existing preconditions, and mental health during the pandemic.

Information and credible resources provided by these institutions guided efforts to dispel misleading information on COVID-19: symptoms, level of contagion, treatment, as well as vaccines, vaccine side effects, and boosting vaccine confidence. In total, 86 educational materials about COVID-19 were developed during this timeline. These materials also included information on the new variant of the virus, COVID-19 vaccine updates, as well as mental health in times of the pandemic.

All materials and messaging were shared by the MHU on social media platforms and during community events, both virtual and in-person. The dissemination of information on social networks (Facebook, Twitter, Instagram, and YouTube), yielded the following results: reach-341,860; reactions-9,890; comments-3,089; and shares-1,741.

In addition to these platforms, other technology was used such as Facebook live, open virtual forums on frequently asked questions, videos to eradicate the myths of the vaccine, and publications of COVID-19 vaccination days. Also, there was the dissemination of photographic evidence of people being vaccinated, infographics of preventive measures, and video testimonials. These other forms of outreach yielded: 1,006,410 reached on Television and 427,870 reached on radio stations.

Additionally, 355,500 brochures with COVID-19 information were printed. They highlighted spread and prevention, myths and facts, vulnerable population, vaccines, and mental health during the COVID-19 pandemic. All of this material was distributed during in-person events.

The MHU held 51 community events known as *Ferias de Salud* (community health fairs or events). Some of these events were carried out exclusively by the MHU, while others were planned with the assistance of local governments, as well as other community organizations. During these events, special attention was given to orientation and counseling in efforts to provide educational resources on priority health issues, screenings, COVID testing, referrals, and COVID and Influenza vaccines. In total 248 events and/or targeted activities were carried out to promote vaccination in COVID-19 confidence and administration.

3.2. Inform and adapt

The MHU documented key myths and misleading information that users shared concerning COVID-19 and vaccines, as well as efforts made to dispel and correct common misconceptions. Efforts included, sharing statistics of people infected with COVID-19, raising awareness and emphasizing the positive outcomes of getting vaccinated. Also, having medical professionals and pharmacists available during vaccination events to address any doubts and concerns.

The MHU generated 24 best practices specific to COVID-19 related issues, most of which were focused on process improvement, better procedure or method, interaction with other institutions, and data analysis for agile decision making. These best practices are proven to support efforts and functionality and easily replicated by other agencies.

3.3. Target and train

Community involvement and engagement are vital to successful dissemination of information and services. There were 187 recruitment events held where 1,585 volunteers (80%), students (19%), and interns (1%) were recruited. Of which, 1,458 were trained on priority health topics, especially on COVID-19 and the vaccine.

Mental health issues during the COVID-19 pandemic added a layer of specialized services needed. The MHU health promoters or *Promotoras*, received specialized training and support in self-care from the Faculty of Psychology of the National Autonomous University of Mexico (UNAM for its acronym in Spanish). Currently, MHU *Promotoras*, are collaborating with the stage of implementation of care through the screening, evaluation, management, and monitoring of high-risk cases in mental health during the COVID-19 pandemic. It is from these initial screenings that *Promotoras* can identify persons experiencing high levels of stress and in need of first-level psychological care services.

Subsequently, the extended network of allies specializing in mental health services facilitated access to second or third level care services. As well, the MHU offered additional social services, in response to the mental health needs of the Latinx community during the COVID-19 pandemic. These specialized mental health services were provided to 76 participants treated during the height of the COVID-19 pandemic. Of these, 61 individuals were referred to specialists from UNAM. They received culturally and linguistically adapted psychological care through telemedicine; 45.45% continue to receive this care. Anxiety and stress were among the most diagnosed conditions, followed by substance use, violence, and depression.

Promotoras providing these services received the "Taking care of my mental health: Skills for the management of emotions in the context of COVID-19". These trainings, in which mental health issues were addressed and strategies were implemented, allowed the *Promotoras* to build skills in emotional management, behavioral rehearsals, and receive feedback on their participation and performance.

It is also important to highlight the 301 local alliances made, 66 of which were exclusively for vaccination purposes. These were made with local health departments, religious and educational centers, and community organizations. They not only carried out COVID-19 vaccination events but were instrumental in the distribution of educational materials to communities that struggle to trust and believe mainstream media sources.

Continued efforts included partnerships with Consulates from different Latin American countries. This is a key component to reach the many mixes status Latinx families that include both US and foreign citizenship, residents, visa holder, DACA recipients and non-status immigrants.

Alliances with State and Local Health Departments allow for the healthcare network in the country to be more inclusive and truly reach the hard-to-reach population.

4. Discussion

The Mobile Health and Wellness Project in collaboration with community organizations Alianza Americas, Latino Commission on AIDS, and the CDC, is a threefold strategy to develop, practice and revisit effective outreach efforts and build trust with hardly reached communities. The Project has proven to be an impactful program when collaboration is the core ingredient that drives the collective effort. This includes collaboration at the governmental level, academic institutions, community-based organizations and the community level *via Promotoras de salud*, volunteers and students at all levels (high school, college, and graduate students).

The first phase of the project (pilot phase) concluded in October 2021. As the Mobile Units continue to participate in the second phase of the project, the partnerships will continue to grow and strengthen, as well as the bond with the Latinx communities within the cities in which these mobile units operate. The MHU will continue to provide services and health education through the creation of educational materials on COVID-19 and other priority health issues, utilizing social media posts, videos, radio and TV spots, posters, webinars, among others. This will potentially encourage and motivate individuals to take care of their own family health, their families and community.

The COVID-19 virus will be among us for many more years even after the mask and distancing restrictions have been lifted and the vaccines become part of annual rituals to keep us healthy. It is vital to keep educating and providing information in order to keep vulnerable communities safe and prepared for any possible future outbreaks. However, the

Mobile Health Units care model, aims to provide preventive services (guidance, screenings, vaccination, and referral), where in addition to COVID-19, other priority health issues are addressed, including HIV/AIDS, chronic degenerative diseases, mental health, cancer, healthy lifestyle, respiratory diseases, health promotion, among others.

Data availability statement

The data analyzed in this study is subject to the following licenses/restrictions: The database belongs to the United States-Mexico Border Health Commission, and is under confidentiality protection laws. Requests to access these datasets should be directed to US-Mexico Border Health Commission, grangel2009@gmail.com.

Author contributions

IL, LO, and AR: first draft and data analysis. CR, HD, MF, JL, RH, and MR: revision and final draft. All authors contributed to the article and approved the submitted version.

Conflict of interest

Author RH was employed by Keisen Consulting Inc.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The epidemiological follow-up process for suspected and confirmed cases of COVID-19 in migrant shelters on the northern border of Mexico from July to December 2020: Between contagion underestimation and containment

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Background: Elements associated with an increased risk factor for the contagion of COVID-19 in shelters include the turnover and overcrowding of people, time spent in communal areas, daily supply needs, water availability, and sanitation levels. The "Report on the Effects of the COVID-19 Pandemic on Migrants and Refugees," shows that factors such as the shortage of food, supplies, water, sanitizing materials, spaces for healthy distancing, financial resources for rent and essential services, and the lack of medical or psychological care complicated providing care for migrants and applicants seeking international protection.

Objective: We describe shelter operations regarding the detection and follow-up of suspected and confirmed COVID-19 cases showing mild symptoms among the migrant population housed in the border cities under study.

Methods: We conducted semi-structured, in-depth interviews with study subjects (people in charge, managers, coordinators, shelter directors) from 22 migrant shelters, and 30 with key informants. We studied the cities of Tijuana (Baja California), Nogales (Sonora), Ciudad Juárez (Chihuahua), Piedras Negras (Coahuila), and Heroica Matamoros (Tamaulipas). The research was based on a qualitative methodological design with an ethnographic approach. The information collected was transcribed and systematized into two tables or analytical templates, one for interviews with study subjects, and another for interviews with key actors.

Findings: Overall, seventy-eight registered shelters provided accommodation services for migrants in the five cities the study focused on: thirty-seven in Tijuana, five in Nogales, twenty-two in Ciudad Juárez, eight in Piedras Negras, and five plus a camp (six in total) in Matamoros. The major concentration of shelters was in Tijuana (47.4%) and Ciudad Juárez (28.2%). At the beginning of the pandemic, only a few shelter facilities met quarantine and isolation guidelines, such as having separate bathrooms and sufficient space to isolate the "asymptomatic" and "confirmed" from close "contacts". The lack of isolation space and the inability to support the monitoring of patients with COVID-19 posed a challenge for those housed in shelters, forcing many shelters to close or continue operating behind closed doors to avoid becoming a source of infection during the pandemic.

Discussion and outlook: Contrary to speculation, during the onset of the pandemic northern border migrant shelters did not become sources of COVID-19 infection. According to the data analyzed from 78 shelters only seven had confirmed cases, and the classification of "outbreak" was applied only in two facilities. Contagion control or containment was successful as the result of following a preventive containment logic, including the isolation of all suspected but unconfirmed cases, without a clear understanding of the human and financial resources required to maintain isolation areas. However, shelters in the study implemented protocols for epidemiological surveillance, control, and prevention with elements that interfered with monitoring spaces, and processes that caused oversights that resulted in underestimating the number of cases.

Limitations: Due to travel restrictions imposed to prevent and contain coronavirus infections it was impossible to stay on-site in the cities studied, except for Tijuana, or carry-out recordings of migrants' views in shelters.

1. Background

On 14 April 2020, the World Health Organization (1) declared that the main purpose of the national and sub-national health systems of every country in the world should be to detect and isolate all suspected cases, trace each contact, and quarantine them to slow down and stop the transmission chains of SARS-CoV-2. Health systems were instructed to conduct robust diagnostic tests and provide adequate and timely care to patients with COVID-19. These objectives were immediately reflected in the standardized guidelines for the detection and epidemiological follow-up of suspected cases of COVID-19 issued by health systems in keeping with the criteria of prevention, control, and epidemiological surveillance.

We analyze how these procedures for epidemiological monitoring and control were followed in contexts of intense population mobility where detection, tracking, isolation, and follow-up faced multiple structural challenges.

The northern border of Mexico is a region with Mexicans and foreigners with various mobility conditions. Recent immigration policies in the United States and Mexico (i.e., border securitization, expedited deportation and expulsion policies, asylum/refugee restrictions), have transformed this region into a transit region, the last great containment filter for national, international, and extra-continental migratory corridors into the United States, and as a waiting territory (2, 3).

This situation was exacerbated in the context of the SARS-CoV-2 pandemic by the establishment of health policies such as Section 265 of U.S. Code Title 42, authorizing U.S. border authorities to expeditiously expel undocumented migrants wishing to enter the United States by land to their last country of transit, rather than their country of origin, even if they had expressed a desire to request asylum (4). In addition,

on 21 March 2020, Mexico and the United States agreed to close their shared border to "non-essential" trips, including those involving requests for international protection. All this led to a backlog of cases of people intending to request asylum and asylum seekers in the U.S. under MPP (Migrant Protection Protocols), forced by the Program to wait in Mexican cities on the northern border for their expected U.S. court hearings. By the end of March 2020, more than 52,000 people enrolled in this program, mostly Hondurans, Guatemalans, Cubans, Salvadorans, Venezuelans, and Ecuadorians, were returned to border cities. Also in March 2020, the deportation policy resulted in 19,681 Mexican migrants being forced to return to cities on the northern Mexican border (5).

These expulsion policies produced a humanitarian crisis in Mexican border cities, characterized by high levels of public insecurity and violence (6), by increasing the number of people on the move needing basic assistance.

One of the pillars of the humanitarian system in the region is a network of ∼90 shelter and house facilities (7) scattered throughout the main border cities that meet the demand for accommodation services for refugees and migrants.

Before the pandemic, these shelters, heterogeneous in terms of the institutions responsible for them and their orientation, model, degree of care provided, and trajectory also faced complex problems. These included the overpopulation of these spaces, the availability of tangible and intangible resources for their operation, resources often dependent on cross-border solidarity (particularly in the case of shelters run by secular or religious non-governmental institutions, which were the majority), and the fact that these spaces were designed as temporary shelters but had to serve migrants needing long stays and a rotating population such as deportees (8).

On 30 March 2020, Mexico declared a health emergency due to the coronavirus, immediately followed by imposing "stay-at-home" orders that turned temporary migrant shelters into spaces for shelter, voluntary isolation, and quarantine of people on the move along the northern border without a place to "stay home."

Elements that increase the risk factors for contagion by COVID-19 in shelters include the turnover and overcrowding of people, gathering in communal areas, the need for daily supplies, water service availability, and sanitation. In addition, since April 2020, states on the northern border, mainly Baja California and Chihuahua, having the main border cities, stand out nationwide by their high rates of contagion and deaths from COVID-19. During the 1st weeks of the health emergency, migrant shelters in this region were associated as possible sources of infection, outbreaks, and contexts where prevention, control, and surveillance of the epidemic had become unmanageable. Was this association verified in the early months of the pandemic?

At the end of March and beginning of April 2020, the first response to reduce the spread of infections in these shelters was to "decongest" shelters and go into lockdown, in other words, to close their doors to new migrants, volunteers, and organizations. Some cities set up sanitary filter shelters. On 11 May 2020, the Ministry of Health (SESA) published the *Operating Plan for the Care of the Migrant Population during COVID-19*, in an environment of public health policies focused on coping with the pandemic, at least from January to September 2020 failed to consider the needs of this population (9).

This Plan prioritized the role of the SESA and the Health Jurisdictions, centralized coordination of "comprehensive care" including medical care (pre-hospital, primary, and secondary care); mental health; epidemiological surveillance and laboratories; health promotion; reproductive health and protection) for migrants in conjunction with various agencies in the health sector, the INM (National Migration Institute), NGOs (Non-Governmental Organizations)/ACs (Civil Associations), and local governments, including migrant houses and shelters. Given the common problems faced by migrant houses and shelters pose the following questions: what were the regional challenges of implementing epidemiological surveillance and control guidelines as described in the Plan? How was the follow-up of COVID-19 cases detected in these shelters conducted? Was contagion successfully contained? Using a qualitative approach, we sought to measure the incidence and spread of contagion in the empirical case of migrant shelters in this region. We answered the question above using qualitative research with an ethnographic approach that included conducting 48 semi-structured in-depth interviews with shelter staff and key informants between July and December 2020, in the cities of Tijuana (Baja California), Nogales (Sonora), Ciudad Juárez (Chihuahua), Piedras Negras (Coahuila), and Heroica Matamoros (Tamaulipas).

The main finding is that the shelters did not become sources of contagion, we found only seven out of 78 shelters had confirmed COVID cases, detected through PCR, and only two registered outbreaks. Nonetheless, certain factors may have influenced the epidemiological surveillance process and resulted in underestimating positive COVID-19 cases at these locations.

2. Materials and methods

This article presents some of the findings of a research project titled "United States-Mexico Border Health Conditions" financed by the US-Mexico Border Health Commission and El Colegio de la Frontera Norte in Tijuana. The overall objective was to analyze the response to the spread of COVID-19 virus infections from a public health perspective among migrant shelters in cities on the northern border of Mexico. The research was based on a qualitative methodological design using an ethnographic approach. Data collection took place between July and December 2020.

2.1. Study areas

The cities on the Mexican northern border chosen to be included in the research met the following qualitative criteria.

- A border city from each Mexican state that has a border with the United States, ∼ 3,000 km long, in order to record the particularities of the states' socio-political context. Efforts were made to select the most populous city and the main border crossing point for each state.
- Cities that are immersed in the main mass migratory flows of people tend to use migrant shelters. Includes cities that serve as a port of return for deported migrants and/or asylum seekers in the United States under the MPP (Migrant Protection Protocols), and/or with the largest number of people on the waiting lists for requesting asylum in the U.S., and/or most involved in the transit of undocumented migrants seeking to cross the U.S. border.
- Key cities that bear a presence of a shelter network that provides accommodation services for migrants. We prioritized cities where the network is comprised of shelters with different trajectories (established, recent, emerging) under the aegis of institutions (secular and religious civil society organizations, governments, and international organizations), to record the heterogeneity characterized in the shelter landscape and its patterns along Mexico's northern border. We included major cities having health filter shelters set up for epidemiological surveillance and prevention during the pandemic.

The eligibility criteria resulted in the following cities being included in this study: Tijuana (Baja California), Nogales (Sonora), Ciudad Juárez (Chihuahua), Piedras Negras (Coahuila), and Heroica Matamoros (Tamaulipas).

2.2. Study subjects and key informants

The study subjects in this research took refuge in shelters, asylums, foster homes, and, in general, institutions with or without a civil society charter that granted humanitarian support by providing accommodations to a population fully or partly composed of migrants with varying profiles along the five cities on Mexico's northern border.

The key informants were institutional actors who, within the framework of the pandemic, intervened in migrant shelters, provided health care in these spaces, and/or participated in the development of strategies to mitigate infection and follow-up on suspected or confirmed COVID-19 cases detected in shelters.

Key informants also included parties holding a holistic view of the study focus who were able to describe the practices, patterns, needs, challenges, facilities, and resources related to the response of shelters to the pandemic. Key informants were mainly identified during the research process, through the narratives and networks of the study subjects consulted.

Migrants housed in the northern border shelters were not interviewed for two main reasons. First, the impossibility of physically going to these spaces complicated contact with this population. Second, when the field data collection phase was conducted between July and December 2020, a time when migrants in shelters saw their migratory and life projects negatively affected by the adoption of public health policies designed to stop the spread of contagion in Mexico and the United States.

2.3. The study population

As a first step, a list was drawn up with the contacts of active shelters for migrants in the cities under study. These shelters were mapped based on previous academic research that had identified these spaces in the region; the websites and/or social networks of migrant shelters in the cities under study; the lists of institutions that provide humanitarian assistance along the migratory routes drawn up by organizations that support populations on the move. The list was also enhanced by information gathered through interviews with study subjects and key actors.

2.4. Research instruments

The research instrument was a semi-structured, in-depth interview conducted in 40 cases by telephone, in five cases through virtual platforms, and in three cases with face-to-face interviews. Out of a total of 48 interviews, 19 were conducted with study subjects (people in charge, managers, coordinators, shelter directors) from 22 migrant shelters, and 30 with key informants. A brief questionnaire was also administered in 74 of the 78 shelters to survey each institution's profile and ensure that it was operational during the time of the research.

Shelter classification was based on the methodology by Albicker and Velazco (10) which categorizes shelters as "pioneering," "consolidated" and "recent" to describe the range of shelters in Tijuana, which coincided with the influx of Haitian migrants in 2016−2017, recording an increase in shelters in the other cities under study. The founding year is when the shelter began to receive migrants. In all the cities in the study, "pioneering" migrant shelters refer to those having over 20 years of experience and were established in 2000 or earlier. "Consolidated" shelters refer to those that were created between 2001 and 2015 and continue in operation. "Recent" shelters refer to those established from 2016 to the present that were set up to meet recent extraordinary migrant flows mainly from those seeking asylum to the United States which varies by

TABLE 1 Pioneering, consolidated, and recent shelters in the cities under study July–December 2020.

City	Pioneering	Consolidated	Recent	Total	%
Piedras Negras	3	4	1	8	10.2
Nogales	1	2	2	5	6.4
Matamoros	3	0	3	6	7.7
Ciudad Juárez	5	4	13	22	28.2
Tijuana	11	12	14	37	47.4
Total	23	22	33	78	100
%	29.5	28.2	42.3	100	

Source: Compiled by the authors based on the information collected and according to the proposal put forward by Albicker and Velasco (10).

city. For example, in Tijuana, the influx of Haitians in 2016-2017 drove the creation of recent shelters, whereas, in Piedras Negras, it was following the arrival of the migrant caravan in February 2019. Similarly in Ciudad Juárez, a "wave" of Cuban and Central American migrants in late 2018 and early 2019 prompted the creation of recent shelters. In Matamoros and Nogales, the implementation of the MPP at the beginning of 2019 triggered an increase in entrapped migrants in need of long-term accommodation which led to the establishment of new shelters, in these two cities, "recent" shelters are those established in 2019 to the present.

The interview guide for study subjects was divided into thematic axes with 57 guiding questions, broken down as follows: the interviewee profile, shelter profile, migratory context where the shelter operates, participation in institutional networks, and efforts to coordinate health care in the shelter and respond to the pandemic. Other axes included the shelter's first response to the pandemic, prevention measures, epidemiological control, surveillance undertaken, monitoring of suspected cases, confirmed cases, contacts detected, outlook, and intervention proposals.

The interview guide for key actors included thirty-five guiding questions divided into the following thematic axes: interviewee profile, institution profile, the migratory context where the institution operates, information on the reaction of migrant shelters to the pandemic, interventions by the institution to support shelters in the context of the pandemic, inter-institutional coordination, and outreach for the health care of the migrant population during COVID-19, prospects and intervention proposals.

2.5. Systematization and analysis

The information gathered was transcribed and systematized into two tables or analytical templates, one for interviews with study subjects and another for interviews with key actors. The information obtained was organized in the tables into several homologous analytical categories. The findings presented in this

document are mainly drawn from an analysis of the categories of "epidemiological monitoring of suspected COVID-19 cases detected in shelters" and "epidemiological surveillance and prevention in shelters." These categories, contained in both templates, were used to analyze the material gathered through the other instruments.

3. Findings

3.1. Shelters on the northern border of Mexico during the lead-up to the pandemic: Heterogeneity and common problems

The following findings emerged:

- Increase in emergency shelters to meet the demand for accommodation of the recent large, extraordinary flows, especially of people seeking international protection, refer to Table 1.
- Heterogeneity of institutions in charge, many types of institutions, and heterogeneity within the same type (international organizations, governments, secular non-governmental institutions, both Protestant (Baptist, Methodist, and Pentecostal) and Catholic (Jesuit, Salesian, and Scalabrinian).
- Different models and degrees of care. Some shelters offered basic care (accommodation, toilets, food, and clothing/shoes), and other shelters offered expansive services (such as accommodation, food, clothing, medical care, education, legal advice, and employment services). These shelters provided comprehensive care to integrate the migrant population into the city (such as Tijuana and Ciudad Juárez's integration centers and certain Migrant Houses).
- Assorted sizes and maximum capacities: small (family) shelters with fewer than 50 people, such as El Puente in Tijuana, and massive shelters for nearly 500 people such

as San Juan Bosco in Nogales, or 1,000 or more such as Pan de Vida in Ciudad Juárez and those repurposed by the government on the premises of former maquiladoras.

- Shelters' adaptation to new user profiles due to the increase of displaced unaccompanied Children and Adolescents (CA), single women and women with children, and families with CA.
- The pandemic reinforced the tendency to eliminate the maximum length of stay in the regulations and the maximum time was adapted to the migratory process for each person for whom accommodation was provided.
- Implementation of confinement policy in shelters that became a "co-responsible domestic shelter" space for people on the move, that is, those without a fixed address in the northern Mexican border region.
- Heavy dependence on shelters run by non-governmental institutions offering cross-border solidarity.
- Epidemiological filter shelters were set up as a result of the pandemic. In both the city of Tijuana and Ciudad Juárez, the International Organization for Migration (IOM) Filter Hotel was adopted. In Ciudad Juárez, two filter spaces operated by a religious non-profit (the San Matías Shelter System and the Espíritu Santo Shelter) were adopted.

3.2. Managing the pandemic in shelters

3.2.1. COVID-19 shelter guidelines

During the early weeks of the health emergency, the epidemiological containment and prevention measures adopted in the shelters resulted from informal consultations and inquiries between responsible parties and local health authorities. As of 19–20 March 2020, federal level and Health Jurisdictions required shelters to implement quarantine measures, the refusal of entry to new migrants, volunteers, and members of organizations supporting these institutions, and the "decongestion" of spaces by relocating residents. This was the general trend in the initial response to the pandemic by shelters located on the northern border of Mexico.

In response to the pandemic, from January to September 2020, public policies and government health initiatives largely excluded the migrant population from health care (9). On 11 May the Ministry of Health published the *Operating Plan for the Care of the Migrant Population during COVID-19* whose main purpose was to "establish effective coordination and liaison for comprehensive health care for the migrant population during COVID-19" (11), particularly in the northern and southern border regions of the country where the target population is concentrated.

This plan prioritized the role of SESA and the Health Jurisdictions, which were charged with coordinating "comprehensive care" for this population, which would be guaranteed in conjunction with the various agencies in the health sector, the INM, NGOs, and state and municipal governments. Migrant houses and shelters, together with points of entry into Mexico and health sector units, were included in the areas of action of the Plan.

Health jurisdiction brigades identified migrant shelters and visited them to establish links, register their population, provide epidemiological guidance, and disseminate information on COVID-19 (through posters and brochures) and the detection of symptoms. They offered guidelines on how to clean up shelters and adopt prevention measures (suggesting ways to adapt the infrastructure to implement physical distancing measures) and provided supplies for prevention and personal protection.

When a case with symptoms related to SARS-CoV-2 virus infection was detected in a shelter in the cities under study, the protocol described in the plan called to immediately notify the city's health jurisdictions for each individual case. The jurisdictions would be responsible for implementing actions and mechanisms to verify the event, surveillance, and laboratory, and ensure the care and follow-up of suspected and confirmed cases and contacts based on their surveillance, control, and epidemiological prevention criteria.

However, the standardized protocol proposed by SESA merely "provided guidelines" for actions and decisions for shelter administrators and personnel in the Health Jurisdictions. In reality, the assigning of the follow-up process by the actors involved led to different, circumstantial, specific care routes, and follow-up practices for each suspected case detected in the shelters in each city.

The factors discussed above led to high uncertainty and improvisation around actions implemented with each circumstance. This was exacerbated during the 1st months of the pandemic when the official guidelines were barely disseminated, which in turn affected compliance with control criteria and epidemiological surveillance.

3.2.2. Early detection and assessment of cases at shelters

The preventive actions recommended by the *Operating Plan for the Care of the Migrant Population* (11) for migrant shelters included a health supervision filter involving the implementation "in all cases" of triage, and a questionnaire to detect signs and symptoms. Respiratory triage was presented as an instrument designed to detect suspected COVID-19 cases and determine the urgency of care.

Furthermore, "triage" means that the institutions implemented the questionnaire and administration model provided by the Ministry of Health systematically and/or for each new admission and were limited to the following:

—Shelters with specialized medical staff responsible for primary care, such as Migrant Houses and the IOM Filter-Hotels.

—Government shelters where permanent medical care was dispensed by the health sector, such as the Integration Centers for Migrants where IMSS, ISSSTE, and SESA doctors provide service.

—Shelters where the Jurisdiction emphasized the training and hiring of health promoters trained to detect symptoms and implement the immediate follow-up phase, as in the case of the Espiritu Santo and San Matías filter shelters in Ciudad Juárez.

Very few of the shelters interviewed were aware of, or administered this instrument. However, they all set up a sanitary filter at the entrance including a registration questionnaire, supplying antibacterial gel, and in some cases, taking temperature and blood oxygen measurements.

However, the fact that the "triage" stipulated by the Health Ministry was not administered or known in the shelters did not stop them from developing instruments and mechanisms for detection and epidemiological control during the pandemic. For example, in the written or oral registration questionnaire where several shelters recorded general information on the migrant and their migratory trajectory at the time of admission, some institutions increased the number of questions regarding their health status. These included questions on chronic degenerative pathologies, living with positive or suspected COVID-19 people, and the presence of the main symptoms of COVID-19.

Shelters that notified authorities of cases reported that the assessment of the event by the Jurisdiction had taken place in an isolated space in the shelter, or another designated area (such as the Fever Clinics in Tijuana or the Centinela Anticipa Unit Clinics in Nogales), and included the administration of a combination of instruments, including the "respiratory triage," and the search for cases with fever. If a person fits the operational definition of a suspected case, an epidemiological study of a suspected case of viral respiratory disease was conducted, and contact tracing began. In addition, assessment could include the collection of a sample for the administration of a rapid test and/or the collection of a sample for a PCR laboratory test. Appropriate isolation measures were subsequently determined. In all the cities under study, the health authorities' evaluation policy regarding a case with symptoms at a migrant shelter only focused on the administration of a diagnostic test in limited cases.

The PCR, the prerogative of the Jurisdictions, tended to be administered to just a small fraction of suspected cases with obvious respiratory symptoms. This may have led to the underreporting of infections at migrant shelters in the official statistics of the Jurisdictions, which are based on positive PCR results.

3.2.3. The isolation of migrants with "suspected" and "confirmed" COVID-19 detected in shelters

One problem from the start of the pandemic and creating enormous concern among responsible parties for the shelters was the need to have an isolated or quarantine area for suspected and confirmed COVID-19 cases, those with mild symptoms, and contacts detected among the migrant population housed in these shelters.

Isolation is required from the time between the detection of a case with symptoms and the confirmation of the event by health authorities at the shelter. When a PCR test was administered, the person remained isolated until the laboratory results were received (from 2 to 4 days depending on the distance from the laboratory). Once the laboratory confirmed a person had tested positive or had been in contact with someone who had (confirmed by epidemiological association), isolation was extended for 2 weeks. This measure was applied to all suspected cases, even when they had not been given a rapid test or laboratory diagnosis.

At the beginning of the pandemic, very few shelters in the study had a designated isolation area meeting necessary requirements such as having separate bathrooms and sufficient space to ensure that "asymptomatic" and "confirmed" cases would not be lumped together with "contacts" (11).

Having a space for isolation depended on a combination of factors such as the availability of space, and the human and financial resources to ensure isolation and provide medical/clinical follow-up to those who needed it, in addition to the resources for the total daily support of the person in quarantine for at least 2 weeks.

The lack of this space, coupled with the impossibility of supporting the process of monitoring COVID-19 cases, forced many shelters to make the decision to close or continue operating behind closed doors to minimize the possibility of becoming a source of infection during the pandemic.

To continue operating and accepting new migrants, some shelters, such as the Casa del Deportado de Tijuana and La Roca de Nogales shelter turned one of their dormitories into an isolation space that could be used in an emergency.

Shelters equipped with a space for the isolation of suspected and confirmed asymptomatic cases, or those with mild symptoms—which do not require secondary care (confirmed cases with severe symptoms are referred to the isolation units of General Hospitals or other COVID-19 units set up in each city) —were characterized by the following:

—Certain Migrant Shelters had areas for isolation with a large backyards.

—Shelters supported by international organizations and/or the government have an isolation area for all suspected cases: "it is a small space. Only the doctors who are there go there all the time with all the necessary equipment and take in food, and from

the time they are suspected cases to the time when they take the test, they are not allowed to leave" (telephone interview with a shelter's responsible party, 25 September 2020).

—Other shelters with large areas were set up.

Most organizations found it impossible to deal with this problem autonomously and immediately. In the 1st weeks of the health contingency, the OIM activated the Program to Strengthen Shelters (The Shelter Program was valid for 22 months ending in April 2021) ([12]) to meet the need, lending canopies to the shelters that required them to isolate people with symptoms during the evaluation phase or confirmed cases indefinitely.

Although some shelters did not fully resolve the need for confinement and containment of contagion given events of a severe outbreak in the establishment, as was mentioned by some of the responsible parties we consulted, the IOM canopies managed to allay widespread fear and uncertainty about how to proceed, providing a solution for the initial isolation of confirmed and suspected cases detected in shelters.

In Tijuana and Ciudad Juárez, the creation of filter shelters such as the IOM Filter-Hotels or the San Matías and the Espiritu Santo prevented an outbreak of COVID-19 cases in the shelter network. Moreover, in each city under study, care referral routes were established for each case with symptoms detected in the shelters, which included their immediate transfer to other establishments equipped with specific isolation spaces, in some cases from the time of the assessment phase. In each city, these spaces consisted of several types of shelters not necessarily exclusively intended for the migrant population, or the shelter population, such as Voluntary Isolation Centers (CAV), mobile clinics, COVID-19 Units at General Hospitals, and COVID-19 Centers set up by the Ministry of Health, often in collaboration with other actors such as Doctors Without Borders and the private sector.

Exercising epidemiological control through isolation posed a challenge for most shelters, which generally had limited, unreliable support, due to the demand for efforts and resources required for monitoring, even if they had a suitable space for doing so. But it was also a challenge for those housed at the shelter.

For migrants, isolation meant separation from friends and family, with the displacement of the entire family nuclei. It meant being away from places with a flow of vital information. As noted by a doctor from the Ciudad Juárez jurisdiction: "often if people at the shelters […] have an appointment with the MPP, they do not want to be isolated, because what if they call them about the MPP when they are in isolation?"

In addition, the need for quarantine and isolation created pressure on the shelters that housed migrants, especially in the areas controlled by the government or with a larger population, such as the Ciudad Juárez Migratory Integration Center and the Matamoros Camp, which housed ∼2,500 migrants at the start of the pandemic, most of them families seeking asylum in the

United States. In some cases, the pressure led to protests, sit-ins, riots, plots, and uprisings, as noted by key respondents.

In Nogales, eleven migrants were isolated in an area of the DIF (National System for Integral Family Development) Municipality that had resulted from a contagion outbreak in a shelter that continued to operate as one of the few accommodation options available to migrants in the city. The key actors interviewed reported difficulty in maintaining and sustaining isolation for 2 weeks due to the lack of government budget funds specifically designated to serve this population. The cost of a portion of the supplies was partly covered by the personal salaries of municipal officials and support from a local civil society organization "Panchito y Su Cristina," supported by the American NGO, Voices from the Border. In addition, it was not possible to have personnel permanently monitor the area or confinement of migrants nor to separate lab-confirmed cases and their contacts. Nonetheless, in all of the cities, the isolation measure was applied to all suspected cases that were detected at the shelters, even when they had not been administered a rapid test or had a laboratory diagnosis.

During the early months of the pandemic, the implementation of the protocol for epidemiological monitoring of migrants with suspected and confirmed COVID-19 acquired a connotation of uncertainty and improvisation that negatively influenced the way the criteria for surveillance, prevention, and control of the epidemic were implemented.

3.3. Contagion at the shelters in numbers: Underestimation in official statistics

3.3.1. Tracking the tests administered

We found heterogeneity in the data figures from the actor interviews in shelters in the cities under study used to estimate the degree of infection. The issue of epidemiological surveillance of the virus among the shelter population was also complicated by the lack of a reliable official record.

The health authorities' event evaluation policy applied in the cities under study included the administration of a PCR (Polymerase Chain Reaction) test for a few cases in migrants showing obvious or severe respiratory symptoms. According to estimates by the Health Jurisdictions, by December 2020, PCR tests confirmed 40 cases recorded at the shelters, an estimate matching the figures shared by the jurisdictions' staff. The estimate above excludes the city of Tijuana because their jurisdiction did not share its figures. The Directorate of Care for Migrants for the Municipality of Tijuana reported two cases were confirmed by PCR tests in the shelters.

In addition, during the 1st months of the pandemic shelters had limited access to rapid tests and there were no official records of rapid tests administered in migrant shelters in the cities studied. Thus, tracing the route of PCR tests or rapid tests

that were applied did not yield a reliable record of infections in the shelters and both routes seemed to lead to an underestimate of infections.

In regards to the scope of the contagion in Tijuana and Matamoros, there was not a marked difference in the figures provided by the actors responsible for receiving migrants. In Piedras Negras, no cases were registered in these spaces by any actor interviewed since the shelters stopped working under the city council's order. In Ciudad Juárez, where the state tends to centralize the coordination of the humanitarian sector and strengthen the link between shelters and the Health Jurisdiction, figures provided by the actors interviewed tended to be similar to official figures.

The Health Jurisdiction estimates considered cases that had tested positive with the PCR test. The numbers declared by other actors came from information based on rapid tests administered directly or indirectly by them and could include cases that tested positive with the rapid test, and/or isolated cases, and/or cases identified as positive as a result of an observation of symptoms assessment.

The difficulty of having reliable information on the spread of infection in shelters could also be due to political factors, and the inaccurate, non-transparent handling of data between different actors, levels, and areas of government.

Reflecting on the following account by a doctor from the Health Jurisdiction (face-to-face interview on 26 October 2020), one can assume that in Tijuana, transferring migrants with suspected COVID-19 between various COVID-19 care centers may also have complicated the estimates:

"There were positive cases, but there were no serious cases we had to hospitalize. They were just patients we had to transfer at the time we had to refer them to the General Hospital. Once they had recovered at Zonkeys (Zonkeys basketball stadium, in Tijuana, where an auxiliary hospital was set up to care for patients with COVID-19) Hospital or the COVID-19 Shelter, they were usually transferred from the General Hospital to Zonkeys and from Zonkeys to the COVID-19 shelters; there was only one case of hospitalization." Thus, contrary to speculation during the first weeks of the pandemic, migrant shelters on the northern border did not become sources of COVID-19 infection, since from the seventy-eight shelters analyzed, only seven had confirmed cases, and only two received the classification of "outbreaks".

Infections were recorded tendentially at the shelters housing most migrants, (such as the San Juan Bosco de Nogales or Campamento de Matamoros) where monitoring was undertaken by staff doctors or specialized medical personnel from the government health sector (such as the CIM in Ciudad Juárez and the Filter Hotels—OIM). Based on the interviews, the people who were isolated came from groups of returnees from the United States and asylum seekers under the MPP. Only two cases of isolated migrants in the cities studied were referred to General Hospitals due to major complications, and

both successfully recovered. In most cases where migrants had been isolated were eventually reincorporated into the community and their shelter after a fortnight, when they did not present symptoms after testing negative, but they did not always administer a confirmatory PCR test.

3.3.2. Circumstantiality of care routes and the threat of quarantine for shelters

Another factor that may have contributed to the underestimation of the official data on people infected by COVID-19 in shelters is due to certain institutions using a different protocol, follow-up, or care route than that established in the guidelines for suspected cases.

Key informants reported that shelters with internal medical personnel and isolation spaces preferred to treat and manage cases with mild symptoms discreetly, isolating them in their facilities without sharing information with health authorities. At the same time, Civil Society Organizations that provided health care in the shelters declared that they were the first and only contact in the event of suspected cases at certain institutions and preferred not to interact with health authorities. The director at one of these organizations commented: " I know the Jurisdiction is trying to do its job, but the simple fact that they wear a uniform prevents them from having access to the shelters [...] the population doesn't trust them [...] and neither do the shelters, especially those that are illegal or clandestine, and are reluctant to let them in."

Fear of the imposition of quarantine or other repercussions may have also discouraged institutions from accessing and notifying suspected cases of the Health Jurisdiction. Notification of a suspected case among migrants or workers and volunteers could imply a quarantine for the entire institution, with the obligation to assume responsibility for the entire sheltered population, which posed an enormous challenge for shelters whose survival depended on a combination of limited and uncertain resources.

3.3.3. The implications of isolation for migrants

A final factor that may have led to the underestimation of infections in the shelters is linked to a trend observed among housed migrants to not disclose the onset of COVID-19 symptoms to the shelter or camp staff. Actors who provided services in the Ciudad Juárez CIM and the Matamoros camp observed this attitude and associated it with the fear of being kept in an isolation space, which would exacerbate the loss of control of their projects which were already profoundly disrupted by health and immigration policies adopted in Mexico and the United States during the pandemic.

Moreover, migrants may have been discouraged from reporting symptoms given a perceived lack of clarity and transparency in protocol compliance. The sensitive nature of the

protocol for monitoring suspected cases and its implementation created uncertainty about what lay in store for migrants in the event they became a "suspected COVID-19 case."

4. Conclusion and discussion

In the past 5 years, cities on the Mexican northern border have received extraordinary flows of foreign and Mexican migrants in transit to and from the United States, with even more complex and diversified profiles and needs including people from various countries (Honduras, El Salvador, Guatemala, and Haiti), an increase in the presence of children and adolescents, women traveling alone with their children, and more families displaced by violence within Mexico. At the same time, the implementation of security, immigration, and health policies by the U.S. and Mexico transformed this border into the last filter to contain these flows (2, 13–20).

This situation called on the humanitarian system that is active on the northern border of Mexico to provide care for this population on the move, stuck on the move, or in a condition of "forced mobility," as it has been classified by several analysts (7, 16).

One of the pillars of this humanitarian system is the range of options offering accommodation to migrants who are highly susceptible to the recent sudden, drastic changes in the migratory dynamics of this border region and fluctuations in the demand for housing (21, 22).

Recently, the array of shelters in this region assumed the appearance of a heterogeneous, fragmented body in terms of the type of structures, responsible institutions, and operating models. At the same time, they shared problems that, during the first few months of the pandemic, challenged the control and containment of contagion in these spaces, as well as the application of epidemiological surveillance protocols and case monitoring.

We attempted to measure the incidence and spread of contagion using a qualitative approach in five cities on the northern Mexican border. We also analyzed the phases of the epidemiological monitoring process for suspected COVID-19 cases detected in these spaces which are, detection, assessment of the event, and isolation. In each phase, we highlighted the factors (social, economic, cultural, and political) that influenced the appropriation of epidemiological surveillance protocols in these spaces. We found that the difficulty of having reliable information on the spread of infection in shelters could also be due to political factors and the inaccurate, non-transparent handling of data between different actors, levels, and areas of government.

Contrary to speculation, during the early weeks of the pandemic migrant shelters in the northern border did not become sources of COVID-19 infection, given that in a total of seventy-eight shelters in the five cities studied, only seven showed confirmed cases, and two shelters received the classification of "outbreaks." Thus, contagion control or containment was successful.

A total of 81% of the 42 cases confirmed through PCR tests given by health authorities were concentrated in Ciudad Juárez. From this figure, 52% were detected in the Integration Centers for Migrants and 33% in the OIM Filter Hotels. These shelters continued to operate and accept new migrants but also had permanent staff and professional medical health care which became a tool to detect infection.

In addition, the implementation of strategies for control and containment materialized such as non-profit shelters operating behind closed doors and accepting new admissions, the implementation of epidemiological filter shelters by religious non-profits and international organizations in Tijuana and Ciudad Juarez, and the adoption of a preventive isolation policy. A preventive containment logic was detected which included the isolation of all suspected, even unconfirmed, cases of COVID-19 among migrants. At the same time, a lack of transparency and clear agreements was observed regarding the human and financial resources required to maintain isolation spaces, which were often improvised (as in the case of Nogales and the Matamoros Camp).

However, the manner in which study contexts appropriated epidemiological surveillance and control protocols incorporated elements that hampered surveillance in these spaces and led to an underestimation of the phenomenon. A comparison of the information provided by the health authorities with that of the shelters and key local non-governmental actors with more contact with the field revealed higher underestimation rates in the cities of Tijuana, Nogales, and Matamoros. The factors that contributed to this underestimation were:

- Circumstantiality of protocols in each city under study during this initial stage of the pandemic. There was a lack of clarity about assistance routes, what happened to the migrant when they became a suspected case, and what happened to the shelter when a suspected case was detected.
- Migrants' and shelters' fear of quarantine and isolation.
- The incipient relationship between the health sector and shelters materialized in the shelters' fear of being sanctioned or "controlled" by health authorities.
- Limited availability of human resources and medical-health personnel in shelters, exacerbated by safe distance and shelter-in-place policies during the pandemic.
- Limited availability and administration of PCR tests when Jurisdictions exceeded their intervention capacity.

The factors mentioned above along with their association with social, political, economic, and administrative spheres reveal the criticality that emerged from observing the planned standardized surveillance protocols in this heterogeneous overview of shelters. During the early

months of the pandemic, shelters in the cities studied managed to contain the contagion while serving as spaces to shelter in place, quarantine, and offer access to some form of medical care in the event of contagion given an institutional environment that was closed to the population on the move. However, this study did not record the opinions of migrants at the shelters and it remains a pending task.

Limitations

The travel restrictions imposed by coronavirus infection prevention and containment measures made it impossible to engage in an on-site stay in the cities in the study, with the exception of Tijuana. As a result of these limitations, this study was an ethnography "at a physical distance" that drew information from telephone interviews, virtual platform interviews with study subjects and key informants, and from a critical hemerographic review of local newspaper articles on the subject. We also accessed documents published by academia, and local and international non-governmental organizations focusing on the issue of care at migrant shelters for the population on the move along Mexico's northern border during the health contingency. Finally, we also reviewed official documents and communication that established care guidelines for these spaces during the pandemic.

Data availability statement

The datasets generated for this study are available on reasonable request to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the Ethics Committee of the United States-Mexico

Border Health Commission. Subjects provided their informed consent to participate in this study.

Author contributions

MR and RC-P: article proposal and review. VC: fieldwork and first and final draft document preparation. AL: document review and editing for Frontiers. MR, RC-P, and AL: final draft preparation. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Mental, neurological and substance use disorders among the Latino migrant population in the United States who visited the Health Windows and Mobile Health Units in 2021

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Background: Mental health is defined by the World Health Organization as a state of wellbeing in which people are aware of their own abilities to cope with the normal stresses of life, work productively and fruitfully, and contribute to their community. Among the minority groups that may be vulnerable to experiencing greater risks for their physical and mental health and full development is the migrant population. The mobile population's migration experience, from their place of origin to destination translates into psychosocial problems and clearly stressful conditions which could be resolved using certain coping strategies. Accordingly, numerous epidemiological studies have found differences in the prevalence of mental health problems between migrants and native-born residents of destination countries, as well as between migrants and their non-migrant co-nationals.

Purpose: To describe sociodemographic characteristics of the Latino migrant population in the United States who visited the Health Windows (HW) and Mobile Health Units (MHU) in 2021, who may have been at risk for mental, neurological or substance use disorders and agreed to a screening for signs and symptoms of mental health conditions.

Method: Users of the HW and MHU were offered preventive health services and completed a mental health screening. These variables were registered in SICRESAL. If their results showed signs and symptoms of mental health conditions, they were screened by credentialed professionals from the Psychology Faculty of the National Autonomous University of Mexico. Screened individuals received a diagnosis and specialized care remotely and/or online with the MHU and HW network partners. To analyze sociodemographic variables corresponding to neurological or substance induced mental illness among the Latino migrant population in the United States who visited the Ventanillas de Salud (VDS)/Health Windows (HW), and Unidades Móviles de Salud (UMS)/Mobile Health Units (MHU), during 2021; contingency tables were created showing percentages and chi square with a significant $p < 0.05$.

Findings: During 2021 HW and MHU completed a total of 794 mental health screenings of which 84% were completed at HW. Further, 59% were women with an average age of 43, ranging from 7 to 86 years of age. Twenty percent 20% of the population who voluntarily agreed to screening yielded a positive result for some type

of mental health symptom or problem. This percentage (37%) was greater among those who consulted MHU. With respect to age, results showed that youth were at greatest risk for mental health problems. Among the screened population, the independent variables, type of Health Window attended, gender, age group, and place of origin are related to the existence of some type of mental health symptom or problem yielding a significance level of <0.05 for depression and anxiety symptoms.

Discussion and prospects: In this study, as in others, the migrant population that visited the HW and UMS in 2021 reported a greater risk of mental health problems, with symptoms related to depression and anxiety among the socio-demographic variables of gender, age group, and place of origin. Thus, these symptoms relate to being a female aged between 18 and 38 and originating from Mexico. Finally, the possibility of screening the migrant population for signs and symptoms of mental health conditions that attended the Health Windows or Mobile Health Units during 2021, made it possible to refer them to psychology or psychiatry services and improve the quality of life of those who accessed the services and, consequently, that of their families and communities.

Limitations: The main limitation is associated with the information source since we worked with secondary data and relied on the information provided by those who attended both the HW and the MHU.

1. Mental health: Concepts and scope

1.1. Defining mental health: World status and Mexico

Mental health is defined by the World Health Organization (1) as a state of wellbeing in which people are aware of their own abilities to cope with the normal stresses of life, work productively and fruitfully, and contribute to their community.

Causes of mental disorders include numerous factors or determinants such as individual or biological characteristics (genetic or environmental and biological) defined as the ability to manage thoughts, emotions, and interactions with others (2). They also comprise psychosocial factors, which are related to the physical and social environment. This encompasses social, cultural, economic, political, and environmental aspects such as the political context, including national policies, welfare, living standards, working conditions and community support networks (2).

According to the mhGAP intervention guide for mental, neurological and substance use disorders in non-specialized health settings: mental health Gap Action Programme (3), the main clinical manifestations of mental illness reflect an alteration of brain functions, such as attention (attention deficit disorder), memory (dementia), thinking (schizophrenia), mood (depression), sensory perception (schizophrenia), learning (child development disorders) and behavior, which interfere with the life and productivity of the individual.

As Morales (4) notes, various social phenomena such as poverty, urban violence, family violence, intense pressure in the workplace, job insecurity, low social support, addictive behaviors, family disintegration, street children, sexual exploitation, and the physical abuse of children, are considered factors that are associated with or influence the mental health of a population.

The "Report on mental health systems in Latin America and the Caribbean, 2013," published by the Pan American Health Organization (5), notes that lifetime prevalence rates of between 12.2% and 48.6% have been estimated for mental disorders worldwide. Likewise, 14% of the global disability burden (Disability-Adjusted Life Years—DALYs) is attributable to mental health conditions and the situation is even more critical in low- and middle-income countries. In these countries, between 76% and 85% of those suffering from serious mental illnesses or disorders fail to receive treatment. In high-income countries, these proportions range from 35% to 50% (5).

In Mexico, the "Report on the mental health system in Mexico, 2011," undertaken by the WHO, PAHO and the Ministry of Health (6), observes that one in four Mexicans aged between 18 and 65 has suffered a mental disorder at some point in their lives. However, only one in five received treatment.

There are minority groups such as Indigenous people, people subjected to discrimination and rights violations, migrants, the LGTBI population, prisoners, those exposed to armed conflicts or natural disasters or other humanitarian emergencies who experience social vulnerability that may place them at increased risk for MH issues. This risk is a condition experienced by people who, due to their age, gender, ethnic origin or physical limitations, experience greater threats to their health, physical and mental integrity and full development, and whose membership of certain groups makes them vulnerable (4).

Specifically, the migration experience is one such major stressor that can increase social vulnerability. The upheavals and stressful conditions associated with migration translate into psychosocial

problems throughout life (7). This is why it is intended to describe the sociodemographic profile of the Latino migrant population in the United States who visited the Health Windows (HW) and Mobile Health Units (MHU) in 2021, who may have been at risk for mental, neurological or substance use disorders and agreed to undergo screening.

1.2. Mental health and migration

The association between migration and mental health problems has been documented for many years (8, 9). Some of the earliest studies on the relationship between migration and mental health include those by Ødegaard (10), undertaken in the 1930s. This author observed that Norwegian immigrants in the United States had a higher incidence of hospital admission for schizophrenia, compared to both native-born residents of that country and non-migrant Norwegians. Bojórquez (11) notes that this and other similar findings sparked a discussion on the two possible forms of association between migration and mental health: causality or selection. According to the former position, migration is a risk or precipitating factor for the emergence of mental health problems. According to the latter, it is a self-selection phenomenon, whereby people with mental health problems are more likely to emigrate.

Authors such as Vilar and Eibenschutz (12) emphasize that perhaps migration is not a direct cause of deterioration of mental health *per se*; more so, can be attributed to relocation from their place of origin to a new place of destination, in which they experience adverse employment situation, poor housing conditions or lack of housing, the traumatic events before, during and after the migration. These factors could be considered sufficient reasons to drive individuals to psychological distress.

Further, Achotegui (13) noted that migration brings about benefits (access to new vital opportunities and horizons) paired with a group of difficulties and strains. Thus, a migrant's lack of health or disabilities could become a risk factor given a hostile environment or experiencing both conditions at their point of destination.

Several epidemiological studies have found differences in the prevalence of mental health risks between immigrants and native-born residents of destination countries, as well as between immigrants and their non-migrant co-nationals. Explanations for the higher prevalence of mental disorders among immigrants than non-immigrants include the fact that migration is a stressful life experience, in which bereavement combines with the difficulties of adapting to a new culture and, in many cases, the risk of discrimination and violence (9, 14, 15).

Mexican-born immigrants have the lowest rates of mental illness, which increase with the length of time spent in the United States and generational descent. The second generation of Mexicans in the United States have higher rates of mental disorders than those observed in the general population.

A smaller proportion, depending on their mental health history, violence experienced before, during and after their journey and personal resources, will present mental disorders (depression, anxiety, post-traumatic stress, and substance abuse disorders) and require specialized services (16).

The mental conditions most frequently reported and described are those related to experiences of psychosis and paranoid reactions

with a tendency to affective disorders, unipolar depression, anxiety, adaptation difficulties, alcohol dependence and post-traumatic stress (17).

Another important aspect with mental health is the abuse of other substances such as psychoactive substances. Some studies report that consumption increases in tandem with greater exposure to North American culture (18). These results are related to the returned population, with 28% of Mexican migrants who returned voluntarily or forcibly from the United States self-reporting lifetime illegal drug use. A third of female returning migrants between the ages of 15 and 45 have used drugs at some time, which is higher than the rate for women of the same age in Mexico.

Regarding the deported migrant population, a study undertaken by Bojórquez et al. (19) notes that the length of time after having returned to Mexico, having a spouse in the US, the number of household members, less social support, anxiety, and an avoidant coping style were directly associated with the self-report questionnaire score. Public health policies must address the need for mental health care among deported migrants (19).

In view of this situation, a collaboration strategy was developed between the Government of Mexico and the Faculty of Psychology of the National Autonomous University of Mexico, through which training, supervision and two-way monitoring are undertaken by the non-specialized health personnel who provide services to the migrant population at the Health Windows (HW) and Mobile Health Units (MHU). As a result of the collaboration protocol, it was possible to undertake promotion and early care actions for mental health among the migrant population that visited these Windows or Units.

As Rangel et al. (20) notes, the mission of HW is to improve access to primary and preventive health services, increase public health insurance coverage, link individuals to medical homes, and promote a culture of self-care among Mexicans living in the US. In addition to general health information, the HW provides (a) counseling and guidance services to prevent risks to physical and mental health; (b) screening for mental health risks; (c) referrals for those with mental health risks to primary care services; and (d) information about the eligibility for the health insurance plans of the Patient Protection and Affordable Care Act (ACA).

MHU also provide health education on priority health topics such as nutrition, obesity, diabetes, women's health, children's health, mental health, substance use, exposure to violence, HIV/AIDS, and other sexually transmitted diseases, as well as legal and financial guidance. In addition, Mobile Health Units provide preventive health screenings, referrals to clinics or community programs, follow up referrals, and administer immunizations (20).

This paper seeks to describe the sociodemographic characteristics of the Latino migrant population in the United States who visited the Health Windows (HW) and Mobile Health Units (MHU) in 2021, who may have been at risk for mental, neurological or substance use disorders. The database of the Continuous Information System for Health Reporting (SICRESAL), developed and maintained by the Mexico Section of The United States-Mexico Border Health Commission, was used as the information source. Data collected from the HW and MHU, based on the basic sociodemographic characteristics, signs and symptoms of mental health diseases yielded by the screening of the population served, was reviewed and analyzed.

2. Methodology

2.1. Design

The collaboration strategy, through training, supervision and bidirectional monitoring among non-specialized health personnel who care for the migrant population at the HW and MHU, allowed for promotion and early care for mental health.

This strategy included the following activities:

1. 40-h training for non-specialized health personnel who care for the migrant population at HW and MHU, on prevention and early care for mental health problems.
2. Coordination of the strategy for the implementation of brief mental health interventions for compatriots cared for at the community level, initially, by VDS and UMS promoters and, subsequently, referred to primary and specialized care, by professionals from the Faculty of Psychology of the UNAM.
3. Coordinate the monitoring and supervision of 37 VDS and UMS promoters who implemented the evaluation, management and follow-up of mental health risk conditions, throughout 11 synchronous sessions, between April and December 2021: essential care/practices depression, psychosis, epilepsy, child/adolescent mental/behavioral disorders, dementia, substance use disorders, self-harm/suicide, and other conditions such as acute stress and violence.
4. Evaluate the implementation process of mental health interventions through the development of three evaluation processes: (a) knowledge, (b) case vignettes, and (c) simulated situations of people with risk to their mental health.

The mental health initiative, called the "Mental Health Gap Action Program (mhGAP)," involved (1) training promoters; (2) evaluation, monitoring, and follow-up; and (3) mental health screening for HW and MHU users. In other words, those treated at HW and MHU were provided with preventive and screening services for mental health risks, with the results being recorded in SICRESAL.

If the promoters of the HW and MHU network partners identified mental health conditions, individuals were then screened by, diagnosed and offered specialized care remotely and/or online from the Faculty of Psychology of the National Autonomous University of Mexico.

It should be noted participation was voluntary. Through direct work in VDS and UMS health promoters gently encouraged participants to accept receiving screening as well as remote mental health services, if necessary.

2.2. Information source

De-identified data from the *Continuous Information System for Health Reporting (SICRESAL)* housed by the Mexico Section of the United States-Mexico Border Health Commission were used for the analysis. In 2021, a total of 36,086 Mexicans received community health care at the HW and 10,384 in the MHU. A total of eighty-three were screened by the HW (71% women, with an average age of forty-two, between the ages of 14 and 67), and 127 by the MHU (69% women, with an average age of forty-one, between the ages of 19 and 73).

2.3. Instruments

The variables included in the screening are associated with the sociodemographic profile such as age, sex, state of residence and medical insurance, as well as mental health signs and symptoms related to depression (six items), experiences of psychosis (four items), epilepsy (one item), dementia (two items), substance use (three items), violence (four items), sexuality (two items), anxiety (three items) self-harm and suicidal ideation (two items). One point was assigned to each item and the occurrence of the event was determined as follows: (a) For depression, anxiety (in the past 2 weeks) and dementia (at the time of assessment), with at least two positive items; and (b) for the experience of psychosis, epilepsy, sexuality (in the past 12 months), violence (in the past 6 months), substance use (in the past month), self-harm and suicidal ideation (at the time of administration) with at least one positive item.

2.4. Data analysis

It is important to clarify that no sample calculation was made for this study since it is an exploratory study that aimed to describe the sociodemographic characteristics of the Latino migrant population that voluntarily agreed to the mental health screening offered at both the HW and MHU.

Based on the information contained in the SICRESAL database, the sociodemographic characteristics of those served in both the HW and the MHU in 2021 was constructed, analyzing variables such as gender, age groups, English proficiency, place of origin and place where there were attended.

In the analysis of sociodemographic variables relating to mental illness, neurological or due to substance use, among the Latino migrant population in the United States attending HW and MHU during 2021, contingency tables were calculated with respective percentages and chi square score with a significant $p < 0.05$. The initial part of the analysis included "any mental health symptom or problem" as a dependent variable; the sociodemographic dependent variables were gender, age group, place of origin, and English language proficiency. The demographic variables of education and time of residency in the USA were not analyzed given the lack of information among registrants. In the second part, used SPSS to analyze the information using the dependent variables, symptoms of depression, anxiety, suicidal ideation, psychosis, epilepsy, dementia, substance use, violence or problems with sexuality, and socio-demographic as explanatory variables.

3. Results

3.1. Positive mental health screenings data analysis

During 2021, a total of 794 mental health screenings were conducted by the HW and the MHU, 84% were done in the HW. Fifty-nine percent of screenings were done among women between 7 and 86 years of age, with an average age of 43.

Table 1 shows data for population screening with or without mental health symptoms/problems and other socio-demographic variables. The following findings emerged:

Characteristics	Any symptoms or mental health problems				
	Yes		No		Sig.
N	160		634		
Health window type	n	%	n	%	
VDS	113	16.9	554	83.1	**0.000***
UMS	47	37	80	63	
Gender					
Women	113	24.1	355	75.9	**0.001***
Men	47	14.4	279	85.6	
Age groups					
5–9 years	0	0	1	100	**0.030***
10–17 years	2	25	6	75	
18–30 years	31	31.6	67	68.4	
31–40 years	43	15.7	231	84.3	
41–50 years	47	20.3	185	79.7	
51–60 years	33	22.6	113	77.4	
Older than 61 years	4	11.4	31	88.6	
Place of origin					
Caribbean	0	0	12	100	**0.000***
Central America	6	26.1	17	73.9	
United States	3	16.7	15	83.3	
Mexico	141	26.9	383	73.1	
South America	5	20	20	80	
English proficiency					
Yes	32	23.4	105	76.6	0.306
No	58	21.6	210	78.4	

*Differences estimated using Chi-square value p < 0.05.
Author's own creation based on Data Base Continuous Information System for Health Reporting (SICRESAL), 2021 (21).

- 20% of the population that voluntarily agreed to screening showed positive results for a mental health symptom or problem. This percentage is higher among those who attended the MHU (37%).
- Analyzing for the variable of gender revealed that the aforementioned symptoms were higher among women.
- Those between 18 and 30 years of age were more likely to report having a mental health symptom or problem.
- For 26.9% of the screened population, Mexico was the country of origin, and 26.1% from Central America.
- The independent variables "type of window," "gender," "age group," and "place of origin" were related with the existence of some mental health symptom or problem among the population who agreed to the screening given that its significance level was below 0.05. The variable for language proficiency was neither significant nor explicative.

A desegregation of screened mental health symptoms found differing results among the migrant population that attended a HW or MHU during 2021. These are described as follows and shown on Tables 2–4.

3.2. Data analysis of positive mental health screenings for symptoms related to emotional state

Table 2 shows data for population screening with or without mental health symptoms/problems of depression. The following findings emerged:

- 19% of the screened population showed positive results for depression. This percentage is higher among those who attended an MHU (31%).
- The aforementioned symptoms were found to be higher among women (23%).
- The population between 18 and 30 years of age were more likely to report symptoms of depression.
- 26% of the screened population reported Central America as their place of origin.
- The independent variables, "type of window," "gender," "age group," and "place of origin" were related to a symptom of depression among those who agreed to the screening given its significance level was below 0.05. While the variable of English proficiency was neither significant nor explicative.

Table 2 shows data for population screening with or without mental health symptoms/problems of anxiety. The following findings emerged:

- 7% of the population who voluntarily agreed to the screening showed positive results for anxiety. This percentage is higher among those who attended the MHU (31%).
- While analyzing for gender, women showed the greatest proportion of symptoms.
- The population between 18 and 30 years of age reported the most having symptoms related to anxiety.
- Most reported South America as their place of origin.
- Only the variable, "place of origin" was related to showing a symptom of anxiety among the population who agreed to this screening given its significance level was below 0.05. The variables "type of window," "gender," "age group," and "English proficiency" among this population were neither significant nor explicative.

Table 2 shows data for population screening with or without mental health symptoms/problems of suicidal ideation. The following findings emerged:

- Only 1% of the population who voluntarily agreed to the screening showed positive results in terms of suicidal ideation.
- Analyzing for gender found the aforementioned had a greater occurrence among women.
- The population between 18 and 30 years of age reported the most symptoms related to suicidal ideation.

TABLE 2 Distribution of sociodemographic characteristics among the population with or without mental health symptoms/problems of depression, anxiety, suicidal ideation for screenings done at HW and MHU during 2021.

Characteristics	Symptoms of depression				Anxiety symptoms				Symptoms of suicidal ideation				
	Yes		No	Sig.	Yes		No		Sig.	Yes		No	Sig.
N	148		646		58		736			10		784	
Health window type	n	%	n	%	n	%	n	%		n	%	n	%
VDS	109	16.3	558	83.7	**0.000***	45	6.7	622	93.3	0.166	10	1.5	657	98.5	0.165
UMS	39	30.7	88	69.3		13	10.2	114	89.8		0	0	127	100	
Gender														
Women	108	23.1	360	76.9	**0.000***	41	8.8	427	91.2	0.059	6	1.3	462	98.7	0.945
Men	40	12.3	286	87.7		17	5.2	309	94.8		4	1.2	322	98.8	
Age groups														
5–9 years	0	0	1	100	**0.040***	0	0	1	100	0.177	0	0	1	100	0.906
10–17 years	2	25	6	75		0	0	8	100		0	0	8	100	
18–30 years	29	29.6	69	70.4		13	13.3	85	86.7		2	2	96	98	
31–40 years	41	15	233	85		20	7.3	254	92.7		3	1.1	271	98.9	
41–50 years	40	17.2	192	82.8		16	6.9	216	93.1		2	0.9	230	99.1	
51–60 years	32	21.9	114	78.1		9	6.2	137	93.8		3	2.1	143	97.9	
Older than 61 years	4	11.4	31	88.6		0	0	35	100		0	0	35	100	
Place of origin														
Caribbean	0	0	12	100	**0.000***	0	0	12	100	**0.005***	0	0	12	100	0.390
Central America	6	26.1	17	73.9		2	8.7	21	91.3		0	0	23	100	
United States	2	11.1	16	88.9		1	5.6	17	94.4		0	0	18	100	
Mexico	131	25	393	75		50	9.5	474	90.5		10	1.9	514	98.1	
South America	4	16	21	84		3	12	22	88		0	0	25	100	
English proficiency														
Yes	29	21.2	108	78.8	0.467	7	5.1	130	94.9	0.554	3	2.2	134	97.8	0.071
No	53	19.8	215	80.2		21	7.8	247	92.2		0	0	268	100	

*Differences estimated using Chi-square value p < 0.05.
Author's own creation based on Data Base Continuous Information System for Health Reporting (SICRESAL), 2021 (21).

- Most reported Mexico as their place of origin.
- None of the independent variables related to a symptom of suicidal ideation among the population agreeing to the screening given its significant level was above 0.05.

3.3. Analysis of data from positive mental health screenings for psychosis, epilepsy, and dementia

Table 3 shows data for population screening with or without mental health symptoms/problems of psychosis. The following findings emerged:

- From the population who voluntarily agreed to screening, 8% had positive results for psychosis. This percentage was higher among those who attended the MHU.
- Analyzing for gender found the aforementioned had a greater occurrence among women.

- The population between 18 and 30 years of age reported the most symptoms related to psychosis.
- 26% of the screened population reported South America as their place of origin.
- The independent variables "place of origin" and "English proficiency" were the only variables related to the presence of any symptom of psychosis among the population who agreed to the screening given its significance level was below 0.05. The variables "type of window," "gender," and "age groups" among this population were neither significant nor explicative.

Table 3 shows data for population screening with or without mental health symptoms/problems of epilepsy. The following findings emerged:

- 3% of the population who voluntarily accepted the screening showed positive results for epilepsy. This result is higher among those who attended the MHU.
- While analyzing the variable of gender the aforementioned symptoms showed a major proportion among men.

TABLE 3 Distribution of sociodemographic characteristics among the population with or without mental health symptoms/problems of psychosis, epilepsy, or dementia for screenings done at HW and MHU during 2021.

Characteristics	Symptoms of psychosis					Epilepsy symptoms					Dementia symptoms				
	Yes		No		Sig.	Yes		No		Sig.	Yes		No		Sig.
N	64		730			20		774			12		782		
Health window type	n	%	n	%		n	%	n	%		n	%	n	%	
VDS	52	7.8	615	92.2	0.531	15	2.2	652	97.8	0.266	11	1.6	656	98.4	0.466
UMS	12	9.4	115	90.6		5	3.9	122	96.1		1	0.8	126	99.2	
Gender															
Women	43	9.2	425	90.8	0.162	9	1.9	459	98.1	0.199	6	1.3	462	98.7	0.526
Men	21	6.4	305	93.6		11	3.4	315	96.6		6	1.8	320	98.2	
Age groups															
5–9 years	0	0	1	100	0.567	0	0	1	100	0.288	0	0	1	100	0.665
10–17 years	0	0	8	100		0	0	8	100		0	0	8	100	
18–30 years	11	11.2	87	88.8		0	0	98	100		1	1	97	99	
31–40 years	26	9.5	248	90.5		12	4.4	262	95.6		2	0.7	272	99.3	
41–50 years	13	5.6	219	94.4		4	1.7	228	98.3		5	2.2	227	97.8	
51–60 years	11	7.5	135	92.5		3	2.1	143	97.9		4	2.7	142	97.3	
Older than 61 years	3	8.6	32	91.4		1	2.9	34	97.1		0	0	35	100	
Place of origin															
Caribbean	0	0	12	100	0.001*	0	0	12	100	0.170	0	0	12	100	0.280
Central America	1	4.3	22	95.7		0	0	23	100		0	0	23	100	
United States	1	5.6	17	94.4		0	0	18	100		0	0	18	100	
Mexico	57	10.9	467	89.1		19	3.6	505	96.4		12	2.3	512	97.7	
South America	3	12	22	88		0	0	25	100		0	0	25	100	
English proficiency															
Yes	8	5.8	129	94.2	0.021*	6	4.4	131	95.6	0.292	3	2.2	134	97.8	0.704
No	14	5.2	254	94.8		5	1.9	263	98.1		3	1.1	265	98.9	

*Differences estimated using Chi-square value p < 0.05.
Author's own creation based on Data Base Continuous Information System for Health Reporting (SICRESAL), 2021 (21).

- The population older than 60 years of age reported the most having symptoms related to epilepsy.
- Most reported Mexico as their place of origin.
- The majority reported English proficiency.
- None of the independent variables was related to a symptom of epilepsy among the population who agreed to the screening given its significant level was above 0.05.

Table 3 shows data for population screening with or without mental health symptoms/problems of dementia. The following findings emerged:

- Only 1% of the population who voluntarily agreed to the screening had positive results for dementia.
- The aforementioned symptoms were present mostly among men.
- The population between 51 and 60 years of age reported the most having symptoms related to dementia.
- Most reported Mexico as their place of origin.

- None of the independent variables was related to the existence of some symptom of dementia among the population who agreed to the screening given its significant level was above 0.05.

3.4. Analysis of data from positive mental health screenings for symptoms related to behavior

Table 4 shows data for population screening with or without mental health symptoms/problems with substance use. The following findings emerged:

- 5% of the population who voluntarily agreed to the screening had positive results for substance use.
- The percentage is higher among those who attended the MHU.
- Analyzing for the gender variable showed the aforementioned symptoms were greater among men.

TABLE 4 Distribution of sociodemographic characteristics among the population with or without mental health symptoms/problems of substance consumption, violence or sexuality for screenings done at HW and MHU during 2021.

Characteristics	Symptoms of substance use					Symptoms of violence					Symptoms of sexuality				
	Yes		No		Sig.	Yes		No		Sig.	Yes		No		Sig.
N	39		755			35		759			35		759		
Health window type	n	%	n	%		n	%	n	%		n	%	N	%	
VDS	24	3.6	643	96.4	**0.000***	33	4.9	634	95.1	0.090	30	4.5	637	95.5	0.778
UMS	15	11.8	112	88.2		2	1.6	125	98.4		5	3.9	122	96.1	
Gender															
Women	17	3.6	451	96.4	**0.046***	23	4.9	445	95.1	0.405	22	4.7	446	95.3	0.630
Men	22	6.7	304	93.3		12	3.7	314	96.3		13	4	313	96	
Age groups															
5–9 years	0	0	1	100	0.545	0	0	1	100	0.952	0	0	1	100	0.873
10–17 years	0	0	8	100		0	0	8	100		0	0	8	100	
18–30 years	9	9.2	89	90.8		5	5.1	93	94.9		4	4.1	94	95.9	
31–40 years	12	4.4	262	95.6		14	5.1	260	94.9		16	5.8	258	94.2	
41–50 years	11	4.7	221	95.3		8	3.4	224	96.6		9	3.9	223	96.1	
51–60 years	6	4.1	140	95.9		7	4.8	139	95.2		5	3.4	141	96.6	
Older than 61 years	1	2.9	34	97.1		1	2.9	34	97.1		1	2.9	34	97.1	
Place of origin															
Caribbean	0	0	12	100	**0.033***	0	0	12	100	**0.017***	0	0	12	100	**0.037***
Central America	2	8.7	21	91.3		0	0	23	100		1	4.3	22	95.7	
United States	1	5.6	17	94.4		0	0	18	100		0	0	18	100	
Mexico	34	6.5	490	93.5		33	6.3	491	93.7		31	5.9	493	94.1	
South America	1	4	24	96		1	4	24	96		2	8	23	92	
English proficiency															
Yes	10	7.3	127	92.7	0.291	6	4.4	131	95.6	0.175	6	4.4	131	95.6	0.079
No	10	3.7	258	96.3		7	2.6	261	97.4		6	2.2	262	97.8	

*Differences estimated using Chi-square value p < 0.05.

Author's own creation based on Data Base Continuous Information System for Health Reporting (SICRESAL), 2021 (21).

- The population between 41 and 50 years of age reported the most having symptoms related to substance use.
- The majority reported Central America as its place of origin.
- Only the independent variables "type of window," "gender," and "place of origin" were related to the existence of some type of symptom related with substance use among the population who agreed to the screening given its significance level was below 0.05. The variables "age group" and "language proficiency" among this population were neither significant nor explicative.

Table 4 shows data for population screening with or without mental health symptoms/problems with violence. The following findings emerged:

- 4% of the population who voluntarily agreed to the screening showed positive results for violence. This percentage is higher among those who attended the HW.
- Analyzing gender showed the aforementioned symptoms were greater among women.

- The population between 31 and 40 years of age reported the most having symptoms related to violence.
- Most reported Mexico as their place of origin.
- The majority reported English proficiency.
- Only the independent variable "place of origin" was related to the existence of some symptom among the population who voluntarily agreed to the screening given its significant level was below 0.05. The other independent variables were not related to the existence of a symptom of violence among the population who agreed to the screening given its significance level was above 0.05.

Table 4 shows data for population screening with or without mental health symptoms/problems with sexuality, the following findings emerged:

- Only 4% of the population who voluntarily agreed to the screening showed positive results for sexuality.

- Analyzing for the gender variable found the aforementioned symptoms occurred mostly among women.
- The population between 31 and 40 years of age reported the most having symptoms related to dementia.
- The majority reported South America as its place of origin.
- Only the independent variable "place of origin" was related to the existence of a symptom among the population who voluntarily agreed to the screening given that its significance level was below 0.05. The remaining variables were not related to the existence of any symptom of violence among the population who agreed to the screening given its significance level was above 0.05.

4. Conclusions and discussion

Migration is an experience in which more and more individuals participate, and which has potentially negative as well as positive consequences for health and wellbeing (22). This can also be considered a psychic or mental risk factor thus it is necessary to address from a health and psychosocial perspective (23). The main purpose of this study was to describe the sociodemographic characteristics of the Latino migrant population in the United States of America who visited the Health Windows (HW) and Mobile Health Units (MHU) during 2021 and who may have been at risk for mental, neurological or substance use disorders.

The study results allow one to gain a deeper understanding of the socio-demographic portrait of the migrant population attending MHU and HW showing a symptom or problem related with mental health in order to adapt needed care and therapeutic interventions. The significant variables in this analysis were gender, age group, and place of origin.

As reported by other studies on mental health and migration, there is a high prevalence of disorders among the migrant population (13). In this study, the proportion of the population with mental health symptoms or problems identified through the screening was 20%. Specifically, 17% in the HW and 37% in the MHU.

In 2021, the mental health screening undertaken in both the HW and the MHU revealed conditions of stress, anxiety, major depression, psychological distress, risks of self-harm/suicide, psychoactive substance use and post-traumatic stress among the migrant population that went to these places. At the same time, it was possible to significantly reduce the waiting times for the mental health care of Mexican migrants.

In this study, as in others, the migrant population that visited the HW and MHU in 2021 reported higher mental health risks with symptoms related to depression, anxiety, psychosis and substance abuse (16–18, 24, 25). At the same time, women and youth have displayed the highest proportions of mental health risk (24). The most frequent symptoms or problems among women were related with depression, anxiety, suicidal ideation, psychosis, violence and sexuality, similarly to other research studies (26). Among men, the aforementioned symptoms were related to epilepsy, dementia, and substance use and abuse.

An analysis of the average age and age groups shows that these conditions are present in the younger population. According to an analysis by age group of the migrant population attended in both the HW and the MHU, the most common symptoms were related to depression, anxiety, suicidal ideation, and psychotic episodes. The studies by Rojas et al. (26) show emotional state and anxiety as mental

illnesses prevalent among the childhood migrant population in Chile. The age group between 31 and 40 years of age most frequently showed symptoms related to violence and sexuality.

Another significant mental health aspect is substance abuse. According to some studies, the greater the exposure to North American culture, physical and emotional distance from partners or family, work pressures, fear of deportation, difficulty in expressing emotions, and social environment, the greater the increase in substance use (18, 27). In this study, substance use was reported as a mental health symptom or problem among 24% of the population, particularly among younger age groups.

It is important to note that although there were few people who agreed to be screened, the possibility of detecting mental health problems in one person, having the possibility of referring them to specialized care (psychological or psychiatrist) and that they agree to be treated, can translate into an improvement in the quality of life and those around them (family/community).

Based on the capacities deployed by the health promoters and the collaboration with the specialists of the UNAM (for the strengthening of the competencies for the evaluation, management and follow-up of mental health risks), during 2021, the strategy addressed conditions of stress, anxiety, major depression, psychological distress, risk of self-harm/suicide, use of psychoactive substances and post-traumatic stress; obtained in the screening to make remote specialized interventions available to them, based on scientific evidence, significantly reducing the wait time of those seeking care.

Evaluation, management and monitoring of mental health risks in community care was taught by the mental health promoters at the HW and MHU, in partnership with specialists from the Faculty of Psychology at UNAM. Mental health screening is also a community contact strategy, which makes it possible to detect the risk in early stages and interrupt the progression toward severity.

The strategy favored mental health risk screening and the collaborative strategy allowed the identification of true positives in specialized risk orders and true negatives in the community and primary level of care. This strategy also favored the reduction of the care gap at the community level, through the consent given to be contacted by specialists. Throughout the protocol, the link between the partners for mental health of the HW and MHU and the monitoring of remote psychological care increased.

Limitations

The main limitation is the information source since we worked with secondary data and relied on information provided by those who attended both the HW and the MHU.

Data availability statement

The datasets generated for this study are available on reasonable request to the corresponding author.

Author contributions

ALJ: first draft, data analysis, and final draft. MR, SM, ALM, IL, and RC: revision and final draft. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships

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