EMERGENT PUBLIC HEALTH ISSUES IN THE US-MEXICO BORDER REGION

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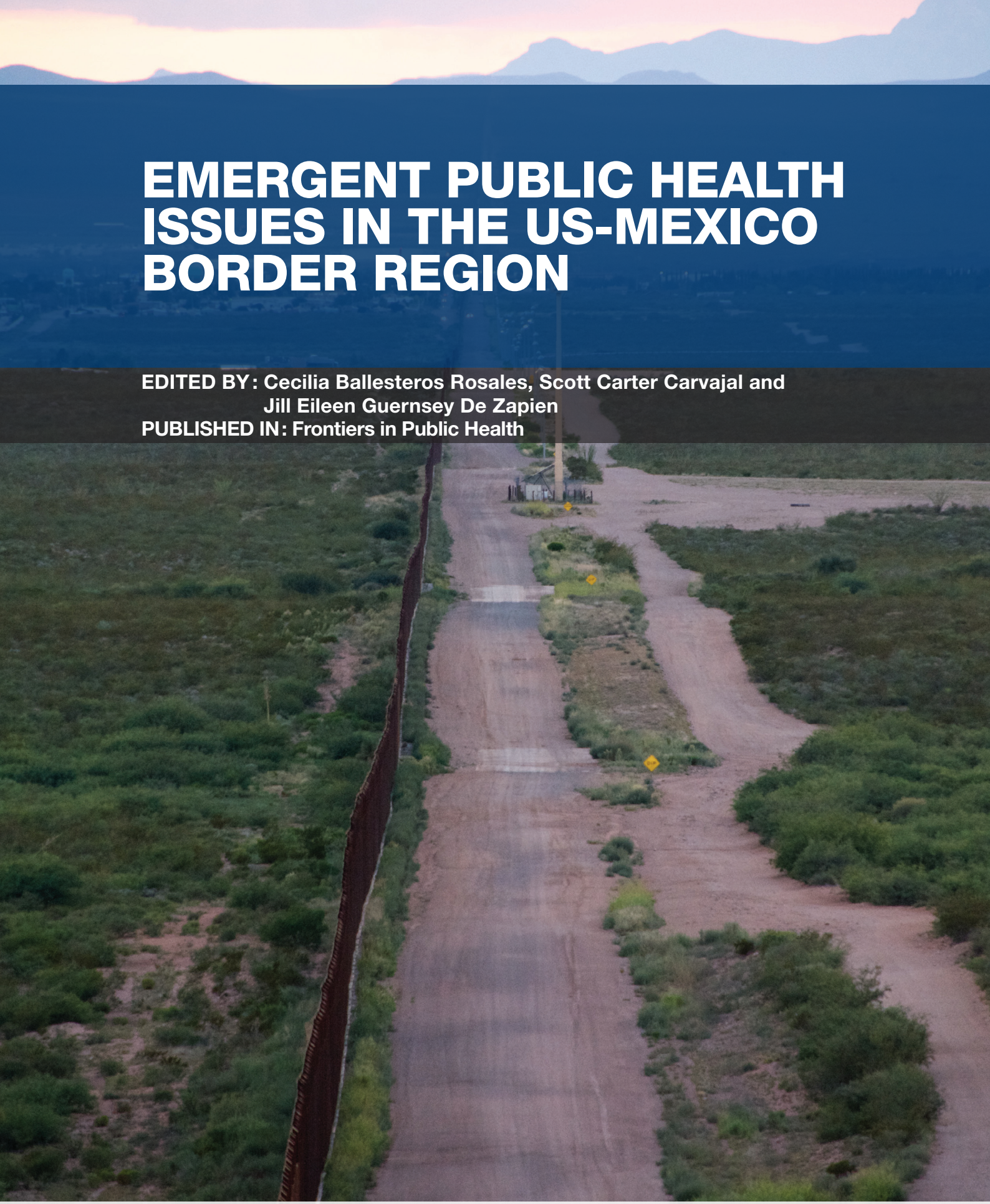

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EMERGENT PUBLIC HEALTH ISSUES IN THE US-MEXICO BORDER REGION

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The Arizona Sonora Border Region

Photo by Robert Guerrero, Arizona Department of Health Services' Border Health Office.

US-Mexico border region area has unique social, demographic and policy forces at work that shape the health of its residents as well as serves as a microcosm of migration health challenges facing an increasingly mobile and globalized world. This region reflects the largest migratory flow between any two nations in the world. Data from the Pew Research Center shows over the last 25 years there has never been lower than 140,000 annual immigrants from Mexico to the United States (with peaks over 700,000). This migratory route is extremely hazardous due to natural (e.g., arid and hot desert regions) and human made barriers as well as border enforcement practices tied to socio-political and geopolitical pressures. Also, reflecting the national interdependency of public health and human services needs, during the most recent five year period surveyed the migratory flow between the US and Mexico has equaled that of the flow of Mexico to the US–both around 1.4 million persons. Of particular public health concern, within the US-Mexico region of both nations there is among the highest disparities in income, education, infrastructure and access to health care–factors within the World Health Organization's conceptualization of the Social Determinants of Health, and among the highest rates of chronic disease. For instance obesity and diabetes rates in this region are among the highest of those monitored in the world, with adult population estimates of the former over

40% and estimates in some population sub-groups for the latter over 20%. The publications reflected in this Research Topic, all reviewed from experts in the field, addressed many of the public health issues in the US Mexico Border Health Commission's Healthy Border 2020 objectives. Those objectives–broad public health goals used to guide a diverse range of government, research and community-based stakeholders–include Non Communicable Diseases (including adult and childhood obesity-related ones; cancer), Infectious Diseases (e.g., tuberculosis; HIV; emerging diseases–particularly mosquito borne illnesses), Maternal and Child Health, Mental Health Disorders, and Motor Vehicle Accidents. Other relevant public health issues affecting this region, for example environmental health, binational health services coordination (e.g., immunization), the impact of migration throughout the Americas and globally in this region, health issues related to the physical climate, access to quality health care, discrimination/mistreatment and well-being, acculturative/immigration stress, violence, substance use/abuse, oral health, respiratory disease, and well-being from a social determinants of health framework, are critical areas addressed in these publications or for future research. Each of these Research Topic publications presented applied solutions (e.g., new programs, technology or infrastructure) and/or public health policy recommendations relevant to each public health challenge addressed.

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EDITORIAL
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Editorial: Emergent Public Health Issues in the US–Mexico Border Region

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Keywords: border health, binational health, binational collaboration, US–Mexico border research

The Editorial on the Research Topic

Emergent public health issues in the US–Mexico border region

The public health literature in recent years has focused extensively on documenting and quantifying health disparities in the US. Race, ethnicity, and poverty are frequently considered the greatest predictors of inequality in health, and these factors are often inextricably tied to one another. Many studies have examined health disparities among those who live in relatively small geographical areas, such as inner cities, that are inhabited by minorities and/or the poor (1). However, in the case of the US–Mexico border region, a careful examination of data on health indicators in the 10 Border States, 4 in the US and the 6 along the northern border of Mexico, reveals both great disparities and strong similarities.

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ACADEMIC RESPONSE

Academic stakeholders in the US–Mexico region are committed to identifying gaps and/or responding to community appeals for solutions to both multifaceted and less complex questions. An example is the case of six universities in the US and Mexico that set out to stimulate collaborative, interdisciplinary scholarship, addressing border health issues relevant to public health in the region. The Puentes Consortium is represented by the Mexican institutions of Monterrey Tec, the University of Monterrey, and the University of the Americas in Puebla. The University of Arizona and Rice University; and as of 2014, University of California San Diego represents the US. The outcome of these efforts as well as a broader call to researchers for papers focused on border health is this special topic focused edition of 13 published articles in the journal Frontiers in Public Health.

The set of academic papers described in this supplement are significant examples of transborder partnerships addressing challenges characteristic of this region. They describe binational endeavors potentially translatable to promote programs and policies that improve population health. Moreover, they address and align with relevant and priority issues published in the US–Mexico Border Health Commission's Healthy Border 2010/2020 Agenda (2). This work addresses broad themes in public health that span issues, such as chronic and infectious diseases, environmental health threats, cooperation of health providers and policymakers across borders, and structural and psychosocial factors, which relate to the health and well-being of marginalized populations in this region. We expect these articles will stimulate discussion and intensify the need for strategic action that can contribute to promoting health and well-being in the coming years in this border region. Further, the challenges, lessons learned, and opportunities from this work may be informative to others across the globe experiencing parallel dynamics, such as (1) the large-scale migration of marginalized populations resulting from economic and geopolitical instabilities in their homelands and (2) where nations near

in physical proximity or with historical migratory corridors have vast disparities in resources, structures, and opportunities.

SPECIAL EDITION ON BORDER HEALTH

Three papers addressed challenges associated with the *monitoring and control of infectious diseases* as well as emerging diseases in the US–Mexico border region. Oren et al. investigated new tools to improve the diagnosis of latent TB. TB rates are elevated in the border region. Latent TB is of particular challenge as without symptoms or knowledge of infection, persons are unlikely to complete the rigorous medical regimen required to eliminate it. Yet, those affected (with some global prevalence estimates above 30%) are at risk for symptomatic TB and are infectious to others. Dengue has been a growing epidemic in Mexico and within the last 2 years there have been confirmed transmissions within Arizona. As mosquitoes that transmit dengue are not limited by physical and political boundaries, the paper by Arellano et al. illustrates the challenge where the interdependence of the knowledge and perceptions within border communities and public health agencies are particularly critical to the monitoring and prevention of potential outbreaks. The article by Valle et al. addressed a long-known border health challenge, HIV/AIDS. This work validated a measure of HIV stigma among men who have sex with men, particularly, disproportionally at risk for HIV/AIDS along the border region. Identification of such stigma in these men is critical for tailoring educational interventions aiming to reduce their risk behaviors and to optimize the likelihood that they will receive adequate medical services within one or both bordering nations they may travel between.

Five works focused on *health threats within marginalized and underserved populations*. As previously described, there was a study on the assessment of perceived HIV-associated stigma and its implications for HIV/AIDS prevention (Valle et al.). Influenced by the degree of national disasters such as Katrina and disproportionately affecting those without means to prepare or evacuate and with special medical needs, Meyer et al. surveyed a border coastal community. They found approximately 20% of the respondents have substantive medical special needs, and among them there is a diverse range of barriers that should be considered in disaster preparedness planning.

Multiple works also highlighted the vulnerability of migratory populations. Crocker elicited and synthesized testimonies of the first-generation (from Mexico) immigrants who are living in Arizona for an average of 15 years. Using a life-history approach, she identified extreme lifelong poverty, family separation, dangerous crossing experiences, and detention conditions as some of the common and major threats to the well-being of these immigrants. The paper by Valdez et al. also identified many parallel stressors and threats to mental health in Central American and Mexican migratory families released from short-term detention facilities in Southern Arizona. They also present a series of recommendations to reduce traumas exacerbated by current detention conditions and practices for immigrant men, women, and children.

The grounded-theory guided investigation of Sabo and Lee, who explored experiences and encounters with officials (border patrol, police, or military) of farmworkers, living and working on both sides of Arizona-Sonora. They found, regardless of legal/permanent status and migration status, these workers infrequently reporting authorities' immigration enforcement-related abuses while frequently experiencing intense stress from interactions with these officials. Reasons for non-reporting include not knowing any mechanism to report violations to accountable officials, beliefs that individual violators would not be held accountable, risk for retaliation to themselves, friends, or family members, and due to the normalization or acceptance of these daily conditions. Finally, Stoesslé et al. investigated health concerns within a migratory sample in shelters in Northern Mexico of predominantly Central American undocumented immigrants. They identified persons needing basic health-care services and at high-risk for communicable diseases – including TB as well as experiencing symptoms of chronic disease. Further, fear with interactions with governmental services or agencies, low health literacy, and the effects of trauma from their homeland or journey were some of the major barriers to addressing those health needs.

Three papers addressed *barriers to improving health-care services in the border region or presented new public health models*. Matthews et al. presented the California Border Health Collaborative. This is a model to systematically promote coordination among hundreds of health-related organizations active in the California–Baja California region. These entities reflect various levels of government (federal, state, local) as well as higher education institutions, local non-profit organizations, and advocacy organizations. One key outcome of this collaboration model is to ensure policy makers are well informed of the implications of their policy decisions by stakeholders closest to those affected.

The following address more narrow but significant challenges to health-care delivery and coordination. Aristizabal et al. provide an innovative model to increase the capacity for a Mexican border hospital to improve cancer outcomes in children. Through partnering with two US-based border hospitals, a first of its kind (in the Tijuana area) pediatric oncology unit was launched. The disparity in 5-year survival from acute leukemia prior to this initiative (10% on the Mexican border side and 88% in the US border side) has been dramatically improved in the 6 years since implementation – with the rates 4–5 times better for Baja California children than prior. This successful model shows the high potential of cooperation of health services within Border States, when that effort is guided by evidence-based practice, cultural responsiveness, developing trust, and respectful interchange. Chronic disease risks also remain disproportionally high for Hispanics living in the border region relative to Hispanics living in other regions of the US and Mexico. De Heer et al. report on a community health worker-delivered intervention in a large US city within the border region. Participants in this intervention were able to use community resources to promote healthy lifestyle and showed improvements in physical activity, diet, and clinical indicators (e.g., weight, blood pressure). Using the relatively lower costs of community health workers (relative to other health-care professionals) and by leveraging existing community resources, this intervention is likely scalable to reduce CVD risk within Mexican-origin populations in both the nations.

In concluding the special topic issue, two papers address *the role of broader social conditions and environments* on health issues

within border populations. Valdez and Langellier examined mental health problems and services within Arizona and focused on differences in Whites and Hispanics. They found Hispanics reported lower mental health diagnosis than Whites, though in both groups, lower SES was associated with greater likelihood of distress. Their findings suggest more undiagnosed cases of mental health conditions in Hispanics and that more culturally and linguistically appropriate strategies to provide mental health diagnosis and services is needed in Arizona. Salinas and Sexton investigated food environment – which could contribute to obesity, diabetes, and CVD risk with community-level ethnic density and poverty. They not only identified some urban border environments appearing as health protective relative to non-border urban minority communities in Texas but also concluded any positive effects may be attenuated by other factors that need to be further explored (e.g., they may be available but costly to low-income residents).

The papers summarized here are exemplars of the high level of collaboration essential to conducting and disseminating public health research that translates into action to improve health and well-being in border communities.

AUTHOR CONTRIBUTIONS

The lead author is CR. CR outlined and drafted the editorial. SC and JZ contributed by reviewing and revising the manuscript.

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ORIGINAL RESEARCH
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Interferon gamma-based detection of latent tuberculosis infection in the border states of Nuevo Leon and Tamaulipas, Mexico

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Nearly one-third of the world's population is infected with latent tuberculosis (LTBI). Tuberculosis (TB) rates in the border states are higher than national rates in both the US and Mexico, with the border accounting for 30% of total registered TB cases in both countries. However, LTBI rates in the general population in Mexican border states are unknown. In this region, LTBI is diagnosed using the tuberculin skin test (TST). New methods of detection more specific than TST have been developed, although there is currently no gold standard for LTBI detection. Our objective is to demonstrate utility of the Quantiferon TB gold In-Tube (QFT-GIT) test compared with the TST to detect LTBI among border populations. This is an observational, cross-sectional study carried out in border areas of the states of Nuevo Leon and Tamaulipas, Mexico. Participants ($n = 210$) provided a TST and blood sample for the QFT-GIT. Kappa coefficients assessed the agreement between TST and QFT-GIT. Participant characteristics were compared using Fisher exact tests. Thirty-eight percent of participants were diagnosed with LTBI by QFT-GIT. The proportion of LTBI detected using QFT-GIT was almost double [38% (79/210)] that found by TST [19% (39/210)] ($P < 0.001$). Concordance between TST and QFT-GIT was low (kappa = 0.37). We recommend further studies utilizing the QFT-GIT test to detect LTBI among border populations.

Keywords: tuberculosis, *Mycobacterium tuberculosis*, tuberculin skin test, interferon gamma, latent tuberculosis infection, Mexico

Introduction

Most US–Mexico border states have high rates of unemployment and low per capita income (1). In these states, overcrowding, poor nutrition, and poor access to health services are common (2). Additionally, the US–Mexico border states have rapidly growing populations (3). The US–Mexico border region, extending 37 miles north and south of the border itself, accounts for 30% of total registered tuberculosis (TB) cases in both the US and Mexico (2), and border states from Northern Mexico have the highest rates of TB in the country, with rates between 15 and 39 cases per 100,000 inhabitants (3–6). Those border states with the highest rates, such as in Baja California, Sonora, and

Tamaulipas, tend to reflect migration routes from the central and southern Mexican states, as well as Central America, toward the US (7). Additionally, prolonged infectiousness, increased drug resistance, and poor access to health services along the border create barriers to stemming TB disease transmission and providing adequate treatment (8–10). The migratory process itself, poverty, and substandard conditions are likely to be primary factors resulting in increased risk of developing active TB (5, 6, 11).

Infection with *Mycobacterium tuberculosis* bacilli may result in latent tuberculosis infection (LTBI), a carrier state where patients are neither symptomatic nor contagious (12). Latent TB infection is thus frequently not detected or diagnosed. However, when the host immune system fails, infection may progress to active TB disease, at which point symptoms may develop and disease spread can occur (13, 14). The overall lifetime risk of LTBI progression to active TB is estimated at approximately 5–10% (13, 15), with risk increased by underlying immunosuppression, including human immunodeficiency virus (HIV), diabetes, and heavy steroid use, conditions frequently observed along the border (6, 16–19).

Along the Mexico-US border LTBI is diagnosed using the tuberculin skin test (TST), an old diagnostic tool with several limitations in sensitivity and specificity (20, 21). Cross-reactive responses due to BCG vaccination or exposure to environmental mycobacterium can lead to false-positive results, leading to unnecessary follow-up (21). Additionally, high-risk groups such as diabetics, HIV-coinfected, or individuals receiving steroids may not have a detectable TST response due to compromised immune systems (16–19).

In the last few years, in the absence of a gold standard test for LTBI, new methods of detection more sensitive and specific than TST have been developed. These include cell-mediated immunity-based interferon-gamma release assays such as the Quantiferon TB gold In-Tube (QFT-GIT). The QFT-GIT is based on interferon gamma cytokine release in response to TB-specific antigen stimulation of peripheral lymphocytes and has shown equivalent sensitivity and greater specificity than TST in detecting LTBI in several populations (21–23). It is important to note, however, that evaluations of sensitivities provide a suboptimal gold standard, as they utilize clinical situations where a specific immune response is likely to occur, such as among patients with either current active TB or a history of TB disease (21, 23).

Of the studies examining the prevalence of LTBI in the Mexican Border side, the focus has been on high-risk populations. One of these was a study that took place in a migrant agricultural community in San Quintín, Baja California, Mexico. Among 133 participants tested with QFT-GIT, 39.8% had a positive test (24). Another study in Tijuana among 1,020 injecting drug users reported an LTBI prevalence of 67% (25). More recently, a case–control study was carried out among 150 patients from the Mestizo population of Cuidad Juárez, Chihuahua, Mexico (26). Finally, our previously reported study in Nuevo Leon and Tamaulipas showed high LTBI prevalence (~40%) among close contacts to active TB cases (27).

The main objective of this work is to demonstrate utility of the QFT-GIT test to detect LTBI among border populations in Mexico. These outcomes could be used to guide test choice in the future as well as to inform future policy regarding LTBI.

Materials and Methods

Study Design and Inclusion Criteria

A cross-sectional study was performed from January through March of 2013 among participants that live in Northern Mexico. Patients from border areas of Nuevo Leon and Tamaulipas were recruited in health clinics belonging to the Nuevo Leon and Tamaulipas Ministries of Health. People living in urban and rural border areas during the above-mentioned period were invited to participate. Patients with active TB disease were referred for follow-up but excluded from the study, although family members of these active TB patients were invited to participate in the study.

Patients diagnosed with cancer, patients diagnosed with HIV, pregnant women, and individuals using steroids for more than 1 month were also excluded. Patients with an incomplete questionnaire or who failed to show for the TST read appointment (48–72 h following the placement) were not included in the data analysis. This protocol was approved by Research and Ethics Committees from the Ministries of Health of Tamaulipas and University of Monterrey (UDEM). All participants, or their parents in case of children, signed an informed consent.

Questionnaire

Sociodemographic and clinical data were derived through interviewing individuals by trained public health staff using a standardized survey. The survey included medical diagnosis, age, gender, housing conditions, crowding, comorbidities such as diabetes and hypertension, and behavioral risk factors such as smoking, excess alcoholic beverages, or drug use. Responses were all self-reported.

Procedures

All eligible participants ($n = 210$) were interviewed and then tested for LTBI by TST and QFT-GIT. The QFT-GIT test was performed by trained laboratory personnel who were blinded to the patient's clinical details. Peripheral blood samples were processed 4–6 h after being obtained from the patient. Initially, the blood was aliquoted into three different tubes: the first did not contain antigens (control), the second tube contained TB antigens, and the third contained phytohemagglutinin (mitogen or positive control) (28). These tubes were incubated for 18–24 h at 37°C. Finally, an ELISA test was performed to determine interferon gamma levels in the plasma of each tube. The results were considered positive, negative, or indeterminate according to the criteria established in the manufacturer's software. Once the blood was removed to perform the QFT-GIT test, the TST was performed using the Mantoux method, using 0.1 mL (2 tuberculin units) of purified protein derivative RT23 (Statens Serum Institute; Copenhagen, Denmark) in the middle of the anterior face of the forearm, and the outcome was evaluated 48–72 h later by experienced staff. To read the TST, the transverse diameter of the induration was measured and the data registered in millimeters. The TST reaction was scored as positive if the induration diameter was >5 mm. Individuals were considered to have a diagnosis of LTBI if they were asymptomatic without clinical evidence of active TB, but had a positive QFT-GIT and/or TST-positive reaction.

Statistical Analysis

Data were entered into Microsoft Excel 2010. Statistical calculations were made with the statistical package PASW statistics version 18.0. The concordance between the QFT-GIT and TST tests was calculated using statistical kappa (κ). Strengths of agreement were considered "poor" ($\kappa \leq 0.20$), "fair" ($0.20 < \kappa \leq 0.40$), "moderate" ($0.40 < \kappa \leq 0.60$), "good" ($0.60 < \kappa \leq 0.80$), and "very good" ($0.80 < \kappa \leq 1.00$). Descriptive statistics were conducted to describe the sample. Participants were grouped as adult, elderly (60 years of age or more), or pediatric (<18 years of age). Differences in frequencies were evaluated by the Fisher exact test. Statistical significance was defined by $P \leq 0.05$. Sensitivity and specificity could not be calculated as there is currently no gold standard for LTBI diagnosis.

Results

Participants

In this preliminary work in the border states of Nuevo Leon and Tamaulipas, Mexico, we evaluated 210 participants. One hundred and forty-seven of the participants (70%) were in contact with patients with active TB under treatment. The mean age of the participants was 31 years, and almost all (94%) were BCG vaccinated. The proportion of participants with diabetes was 11.9%, while 10% reported suffering from hypertension (**Table 1**).

LTBI Diagnosis

All (210) the participants were QFT-GIT tested, with 207 (99%) completing the TST evaluation. The proportion of LTBI detected using QFT-GIT was close to double [38% (79/210)] that found by TST [19% (39/207)] ($P < 0.001$) (**Table 2**). The proportion of participants with LTBI detected by QFT-GIT among close contacts was 49.7% (73/147) compared to 21% by TST (31/147). When a positive result on either test was considered evidence of LTBI, 40.9% (86/210) of participants were found to have LTBI. Individuals not considered contacts were only positive by QFT-GIT 9.5% of the time (6/63) ($P < 0.001$) and by TST 12.6% of the time (8/63) ($P < 0.01$).

No significant differences were observed across gender. The proportion of participants with positive TST was inversely associated with increasing age ($P = 0.05$). While the proportion of participants testing positive by QFT-GIT was higher among the elderly and children (**Table 2**), these differences were not statistically significant. The proportion of participants with positive QFT-GIT was significantly higher in people with diabetes (56%) compared to that of non-diabetics (35%) ($P = 0.03$). These differences could not be detected with TST. No differences were found in the proportion of positive QFT-GIT and TST tests among participants with or without hypertension.

TABLE 1 | Patient characteristics ($N = 210$).

Characteristic	N	%
Age		
Adults	125	59.5
Elderly	19	9.1
Pediatric	66	31.4
Gender		
Male	77	30.6
Female	133	63.4
BCG History		
Yes	198	94.3
No	12	5.7
Diabetes		
Yes	25	11.9
No	185	88.1
Hypertension		
Yes	21	10
No	189	90

Elderly, 60 years of age or more; pediatric, <18 years of age.

Test Concordance

The assays had a concordance of just $k = 0.37$ ($P < 0.01$) with each other among contacts (**Table 3**), approximately the same as when all asymptomatic people reviewed in the study were included (0.39) (**Table 4**). When close contacts of pulmonary active TB cases were tested with QFT-GIT and TST, some individuals with positive QFT-GIT had negative TST (45/73) and some with negative QFT-GIT had positive TST results (3/74). In this scenario, only 38.3% (28/73) of individuals with LTBI detected by QFT-GIT had a positive TST test; however, when QFT-GIT was negative (71/74), 95.9% of the individuals were TST negative as well. If the QFT-GIT results are correct, the proportion of false-negative TST tests was 61.6% (45/73) and false positive was 4.1% (3/74) (**Table 3**).

Discussion

This study showed a high prevalence of LTBI among border populations. An even higher proportion of participants were found to have LTBI when limited to those with close contact to active TB patients. Higher positivity rates were observed by the QFT-GIT test, with many of these individuals displaying a negative TST. Test concordance between the two tests was fairly low.

Others have also shown a prevalence of close to 40% among migrant residents on the US side of the border, in Baja California (24). Given the elevated LTBI prevalence observed, there are likely many individuals who have active TB who are not being diagnosed or treated. Particularly, troubling is the high prevalence of LTBI among high-risk groups for progression to active TB, such as close contacts and individuals with comorbidities such as diabetes. In Mexico, most patients are not offered testing or treatment for LTBI, with the exception of diabetic patients in close contact with active TB patients, who are currently offered preventive treatment regardless of their LTBI status (29). Moreover, Mexican-born TB patients on the US border have been previously reported to have greater disease severity, with more frequent sputum smear-positive and cavitary disease, possibly due to more limited access or delay in seeking care (30). Delayed diagnoses, combined with the lack of LTBI detection, only serve to continue a cycle of disease transmission within and across households.

Given these high prevalence rates, it is essential that screening and appropriate preventive therapy be provided for those at high

TABLE 2 | Comparative outcomes from QFT-GIT and TST.

Distribution of patients	QFT-GIT		*P*-value	TST			*P*-value
	Negative *n* = 131	Positive *n* = 79		Negative *n* = 168	ND *n* = 3	Positive *n* = 39	
Age							
A	81 (64.8%)	44 (35.2%)	0.67	104 (83.2%)	3 (2.4%)	18 (14.4%)	0.05
E	11 (57.9%)	8 (42.1%)		17 (89.5%)	0 (0%)	2 (10.5%)	
P	39 (59.1%)	27 (40.9%)		47 (71.2%)	0 (0%)	19 (28.8%)	
Gender							
M	49 (63.6%)	28 (36.4%)	0.44	63 (81.8%)	0 (0%)	14 (18.2%)	0.24
F	82 (61.7%)	51 (38.3%)		105 (78.9%)	3 (2.3%)	25 (18.8%)	
Contact							
Yes	74 (50.3%)	73 (49.7%)	0.001*	116 (78.9%)	0 (0%)	31 (21.1%)	0.01*
No	57 (90.5%)	6 (9.5%)		52 (82.5%)	3 (5.8%)	8 (12.7%)	
BCG							
Yes	123 (62.1%)	75 (37.9%)	0.50	157 (79.3%)	3 (1.5%)	38 (19.2%)	0.48
No	8 (66.7%)	4 (33.3%)		11 (91.7%)	0 (0%)	1 (8.3%)	
Diabetes							
Yes	11 (44%)	14 (56%)	0.03*	150 (81.1%)	3 (1.7%)	32 (17.2%)	0.33
No	120 (64.9%)	65 (35.1%)		18 (72%)	0 (0%)	7 (28%)	
Hypertension							
Yes	13 (61.9%)	8 (38.1%)	0.56	152 (80.4%)	3 (1.6%)	34 (18%)	0.60
No	118 (62.4%)	71 (37.6%)		16 (76.2%)	0 (0%)	5 (23.8%)	

A, adult; E, elderly, 60 years of age or more; P, pediatric, <18 years of age; M, male; F, female; ND, not done.
**Statistically significant, P < 0.05.*

TABLE 3 | Concordance between TST and QFT-GIT among contacts only.

Test	QFT-GIT+	QFT-GIT−	Total
TST+	28	3	31
TST−	45	71	116
Total	73	74	147

k = 0.37.

TABLE 4 | Concordance between TST and QFT-GIT among all participants.

Test	QFT-GIT+	QFT-GIT−	Total
TST+	32	7	39
TST−	47	121	168
Total	79	128	207[a]

k = 0.39.
[a]Three TSTs were not read.

risk of progression, and perhaps more broadly for workers and their families. However, given the early risk of isoniazid (INH) toxicity, persons diagnosed with LTBI will need to be counseled and instructed to seek medical attention if they develop TB symptoms having declined INH treatment (31). Targeted testing of specific populations at high risk for progression to active disease, such as priority groups that are medically underserved or immune-compromised, may be helpful in curbing the progression to active TB disease (30). However, as has been previously noted, how to best target populations in a systematic manner is still unclear (32, 33).

Quantiferon TB gold In-Tube has previously been shown to have higher specificity compared with the TST when compared to patients with a positive culture, as well as a higher predictive ability that a test-negative individual will not develop disease or that a test-positive individual will progress (22). However, in this study, the proportion of individuals who tested positive by QFT-GIT was greater than those testing positive by TST, indicating that QFT-GIT may be more likely to correctly identify individuals as infected with TB compared to the TST. Given these results, it might be important to consider QFT-GIT among high-risk groups who may not have a detectable TST response, such as diabetics, HIV-coinfected, or individuals receiving steroids or immunotherapy (34). As an example, in populations (such as in Monterrey, Nuevo Leon, Mexico) where the incidence of TB is 20 per 100,000 habitants, this would mean that if each patient had a mean of five contacts, approximately 2,000 contacts would be located in a given year. Given the data from our study, we would then expect 1,200 false-negative test results with the TST. In essence, this means that many individuals who actually have LTBI are left untreated and may subsequently progress to active TB disease. This is particularly true in a population with many comorbidities that decrease immune function (16–19).

As per the authors' prior results from the Mexico side of the border, we found the TST and QFT-GIT to show a low level of concordance (27), although this was more often due to QFT-GIT+/TST− combinations, rather than the converse, as had previously been reported (27).

Since no systematic procedures have been in place to screen individuals for latent TB infection, we recommend a study to

examine the feasibility of providing infected individuals with testing, follow-up screening, and treatment services. The main objective of the proposed study would be to demonstrate the potential utility of the QFT-GIT test to detect LTBI as well as the feasibility of implementation among border populations. Since LTBI is not routinely diagnosed, testing on the border will potentially allow for diagnosis and follow-up prophylaxis. An earlier version of the QFT-GIT has previously been shown to be cost-effective for targeted screening in Mexico (35). Additionally, assessing the LTBI status along the border will both provide an assessment of whether QFT-GIT should replace the TST in routine practice and identify predictive risk factors for LTBI in these populations. These results could be of particular significance because of both the costs and adverse effects of LTBI treatment that might occur among false positives as well as the possible detection using QFT-GIT of immunocompromised individuals (36). We are continuing this work in Mexico and have begun following up on this work in the Yuma/San Luis region in the state of Arizona in the United States.

Limitations of our study include the cross-sectional nature of the results, self-selection of participants into the study, as well as the ability to generalize these results to other parts of the border – the rural farmworkers sampled are more economically stable and far less mobile than the migrant farmworkers observed in many parts of the US and may not be representative of other farmworker groups. Another important limitation is the lack of culture confirmation of TB disease in Mexico. Close contacts were thus selected based on both a self-report and a sputum smear (Ziehl–Nielsen) diagnosis among the active index case, which is not considered confirmatory. Nevertheless, given the high prevalence of LTBI among the close contacts, it is likely that many of the index cases were at some point infectious.

An association has previously been found between travel to the US and the presence of LTBI (8). Initiatives to increase TB awareness and testing and treatment of latent TB infection and disease are thus critical to TB elimination efforts along the border region, as populations repeatedly move and work on both sides of the border. Binational public health action to prevent individuals with LTBI from progressing to TB through proper screening and treatment is essential for TB control and prevention, just as has been advocated for active TB (20). As for active TB, we believe that partnerships should be facilitated between healthcare providers for LTBI across both sides of the US–Mexico border, considering the border region to be one single unit, with documentation of effective strategies for cross-border notification of movement and treatment coordination (7).

Additional next steps based on this work could include providing populations on the border with information around TB and LTBI, including training and informational materials. Increasing service utilization is a key challenge. Poor communication, government mistrust, and misunderstanding of the health system are some of the barriers to effective health service delivery. Explaining the flow of the clinic and health system process for those with TB exposure may provide a significant first step. Such education could be integrated with existing programs and community health center initiatives for individuals living on the border.

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Knowledge and beliefs about dengue transmission and their relationship with prevention practices in Hermosillo, Sonora

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Background: Dengue is an emerging threat in the U.S.-Mexico border region. Transmission has regularly occurred in Sonora, MX since 1982 but it was not until 2014 that cities directly on the Arizona-Sonora border had local transmission. One of the closest urban areas to have regular seasonal transmission is Hermosillo, SN, MX. Developing a better understanding of the knowledge and perceptions of dengue in close geographic proximity to the border can identify areas to target for prevention and control measures.

Methods: We conducted focus groups in six neighborhoods in Hermosillo, SN, MX; three with high-dengue transmission and three with lower transmission. Awareness of dengue and experience with dengue was common.

Results: In all focus groups, discussants reported knowing someone personally who had past dengue infection. We further identified several key ways that the perceptions of dengue transmission could influence the effectiveness of dengue control campaigns. First, there was confusion about how dengue is transmitted. While people associated dengue with mosquitoes, multiple modes of transmission were perceived including direct person-to-person transmission. In one focus group, discussants indicated a stigma surrounding dengue infection. The necessity to maintain cleanliness in their households was identified as a primary strategy to fight dengue; however, participants also noted the limited impact and their actions may have on transmission if there is lack of community support or governmental infrastructure to control neighboring and public spaces.

Conclusion: As dengue risk increases in the border region, more efforts should be made to clearly convey the single mode of transmission of dengue to avoid the development of stigma. More coordinated efforts should be made to not only control but also prevent dengue.

Keywords: dengue, transmission, focus groups, U.S.-Mexico border, knowledge, attitudes

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Introduction

The dengue virus, transmitted through the bite of the *Aedes aegypti* mosquito, has spread widely across the globe over the past several decades. An estimated 390 million people are infected every year (1). In Americas, dengue transmission has expanded rapidly in both geographic distribution and incidence (1). Dengue manifests with high fever, skin rash, headache, retro-orbital pain, and in severe cases it can lead to hemorrhaging and death. In Mexico, dengue is endemic with a seasonal peak following the monsoon rains. Transmission intensity generally declines moving north from the hot and humid southern region of Mexico (2) to the northern, more arid region of Mexico including the state of Sonora in the U.S. – Mexico border. Dengue has been reported in Sonora since 1982 (3). Most years Sonora has only a modest number of cases; however, in 2010, over 4,000 laboratory-confirmed cases were reported with 7 deaths (4, 5). In 2014, a similar outbreak occurred with several thousand laboratory-confirmed cases and hundreds of dengue hemorrhagic manifestations (6). Most research on dengue has focused on tropical areas where the transmission rate is high and the communities have extensive personal experience with the disease. Few studies have examined community awareness of dengue in arid regions, such as Hermosillo, SN, MX, which is experiencing increasing transmission.

The objectives of the study were (1) to assess knowledge and beliefs about dengue transmission and (2) to gain insight into dengue prevention practices in Hermosillo, SN, MX. Hermosillo is also the closest city to the Arizona-Sonora border with regular seasonal transmission. Six focus groups were conducted to obtain information from neighborhoods with diverse socio-economic status and different levels of dengue transmission. We present information on the knowledge and beliefs about preventing dengue in the household, accessing healthcare when ill, how dengue is transmitted, risk factors for dengue, and the role climate change has on transmission. The study is a binational collaboration between the University of Arizona and El Colegio de Sonora.

Theoretical Background

Wellbeing/illness/care (w/i/c) is not just a medical but also a cultural process. According to Menéndez (7), the w/i/c processes are "social facts on which social groups need to build actions, techniques, and ideologies... collective social meanings." Based on this premise, we recognize that collective knowledge is socially shared.

This social representations theory provides a theoretical framework to analyze the process of w/i/c surrounding dengue. The concept of social representation is a contribution of Serge Moscovici to the field of social psychology (8). It was first used in 1960s to refer to "an organized body of knowledge and a psychological activity through which people make the social and physical reality understandable," in other words, group interactions that make the unfamiliar familiar (9). This definition allows us to analyze the collective social thinking as a system of values, practices, and ideas that gives order and communication among people from a social group. This theory collates other concepts such as attitude, belief, image, stereotype, and perception, related to cognitive processes that create an "elaborated and shared social knowledge" (9).

According to Moscovici, three elements of social representation can be analyzed: (1) *information*, which is the quantity and quality of shared knowledge among social group members that drives their interpretation of reality; (2) the *field of representation*, which refers to the order and organization of the content of representation that integrates a social model and image of the representation; (3) *attitude* or behavioral elements related to the agreement or disagreement with the object of the social representation, in this case, dengue.

Based on these three elements of social representation, in this study, we identified knowledge and beliefs of participants in the six focus group discussions (FGDs) about the mode of dengue transmission and their relation to themes about prevention practices.

Methodology

Focus groups were carried out to identify current discussion, beliefs, values, and attitudes about dengue in neighborhood groups in Hermosillo, SN, MX (10). This study was reviewed by the University of Arizona Human Subjects committee and was deemed exempt. El Colegio de Sonora deferred IRB oversight to the University of Arizona. All focus group participants were read a disclosure statement but written consent was not obtained to minimize any connection between participants and responses. Participation was voluntary and did not include compensation. The use of qualitative methods can provide information on how the perception of dengue is constructed in these communities. These findings can inform public health interventions surrounding prevention and treatment and take into consideration the cultural significance and interpretation of concepts of well-being and illness in diverse environmental settings with differing levels of dengue transmission. This dynamic can be applied to similar communities in the border region that have yet to experience dengue transmission.

Study Methods

We conducted 6 FGDs; ranging from 6 to 10 participants. Common topics were explored among all focus groups to determine distinct perspectives and to identify areas of agreement and disagreement among communities (11). A semi-structured guide was created *a priori* to direct the discussion. Topics covered four primary areas (1) perception of risk of dengue, (2) awareness and knowledge of the disease, (3) factors perceived as increasing risk of disease, and (4) prevention and control strategies in which community members were engaged.

Sampling and Recruitment of Participants

Purposive, stratified sampling of neighborhoods was conducted to identify neighborhoods with different levels of socio-economic status, education, and dengue incidence. The selected neighborhoods with high incidence (HI) were Insurgentes, Minitas, and Periodista; while Fonhapo, Y Griega, and Altares were part of the low incidence (LI)[1] group (see **Table 1**; **Figure 1**).

[1]The abbreviations HI and LI will be used to refer high incidence and low incidence, respectively.

Initial support was sought from female community leaders and community center personnel (the FGDs were conducted in community centers). Walkthroughs in targeted neighborhoods were undertaken to invite people to the FGDs. Verbal informed consent of all of the participants was requested during which the voluntary nature of participation and the confidentiality of their information was reiterated. Permission to record the discussions was requested and they were subsequently transcribed and coded using the NVivo version 7 software.

Site Description/Socio-Demographic Context

Socio-demographic conditions of the six study areas are shown in **Table 2**. The neighborhoods with higher population density were Insurgentes (120 persons/hectare) and Las Minitas (98 persons/hectare) both categorized as high-dengue incidence areas. However, there were fewer differences among neighborhoods in terms of average persons per house, which ranged from 3.3 (Periodista) to 4.0 (Insurgentes).

The neighborhoods with the highest proportions of the population with no basic education were Y Griega (32.9%), Insurgentes (31%), and Las Minitas (36%). Moreover, these same neighborhoods had the highest proportions of the population with no healthcare services (24.7, 28.8, and 23.2%, respectively).

In terms of housing conditions, Insurgentes had the highest proportion of houses with no piped water (5.3%). Las Minitas had the highest proportion of houses with dirt floors (6.6%), no drainage (6.2%), and no electricity (2.1%). Although the Periodista neighborhood had better socio-demographic conditions, it was categorized as a high-dengue incidence area in Hermosillo.

TABLE 1 | Study area: six neighborhoods of Hermosillo, SN, MX.

Dengue incidence	Neighborhoods
High	Insurgentes
	Minitas
	Periodista
Low	Altares
	Fonhapo
	Y Griega

Participant Description

In this study, only self-reported heads of household were included since they are more likely to be the ones making healthcare decisions, including care practices and treatment seeking behaviors. In the 6 FGDs, a total of 68 people participated: 66 women and 2 men; the 2 men were from the Altares neighborhood. All the participants had at least one child. The average age of the participants was 38 years (the youngest was 22 and the oldest 74 years old).

Even though having suffered from dengue was not an inclusion criteria, seven of the participants had previously suffered from the disease; furthermore, in all six neighborhoods discussants

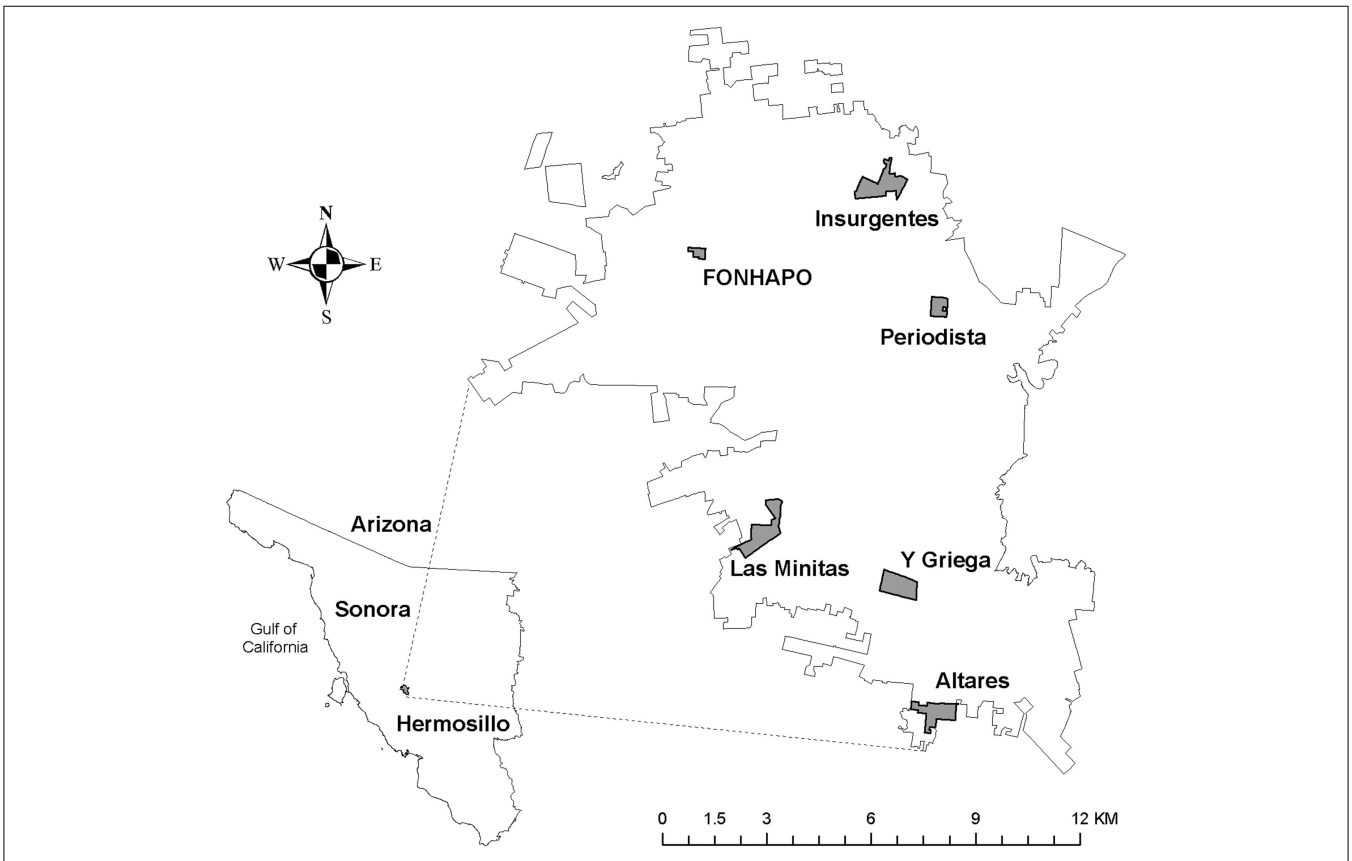

FIGURE 1 | Study sites, six neighborhoods identified in Hermosillo, SN, MX for carrying out the focus group discussions.

TABLE 2 | Socio-demographic characteristics of the six study areas by level of dengue incidence.

Socio-demographic characteristics	High incidence			Low incidence		
	Insurgentes	Periodista	Las minitas	Fonhapo	Y griega	Altares
Total population	9,653	1,178	3,824	1,105	1,988	11,377
Number of blocks	101	26	67	18	39	104
Total area (ha)	80	40	40	30	80	240
Population density	120	27	98	43	25	47
Population with incomplete basic school ≥15 (%)	31.0	11.3	36.0	19.8	32.9	16.5
Population with no healthcare service (%)	28.8	14.3	23.2	17.8	24.7	16.8
Occupied particular houses	2,389	358	981	292	527	3,057
Average/persons houses	4.0	3.3	3.9	3.8	3.8	3.7
No piped water (%)	5.3	0.6	3.7	0	0.8	1.8
No toilet (%)	1.2	0.6	2.8	0.3	1.1	0.5
No drainage (%)	1.3	0.6	6.2	0.3	1.1	1.4
Dirt floor (%)	6.2	0.6	6.6	1	2.7	1.3
No electricity (%)	0.8	0.6	2.1	0	0.9	0.6

Source: INEGI. 2010 Mexican Census.

reported knowing at least 1 person with a history of dengue diagnosis. Experiencing dengue directly or knowing someone who has had dengue may lead to a different perspective of the importance of dengue as compared to individuals who are only aware of the disease through information provided by health institutions or the media.

Results

The main empirical findings were centered on two major themes: (1) beliefs about the way dengue is transmitted, and (2) dengue prevention strategies in household and community environments. We further distinguish between those strategies that are undertaken at a family and/or community level, and those implemented by governmental institutions.

Beliefs About Transmission

Participants' beliefs about the way dengue is transmitted come from several sources: previous experiences with dengue itself, messages transmitted by the media, and preventive campaigns implemented by health institutions. In general, the participants were confused about the way dengue is transmitted. Despite identification of the mosquito as a source of transmission, alternative routes of transmission were also speculated, including person-to-person transmission. One participant commented, "*And they say it is contagious, right?*" (Y Griega-LI).

This idea of person-to-person transmission is played out in the collective imagination due to the participants' recollection that often more than two people fell ill in the same household during simultaneous or consecutive periods. The direct experience with several sick people led participants to question if the transmission was due to a mosquito bite or by person-to-person contact, as is shown in the next testimony:

> And when there are four people in the same place, are the four people infected by the same mosquito? or by others or how?... because my husband got sick (with dengue), later my mom got sick, later my aunt got sick, and so on four or five people living in the same house. It must be like the flu, I guess, right? (Altares-LI)

This statement suggests confusion regarding the transmission of dengue. It is unclear to participants if transmission is due to a mosquito bite or through direct contact with sick persons. They confuse the mechanism of dengue transmission with the transmission mechanism of other familiar viral diseases. This confusion is reinforced by knowing of multiple sick people within the same space-time. This idea is shared in the collective perceptions of participants from other neighborhoods and even among those with direct experience with dengue.

> My father in law got sick and one or two days later I got sick too (Insurgentes-HI).

As mentioned above, disease perceptions go beyond the medical model and into a system of social representation integrated by meanings and beliefs around the w/i/c process. Despite having direct experience with the biological process of getting sick, some of these beliefs about the contagious nature of dengue are supported by the participants because key information is not presented in a clear and simple way. This has been noted in other disease systems as well (12). This perception may impact prevention/care practices further down the pathway of w/i/c. Confusion about the vector–host relationship was also expressed. The mosquito was identified as the vector; however, it was also implicated in transmitting non-vector borne diseases.

> If you have the flu and a mosquito comes to bite you, and nothing happens to you but there is another weaker person. That's when he gets sick.
> And people said that our disease is transmitted and it is true... if a person has a disease, everything is transmitted to another person. That's true. That's why sick people should be isolated (Minitas-HI).

This belief is not only found in those with no experience with the dengue but even among those that have had direct or close experience with dengue. These data indicate the importance of doctor–patient communication. Beliefs about the disease could affect care, follow-up and future prevention practices. In two

FGDs, participants mentioned the need to "isolate" the ill from other people to avoid spreading the disease:

> Interviewer: "And how long did he remain sick (the son of one the informant)?"
> Participant: "Eight days and for him not to have contact with the other kids, but he has to get out of the house, and it can't be done."
> I: "What do you mean by keeping him isolated?"
> P: "Yes, like keeping him isolated. . . because it is contagious." (Altares-LI).

The idea of isolation was discussed in two ways, one way; as described earlier, was to avoid contact between those who are ill and other people to prevent direct transmission. Another way, points out the need to avoid contact between the sick person, the mosquito, and other people to whom the disease could be transmitted. This perception of the need for isolation was expressed as follows:

> The ill need to be covered. . . be isolated from other people, covered with a mosquito net, or something like that, right? So that the mosquito doesn't get back in and transmit it to the same people and have a period of 40 days of bed rest. (Insurgentes-HI)

This belief is mentioned throughout neighborhoods with both high- and low-dengue occurrence; the concept of isolation of ill people is part of social representations of dengue as a contagious disease. While dengue is not transmissible person-to-person, this concept is part of the local knowledge that people use to prevent disease and isolating the sick person may, in fact, reduce the number of mosquitoes that can be infected in a household. In one of the FGDs in a neighborhood with high occurrence, the participants contemplated blood contact as a way of transmitting the disease:

> But if you get a cut and just happen to grab it, I imagine that then yeah [you could get dengue], because your blood mixes with the other blood. (Periodista-HI)

This idea about transmission through blood may be related to knowledge about how prevention of other viral diseases requires avoidance of contact with bodily fluids like blood and saliva. An example is HIV/AIDS, which is strongly stigmatized (13, 14). These beliefs about dengue transmission are exacerbated when a person dies from dengue; this prompts other measures to avoid transmission, as is shown in the following testimony:

> They had to fumigate, throw away the bed of the kid, the clothes, they sterilized everything. . . do you know what people did? They distanced themselves, the people next door raised their wall, they protected themselves. . . maybe so that the same wouldn't happen, right? Because one has to protect oneself, but it was so obvious that people distanced themselves. And actually only a few of us went to his burial. (Altares-LI)

There is a need to broaden the discussion about stigma and transmittable disease, because even though the participant in Altares condemns the act of distancing oneself, she herself makes reference to the need to protect oneself. What does protecting oneself against dengue imply? This confusion about the mode of transmission is likely what has led to this type of community reaction.

In all of the FGDs, the mosquito is identified as the carrier of the disease, but the ways through which dengue can be spread leads to confusion. In the Altares FGD, the participants discussed ideas and beliefs related to modes of transmission. At the end of the session, they mentioned this:

> It is more about lack of information. For example, they told her that she could get infected, Others say that it is not contagious, that it should be [transmitted] by the bite. Then, what happens? Happens that we don't know if it is contagious or not, or if the mosquito with the dengue virus is the only one able to transmit the disease (Altares-LI).

These ideas about alternative mechanisms of dengue transmission come from previous experiences and socially shared images about the disease. They are based on practical experiences dealing with other diseases and using that experience to interpret reality. Only in the Fonhapo FGD (neighborhood with low occurrence) was transmission through the mosquito bite referred to in a more definitive way:

> I know that it is caused by a mosquito.
> I believe that if there is a person with dengue and a mosquito bites them and that mosquito bites you, then you have it. . . (Fonhapo-LI)

In the Fonhapo FGD, there was not only a participant with a dengue diagnosis but also some of the participants belonged to a neighborhood health committee, and they had received training and information about this and other diseases. Both of these factors could have led to increased awareness about dengue transmission as compared to the other FGDs. The information people have about forms of transmission and spread of dengue are confusing, building a diffuse field of representation, even among those who have suffered from dengue directly. This forms an attitude toward the disease that may lead to stigmatization of people (through the isolation).

Prevention Strategies

In general, cleanliness was one of the primary factors in dengue prevention that was mentioned by the FGDs in all neighborhoods with either high- or low-dengue incidence. For example:

> Cleaning our houses, yards, get Abate (Temephos) to use on the plants, the ones in pots, especially. (Insurgentes-HI).

The relationship between cleanliness and disease has a deep-rooted history, first introduced as the miasma theory that relates lack of cleanliness with certain diseases (15). In the case of dengue, the information shared by participants about the importance of cleanliness in prevention reiterates the need to maintain clean household spaces. Social messaging from the government may

also shape this perception of prevention. *Patio Limpio* is one of the primary government sponsored campaigns to reduce dengue in which community members are encouraged to keep a clean yard to prevent the creation of mosquito habitat (16). Differential risk is perceived for people who undertake or do not undertake these measures.

However, these preventive measures are not localized only at the household level. Cleanliness of the community environment was also considered important. But at the community level, there are limits to the residents' ability to undertake preventive actions. In all of the FGDs, the informants recalled situations of conflict with neighbors for not maintaining the cleanliness of their household space. Because of this, they recommended that the authorities impose a fine to coerce residents to keep household spaces clean*: For them to put some pressure on us, you'll see that with a good fine* (Y Griega-LI).

Despite individual efforts, participants recounted that their prevention actions do not have corresponding support at the institutional level; and there is the perception that actions to reduce mosquito densities are limited, as mentioned in the Altares FGD:

> We do a lot in the house so that the mosquito doesn't settle, so that it doesn't nest... but the government doesn't support it, because if it supported it, it would say, let's fumigate two or three times a year or prevent by giving Abate (Altares-LI).

At an institutional level, lack of preventive strategies has also been reported by health professionals in other regions of Mexico. These health professionals make reference to the importance of coordination among the community, health personnel, and the authorities (17). Maintaining cleanliness is, on one hand, viewed as an individual family's responsibility while conducting fumigation and Abate supply campaigns are recognized as prevention strategies that should be undertaken by authorities. Abate is a larvicide, Temephos, that can be applied to water storage containers including water used for drinking to kill the immature stage of the mosquito vector of dengue. Beyond these concrete forms of dengue prevention, there are others that are tied to structural conditions that place distinct social groups at varying degrees of risk based on their socio-economic conditions. For participants from Minitas and Insurgentes neighborhoods, both with historically high dengue occurrence, access to services such as piped water and drainage are central to their concepts of disease prevention.

> Although it doesn't depend so much on us, also the government, for example, they don't fix leaks or lack of drainage. In my case there is no drainage in the house and people have a moat and they dispose of the washing machine and bathroom water in the street... (Minitas-HI)

Lack of piped water in some neighborhoods has complicated the control of dengue. Some sections in both the Mintas and Insurgentes neighborhoods have piped water and drainage in the households; however, other households that have been established for more than 20 years still need to store water and request water truck services. These communities reported the importance of cleaning water storage containers and using Abate.

Regarding this discrepancy between knowledge and actual practices, Pinto (18) documents finding potential mosquito breeding sites within households, even though individuals indicate that they execute measures to keep their premises clean. This does not suggest that blame be placed on individuals, but rather it exposes how knowledge of what they are supposed to do may influence their reporting and intentions of prevention practices.

In both high- and low-transmission areas, participants recount that government campaigns are generally implemented to *control* an outbreak, not to *prevent* one from occurring. They note:

> It is very obvious when there is dengue in the neighborhood because we hear the fumigation truck afterwards. They only send it when there is a case of dengue, that's when they send the fumigation truck.

As soon as there is a case like that there is a guy dispensing abate (Fonhapo-LI). For the participants, these actions indicate a failure on the part of the public sector to proactively address and/or eradicate the problem. The results overall provide a voice to the people and their discussions can be used to help define community-level prevention strategies that simultaneously promote social participation.

Discussion and Conclusion

According to the Social Representation theory, the ideas, beliefs, and meanings about a social fact are the action guidelines of the social groups' practices. Participants were confused about the mode of dengue transmission. This was particularly true in communities where dengue cases clustered in space and time, giving the appearance of direct transmission. In these communities, there was the misconception that dengue can be transmitted directly from person to person.

This study revealed that community members perceived transmission to occur even through contact with inanimate objects, known as fomites. For example, practices undertaken when a person dies from dengue, such as throwing away the bed of the person and their clothes, are related to a social representation of dengue as a disease caused by a miasma. Additionally, the belief that dengue can be transmitted from person to person suggests individuals may be making an association between dengue and other infectious diseases, such as influenza with which they may have had a longer history and more experience. Thus, people incorporate information and beliefs from other diseases into their interpretation of the transmission of dengue (18).

Future information and/or education campaigns should emphasize that dengue can only be transmitted through the bite of an infected mosquito. The concept of isolating individuals from interacting with other people should be discouraged as they could lead to rejection or social isolation as one of the participants mentioned. Although this experience was not repeated in other FGDs, future investigations should inquire about the stigma related to the disease. These beliefs could influence the uptake

of prevention measures and may lead to stigma of dengue as is evidenced in some of the discussions. Stigma of a disease can complicate prevention and control efforts, alter treatment seeking behavior, and openness of discussion about the disease (19, 20). Even if stigma toward dengue is uncommon, alternative modes of dengue transmission are also mentioned in the FGDs where there were participants who had had dengue or who had cared for people who had had dengue. This reveals a significant gap in the information being passed from doctors to patients and their caregivers during diagnosis. These missed opportunities may also lead to negative outcomes due to a lack of follow-up of treatment and effective means of self-care.

Participants' perception that isolating individuals with dengue from mosquito bites would reduce further spread could provide a significant opportunity for furthering prevention. If a viremic individual sleeps underneath a bednet, this could theoretically reduce new dengue virus infections in local mosquito populations that might have come into contact with the viremic person. Recent evidence suggests bednets can effectively reduce dengue (21). This concept of isolation from mosquitoes as a preventive strategy arose spontaneously from FGD, suggesting that it might be an acceptable strategy for communities to employ if it were determined to be effective in this setting. It is clear that participants' felt individual action was the realm which they controlled and this type of household level protective measure could be acceptable.

We also found themes centered on social action, or more specifically, on the need to provide social participation in the prevention of the disease. Because of this, we look to emphasize the importance of this w/i/c process as a necessary component for the design of dengue prevention and eradication strategies. Under a social participation focus and according to Caballero (22) cultural significance should guide prevention practices, beyond the guidelines and biomedical prescriptions. Because community members recognized the need for action beyond just their own households, actions that mobilize the community toward social participation, such as clean-up campaigns may be successful. Social participation often varies by community, and higher rates of participation are associated with more success in reducing *Ae. aegypti* habitat in other regions of the world where dengue is endemic (23, 24). Clean-up for dengue control should involve a community-based approach, since the efforts at the household level do not reduce *Aedes* breeding sites in nearby areas (25). Strategies implemented in Mexico, such as Patio Limpio should be accompanied by educational messages about the storage of water, especially in communities where access to piped water is scarce and inappropriate storage practices may increase dengue risk. Also, dengue prevention should be approached using an environmental health model, promoting the active participation of the community, while improving access to public services (26). In this paper, we emphasize the social viewpoint of dengue and how it affects populations that do not have public services and basic health care.

Dengue is an emerging threat in the U.S.-Mexico border region. Understanding the community-level perceptions and beliefs about the disease can assist in developing strategies to improve understanding and reduce risk. As evidenced in 2014 when the first cases of dengue occurred in Caborca, San Luis Rio Colorado, and Nogales, dengue transmission is not static. Expansion into neighboring communities with less experience with dengue is going to occur and social connections with residents in areas with regular seasonal transmission, such as Hermosillo, will play a role in shaping the perspectives of the newly affected communities. Ensuring consistent and accurate messaging and engaging communities should be a critical component of all dengue prevention and control campaigns.

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Perceived HIV-associated stigma among HIV-seropositive men: psychometric study of HIV stigma scale

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Objectives: To assess the internal consistency and factor structure of the abridged Spanish version of the Berger HIV Stigma Scale (HSS-21), to provide evidence for its convergent and discriminant validity, and to describe perceived stigma in an urban population from northeast Mexico.

Methods: Seventy-five HIV-positive men who have sex with men (MSM) were recruited. Participants answered the Spanish versions of three Likert-type scales: HSS-21, Rosenberg's self-esteem scale, and the abbreviated version of the Zung's Depression Scale.

Results: HSS-21 showed high reliability and validity; its factor structure included four components: concern with public attitudes; negative self-image; disclosure concerns; and enacted stigma. The level of stigma was high in 27 out of 75 (36%) participants; nevertheless, the score found in the component related to disclosure concerns indicated high level of stigma in 68% of participants. The score of HSS-21 was positively correlated with the score of depression and negatively correlated with the score of self-esteem.

Conclusion: Results demonstrated high reliability for the HSS-21; correlations with other scales supported its validity. This scale demonstrated to be a practical tool for assessing stigma among Mexican HIV-positive MSM. High level of stigma was found only in the factor related to disclosure concerns.

Policy implications: Identifying HIV-associated stigma through a short, reliable, and validated instrument will allow the development of interventions that cope and manage stigma in HIV-positive MSM. HSS-21 distinguishes between different dimensions of stigma and will contribute to a better understanding of this phenomenon.

Keywords: HIV, AIDS, social stigma, men who have sex with men, public health, validation studies, psychometrics, Mexico

Introduction

As the human immunodeficiency virus (HIV) epidemic enters in its fourth decade, it is still regarded as an important public health issue worldwide. In turn, the social perception toward those individuals who live with HIV and AIDS (PLWH) continues to be a negative one. HIV's ways of transmission, its implications regarding the more traditional gender roles, and its association in the social imaginary to socially marginalized groups are the cause of stigma and discrimination in various circles (1). Stigma can be conceptualized as a "mark" (attribute) linking an individual with a set of undesirable characteristics (stereotypes) (2, 3). Three main sub-types of stigma have been described: *acted stigma* refers to the actual experience of acts of discrimination. *Perceived stigma* refers to the fear experienced by an individual in the presence of negative attitudes of a society toward a given attribute considered as undesirable, for example, an ethnic group, a disease, some personal behaviors, etc. A third sub-type is *internalized stigma* (*self-stigma)*, a term which includes the negative beliefs, opinions, and feelings that an individual holds toward a given attribute and toward himself/herself as a result of an internalization process of the societies' opinions and beliefs toward such attribute (4).

The term HIV- and AIDS-related stigma (HARS) makes reference to the negative appraisal that society as a whole give to any person who lives, or is believed to live with HIV and AIDS. In the psychosocial model developed by Berger et al. (5), the term "*perceived stigma*" is conceptualized as the perception of PLWH of social disqualification (incomplete social acceptance or even rejection), denial or limitation of opportunities (e.g., housing and employment offers, access to medical services, etc.), as well as negative changes to their social identity as a result of their HIV serostatus. This stigmatization process is also associated to other factors involved in judgment formation, such as sexual orientation, diversity of sexual partners, and use of illegal substances. This "blame the victim" attitude increases the isolation sensation and the interiorized sense of shame by the HIV infected individual (1).

From a public health perspective, HARS is an important factor that hinders voluntary testing for a timely diagnosis and treatment of HIV infection (1, 6, 7). HARS is also an obstacle for individual's serodiagnosis disclosure to their sexual partners, thus prolonging sexual risk behaviors and contributing to HIV transmission (6, 8); particularly in socially stigmatized and discriminated groups such as gay men and men who have sex with men (MSM), where social conditions generated by HARS lead MSM to participate in sexual risk behaviors with a higher risk of acquisition and propagation of HIV (9, 10). Thus, it is not a surprise that worldwide gay men and other MSM are 19 times more likely to be living with HIV than the general population (11). The incidence of HIV among MSM is rising in several parts of the world and Mexico is not the exception (11–13).

Likewise, HARS can also lead PLWH to postpone the use of medical public health services (6, 14), to a suboptimal adherence to antiretroviral therapy (15–17), and to a poor overall health (7, 18). Furthermore, HARS is associated with stress, anxiety, depressive symptomatology, and a decreased quality of life (19, 20). Aforementioned, HARS and its multiple consequences have a deep impact on the HIV epidemic development by reinforcing existing social inequalities with serious implications in public health policies.

Several instruments have been developed and validated to evaluate HARS in PLWH (5, 21–23). One of the best known is the HIV Stigma Scale (HSS-40) developed by Berger et al. (5). This scale has been used to assess perceived stigma among adult PLWH (24–27), likewise it has been adapted for PLWH children (28), and as well to assess perceived stigma of other diseases (29).

The HSS-40 scale assesses how PLWH feel in regards to four dimensions of stigma: (a) personalized stigma (or acted stigma), (b) individuals' concerns related to disclose his/her own HIV serostatus, (c) negative self-image (self-stigma), and (d) individuals' concerns related to public attitudes toward PLWH. The instrument has shown evidence of construct validity and high internal consistency for a set of 40 items ($\alpha = 0.96$), as well as for its factors ($\alpha = 0.90$–0.93) (20). The HSS-40 Spanish language translation, adaptation, and validation were done by Franke et al. (30), who also developed a shorter version (HSS-21). Likewise, as the complete scale version, the HHS-21 also showed evidence of construct validity ($\alpha = 0.84$ as a total score), and an adequate-to-high internal consistency ($\alpha = 0.68$–0.80) in assessing the four dimensions of stigma.

Since HARS not only represents one of the greatest obstacles in preventing new HIV infections but also deeply and negatively affects multiple aspects of HIV treatment, as well as the physical, mental, and emotional well-being of the PLWH (31), it becomes important to assess perceived stigma among PLWH. Considering the lack of adapted and validated instruments for HARS assessment that could improve current HIV and AIDS public health policies in México (e.g., Healthy Border 2010/2010 initiative), this study aims to evaluate the internal consistency, factorial structure, convergent, and discriminant validity of the HSS-21, as well as to describe HARS in a sample of HIV-positive MSM in Nuevo León (Mexican border state with U.S. Texas state).

Materials and Methods

Participants

Research involved 185 MSM and who collaborated with non-governmental and community-based organizations members of Nuevo Leon's Multisectoral STI/HIV/AIDS Response Board (MEMUREVIH). Inclusion criteria involved only male subjects who had had sexual experiences with other men, HIV-positive, aged 18 years or more, and who resided in Nuevo León, Mexican state. Taken into account that most HIV-positive MSM do not disclose their serological HIV status, this study adopted a non-probability sampling and a respondent-driven sampling. The sample consisted of 75 MSM who voluntarily declared to have an HIV-positive serodiagnosis, and who responded to a written or an online survey.

Recruitment

The data collection process lasted 60 days. Prior to the data collection process, collaboration was requested to the different non-governmental and community-based organizations members of MEMUREVIH to implement the survey in their office location and to their MSM affiliates. Four properly qualified surveyors

visited all sites and applied the written or online surveys on the previously agreed dates and time with the aforementioned organizations.

Procedure

In order to guarantee information input reliability, a digital survey database was created and submitted to a double-quality control check. All subjects were given both verbal and written information about the nature of the study, prior to responding to either the written or online questionnaire. The study procedures were undertaken according to ethical principles with the understanding and written consent of each subject. The study protocol was reviewed and approved by the ethics and research committee at the Tecnologico de Monterrey. Anonymity was guaranteed throughout the process, as well as confidentiality of both physical and electronic data. To access the *online* questionnaire, respondents accessed the survey via the website – (www.encuestas.no-ip.org), and none of the log-in data (IP address, etc.) was stored in the electronic access. Completion of either the written or online survey took an average of 25 min.

Instrument

The study used an analytical-type structured questionnaire (closed-ended questions and multiple response alternatives) in either written or online formats. The questionnaire explored socio-demographic characteristics, perception of HARS, self-esteem, and depression by means of the following Likert-type scales:

HIV Stigma Scale (HSS-21)

The abridged and Spanish-adapted version of the HIV stigma scale (HSS-21) used in this study was developed by Franke et al. (29); it is composed of 21 positively keyed items that are evaluated along a 4-point Likert-type scale (from 1 = strongly disagree to 7 = strongly agree), and was shown to be internally consistent. The sum of these items yields a total score, with higher scores representing a greater degree of perception of stigma.

Rosenberg Self-Esteem Scale (RSS-10)

It is composed of 10 items rated on a 4-point Likert-type scale. Possible scores range from 10 to 40, with higher ones indicating greater self-esteem. Among men, scores lower than 28 indicate low self-esteem (32).

Zung Depression Scale (ZDS-10)

Zung depression scale constituted of 20 items that involve affective, psychological, and somatic symptoms. Respondents indicate the frequency with which any symptom is experienced: the higher the score, the greater the degree of depressive symptoms. Diaz et al. (33) developed and validated a short, Spanish-adapted version of this scale (ZDS-10); the cut-off point to distinguish the presence of clinically significant depressive symptoms is 22 (sensitivity = 92.3%, specificity = 71.4%).

Statistical Analysis

Two psychometric properties of the items in HSS-21 were estimated: discrimination and internal consistency. Discrimination was estimated by the ability to differentiate in a statistically significant manner the high score group (percentile equal or >73) and the low score group (percentile equal or <27) in the sum score of the 21 items. A mean difference higher than two was considered to be significant, as well as a reliable discriminant property for each one of the assessed items. The internal consistency of the items was estimated by means of: corrected correlation, estimation of Cronbach's alpha excluding the item, and communalities. It was sought that the corrected correlation values were >0.30, that a non-decrease value of Cronbach's coefficient alpha after eliminating the item could demonstrated a reliable internal consistency, and that the communalities values were >0.20. Consistency was interpreted as high when it expressed a value equal or >0.70. The distribution fitting to a normal curve was contrasted using Kolmogorov–Smirnov test or Shapiro–Wilk test (34). All data were analyzed with SPSS® software (version 20.0).

The dimensional structure was studied by means of exploratory factor analysis; considering appropriate factoring characteristics: (a) that the determinant of the correlation matrix would tend to 0 ($|R| < 0.01$), (b) $KMO > 0.6$, and (c) that the null hypothesis of equivalence of the correlation matrix to an identity matrix by Bartlett's sphericity test would be rejected (34). The extraction was executed by generalized least squares (GLS) and the Promax rotation method of the factor matrix, adjusting the solution to four factors in agreement with the structure found in other studies (5, 30).

The correlations between factors were calculated by Pearson's correlation coefficient. The correlations between the HSS-21 scores and the EDZ-10 and RSS-10 scores were established by Spearman's *rho*. The significance of the score difference in the scales ZDS-10 and RSS-10 among the respondents who expressed or did not expressed HARS was carried out by the Mann–Whitney *U* test. The effect size was calculated by Cohen's d (34).

Results

Respondents

The 75 HIV-positive MSM respondents had an average age of 35 (SD = 7.38) years old. Median time since HIV infection diagnosis was 18 months. Average years in school was 13.93 (SD = 3.73) years. At the time of the survey 81.9% of men were working full time, while 10.6% worked part time, and 7.4% were unemployed. Moreover, despite of employment status, 69.2% indicated that they received a monthly income of ≤15,000 MXN ($ 1.146/867.45 €). Regarding sexual orientation, 88% of participants defined themselves as homosexual, 9.23% as bisexual, and 2.67% as heterosexual.

HSS-21 Descriptive Statistics

The HSS-21 mean total score was 76.28 (SD = 21.522) and its distribution was fitted to a normal curve (ZK-S = 0.67, $p = 0.20$). Considering the whole scale items, its mean can be transformed into a continued value between 1 and 7 or equal to 3.63. Using the same procedure, most items means scores were also between 2.5 and 4. However, eight items (V2, V6, V11, V12, V14, V15, and V17) had a mean value ≥4 (**Table 1**).

TABLE 1 | HSS-21 items' descriptive statistics, interpretation, homoscedasticity, discrimination, and internal consistency.

Item	Descriptive statistics						K–S		I	Homoscedasticity		Discrimination				Consistency		
	M	Mdn	Mo	SD	Sk	*K*	Z	*p*		*F*	*p*	MD	*t*	df	*p*	$r_{i,\,t-i}$	α_{t-i}	hi
V1	2.95	3	1	2.18	0.63	−1.03	0.29	0.00	2	1.67	0.20	2.7	−4.75	38	0.00	0.48	0.88	0.62
V2	4.73	5	5	1.84	−0.69	−0.17	0.30	0.00	3	18.10	0.00	2.5	−4.54	26.66	0.00	0.52	0.87	0.70
V3	3.85	3	3	2.23	0.16	−1.33	0.21	0.00	2	0.79	0.38	2.6	−3.86	38.00	0.00	0.38	0.88	0.70
V4	2.73	3	1	1.95	0.81	−0.47	0.28	0.00	2	2.10	0.15	2.2	−4.41	38.00	0.00	0.36	0.88	0.44
V5	3.21	3	1[a]	1.96	0.14	−1.36	0.25	0.00	2	0.05	0.82	2.4	−4.22	38.00	0.00	0.43	0.88	0.56
V6	4.07	5	5	1.65	−0.55	−0.39	0.33	0.00	3	3.63	0.06	2.6	−5.81	38.00	0.00	0.55	0.87	0.74
V7	2.52	1	1	1.83	0.83	−0.50	0.32	0.00	2	9.62	0.00	2.6	−5.64	30.76	0.00	0.56	0.87	0.71
V8	2.20	1	1	1.68	1.16	0.28	0.36	0.00	1	12.10	0.00	2.5	−5.54	29.67	0.00	0.55	0.87	0.62
V9	3.53	3	5	1.72	−0.16	−9.98	0.26	0.00	2	0.21	0.65	2.3	−5.04	38.00	0.00	0.40	0.88	0.64
V10	1.99	1	1	1.48	1.35	0.97	0.39	0.00	1	20.14	0.00	2.3	−5.68	23.89	0.00	0.56	0.87	0.68
V11	4.44	5	5	1.70	−0.52	−0.16	0.31	0.00	3	8.37	0.00	2.5	−5.15	32.44	0.00	0.55	0.87	0.73
V12	6.31	7	7	1.21	−1.94	4.45	0.42	0.00	4	3.35	0.07	0.5	−1.12	38.00	0.27	0.06	0.88	0.65
V13	3.00	3	1	2.00	0.67	−0.23	0.23	0.00	2	15.31	0.00	2.5	−4.86	26.32	0.00	0.41	0.88	0.60
V14	4.44	5	5	1.56	−0.50	0.55	0.32	0.00	3	0.02	0.90	2.7	−6.76	38.00	0.00	0.58	0.87	0.59
V15	4.23	5	7	2.39	−0.28	−1.48	0.21	0.00	3	9.30	0.00	4.4	−8.63	25.59	0.00	0.68	0.87	0.76
V16	2.16	5	5[a]	2.16	0.33	−1.12	0.21	0.00	1	6.81	0.01	2.7	−4.34	32.67	0.00	0.44	0.88	0.64
V17	4.84	5	7	2.13	−0.53	−0.99	0.23	0.00	3	6.73	0.01	3.3	−5.96	28.57	0.00	0.63	0.87	0.67
V18	3.87	3	3	2.07	0.44	−0.95	0.23	0.00	2	8.25	0.00	2.2	−3.47	31.76	0.00	0.32	0.88	0.77
V19	2.97	3	3	1.72	0.55	−0.36	0.24	0.00	2	2.25	0.14	2.1	−4.58	38.00	0.00	0.38	0.88	0.74
V20	3.37	3	1	2.02	0.26	−1.10	0.20	0.00	2	6.75	0.01	2.9	−5.22	29.50	0.00	0.53	0.87	0.62
V21	3.03	3	3	1.82	0.64	−0.30	0.25	0.00	2	9.76	0.00	3.1	−6.94	27.84	0.00	0.64	0.87	0.73

M, mean; Mdn, median; Mo, mode; SD, standard deviation; Sk, skewness; K, kurtosis; K–S, Kolmogorov–Smirnov test; p, probability; I, interpretation; 1, totally in disagreement; 2, in disagreement; 3, in agreement; 4, totally in agreement; MD, mean difference between the group with high scores and the group with low scores in the scale; df, degrees of freedom; $r_{i,t-i}$, correlation between the item and the scale; α_{t-i}, Cronbach's alpha coefficient after removing the item; hi, communality.

[a] *α_{t-i}, Cronbach's alpha coefficient after removing the item (significance $\alpha \geq 0.70$).*

Discrimination, Internal Consistency, and Validity of HSS-21 Items

HSS-21 presented a high internal consistency ($\alpha = 0.88$). Items expressed reliable internal consistency values, since deletion of none of them increased Cronbach's alpha coefficient. Items' corrected correlations ranged from 0.32 to 0.68 (except item V12, whose corrected correlation was 0.06). Initial communalities varied between 0.44 and 0.77, except for item V12 (MD = 0.05). Thus, with the exception of item V12, the remaining 20 items had reliable psychometric properties (**Table 1**).

HSS-21 Dimensional Structure

The correlation matrix of the 21 items of the HSS-21 scale showed adequate properties for factor extraction. Its determinant tended to 0 ($|R| < 0.01$), the *KMO* index was >0.6 ($KMO = 0.777$), and the null hypothesis of equivalence of the correlation matrix to an identity matrix by Bartlett's sphericity test was rejected [χ^2 (210, $N = 75$) = 752.413, $p < 0.001$]. Four components were extracted, which accounted for 60.51% of the total variance.

After rotating the factor component matrix by the Promax method and performing the extraction by GLS, four factors were found with a high internal consistency; they were constituted by positive indicators and factor loadings >0.32 (**Table 2**). The first factor (self-stigma, VNS) integrated by six items (V1, V4, V7, V8, V10, and V16) related to feelings of not being as good as others and emotion of guilt or shame ($\alpha = 0.81$). The second factor (acted stigma, VES) integrated by five items (items V13, V18, V19, V20, and V21) related to the consequences of others finding out the individuals' serodiagnosis and personal experiences of rejection ($\alpha = 0.83$). The third factor (concern about public attitude toward HIV and AIDS, VPA) integrated by five items (V5, V6, V9, V11, and V14) related to what PLWH believe that other people could think of them if they knew their serostatus ($\alpha = 0.83$). The fourth factor (PLWH concern about HIV serodiagnosis disclosure, VDC) integrated by five items (V2, V3, V12, V15, and V17) related to the perceived need of controlling HIV serodiagnosis information ($\alpha = 0.76$). Item 21 had a high factor loading in two factors. Nevertheless, including it in the second factor increased its internal consistency from 0.80 to 0.83, due to its content item 21 is highly related to acted stigma. The correlations between factors were medium ($r = 0.32$–0.46), with the exception of the correlation between factors 3 and 4, which was small ($r = 0.21$).

HSS-21 Factors' Descriptive Statistics

The score range for all items is from 1 to 7 and the higher score results are correlated to a high stigma. Considering the number of items in each of the four factors, their mean can be transformed into a continuous value within 1 and 7. Such value can be interpreted as the answer label for each item, dividing the answer range value by four intervals of constant amplitude. **Table 3** exposes factor descriptive statistics.

The mean of VNS can be interpreted as a non-definitive disagreement with HARS dimension. Means comparison among the 36 (48%) respondents who expressed stigma [$M = 5.04$, SD = 0.59; 95% IC = (4.85, 5.24)] and the 39 (52%) respondents who did not express stigma [$M = 3.02$, SD = 0.74; 95% IC = (2.78, 3.26)] were statistically significant ($p < 0.01$).

Also, VES mean can be interpreted as a non-definitive disagreement with HARS dimension. The comparison of means among

TABLE 2 | HSS-21 factors' loadings from exploratory factor analysis.

	Item	Factor			
		1	2	3	4
V6	Most people believe a person who has HIV is dirty	0.88			
V11	Most with HIV are rejected when others learn I have HIV	0.77			
V9	Most people think a person with HIV is disgusting	0.73			
V5	People with HIV are treated like despicable persons	0.71			
V14	Most people are uncomfortable around someone with HIV	0.59			
V21	People seem afraid of me because I have HIV	0.53			0.44
V7	Having HIV makes me feel unclean		0.93		
V8	I feel set apart, isolated from the rest of the world		0.71		
V10	Having HIV makes me feel I am a bad person		0.68		
V1	I feel guilty because I have HIV		0.67		
V4	I feel I am not as good as others because I have HIV		0.36		
V16	Having HIV in my body is disgusting to me		0.32		
V2	Telling someone I have HIV is risky			0.77	
V15	I worry that people may judge me when they learn I have HIV			0.76	
V17	I worry people who know I have HIV will tell others			0.69	
V3	I work hard to keep my HIV a secret			0.65	
V12	I am very careful whom I tell that I have HIV		−0.39	0.50	
V18	I regret having told some people that I have HIV				0.93
V19	As a rule, telling others has been a mistake				0.92
V20	Some people act as though it is my fault I have HIV				0.51
V13	Some people who know have grown more distant	0.37			0.48

Extraction method: GSL. Rotation method: Promax with Kaiser normalization.

the 23 (30.7%) respondents who expressed stigma [$M = 4.96$, DE = 0.69; 95% IC = (4.66, 5.26)] and the 52 (69.3%) respondents who did not express stigma [$M = 2.34$, SD = 0.91; 95% IC = (2.09, 2.60)] was statistically significant ($p < 0.01$).

The VPA mean can be interpreted as a non-definitive disagreement with HARS dimension. The comparison of means among the 40 (53.3%) respondents who expressed stigma [$M = 4.99$, DE = 0.65; 95% IC = (4.78, 5.20)] and the 35 (36.7%) respondents who did not express stigma [$M = 2.74$, SD = 0.75; 95% IC = (2.48, 3.00)] was statistically significant ($p < 0.01$).

Likewise, VDC mean can be interpreted as a non-definitive disagreement with HARS dimension. Means comparison among the 51 (68%) respondents who expressed stigma [$M = 5.59$, DE = 0.94; 95% IC = (5.32, 5.85)] and the 24 (32%) respondents who did not express stigma [$M = 3.10$, SD = 0.74; 95% IC = (2.79, 3.41)] were statistically significant ($p < 0.01$).

ZDS-10 Descriptive Statistics

ZDS-10 scale had an average score of 20.48 (SD = 4.82) with a non-normal distribution curve (ZK-S = 0.11, $p = 0.02$). Likewise, scores among the 48 respondents who did not express stigma showed a non-normal distribution curve (ZS-W = 0.93, $p = 0.01$). Whereas, distribution among the 27 respondents who expressed stigma was adjusted to a normal curve (ZS-W = 0.95, $p = 0.17$).

After running the Mann–Whitney *U* test, it was found that the respondents with HARS had significantly higher scores in ZDS-10 [$M = 22.41$, SD = 4.40, $n = 27$; 95% IC (20.67, 24.15)] than the scores of the respondents without HARS [$M = 19.40$, SD = 4.74, $n = 48$; 95% IC (18.02, 20.77)], with a medium size effect of stigma on the total ZDS-10 score; $Z = -2.37$, $p < 0.02$, $d = 0.65$, 95% IC (0.16, 1.13).

Of the 48 HIV-positive MSM respondents who did not express HARS, 14 (29.17%) presented clinically significant symptoms of depression, while 34 (70.83%) did not show such symptoms. Of the 27 respondents who expressed HARS, 16 (59.26%) showed clinically significant symptoms of depression, while 11 (40.74%) did not showed such symptoms.

RSS-10 Descriptive Statistics

The mean in the total score of the RSS-10 was 34.43 (SD = 4.78) with a non-normal distribution curve (ZK-S = 0.20, $p < 0.0.001$). Similarly, the distribution of the scores between the respondents who did not express stigma (ZS-W = 0.87, $p = 0.001$) and those who did express stigma (ZS-W = 0.88, $p = 0.007$) presented a non-normal distribution curve.

After running the Mann–Whitney *U* test, it was found that the HIV-positive MSM respondents who did not express HARS had significantly higher RSS-10 scores [$M = 35.53$, SD = 3.62, 95% IC (34.50, 36.60)] than those of the respondents who did express HARS [$M = 32.48$, SD = 5.93, 95% IC (30.14, 34.83)], with a medium size effect of stigma on the total RSS-10 score; $Z = -2.26$, $p < 0.03$, $d = -0$–67, 95% IC (−1.14, −0.18).

Of the 48 respondents who did not express HARS, one (2%) respondent presented a low self-esteem and 47 (98%) presented a high self-esteem. Of the 27 respondents who expresses HARS, six (22.2%) respondents presented a low self-esteem and 16 (77.8%) presented a high self-esteem.

Validity Evidences

The total HSS-21 score expressed convergent validity with a significant and direct correlation to the ZDS-10 total score. The factors that expressed a high correlation were VNS ($\rho = 0.336$, $p < 0.001$) and VES ($\rho = 0.252$, $p < 0.01$). Also, the total HSS-21 score demonstrated discriminant validity with significant and reverse correlation to RSS-10 total score. HSS-21 factors showed correlations from small (VNS, VDC, and VES) to trivial (VPA) with the RSS-10, but did not reached a statistical significance.

TABLE 3 | HSS-21 factors' descriptive statistics.

Factor	Descriptive statistics						K–S		Interpretation
	M	Mdn	Mo	SD	Sk	*K*	*Z*	*p*	
VNS	3.99	3.83	3.83	1.22	−0.17	−0.66	0.10	0.07	In disagreement
VES	3.15	3	1	1.48	0.56	−0.40	0.10	0.07	In disagreement
VPA	3.94	4.2	5	1.33	−0.22	−0.71	0.18	0.01	In disagreement
VDC	4.79	4.6	4.6	1.46	0.81	−0.47	0.10	0.07	In agreement

M, mean; Mdn, median; Mo, Mode; SD, standard deviation; Sk, skewness; K, kurtosis; K–S, Kolmogorov–Smirnov test; p, probability; VNS, negative self-image; VES, enacted stigma; VPA, public attitude; VDC, disclosure concerns.

Discussion

Stigma can be conceptualized as a deeply degrading attribute that binds an individual with one or more undesirable characteristics and finally diminish socially his/her self-image. Concern about stigma is widely extended among PLWH, although this is not universal (35). The results of the study determined that the Spanish-adapted version of the HSS-21 scale developed by Franke et al. (30) has good overall internal consistency, reliability, and psychometric characteristics among the sub-population studied (HIV-positive MSM).

From the HSS-21 total scores, more than half (64%) of the HIV-positive MSM respondents did not express HARS. However, VDC factor scores showed that 68% of the respondents perceived HARS. The HSS-21 score had a significant and direct correlation with the ZDS-10 total score, showing evidence of convergent validity. Likewise, it also presented a significant and reverse correlation with the RSS-10 total score, demonstrating evidence of discriminant validity. The respondents who perceive HARS had significantly higher scores ($p < 0.02$) in ZDS-10 and significantly lower scores ($p < 0.03$) in RSS-10 than the respondents who do no perceive HARS.

There are only a small number of published studies on interventions and programs designed to reduce HARS. Given the difficulties in defining and measuring stigma, few such interventions and programs described in the literature have been rigorously evaluated in developing countries (10, 21). One of the limitations of this study – typically found in other HIV-related studies – is the fact that it was conducted with a small and convenience sample. For this reason, the study does not offer sufficient data to assess the true meaning of the stigma scores of the scale, and herein reported results and derived conclusions should be considered as hypothetical for similar social groups, which limits the ability to apply it to the general PLWH population, or to draw conclusions about the impact of perceptions of HARS in Mexico. Moreover, HARS data were obtained through a self-reported evaluation and therefore they can be different from those obtained through an interview, projective tests, or psychophysiological tests, etc. Also, sexual orientation, gender identity, social, economic, and cultural differences need to be assessed. Nevertheless, the findings can serve as the basis for HARS measurement research with Spanish-speaking populations in Mexico and other countries.

To improve our understanding of HARS, it is necessary to focus on a series of distinguishable variables across different societies. Implementing HARS evaluation in PLWH is important, as it can lead to identify clinically significant symptoms of depression which could have a negative influence in treatment adherence (15–17), it could also limit the use of public health services (36, 37) and limit social support seeking due to fear of rejection (38, 39). Identifying perceived stigma among PLWH through a short, reliable, and validated instrument provides data that will help governments make efficient and effective use of resources spent on stigma and discrimination reduction as well as the opportunity to develop public health interventions that help PLWH to cope and manage stigma. The implementation and evaluation of these strategies will benefit from the availability of a widely validated and user-friendly psychometric instruments to assess the HARS.

This study was the first to use the Spanish-adapted version of the HSS-21 scale in HIV-positive MSM in Mexico, and the findings help move from evaluating HARS to implementing reduction interventions to mitigate the impact of HARS and promote empowerment among HIV-positive men and to enhance the sexual health of gay and bisexual men through a community-based process involving the MEMUREVIH (program developed by a consortium of members who represent four sectors: academia, government, key population, non-governmental and community-based organizations in Nuevo León state). Through study results, the MEMUREVIH intervention aimed to diminish HARS, create greater support for HIV-positive men, make disclosure safer and easier, discourage reliance on disclosure to prevent HIV transmission and encourage testing. The contact hypothesis suggests that facilitating social interaction between PLWH and others (e.g., healthcare providers, friends, family, co-workers, etc.) may help to reduce prejudice, stereotypes, and discrimination among others via the mechanisms of increased knowledge of HIV, reduced social anxiety regarding PLWH, and increased empathy toward PLWH (40). The corresponding author is currently working on MEMUREVIH intervention data.

As HARS places people at a substantial social disadvantage, it increases their exposure to risks and limits access to protective factors, potentially adding to their burden of disease or disability. Stigma not only predisposes PLWH to greater HARS and discrimination but also critically reinforces stereotyping and status loss of all them, regardless of how they may have acquired the infection. In such manner, underestimating the insidious power of stigma jeopardizes the success of public health programs aimed to prevent, timely detect, and treat HIV and AIDS. HSS-21 scale distinguishes different dimensions of stigma and contributes to better understand HARS impact in public health-related issues. Furthermore, the intention is also to encourage researchers to

consider additional ways to reduce stigma and discrimination, acknowledging and addressing HARS challenges with research methodology; thereby, creating a sense of timeliness and urgency for the development and testing of HARS, and thus, contributing with discrimination reduction efforts. It is only with stronger, more nuanced understandings of HARS that we will be able to break the associations between HIV stigma and indicators of poor affective, behavioral, and physical health and well-being among PLWH within interventions.

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Barriers to disaster preparedness among medical special needs populations

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A medical special needs (MSN) assessment was conducted among 3088 respondents in a hurricane prone area. The sample was female (51.7%), Hispanic (92.9%), aged >45 years (51%), not insured for health (59.2%), and with an MSN (33.2%). Barriers to preparedness were characterized for all households, including those with inhabitants reporting MSN ranging from level 0 (mild) to level 4 (most severe). Multivariable logistic regression tested associations between hurricane preparedness and barriers to evacuation by level of MSN. A significant interaction effect between number of evacuation barriers and MSN was found. Among households that reported individuals with level 0 MSN, the odds of being unprepared increased 18% for each additional evacuation barrier [OR = 1.18, 95% CI (1.08, 1.30)]. Among households that reported individuals with level 1 MSN, the odds of being unprepared increased 29% for each additional evacuation barrier [OR = 1.29, 95% CI (1.11, 1.51)]. Among households that reported individuals with level 3 MSN, the odds of being unprepared increased 68% for each additional evacuation barrier [OR = 1.68, 95% CI (1.21, 1.32)]. MSN alone did not explain the probability of unpreparedness, but rather MSN in the presence of barriers helped explain unpreparedness.

Keywords: Hispanics, disaster preparedness, evacuation barriers, medical special needs, hurricane

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Introduction

Lack of preparedness for natural disasters stresses an already overwhelmed public health and medical system when disaster strikes (1, 2). For individuals, disaster preparedness involves the steps taken beforehand to identify and assemble adequate supplies for household members, including food, water, and medical needs, as well as establishing an emergency plan that should include possible evacuation shelters (3). However, lack of disaster preparedness is common and can increase potential damage, injury to self, and mortality (4). At the system level, there is a need for greater understanding of how organizations charged with managing disasters interact with the public before and during an emergency situation, and how these entities respond (1). For professionals responsible for directing public health disaster responses, preparedness includes identifying which populations may be most affected by the disaster and who will need priority responses to avert danger (5). Factors to consider include limited access and exposure to natural, technical, and social resources (5) and disproportionate access to medical care during extreme weather events (6).

The National Center for Emergency Medical (2) emphasizes that an effective and efficient evacuation requires the rapid assessment of individuals in need of assistance, the subsequent evacuation of those individuals, and their proper care (7). For example, individuals with limited

financial resources may find it difficult to purchase extra food, water, or medications in preparation for a disaster and in the event of an evacuation. Others in need may include those with poor health, lack of social support networks, without knowledge of evacuation centers, without access to reliable transportation, or without knowledge of what to do in the event of an evacuation (8).

Almost 50%of adults in the US do not have emergency supplies in case of a disaster (9). This is particularly true among Hispanics who have been found to be the least prepared compared to other racial and ethnic groups (10–13). Previous studies have shown that Hispanics are less likely compared to Whites and Blacks to have a 3-day food supply, 3-day supply of medication, a working battery-operated radio, or a flashlight (11). Primarily Spanish-speaking Hispanics, compared to primarily English-speaking Hispanics also report lower levels of preparation in these four categories, but are more likely to have an emergency evacuation plan and 3-day supply of water (11). Differences in disaster preparedness have been documented (11–15), but few studies have examined if the presence of medical special needs (MSN) influences disaster preparedness.

The Special Needs Assessment for Katrina Evacuees (SNAKE) project, conducted by the National Organization on Disability, shed light on numerous barriers and policies associated with negative experiences shared by individuals with disabilities who evacuated to shelters when Hurricane Katrina struck the Gulf Coast in 2005 (16). Barriers included access to reliable and accessible shelters with protocols in place to provide services for individuals with disabilities and MSN (16). Individuals with MSN have decreased access to appropriate transportation for evacuation (17), may require additional equipment that would need transportation (18), and have limited access to an appropriate host shelter due to the level of care required (17).

Research on vulnerable populations and disaster preparedness geographically is limited (10, 19, 20). Previous studies have surveyed the general Texas population for evacuation intentions and experiences (21, 22). An assessment of disaster preparedness determined that slightly more than half (59%) of residents in this three county area known as the Texas Rio Grande Valley stated that they were prepared for a hurricane (13). Previous research has not reported differences between disaster preparedness and MSN levels of vulnerability among a population in a disaster prone region.

This study aims to characterize disaster preparedness and its barriers among vulnerable populations living in a hurricane prone area. Specifically, we will compare disaster preparedness and barriers to evacuation across households reporting MSN and households without MSN. We hypothesize that households with higher levels of MSN will experience more barriers to evacuation and less preparedness for disasters.

Materials and Methods

Sample

The study sample included household respondents surveyed as part of the Medical Special Needs Assessment of the Lower Rio Grande Valley (23). The survey was administered to 3088 individuals in 172 census tracts and was weighted to represent the 696,349 individuals across Cameron, Hidalgo, and Willacy Counties, Texas. These are counties located on or near the Texas Coastline, an area prone to hurricanes. The methods for data collection have previously been reported (12, 23).

The assessment was conducted by trained community health workers who interviewed, with signed informed consent, one adult per household. Thirty surveys were completed from each of 100 census tracts and were administered in English or Spanish, depending upon the respondent's preferred language.

Measurement of Medical Special Needs

Previously defined levels of MSN, customary in the state of Texas in 2007 (23), are described in **Table 1** and were measured in the current study. MSN level 5 includes individuals in institutional settings, such as hospitals, long-term care facilities, assisted living facilities, or state schools, and is not assessed in the present study because data collection was conducted solely in homes.

Measurement of Disaster Preparedness

To assess disaster preparedness, respondents were asked "How prepared are you if a major hurricane were to strike your community during the next hurricane season?" Responses of "very" and "somewhat" were identified as "prepared" for a hurricane. Responses of "not too" and "not at all" were identified as "not prepared" for a hurricane.

Measurement of Barriers

A total of 15 barriers to evacuation for a hurricane were assessed based on a previous instrument (24). A scale score was calculated by summing the number of affirmative responses to each barrier. This scale score was used in multivariable analysis models.

Sociodemographic Variables

Sociodemographic variables used to characterize the population included gender, age, educational attainment (elementary/middle school, high school, or college/technical), marital status (married or not married), ethnicity, acculturation (high adherence with Spanish, biculturalism, or high adherence with English), health status (poor, fair, good, very good, or excellent), health insurance, homeowner/renter's insurance, household size, household income, adults in household ages 65 years and older, children in household under the age of 10, cash savings, and distance to shore.

TABLE 1 | Level of medical special needs (MSN).

No special needs: no medical needs and no required assistance
Level 0: no medical needs, but require transportation assistance for evacuation
Level 1: dependent on others for routine care (eating, walking, toileting, etc.) and children under 18 without adult supervision
Level 2: physical or developmental disabilities, such as blindness, significant hearing impairment, amputation, deafness, and mental retardation
Level 3: require assistance with medical care administration, monitoring by nurse, dependent on equipment, assistance with medications, and mental health disorders
Level 4: persons outside an institutional facility care setting, who require extensive medical oversight (i.e., IV, chemotherapy, life support equipment, morbidly obese)

Levels defined as by the State of Texas Hurricane Evacuation and Mass Care Plan, 2007.

Statistical Analysis

Population estimates for the parameters and their SEs were generated by taking into account the study design features and incorporating the sampling weights. For descriptive purposes, categorical variables were summarized in unweighted frequencies and weighted percentages. Continuous variables were summarized using weighted means and their SEs. In univariable weighted logistic regression analysis, we determined association between variables and the dichotomized variable for self-reported preparedness. Results are presented with weighted odds ratios and their 95% confidence intervals. In addition, an ordinal variable with the six levels of MSN was created. Since the assumptions for ordinal logistic regression did not hold, weighted multinomial logit models were fitted to obtain the odds of higher levels of MSN versus no MSN. We built a weighted multivariable logistic regression model for self-reported preparedness (no/yes), including variables with Rao-Scott design-adjusted chi-square test statistics p-value <0.10 from the univariable analysis. Harmful multicollinearity between the independent variables considered in the model was not found (VIF < 1.5). The linearity assumption in the logit for continuous variables was checked. The contribution of interactions to the fit of the model was tested using design-adjusted Wald test significance level $p < 0.05$ and the statistically non-significant interactions were removed from the model. The preliminary final model was tested for goodness-of-fit applying Archer and Lemeshow's F-adjusted mean residual goodness-of-fit test using (25). All other weighted analyses were conducted using (26). All statistical testing was two-sided and was performed using a significance (alpha) level of 0.05.

Results

The final sample for this study consisted of a total of 2981 respondents (**Table 2**). Slightly more than half of respondents were female (51.7%), aged 45 years or older (51%), with a mean age of 46.9 (SE 0.79). Only 18.3% of respondents had a college or technical education and 73.5% were married. The sample was predominantly Hispanic (92.9%) with high acculturation levels of adherence to the Spanish language (58.4%). A low percentage (5.1%) of respondents was in excellent health, 59.2% were without any form of health insurance, and 61.4% were homeowner uninsured. The majority household size was between 3 and 5 people (58.7%) with a household income below $35,000 (87.6%). Among households, 12.9% had at least one adult aged 65 or older; 40.8% had at least one child under the age of 10; 40.8% had at least $300 in cash savings; the mean distance from the shore was 41.6 miles (SE 1.03); and 66.8% had no MSN household members.

On average respondents with <8 years of education had significantly higher numbers of evacuation barriers (mean 6.2, SE 0.16, $p = 0.0406$) in comparison to those with a college or technical education (mean 5.4, SE 0.35) (**Table 2**). In addition, respondents at any level of self-reported health conditions (poor: $p = 0.0002$, fair: $p < 0.0001$, good: $p < 0.0001$, very good: $p = 0.0071$) reported significantly higher average number of evacuation barriers compared to those with excellent self-reported health. Smaller households of size 1–2 people ($p < 0.0001$) or 3–5 people ($p = 0.0021$) reported significantly lower average number

TABLE 2 | Demographics characteristics of respondents and households and reported barriers to evacuation ($n = 2981$).

	n (weighted %)	Total number of evacuation barriers Mean (SE)	Difference in mean *p*-Value
RESPONDENT LEVEL			
Gender			
Male	760 (48.3)	5.8 (0.23)	0.6728
Female[a]	2221 (51.7)	5.9 (0.12)	
Age			
18–44 years[a]	1460 (49.0)	5.8 (0.23)	0.7899
≥45 years	1520 (51.0)	5.9 (0.12)	
Education			
≤8 years	1123 (38.5)	6.2 (0.16)	0.0406
High school	1235 (43.2)	5.7 (0.22)	0.5145
College/technical[a]	529 (18.3)	5.4 (0.35)	
Marital status			
Not married	901 (26.5)	5.5 (0.21)	0.003
Married[a]	2080 (73.5)	6.0 (0.16)	
Ethnicity			
Hispanic	2738 (92.9)	5.9 (0.17)	0.1317
Non-Hispanic[a]	243 (7.1)	5.1 (0.52)	
Acculturation			
Spanish	1780 (58.4)	6.0 (0.14)	0.315
Bicultural	903 (32.1)	5.8 (0.26)	0.5429
English[a]	267 (9.5)	5.4 (0.50)	
Health condition			
Poor	65 (1.9)	6.4 (0.33)	0.0002
Fair	537 (15.4)	6.2 (0.26)	<0.0001
Good	1677 (57.4)	6.0 (0.13)	<0.0001
Very good	518 (20.1)	5.6 (0.38)	0.0071
Excellent[a]	163 (5.1)	4.4 (0.39)	
Health insurance			
Insured	1213 (40.8)	5.7 (0.21)	0.3388
Not insured[a]	1758 (59.2)	5.9 (0.18)	
Homeowner's insurance			
Insured	1140 (38.6)	5.6 (0.23)	0.1927
Uninsured[a]	1620 (61.4)	6.0 (0.21)	
HOUSEHOLD LEVEL			
Household size			
1–2 people	710 (24.0)	5.3 (0.21)	<0.0001
3–5 people	1737 (58.7)	5.9 (0.20)	0.0021
>5 people[a]	527 (17.4)	6.5 (0.17)	
Income			
<10,000	902 (32.8)	6.2 (0.18)	0.1262
10,000 to <15,000	676 (27.9)	6.1 (0.30)	0.1944
15,000 to <25,000	394 (17.5)	5.7 (0.22)	0.421
25,000 to <35,000	217 (9.7)	5.7 (0.32)	0.4481
≥35,000[a]	278 (12.4)	5.3 (0.53)	
Adults >65 years			
≥1 person	430 (12.9)	6.0 (0.19)	0.3029
Children <10 years			
≥1 person	1270 (41.6)	5.9 (0.18)	0.2976
Cash savings			
≥$300	1164 (40.8)	5.6 (0.21)	0.0527
Level of medical needs			
No medical needs	1976 (66.8)	5.5 (0.19)	0.1023
Level 0	500 (16.1)	6.4 (0.23)	0.9401
Level 1	251 (9.2)	6.0 (0.34)	0.4623
Level 2	66 (2.0)	5.9 (0.38)	0.4195
Level 3	83 (3.3)	8.4 (0.46)	0.0008
Level 4[a]	78 (2.6)	6.4 (0.53)	

[a] *Reference group.*

TABLE 3 | Individual level characteristics by hurricane preparedness.

	n (weighted %)	Not prepared (weighted %)	Prepared (weighted %)	OR (95% CI)
Gender				
Male	747 (40.5)	268 (59.5)	479 (50.2)	0.85 (0.70, 1.03)
Female[a]	2176 (51.5)	907 (45.58)	1269 (55.5)	
Age				
18–44	1442 (49.3)	652 (48.6)	790 (51.4)	**1.63 (1.30, 2.05)**
45–75+[a]	1480 (50.7)	522 (36.7)	958 (63.3)	
Mean (SE)	46.9 (0.8)	44.0 (1.0)	49.0 (0.8)	**0.98 (0.975, 0.989)**
Education				
≤8 years	1097 (38.5)	459 (44.2)	638 (55.8)	**1.45 (1.01, 2.09)**
HS diploma	1213 (43.2)	508 (44.6)	705 (55.4)	**1.48 (1.04, 2.10)**
College/technical[a]	521 (18.3)	173 (35.3)	348 (64.7)	
Marital status				
Not married	877 (26.3)	353 (40.7)	524 (59.3)	0.90 (0.72, 1.12)
Married[a]	2046 (73.7)	882 (43.3)	1224 (56.7)	
Ethnicity				
Hispanic	2681 (92.8)	1101 (43.5)	1580 (56.5)	1.68 (0.99, 2.86)
White[a]	242 (7.2)	74 (31.3)	168 (68.7)	
Acculturation				
Spanish	1748 (58.6)	750 (45.6)	998 (54.4)	1.32 (0.81, 2.14)
Bicultural	880 (31.8)	332 (38.1)	548 (61.9)	0.97 (0.59, 1.58)
English[a]	266 (9.6)	82 (38.9)	184 (61.1)	
Health condition				
Poor	58 (1.8)	31 (50.0)	27 (50.0)	1.90 (0.84, 4.30)
Fair	526 (15.3)	233 (47.7)	293 (52.3)	1.73 (0.98, 3.06)
Good	1641 (57.3)	668 (43.6)	973 (56.4)	1.47 (0.86, 2.51)
Very good	515 (20.4)	185 (36.8)	330 (63.2)	1.11 (0.65, 1.89)
Excellent[a]	162 (5.2)	48 (34.5)	114 (65.5)	
Health insurance				
Insured	1184 (40.6)	411 (36.9)	773 (63.1)	**0.67 (0.51, 0.88)**
Uninsured[a]	1729 (59.4)	762 (46.6)	967 (53.4)	
Homeowner's insurance				
Insured	1114 (38.4)	357 (34.6)	757 (65.4)	**0.60 (0.45, 0.80)**
Uninsured[a]	1597 (61.6)	717 (47.0)	880 (53.0)	

Bold font indicates statistical significance.
SE, standard error; HS, high school; HA, high adherence.
[a]*Reference group.*
The percentages, odds ratios, and 95% confidence intervals are weighted.

of evacuation barriers compared to households with more than 5 people. Households reporting an individual requiring assistance with medical care administration (MSN Level 4) reported significantly higher average number of evacuation barriers (mean 8.4, SE 0.46) compared to households reporting an individual requiring extensive medical oversight (MSN Level 5) (mean 6.4, SE 0.53; $p = 0.0008$).

Using univariable logistic regression analyses, the odds of being unprepared for a hurricane (**Table 3**) were 1.63 times higher for respondents aged between 18 and 44 years [95% CI (1.30, 2.05)] than the odds for respondents aged 45 years or older. Similarly, the odds of being unprepared were higher for those with 8 years of education or less [OR = 1.45, 95% CI (1.01, 2.10)] or a high school diploma [OR = 1.48, 95% CI (1.04, 2.10)] compared to those with a college or technical education. In addition, respondents who reported having health insurance were 33% [OR = 0.67, 95% CI (0.51, 0.88)] more prepared compared to those without health insurance, and respondents with homeowner's insurance were 40% [OR = 0.60, 95% CI (0.45, 0.80)] more prepared compared to those without homeowner's insurance.

Household size also had a significant effect on preparedness (**Table 4**). Respondents of smaller households, 1–2 people, or 3–5 people were 40% [95% CI (0.28, 0.56)] and 58% [95% CI (0.46, 0.73)], respectively, less likely to be unprepared compared to larger households of more than 5 people. Households with lower annual income were more likely to be unprepared compared to households with an income >$35,000. Respondents reporting higher numbers of evacuation barriers were significantly more likely to be unprepared for a hurricane. With a 1 count increase in number of evacuation barriers, the expected increase in the odds of being unprepared was 3%. The evacuation barriers of "the entire family cannot leave," "think the roads would be too crowded to leave," "worry possessions would be stolen or damaged," "cannot afford to leave (travel expenses)," "think evacuating will be dangerous," "will be safe at home," and "unable to work will mean being replaced" were significantly associated with evacuation unpreparedness, where very high odds of being unprepared were observed in respondents where "the entire family cannot leave" [OR = 2.62, 95% CI (2.00, 3.40)], in respondents who "think the roads would be too crowded to leave" [OR = 2.37, 95% CI (1.76, 3.19)], and in respondents who reported that being "unable to work will mean being replaced" [OR = 2.25, 95% CI (1.55, 3.27)]. Additionally, respondents reporting a higher level of MSN were more

TABLE 4 | Household level characteristics and barriers by hurricane preparedness.

	n (weighted %)	Not prepared (weighted %)	Prepared (weighted %)	OR (5% CI)
Household size				
1–2 people	688 (23.6)	233 (33.4)	455 (66.6)	**0.40 (0.28, 0.56)**
3–5 people	1710 (59.0)	680 (42.3)	1030 (57.7)	**0.58 (0.46, 0.73)**
>5 people[a]	519 (17.4)	260 (56.0)	259 (44.0)	
Income				
<$10,000	878 (32.3)	378 (45.4)	500 (54.6)	**2.13 (1.32, 3.42)**
$10,000–$14,999	661 (27.9)	301 (48.5)	360 (51.5)	**2.41 (1.50, 3.89)**
$15,000–$24,999	394 (17.8)	145 (40.6)	249 (59.4)	**1.75 (1.11, 2.76)**
$25,000–$34,999	216 (9.7)	83 (45.0)	133 (55.0)	**2.09 (1.22, 3.57)**
≥$35,000[a]	274 (12.4)	77 (28.1)	197 (71.9)	
Adults >65 years				
≥1 person	414 (12.8)	127 (32.0)	287 (68.0)	**0.59 (0.44, 0.80)**
Children <10 years				
≥1 person	1256 (41.9)	564 (48.0)	692 (52.0)	**1.46 (1.15, 1.85)**
Cash savings				
≥$300	1145 (41.0)	325 (32.7)	820 (67.3)	**0.50 (0.39, 0.63)**
Distance from shore (miles)				
Mean (SE)	41.6 (1.02)	46.6 (1.1)	38.4 (1.1)	**1.03 (1.03, 1.04)**
Evacuation barriers				
1. The entire family cannot leave	2016 (72.6)	943 (48.6)	1073 (51.4)	**2.62 (2.00, 3.40)**
2. Think road would be too crowded to leave	1991 (71.1)	909 (48.4)	1082 (51.6)	**2.37 (1.76, 3.19)**
3. Worry possessions stolen/damaged	1971 (69.5)	836 (44.5)	1135 (55.5)	**1.31 (1.04, 1.65)**
4. Cannot afford to leave (travel expenses)	1620 (56.9)	710 (45.4)	910 (54.6)	**1.30 (1.01, 1.68)**
5. Do not know where to go	1564 (55.5)	662 (45.0)	902 (55.0)	1.25 (0.96, 1.62)
6. Do not have transportation	1287 (46.7)	542 (43.8)	745 (56.2)	1.10 (0.83, 1.45)
7. Think shelters might be unsafe or unsanitary	1227 (40.5)	492 (42.1)	735 (57.9)	0.97 (0.77, 1.21)
8. Have medical/physical problems	432 (12.8)	177 (46.0)	255 (54.0)	1.18 (0.88, 1.56)
9. Think evacuating will be dangerous	1146 (41.8)	530 (50.2)	616 (49.8)	**1.71 (1.30, 2.25)**
10. Work during hurricane	391 (12.7)	135 (36.3)	256 (63.7)	0.74 (0.51, 1.07)
11. Do not want to leave pet	893 (31.0)	367 (45.0)	526 (55.0)	1.15 (0.83, 1.62)
12. Will be safe at home	1269 (45.5)	584 (49.1)	685 (50.9)	**1.63 (1.21, 2.21)**
13. Unable to work will mean being replaced	453 (16.4)	231 (59.3)	222 (40.7)	**2.25 (1.55, 3.27)**
14. No proper documents to leave area	1213 (45.8)	500 (42.5)	713 (57.5)	1.00 (0.76, 1.31)
15. Care for someone who cannot leave	320 (9.5)	118 (42.0)	202 (58.0)	0.98 (0.69, 1.38)
No. evacuation barriers				
Mean (SE)	5.8 (0.2)	6.4 (0.2)	5.4 (0.2)	**1.13 (1.07, 1.19)**
Level of medical needs				
No medical needs[a]	1932 (66.7)	681 (36.6)	1251 (63.4)	**1.88 (1.37, 2.58)**
Level 0	498 (16.3)	241 (52.0)	257 (48.0)	**2.46 (1.64, 3.70)**
Level 1	245 (9.1)	137 (58.7)	108 (41.3)	1.52 (0.78, 2.96)
Level 2	65 (2.0)	25 (46.7)	40 (53.3)	**3.82 (2.08, 7.02)**
Level 3	82 (3.3)	50 (68.8)	32 (31.2)	1.19 (0.65, 2.19)
Level 4	75 (2.6)	28 (40.8)	47 (59.2)	

Bold font indicates statistical significance.
SE, standard error.
[a]*Reference group.*
The percentages, odds ratios, and 96% confidence intervals are weighted.

likely to be unprepared compared to those reporting no MSN. Specifically, the odds of respondents reporting an individual requiring assistance with medical care administration (MSN Level 4) were 3.82 times higher [95% CI (2.08, 7.02)] to be unprepared for an evacuation compared to those reporting no MSN. Likewise, respondents reporting an individual who depends on others for routine care (MSN Level 1) were 2.46 times more likely to be unprepared [95% CI (1.64, 3.70)] compared to those with no MSN. Respondents reporting an individual requiring transportation assistance (MSN Level 0) were 1.88 times more likely to be unprepared [95% CI (1.37, 2.58)] compared to those with no MSN.

Univariable multinomial logistic regression analyses tested the individual, household, and evacuation barriers by MSN (data not shown). The odds of level 0 MSN versus no MSN was 26% lower for males compared to females [OR = 0.74, 95% CI (0.55, 1)]. We also found the odds of level 0 MSN versus no MSN toss be 71% lower in respondents aged greater than 45 years in comparison to those aged 44 years or younger [OR = 0.29, 95% CI (0.21, 0.41)]. The odds of level 0 MSN versus no MSN was 35% lower for unmarried respondents compared to married respondents [OR = 0.65, 95% CI (0.48, 0.9)]. Respondents reporting higher numbers of evacuation barriers were significantly more likely to be level 0 MSN. With a 1 number increase in evacuation barriers, an expected increase in the odds of reporting level 0 MSN was 13% [OR = 1.13, 95% CI (1.05, 1.21)]. Higher odds of reporting level 0 MSN were observed when respondents also reported "the entire family cannot leave" [OR = 6.58, 95% CI (3.73, 11.58)], or

that "the roads would be too crowded to leave" [OR = 2.63, 95% CI (1.75, 3.96)], or "unable to work will mean being replaced" [OR = 3.03, 95% CI (2.00, 4.59)].

The multivariable logistic regression model for the probability of being unprepared for a hurricane (**Table 5**) shows that after adjusting for ethnicity, adults in household 65 years or older, cash savings of at least $300, income, age of respondent by household size, distance from shore and level of MSN and number of evacuation barriers, the odds of Hispanics to be unprepared for a hurricane were 49% lower in comparison to non-Hispanics [OR = 0.51, 95% CI (0.27, 0.95)]. In addition households with incomes between $25,000 and $35,000 had 1.96 [95% CI (1.13, 3.39)] times higher odds of being unprepared compared to those with income greater than $35,000. The odds of households with at least one adult aged 65 years or older to be unprepared is 32% [OR = 0.68, 95% CI (0.47, 0.98)] lower compared to households with no adults aged 65 years or older. Additionally, there was a significant statistical interaction between age and household size, where the effect of age on unpreparedness was significant only in household sizes with 1–2 people [OR = 0.98, 95% CI (0.97, 0.99)]. This result indicates that for every year increase in age of respondents among households with 1–2 people, there were slightly decreased odds of being unprepared. For every one mile increase in distance from the shore, the odds of being unprepared increased by 3% [OR = 1.03, 95% CI (1.02, 1.04)].

A significant interaction between the number of evacuation barriers and the levels of MSN resulted in varying effects of being unprepared across the MSN levels. Among households with individuals requiring transportation assistance (MSN Level 0), for every one additional increase in the number of evacuation barriers the odds of being unprepared increased by 18% [OR = 1.18, 95% CI (1.08, 1.30)]. Among households that reported individuals who depend on others for routine care (MSN Level 1), for every one additional increase in the number of evacuation barriers the odds of being unprepared increased by 29% [OR = 1.29, 95% CI (1.11, 1.51)]. Also, among households that reported individuals who require assistance with medical care administration (MSN Level 3), for every one additional increase in the number of evacuation barriers the odds of being unprepared increased 68% [OR = 1.68, 95% CI (1.21, 1.32)].

TABLE 5 | Multivariable logistic regression model for probability of being unprepared for effects.

	Unprepared for hurricane OR (95% CI)
RESPONDENT LEVEL	
Ethnicity	
Hispanics	**0.51 (0.27, 0.95)**
Non-Hispanics[a]	
Adults >65 years	
≥1 person	**0.68 (0.47, 0.98)**
No adults >65[a]	
Cash savings	
≥$300	**0.60 (0.48, 0.74)**
<$300[a]	
Income	
<$10,000	1.52 (0.97, 2.37)
$10,000–$14,999	1.39 (0.87, 2.22)
$15,000–$24,999	1.16 (0.74, 1.83)
$25,000–$34,999	**1.96 (1.13, 3.39)**
≥$35,000[a]	
HOUSEHOLD LEVEL	
Age of respondent by household size	
Age of respondent in household of 1–2 people	**0.98 (0.97, 0.99)**
Age of respondent in household of 3–5 people	1.01 (0.99, 1.03)
Age of respondent in household of >5 people	1 (0.99, 1.01)
Distance from shore (miles)	**1.03 (1.02, 1.04)**
Level of medical special needs	
Number of evacuation barriers in individuals with No MSN	0.98 (0.93, 1.03)
Number of evacuation barriers in individuals with Level 0 MSN	**1.18 (1.08, 1.30)**
Number of evacuation barriers in individuals with Level 1 MSN	**1.29 (1.11, 1.51**)
Number of evacuation barriers in individuals with Level 2 MSN	1.14 (0.86, 1.52)
Number of evacuation barriers in individuals with Level 3 MSN	**1.68 (1.21, 2.32)**
Number of evacuation barriers in individuals with Level 4 MSN	0.96 (0.79, 1.16)

Bold font indicates statistical significance.
MSN, medical special needs.
[a]*Reference group.*

Discussion

This study examined preparedness for a hurricane and barriers to evacuation among households reporting MSN and households without MSN along the South Texas Gulf Coast. We hypothesized that households with higher levels of MSN would experience more barriers to evacuation and less preparedness for disasters. Our hypothesis was not proven because the effect of MSN on preparedness is more complex than our proposed simplistic linear hypothesis.

Medical special needs alone did not explain the probability of unpreparedness, but rather MSN in the presence of barriers played a role in explaining unpreparedness. As the number of barriers increased, households reporting the presence of individuals with MSN of levels 0, 1, and 3 were significantly more likely to be unprepared, but this interaction effect was not significant in households reporting the presence of individuals with levels 2 and 4 MSN and among households with no MSN members. Therefore, it was not as simple as the higher the level of MSN the greater the unpreparedness. Likewise, there is no simple explanation for these findings, but rather we propose potential scenarios to shed light on the complexities. For households (MSN Level 0) that need transportation assistance during an evacuation, the barriers of feeling the family will be safe at home and not having travel expenses among other barriers may have led respondents to report being unprepared for a hurricane. For households (MSN Level 1) with either small children or adults who need help with routine care, the barrier of the roads will be too crowded to leave may be tied to respondents reporting being unprepared for a hurricane. Finally, for households (MSN Level 3) that have individuals who are monitored by a nurse, receive medication assistance, are dependent on equipment, or have a mental health disorder, the barrier of the entire family not being able to leave, in addition to other barriers, may have influenced respondents reporting being unprepared for a hurricane. In essence, it appears that once a household reports MSN where individuals are primarily dependent on others in the household for care or have medication or

equipment needs and the barriers increase, the result is a greater likelihood of unpreparedness. However, we did not find that level 2 (physical or developmental disabilities) or level 4 (extensive medical oversight) reported the same level of unpreparedness in the face of barriers. It is possible that households with individuals at level 2 and level 4 are more likely to receive aid from government institutions and local entities. For example, individuals with MSN level 2 (mental retardation, amputations, and blindness) have access to some services provided through the State Department of Health and Human Services. For individuals with level 4 MSN (requiring extensive medical oversight in the home), some level of access to services has already been obtained by these households and it is possible that preparedness plans are part of that medical oversight care. Further exploration of the interactions between barriers and MSN is needed not only in this Gulf Coast region where preparedness for hurricanes is essential but also in other geographic regions of the country and world where individuals with MSN may be at greater risk for morbidity or mortality in the face of a disaster.

We found that Hispanics were generally less likely to be unprepared for a hurricane than the non-Hispanic population in the region. Over 50% of the sample preferred Spanish language. Past research has found that primary Spanish-speaking Hispanics are more likely to report having an emergency evacuation plan although less likely to have the supplies necessary to survive during a disaster (11). Households with at least one person aged 65 years or older, and with less cash on hand were less likely to be unprepared for a hurricane. These results may indicate that individuals in those particular households have developed the networks and support needed to manage and create a sense of preparedness for hurricanes. We also found that as respondents' age increases in smaller households, the respondents indicated less unpreparedness. It is also possible that households with older individuals have faced and survived past hurricanes and therefore have a more accurate depiction of their preparedness for a hurricane. Finally, our results indicate that respondents living in households further from the shoreline indicated greater levels of unpreparedness. It is likely that this is a function of the belief that inland locations are safer from hurricane devastation than shoreline locations, and while not always an accurate belief could be an explanation of this finding.

Our study has limitations. One is that the surveys were based on interview and self-reported data and therefore potentially introduced respondent bias. The cross-sectional study design also limits any causation inferences. This study is based on a specific geographical location with the sample comprised predominately of low income Hispanic households and thus may not be generalizable to other geographic regions or populations. Also, respondents answered evacuation barriers in response to hurricanes which are prominent in the area and may not be representative of barriers to a different natural disaster or emergency evacuation situation.

Future research should examine the role support systems have in preparedness for individuals with MSN. Not all individuals who need assistance or qualify for assisted living are housed in a facility. While we found that 33.2% of respondents in our study sample reported at least one individual with MSN (Level 0–4) in the household, we expect that this is a higher rate of MSN found in home settings because of high levels of poverty and lack of health insurance found in this region. Future research also should characterize the strategies and effectiveness of the public health system's response to the evacuation needs of the MSN population. This characterization could identify gold standard evacuation processes for MSN and foster their dissemination broadly.

Conclusion

Certain MSN populations in light of increasing barriers reported unpreparedness for hurricanes in a region of the country prone to such natural disasters. Our results characterize a population vulnerable to hurricanes, and highlight variables and interactions among variables influential in preparedness. This study contributes new understanding of preparedness among MSN populations.

Authors Contributions

LM, SC, and BR conceptualized the research hypothesis. KV conducted statistical analysis and LM, KV, SC, and BR interpreted the data. LM, KV, SC, and BR drafted the manuscript. All authors read and approved the final manuscript.

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Emotional testimonies: an ethnographic study of emotional suffering related to migration from Mexico to Arizona

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It is increasingly argued that social and economic inequities poorly affect overall health. One of the means through which these inequities are translated to the body is via negative emotions, which carry known psychological and physiological responses. This paper examines migration-related psychosocial stressors impacting first-generation Mexican immigrants in southern Arizona, and reports on the primary emotional experiences immigrants associate with these stressors. Data were drawn from a qualitative, ethnographic study conducted over the course of 14 months during 2013–2014 with first-generation Mexican immigrants ($N = 40$) residing in Tucson Arizona and service providers working directly in the immigrant community ($N = 32$). Results indicate that the primary structural vulnerabilities that cause emotional hardship among immigrants are pre-migration stressors and adversity, dangerous border crossings, detention and deportation, undocumented citizenship status, family separation, and extreme poverty. Many of these factors have intensified over the past decade due to increased border security and state level anti-immigrant legislation in Arizona. Immigrants connected these hardships to the emotions of trauma (50%), fear (65%), depression (75%), loneliness (75%), sadness (80%), and stress (85%), and most respondents reported suffering from three or more of these emotions. Given the heavy emotional toll of migration and the direct impact that regional legislation and border security had on well-being, this paper argues that emotion be considered an important mechanism for health declines in the immigrant community. In order to stem the frequency and intensity of emotional stress in the Mexican immigrant community in Tucson, it is imperative to support organizations and policies that promote community building and support networks and also expand access to and availability of mental health services for immigrants regardless of documentation status.

Keywords: mental health, emotion, depression and anxiety disorders, stress, Mexican immigrants, structural vulnerabilities, embodiment theory

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Introduction

This article aims to establish emotion as a critical means by which the context of immigrant life gets transferred to the bodies of individual Mexican immigrants. As the means by which individuals sense the structure of their larger environs, emotion can be understood to link our bodies to the outside world (1). Based on a qualitative, ethnographic study among first-generation Mexican immigrants

in southern Arizona, this article highlights the contextual factors that Mexican immigrants commonly connect to emotional suffering, namely pre-migration stressors, dangerous border crossings, undocumented citizenship status, detention and deportation, family separation, and extreme poverty. I then use the words of the immigrants themselves to reveal the nuanced marks of stress, loneliness, fear, sadness, and trauma related to these factors. Emotional suffering often remains masked by the individual and disassociated from both the structural causes that contribute to it and from its broad and debilitating impacts on the body (2). By drawing intimate emotional experiences out of the realm of the secret body and into the light of critical academic analysis, this article seeks to expand the discussion on structural causes of health disparities and identify policy recommendations specifically geared toward reducing emotional stress.

This article employs the theoretical framework of structural vulnerability to examine how the daily "lived lives" (3) of Mexican immigrants in southern Arizona may generate emotional suffering. Quesada et al. argue that Mexican immigrants have come to "occupy a disjunctive liminal quasi-caste status" in which they are marginalized via processes of economic subordination, cultural depreciation, and legal persecution, all of which has left them structurally vulnerable to poor health [(4), p. 346]. While the most commonly identified structural barrier to immigrant health is limited access to medical care (5), a smaller body of literature has documented the occurrence and potential health consequences of other powerful psychosocial stressors present during immigration. These include discrimination (6); targeted enforcement by police and border authorities (7, 8); social isolation (9); mistrust of police authorities and fear of deportation and detention (10, 11); and family separation (12).

The presence of social suffering and stress related to contextual circumstances is increasingly being documented in the literature on marginalized groups. Yet, we know far less about the nuanced, day-to-day, and highly individualized emotional impacts of these experiences [see Ref. (2, 3, 12–14)]. Krieger (15) states that disentangling the causal mechanisms by which our bodies express and mirror our social environments is the key to future health studies (16–18). The phenomenological theory of embodiment holds that the body is in constant dialog with its surroundings and relationships (15, 19–21), and it follows that immigrants carry the intimate imprints of migration-related stressors in their physical bodies. In fact, periods of physical displacement, such as migration, likely produce intensified embodied consequences, because "geographic orientation is embedded in the whole body" [(22), p. 1518]. As such, migration may be experienced by Mexican migrants as a fundamental ungluing, a disembedding, and reembedding of the body into unfamiliar and often hostile spatial and social worlds.

The potential contribution of this research on migration-related emotional suffering lies in the wide-ranging health impacts of emotion. While the concept of emotion remains a contested concept in social theory (1), emotional suffering and stress carry known psychological and physiological responses with important consequences for overall health (23–25). It is increasingly argued that inequitable structural factors in society produce health disparities (26, 27). Using the theories of structural vulnerability and embodiment, this study highlights emotional experience as a key mechanism by which the marginalization of immigrant life gets translated to the bodies of individual Mexican immigrants. Given that the well-documented health declines that occur in the Mexican immigrant community post-migration remain poorly understood (28, 29), emotion offers an important means by which to explore how race and citizenship status "get under the skin" to impact the mental and physical health of Mexican immigrants (30).

Materials and Methods

Research Setting

Lying just 70 miles north of the current US–Mexico border, Tucson, AZ, USA is a rich setting for exploring the emotional experiences of migration. The city and surrounding areas house a large and diverse population of Mexican immigrants ranging from recent arrivals to established Mexican American families pre-dating the transfer of the region to American jurisdiction in 1854. According to the 2010 U.S. Census Bureau, 41.6% of Tucson's population was of Latin American origin and over a quarter of that population was foreign born. Statewide in Arizona, over 10% of public school students currently have at least one undocumented parent (31), further demonstrating the high percentage of Arizonans living in immigrant and mixed status families. Tucson's historical origins as a Mexican town and its enduring status as an immigrant receiving community are reflected in the city's wealth of Mexican storefront specialty shops and markets, cultural celebrations, historical landmarks, and bilingual community services. Yet, a longstanding and prejudicial "racial subtext" (32) underpinning Arizona state laws can be traced back to the state's founding and has climaxed over the past decade as Arizona has witnessed a dramatic spike in immigration from Mexico during a period of state recession (33). This surge in-state level exclusionary legislation has had very real and deleterious effects on immigrants' ability to access recreational, religious, educational, and health services (34).

Study Sample and Procedure

This qualitative ethnographic research project was conducted over the course of 14 months in 2013–2014. Project approval from the University of Arizona Institutional Review Board (IRB) was obtained in November 2013 and extended for a second year in September 2014. The exploratory phase of research consisted of semi-structured background interviews ($N = 32$) with local activists and service providers selected on the basis of snowball sampling techniques in addition to extensive research into immigrant-serving organizations. The interview guide was designed to draw out information on conditions of daily life for Mexican immigrants, impact of state laws on the provision of medical services, structural vulnerabilities in immigrant life, and group-level health risks and outcomes. This exploratory research helped to establish the demographic parameters of the sample population, inform the immigrant interview guide, and identify appropriate venues to reach this vulnerable community.

I then conducted participant observation and in-depth semi-structured interviews ($N = 40$) with first-generation adult immigrants from Mexico. Because randomized techniques, such as phone sampling or recruitment of interviewees in public spaces, were not feasible or advisable given immigrants' high rate of

mobility and their concerns about avoiding detection by police authorities, I employed the method of "venue-based application of time-space sampling," a convenience sample strategy using known venues where members of hidden populations gather safely (35). The sites identified for this study include a day laborers' center, a women's empowerment group, and two free medical clinics that serve the undocumented and uninsured communities. Due to the extreme vulnerability of undocumented individuals, study participants were consented verbally in lieu of signing a written statement. I recorded the interviews using a digital audio recording unless background noise was too distracting, and I also took copious notes regarding non-verbal cues to emotion. These precautions helped establish a safe environment for potential participants and only one person I approached for an interview declined to participate.

This study employed a life-history approach to immigrant emotional health, addressing factors intersecting with the emotional health of individual migrants before, during, and after the process of migration (36). Questions addressed early life in Mexico, and pre-migration stressors including childhood poverty, nutrition, emotional trauma, illness, and access to health care in order to establish a binational approach to migrant health capable of highlighting intra-group variations (37). Large-scale studies linking childhood exposure to poor health outcomes in adults make clear the necessity to examine health risks faced by migrants before arriving to the U.S. Though such studies lack inclusion of migration-related risk factors (8), a small body of qualitative research has demonstrated that variations in health exposures in Mexico have important ramifications for health behaviors including diet and pursuit of health care once in the U.S. (38–41). The life-course approach also highlights the increasingly lengthy and dangerous border crossing, which should be considered a health determinant in and of itself (42). Since the topic of illegal border crossing can be sensitive, I approached the issue by asking: "What mode of transportation did you use to reach the United States?" which enabled participants to address the experience of the crossing and related dangers and stressors.

I employed a fixed interview guide, which included a brief survey section tabulating basic demographic information on family background and physical and mental health problems. The majority of the interview addressed the structural challenges faced by immigrants once in Tucson, including those mentioned in the introduction as well as experiences of discrimination, barriers to healthy diet and exercise, and lack of access to medical care. I then presented participants with a list of both positive and negative emotions and asked that they identify those they related most strongly to their experience of immigration. I followed up on these response with tailored questions such as "how did you cope with being in jail during those weeks?" or "When the bills come in, where do you feel that stress in your body?" or "When your son was deported, how did that change your feelings about living here?" The interview guide also covered definitions of health, disease etiology, and healing traditions and practices pre and post-migration.

I conducted this research in Spanish, relying on my own professional training as a Spanish language interpreter and translator, as well as the assistance of native speakers and dictionary sources when necessary. I conducted the complete interview guide with all 40 participants, and interviews ranged in length from 1 to 3 hours. In addition, I conducted participant observation in courtrooms, political protests, churches, and participant's homes in order to gain intimate familiarity with the structural and social factors shaping immigrants' daily lives. My regular weekly appointments as volunteer English teacher and medical interpreter also enabled more extended and informal interactions with approximately one-quarter of sample participants who regularly attended either the health clinic or day laborers center where I worked. For the protection and privacy of all who participated in this study, I use pseudonyms throughout this article.

Analysis

Data analysis was an iterative process that spiraled back and forth between data gathering and examination during the course of the project. Using MAXQDA qualitative data analysis software, I first coded the service provider interviews using "focused coding" methods designed to identify salient themes in immigrant life. I then simultaneously transcribed and translated the immigrant interviews, and later coded them according to the principles of "selective coding" (43), highlighting the links between categories of codes addressing the most common migration-related hardships and their associated emotional responses, in order to define the relationship between migration-related stressors and declines in health and well-being in individuals.

Results

The Section "Results" of this article is organized according to the six primary emotional stressors identified by study participants: pre-migration stressors, dangerous border crossings, undocumented citizenship status, detention and deportation, family separation, and extreme poverty.

Demographic Portrait of Study Population

The study sample was evenly divided between men and women, with a median age of 42 (**Table 1**). This study sample included mostly long-term stable residents of Tucson, with the median number of years spent in residence being 15. Participants were evenly divided between having been raised in rural versus urban environments in Mexico. Just over one-half of this sample population was from Arizona's bordering state of Sonora. Other highly represented states were Sonora's southern neighbor Sinaloa and two southern states, Oaxaca and Chiapas, while remaining states of origin included Veracruz, Distrito Federal, Michoacán, Jalisco, Chihuahua, Guanajuato, Zacatecas, and Puebla. This sample reflects the recent diversification of the historically Sonoran-origin

TABLE 1 | Study sample demographics.

Factor	Men (n = 20)	Women (n = 20)
Median age	38	43
Median residency in US (years)	14.5	15
Of Sonoran origin (%)	60	55
Monthly income ($US)	1500	1100
Average number of household members in US	3.9	3.6

Mexican population in Tucson in response to shifting patterns of emigration from Mexico as well as the purposeful funneling of migrants through the deserts of Arizona (33).

Childhood Adversity

The majority of participants came from large, working class families with the average number of children in the family being just over 6. Most cited economic scarcity in their childhoods, and many noted common experiences of lacking money for basic clothing and enduring periods of nutritional deprivation. Less than one-quarter of the sample completed high school, with most having left school in order to augment family resources through informal employment. Many participants cited beginning to work at a very young age, sometimes selling gum or cleaning cars out on the streets. While the majority of participants cited being healthy as children and having little need for medical intervention, less than half of participants had health insurance during their childhoods in Mexico, and most reported relying primarily on home remedies and traditional modalities for their non-emergency medical care. Eighteen percent of participants came from families in which one or more siblings died during infancy.

Despite these common economic challenges, participants largely described their childhoods in a positive light, recalling the warmth and safety of their extended family networks. When extreme deprivation, emotional trauma, or abuse was present, however, this delicate balance was upset, and several participants demonstrated lasting damage from childhood suffering in their adult life in the US. Approximately, one-fifth of participants reported this degree of childhood suffering, with the most common experiences cited being parental abandonment, domestic violence either in childhood homes or adult romantic relationships, severe material deprivation, and sexual abuse. Those participants who reported childhood trauma also reported on-going suffering from emotional imbalance and depression at the time of the interview.

Enrique is a 54-year-old man from the state of Zacatecas who grew up in dire poverty in a family of 15 children, only 6 of whom survived their first year of life. Although he is now a citizen and once had stable employment, Enrique's health problems have steadily worsened, and he is now physically disabled and severely depressed. He believes his current state of ill health results from having started to work at age 11, often under very harsh and exploitative conditions in both Mexico and US. He said:

> All of this comes from my childhood. I never knew what it was to go from childhood to adolescence. I went from childhood straight to adulthood, to the responsibility. And when you see other young getting to enjoy life, you say 'why didn't I ever get to do that?' But we came from a very poor family. If we ate breakfast, we didn't know whether there would be any more food that day, because my father didn't have that awareness that he had to work in order to feed his children… So I had to leave school and play the role of father.

These pre-migration emotional and physical risk factors underscore the importance of employing a binational and life-course approach to immigrant health studies.

Border Crossing

Slightly over half of the participants crossed the border without legal permission, many of them crossing two or more times (**Table 2**). More men in the sample crossed without legal permission than did women (80 and 25%, respectively). Likewise, participants from Sonora had greater access to temporary tourist visas and thus were more likely to have crossed legally. Most study participants who immigrated without legal permission crossed on foot through the Arizona desert, reflecting the impacts of the federal "Border Strategic Plan" in the 1990s that shut down traditional points of entry in Nogales, San Diego, and El Paso (44). The majority of study participants who crossed the desert spent between $1,000–3,000 for a "*coyote*" to guide them and walked for several days. A nurse who regularly treats distressed migrants concludes that the stressors of crossing the desert on foot are so intense, that "if migrants have crossed the desert, their emotional health is very affected by that experience" (Roberts, personal communication).

Most desert crossers in this sample referenced the intense physical exertion, extreme temperatures, and bodily injury endured during the crossing period, which often resulted in dehydration and hunger. Aid workers in the desert reported that common injuries include blisters, sprained and broken lower extremities, cuts and scratches, snake bites, exposure to the elements, and emotional trauma due to assault and near-death experiences (Price and Wallin, personal communications). Serious bodily injury, such as acute kidney failure and broken bones, are likewise not uncommon.

Fear and trauma were the most commonly cited emotional experiences related to the crossing, which immigrants identified as a period of extremely heightened anxiety. Participants reported fear of criminal extortion and kidnapping, and several cited attacks and robbery by "*bajadores*" – Mexican criminals who assault migrants just before they cross the border. Once in US territory, participants feared detection by Border Patrol agents and Mexican drug runners, as well as non-human surveillance and threats to safety, such as animals, aerial drones, and ground sensors. Recovery from the emotional and physical stress of the border crossing was often slow. Lalo, a 37-year-old native of Chiapas, has crossed the border and been deported multiple times. He described the bodily sensation of crossing in this way:

> When you are crossing, you have one 100% adrenaline; you are alert the entire time. If you get a spine in your body or are bitten by a spider, you don't feel anything, your blood is hot, your mentality is to be totally alert. So at the time you don't feel anything, but the problem starts after you arrive and you relax. I remember that I was taking spines out of my body for many days, like I didn't feel all the scrapes and cuts for a long-time afterward.

TABLE 2 | Migration-related conditions and experiences (%).

	Men ($n = 20$)	Women ($n = 20$)
Undocumented residency status	60	75
Detained or deported	65	45
Separated from immediate family	45	35
Extreme financial hardship	80	75
Crossed through desert	80	25

Between 1990 and 2012, approximately 2,238 migrants are believed to have died in the Arizona deserts (45). Crossers often lack the control to improve their own conditions or help others in their group, and traumatic experiences therefore cause feelings of helplessness, anxiety, guilt, and deep sadness. Jacobo Tellez of the Mexican Consulate in Tucson recalls the day a boy faced 15-year-old desert crosser from Oaxaca was placed into the custody of the consulate after his father fell dead in the desert. After offering the youth whatever comfort they could, he said he was ready to tell his mother the news. "I connected the phone line and went to sit back down," Tellez recalls. "But as soon as the boy heard his mother's voice on the phone, he started wailing and screaming: 'Mamá! Mamá! He died on me, I couldn't do anything! I couldn't do anything!' and the pain in his voice ran chills through my body, because it was his sheer impotence, his inability to do anything for his father."

Moreover, the perils of the desert crossing reverberate far beyond the individual crossers and into the immigrant community more broadly. Many participants described periods of high anxiety and worry as loved ones were attempting the desert crossing, with some having been extorted by criminals in exchange for the release of abducted crossers. A small minority of the sample had experienced the death of friends or family during the crossing. Elena Burgos, who offers "healing touch" massage therapy in Tucson, reports that many families come to her because of trauma related to the desert crossing. Burgos can relate to others' experience because her own brother died crossing the desert.

> Someone called my mom and said the animals had eaten [my brother's] body and that they just found the bones, and that is when she had a heart attack. And we felt like we were losing our minds, because of course we never thought this would happen – we kept thinking that he was coming, that he would arrive. He had five kids and was 32 years old. So you feel like your heart is just breaking to pieces.

Legal Status

The majority (67.5%) of the sample was undocumented, 22.5% had work permits or were legal residents, and 10% were citizens (**Table 2**). There was not always a direct correlation between the illegal border crossing and current status an undocumented immigrant. Several participants who initially had to trek across the desert had since been able to achieve legal status. Contrastingly, almost half of the Sonorans in the study sample had initially crossed the border legally with a tourist visa, but had since outstayed the visa and were undocumented. The majority of service providers and immigrant participants independently noted the damaging impacts of Arizona state legislation, specifically State Bill 1070, in increasing the dangers, frustrations, and stressors of undocumented life in Arizona. These compounding hardships in the lives of undocumented immigrants cause such emotional upheaval that Cavazos-Rehg et al. call undocumented status itself "a persistent and insidious psycho-environmental stressor" (2007: 1126). Participants with temporary work visas and permanent residency likewise expressed feeling vulnerable both to the whim of local and federal politics as well as that of individual law enforcement agents.

When I asked Abelardo, a 54-year-old day laborer from Chihuahua, how it felt to be undocumented in Arizona, he took off his worn sports cap, put his arm down on the table to rest his head and began to quietly sob. "It feels so hard," he managed softly. "It just feels so bad." Undocumented participants reported that their lack of legal status obstructed their ability to live "*a gusto*" or at ease, and caused emotional expressions including fear, sadness, trauma, frustration, helplessness, and loneliness. Due to the fact that Tucson houses the overlapping jurisdictions of local police forces, country sheriffs, Border Patrol, and Immigration and Customs Enforcement agents (ICE), fear of arrest and deportation was a very common experience for participants (65%). Many participants lamented the feeling of having to always "*andar muy recto*" (not make any mistakes) and to leave home only for work and other mandatory activities, often causing them to bypass necessary medical attention. Diana, who has lived in Tucson for 15 years without legal status, suffers from an autoimmune disease called pemphigus, the onset of which has been linked to emotional stress (46). She states:

> For me, fear has been the most direct impact on my condition, what I suffer from. Fear of leaving the house or not returning, that at any moment I could be captured and identified as what we are, as immigrants. Even though I have an application in through my mom, it is still not a legal condition, so I am still dealing with the fact that I am here in limbo, without being anybody, without being a true entity as we say, a somebody.

Many participants described how their fear of police detection, particularly following the passage of SB 1070 in 2009, prevented them from participating in community activities and from fulfilling civic duties, such as reporting crimes in their neighborhoods. Moreover, their lack of legal residency and the dangers of the crossing made returning to Mexico virtually impossible (see Family Separation). This isolation in turn generated feelings of loneliness, which was a salient theme in the lives of 72.5% of study participants. According to Leticia, a 34-year-old married woman from Guanajuato:

> I don't have a lot of community – I think that's because of the laws they've passed here. I feel like at any moment they can decide that we all need to leave. So my life, I feel like today it is good, but tomorrow I don't know how it will be. That is why I started to feel depressed, because I feel like in reality I don't have a stable life here. I feel part of Tucson but sometimes, like when I have to present an ID, my reality hits me and makes me feel like, no, I am really not a part of it.

Undocumented status likewise impeded immigrants' ability to progress toward their goals, leading to feelings of hopelessness and frustration in regards to their educational and vocational opportunities. Many participants used words such as *estancado* (stuck) and *impotente* (helpless or hopeless) to describe their day-to-day feelings about being undocumented. Adrián, a 24-year-old who was brought from Sonora by his family as a small child

recalled that: "In school growing up I always wanted to continue my education. But when I understood more of what it meant to be undocumented, it brought me down and I felt hopeless. I thought "why the heck should I go to high school if I can't go to college?" I felt depressed and in my senior year I lost all motivation and almost dropped out."

Detention and Deportation

Forty-five percent of women and 65% of men had faced experiences of detention, deportation, or both in their immediate families (**Table 2**). Undocumented immigrants were most commonly detained during the initial crossing, on routine traffic stops, and workplace raids. One participant was arrested in the process of reporting a crime to police. Deportation and detention carried acute emotional responses including trauma, loneliness, fear, and sadness, both for the person directly involved as well as for family members who faced concomitant emotional and financial challenges. Service providers also noted the impact on the wider community, as "the community is always fluctuating and is really unstable with detentions, deportations, and loss of jobs. This is really challenging for people without papers – there is an emotional tax in seeing people here one day and simply gone the next" (Sharer, personal communication).

Many participants reported that their fear and anxiety levels increased following their own deportation or detention or that of a loved one. Yesenia, a 42-year-old undocumented immigrant mother from Sonora, said that her brother's deportation changed her daily experience in Tucson:

> After my brother got deported six years ago, my fear got worse and I got sick from all the anxiety. It was like psychological terror. I can't sleep until everyone in my family is altogether – I worry that one of them won't come home one day. The last time the police pulled us over, I shook the policeman's hand and said '*felicidades*. If what your government wants is to make us sick and keep us scared, then congratulations, you're doing your job.'

Other participants described the sadness and loneliness that resulted from losing family members who had been deported and were unable to return. Teresa's husband of 28 years was deported one day without notice, leaving her struggling to raise their teenaged son alone. Since his departure, Teresa has been evicted from their apartment and has fallen into a deep depression.

> When he first left there were many days that I hardly ate, could barely sleep. I am embarrassed to say this but there are still days when I don't even want to bathe myself or get dressed. It seems like no matter what I am doing, if I am on the bus, or walking somewhere, or going to the market, that I start to cry. And it seems like wherever I am that everything is ugly now. Even my plants, which used to be so beautiful to me, seem ugly now.

Detention also led to extended periods of separation, which were exacerbated because undocumented family members were unable to visit the jail due to their own lack of legal status. Eva, a 42-year-old who has lived in the US for over 15 years recalls the isolation of her 60-day separation from her then 4- and 7-year-old sons while in detention following a traffic violation. "It is so hard, imagine how lonely and sad you feel, without anyone there to accompany you. And on the weekend everyone else had visitors, but my sons and my husband couldn't be there." Study participants who had been detained also cited common experiences of discrimination and mistreatment, including overcrowded cells, freezing temperatures, lack of proper nutrition, intentional family separation, and denigrating treatment by guards, all of which has been extensively documented (7, 47).

According to a medical doctor who works in a federal prison in Arizona, the combination of these factors leads to toxic levels of stress and anxiety while incarcerated, which carry potential physical consequences including high blood pressure and blood sugar levels (Olsen, personal communication). Lalo recalled the desperation that set in soon after his arrival to a federal detention center in Eloy following a routine traffic stop in Tucson:

> The doctor asked me if I suffered from schizophrenia, if I heard voices, or if I had tried to kill myself, and it seemed weird to me, because I have never wanted to do any of those things. But then I understood that the problem was when they locked us up, when they closed the door. And the guard yelled "don't move, don't make noise, go to sleep now!" And I started to feel desperate, my heart beat like crazy, and I felt claustrophobic and I started to sweat, and I wanted to throw open the doors and just fly out of there or disappear. I even wanted to hurt myself so they would take me out of there.

Family Separation

While participants mourned many aspects of what they missed about Mexico, including traditional foods, their personal freedoms, and the more relaxed pace of life, the vast majority cited family separation as the most emotionally challenging part of leaving Mexico. The primary emotions immigrants associated with these separations were loneliness, frustration, and sadness, which sometimes led to longer-term depression. Forty percent of participants were separated from a child or spouse for at least 1 year during their immigration experience, and the vast majority faced on-going separation from siblings and parents (**Table 2**). This high occurrence of family separation reflects the increased costs, dangers, and legal penalties of the border crossing, which have encouraged migrants to settle for longer periods in the US without the possibility of return or cyclical migration (48, 49).

Service providers frequently addressed the negative mental health impacts of immigrants' long-term loss of family-based social and support networks. For immigrants, the inability to return to Mexico due to both financial and legal constraints for family events, funerals, and celebrations was a source of on-going sadness and loneliness. Araceli, a 48-year-old from Puebla recalls that during her years without papers she felt very lonely. "When my mother died, they told me from Mexico but I couldn't go. My grandfather and then my dad, and my uncle

who was like a father to me, they all died and I couldn't go to their funerals. Later I went back and saw their graves. That is my own little piece of loneliness: to have so many years go by without seeing my family." Participants worked hard to stay in close touch with family via regular phone calls and internet communication, but the physical distance and passage of time frustrate efforts to maintain closeness and many participants bemoaned lost or strained emotional connections with children, siblings, and parents.

Approximately half of study participants reported having little community support in Tucson, and even those with intact nuclear families and strong community ties in Tucson still commonly reported missing the close-knit spontaneous gatherings with extended family in Mexico. Thirty-two-year-old Gregorio who came to the US 4 years ago from Sonora explained that, "Sometimes I am happy here because I have my own family but I also miss my family in Mexico, so I am not totally content. Here my family is just my wife and my kids. There I have my brothers and sisters and my mom and dad, and one also misses them." For those participants separated from spouses and children, or who have been unable to establish community in Tucson, the feelings of sadness and loneliness are often debilitating and accompanied by depression. Teresa, who remains separated from her husband following his deportation over 1 year ago, described her emotional state: "I have some family here but it's like it makes no difference, they don't ask me how I am doing or if we have food, or how my son is. I still feel so alone. I don't know if I can handle this anymore, I am so lonely here. I don't go out or talk to anyone – I just go to work and come home."

Financial Stress

Financial stress was a constant theme during my interviews, with 77.5% of the sample stating that they were only "surviving" or "barely surviving" economically (**Table 2**). The average monthly income in this study was $1,400 for households consisting of an average of 3.7 people, with several low outliers earning as little as $600 or less (**Table 1**). Many service providers described a debilitating level of economic stress among Mexican immigrants in Tucson, and observed that this stress had increased over the past 10 years in response both to the economic downturn and the 2007 passage of state legislation requiring all Arizona employers to use the federal E-Verify technology to verify legal status. Many immigrants stated feeling frustrated and impotent against the legal barriers that prevented them from securing more stable and remunerative employment.

Although three-quarters of participants stated that they were financially better off in the US than they had been in Mexico, most reported greater financial stress in the US due to the inflexibility of the American billing system. Referred to ubiquitously as "*los biles*," monthly bills were a perpetual source of worry for both men and women. The need for adults to work long hours and multiple jobs in order to survive financially put major stressors on families. Women addressed the stress that came from both parents needing to work, and lamented how this left little time for family relaxation and healthy eating habits. Isabella, a 35-year-old participant corroborated the experiences of many other women in this study:

> We have more work to do in the house than [the men do]. They go to work and come home and relax. But we don't get to relax. And so what happens is our health gets worse every day. We can eat all the vegetables and lentils that we want, but if we don't have peace in our homes and in our minds, then we can't be healthy. It's just that the stress of all the rules with everything here. My head hurts here from all the pressure of paying the bills and the go-go-go. We wanted a better life: We got more things, but less life.

Men in the sample commonly emphasized the need to work in order to have positive self-esteem and feel healthy. The majority of men in this sample worked as day laborers and struggled to secure jobs on a daily basis. Many men blamed this lack of job security and stable income for their unhealthy sleep patterns and high levels of generalized stress. Esteban, a 55-year-old undocumented laborer from Sonora explained:

> When I don't work the full 40 hours, I don't feel like a normal person. A normal person works every day. And I can work – I am a carpenter, I have energy. And I have a nice truck (he points to a truck sitting idly in the parking lot) – I am all ready. So I just feel this stress and a depression that's like a sadness. The stress gives me a headache so I cannot sleep, and I am up almost all night.

Because the vast majority of sample participants had no economic reserves, many underwent feelings of stress, hopelessness, sadness, and even trauma during periods of transition and hardship. Common stressors included the deportation or incarceration of a spouse, evictions, overcrowded living conditions, temporary homelessness, and reliance on soup kitchens and food banks. Tomás, a 39-year-old father from Sonora described a period of time in which he could not find work for an entire month.

> I felt so much stress and *nervios* that my mind got all twisted up. I had to go see the doctor at the clinic because the muscles on one side of my face stopped working completely, so that when I tried to drink water it would just dribble out of my mouth. But the doctor just told me not to worry so much about my life, because that worry became stress and that was damaging my body. And he gave me some pills that I took for awhile.

Mental Health Outcomes and Access to Care

The compounding and cumulative effects of these emotional experiences took a serious toll on the self-reported mental health of this study sample (**Table 3**). Participants most commonly cited experiencing the emotions of trauma (57.5%), fear (70%), depression (75%), loneliness (77.5%), sadness (82.5%), and stress (87.5%), and most respondents reported suffering from three or more of these emotions. The three-quarters of the sample that stated feeling depressed connected the depression with either long-term declines in well-being or with particularly challenging periods, such as during detention or following the deportation of loved ones. Mental health practitioners I interviewed uniformly reported

TABLE 3 | Self-reported emotional condition of participants (%).

	Men (n = 20)	Women (n= 20)
Fear	70	70
Sadness	80	85
Loneliness	70	75
Stress	95	80
Trauma	55	60
Depression	70	85

that the most common mental health issues they witnessed in the immigrant community were depression and anxiety related to economic stress, fear of detention, family separation, social isolation, family stress, and the desert crossing. Practitioners stated that the incidence of depression and anxiety in the immigrant community had increased since the recent economic downturn in Arizona and passage of anti-immigrant legislation. Reverend Raul Trevizo, long-time pastor of Tucson's largest Mexican-origin Catholic parish, describes what he has seen among his congregants in recent years:

> It's a collective depression, a desperation that is epidemic in the immigrant community. You begin to see all the effects of what could probably be diagnosed as clinical depression. This is very collective; this is not individual. They feel that they are in a country where they are not wanted, they are looked upon suspiciously, they face deportation at any moment, and they are struggling to survive. It's like a collective post-traumatic stress syndrome.

Strikingly, the vast majority of Mexican immigrants lack access to mental and behavioral health care services that could help mitigate migration-related stress. The passage of House Bill 2008 in 2009 blocked immigrant access to preventive and follow-up mental health care (50). These provisions make it nearly impossible for immigrants to receive behavioral health services unless they are visibly presenting psychotic symptoms and are remanded to crisis response services by police authorities. Even in those dire cases, very little can be done to address on-going issues or secure necessary follow-up care for immigrant patients suffering from psychosis.

Immigrants suffering from lower grade conditions like depression and anxiety were limited to a handful of low-income and free clinics with limited volunteer-staffed counseling programs. However, there are barriers to accessing the scant services available, including limited knowledge about available services and individual willingness to seek emotional support in a community that still has many reservations and negative stereotypes about mental health services (Meza, personal communication). Moreover, even the sliding scale offered by the low-income clinics can be prohibitive for immigrant patients, and many immigrants feel debilitating fear and lack of trust in medical facilities due to having seen Border Patrol policing area hospitals or having known someone who was detained or deported after accessing care (Al-qaraz Ochoa, personal communication). In addition, even those few immigrants who qualify for state Medicare coverage are often afraid to use it because they fear that it will label them as a "public charge" and therefore damage their citizenship applications (Roberts, personal communication).

While access to care is severely curtailed in this community, immigrant participants and services providers alike noted the benefits for those who were able to receive therapy services. Many participants expressed reticence to share openly with friends and family. Leticia explained that talking to the psychologist about her depression related to being undocumented made her feel better "because I really don't have friends, just my sisters and my husband. And with [the therapist] I can say things I can't tell my sisters or my husband because they would talk to each other." Having access to a trained therapist offered an outlet for self-expression that afforded potential emotional and physical healing. Therapist Michelle Humke described a teenager who came to counseling because she lost her ability to walk following the imprisonment of her undocumented mother.

> This was a mental health issue that manifested as physical issue – all she knew was that she couldn't walk, and I said 'this is all related to the family issue.' She was in the care of her extended family, and the whole family was traumatized. So I brought them all in and helped them learn how to better verbalize when they were feeling strong emotions and how to talk about it. And this is what helped her walk again.

These results demonstrate the cumulative impact that migration-related emotional suffering has on the overall mental health of immigrants and the potential for expanded mental health services to play a role in healing.

Discussion

Rather than directly testing the biological impacts of psychosocial stress on the body, this article uses self-reported emotional suffering to place the incidence of such stressors in a broader contextual framework. I use the words of first-generation Mexican immigrants to portray the oppressive nature of living within the structural vulnerabilities at force in their lives and their resulting experiences of emotional suffering and trauma. Because "emotional practices can … be seen as social acts which are significant in revealing the complex interrelationships between the individual and society via the body," the emotional testimonies presented here offer insight into how Mexican immigrants in southern Arizona experience the daily context of their lives on a body level [(1), p. 396]. These are testimonies to how individuals embody social inequalities, which may in turn help to make sense of existing health disparities.

An Emotional Perfect Storm

The vast majority of the interview sample for this paper report experiencing multiple negative emotions related to the compounding experiences of childhood adversity, family separation, dangerous border crossings, undocumented status, detention and deportation, and financial stress. Many of these "psychic costs" of migration [(51), p. 297] have been studied previously and linked to self-reported declines in well being and mental health. The

pervasive fear of detention and deportation, which dramatically curtails freedom of movement and promotes distrust (12), has been linked to a direct decrease in perceived emotional and physical health status (52). Border crossing and militarization have been linked to the severing of family and social networks and related feelings of isolation and loneliness (11, 53), while deportation itself has been associated with poor self-reported physical and mental health (54). Discrimination and stigma related to immigrant status have been shown to increase self-reported stress and health declines (29). The undocumented community (52), children and separated families (12), and migrant workers (6, 55, 56) have all reported particularly high levels of migration-related stress.

Science of Emotion

Some researchers argue that emotional stress may help explain health disparities patterned across lines of race and socio-economic status. A small but promising body of literature has begun to use bio-marker data to link migration-related stressors to physical health declines (57–59). Says Sternberg: "we are discovering that while feelings don't directly cause or cure disease, the biological mechanisms underlying them may cause or contribute to disease" (2001: 13). The emotional suffering reported on in this article – namely stress, loneliness, fear, depression, and trauma – implies varied and well-documented biological consequences.

Stress has been so closely linked to widespread and generalized health declines that Sapolsky determines that "chronic stress can be pathogenic" [(60), p. 395]. Deficiencies in social networks have been shown to impact all-cause mortality (61), and loneliness is now understood to produce immune deficiencies and disruptions to cardiovascular functioning and complex cognitive functioning (62). Moreover, the fear response has been linked to the onset of anxiety, depression, and other mental disorders in addition to physical health problems, such as weakened immune function, hypertension, and insulin resistance (63, 64). Likewise, depression is posited to cause dysregulation of the metabolic, immuno-inflammatory, and autonomic and hypothalamic–pituitary–adrenal axis, potentially increasing the incidence of morbidity related to cardiovascular disease, stroke, and obesogenic co-morbidities (65). Lastly, trauma has been shown to disrupt homeostasis via impacts on the brain, endocrine system, and sympathetic nervous system, and "through a physiological domino effect, these changes affect many other body systems, including the cardiovascular system, respiratory system, and muscular system" [(66), p. 52].

Limitations and Strengths

This paper takes a life-course approach to immigrant mental health, incorporating pre-migration factors as well as a complex web of post-migration stressors. According to the theory of "cumulative adversity," individual hardships cannot be holistically evaluated in isolation, as they both compound and overlap with one another to produce long-term ill effects on physical and mental health (67). The categories I presented in the Section "Results" of this paper are by definition interwoven and iterative, and thus do not break down for neat analysis of the impact of individual factors on immigrant emotional health. Certain categories, namely family separation and undocumented status, undergird all aspects of immigrant experience and are challenging to tease out from their associated impacts on other areas of immigrant's daily lives. At the same time, the factors I address in this paper are by no means exhaustive of the emotional hardships that may contribute to immigrant's cumulative toll of adversity over the lifecourse. I only investigated emotional experiences closely linked to migration, and therefore intentionally did not address emotions related to more intimate changes in family dynamics and relationships, such as changing gender roles (68) and role loss (69).

In addition, this paper does not argue that all emotional experiences related to migration are negative. While study participants overwhelmingly reported emotional hardship related to migration, a minority of participants (25%) also stated ways in which immigration had a positive impact on their emotional or physical health. This was especially so for participants who had made a significant life change upon migrating – such as overcoming drug or alcohol addiction, leaving an abusive relationship, or conversion to a new church or religion – or for those who had faced debilitating levels of poverty in Mexico. These examples highlight the possibility for migration to be associated with positive emotions and experiences depending on pre-existing circumstances and individual motivation for change.

Conclusion

The immigrants and service providers I interviewed indicate that the recent rash of state level exclusionary legislation in Arizona has intensified and compounded emotional hardship in the immigrant community. The state passed English-only legislation in 1987 and 2005, denied undocumented immigrants access to in-state tuition and state scholarship monies through Proposition 300 in 2006, limited immigrant access to state services under HB 2008 in 2009, banned Mexican American Studies from the Tucson public schools in 2010 under HB 2281, and that same year passed SB 1070, requiring immigrants to carry identifying documents at all times and institutionalizing cooperation between police and immigration authorities. The immigrants I interviewed lived with the tangible results of this rash of legislation, including increased risk of detention and deportation, longer family separations, more dangerous border crossings, and restricted access to full employment, education, and medical care. Their emotional reactions to these changes are embodied testimonies to the ways these policies touch individual lives.

In the absence of an overhaul of state and federal immigration policy, the findings presented in this paper indicate several pragmatic solutions that could serve to reduce the incidence and intensity of emotional suffering among Mexican immigrants in southern Arizona. I make the following recommendations in regards to strengthening community support and public safety: (1) expand local networks of support called "*redes de proteccion*" that offer leadership training, community building, and assistance to immigrants in the event of detention or deportation, and thus buffer against related fear, stress, and loneliness; (2) increase access to identification cards currently available from the Mexican Consulate and in discussion by the City of Tucson, which provide migrants with a valid form of identification and thus foster a sense of increased personal security; (3) encourage further dialog between community groups and local police agencies to reduce

fear and likelihood of unnecessary non-criminal detention and family separations. In addition, in order to increase immigrant access to mental health services, I make the following recommendations: (1) educate medical personnel regarding the emotional stressors affecting this community and encourage wider application of screening measures for immigrant patients; (2) expand the availability of Spanish language mental health services to screen for mental illness, offer an outlet for immigration-related stress, and aid immigrants in making practical choices to improve their living conditions; and lastly, (3) increase outreach to Spanish speaking immigrants about available health and support services via regularly updated pamphlets and improved communication between service providers.

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Structural vulnerability among migrating women and children fleeing Central America and Mexico: the public health impact of "humanitarian parole"

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Since October 2013, US Customs and Border Patrol has apprehended 15,979 families on the Southwest Border of the US. Daily, migrating women and children from Mexico and Central America that qualify for *humanitarian parole* are released from immigration detention to a humanitarian aid organization in Southern Arizona. After several days in detention facilities, these families arrive tired, hungry, dehydrated, and with minimal direction regarding their final destination, and adherence to the parameters of their parole. *Project helping hands* (PHHs) utilizes a network of volunteers to provide the women and children with food, water, clothing, hygiene products, hospitality, and legal orientation. The aim of this assessment was to document the experiences of families granted humanitarian parole through the lens of structural vulnerability. Here, we apply qualitative methods to elicit PHH lead volunteer perspectives regarding the migration experience of migrating families. Using inductive analysis, we found six major themes emerged from the qualitative data: *reasons for leaving*, *experience on the journey*, *dehumanization in detention*, *family separation*, *vulnerability*, and *resiliency.* These findings elucidate the different physical and psychological distresses that migrating families from Mexico and Central America experience before, during and after their arrival at the US–Mexico border. We posit that these distresses are a result of, or exacerbated by, structural vulnerability. Structural vulnerability has life-long health implications for a sub-population of young mothers and their children. The number of migrating families who have experienced traumatic events before and during their migration experience continues to expand and thus warrants consideration of mental health surveillance and intervention efforts for these families. More public health research is needed to better understand and combat the health challenges of this growing population.

Keywords: structural vulnerability, humanitarian parole, immigration, detention, US–Mexico border

Introduction

Since October 2013, US Customs and Border Patrol (USCBP) has apprehended 15,979 families on the Southwest Border of the US (1). Approximately 1,663 families traveling mostly from Mexico and Central have been apprehended in the Tucson sector of the border (1). After spending several days in detention, qualifying families are released to the local bus station to continue travel and reunite with their families in the US. However, due to language and cultural barriers, it is difficult for most families to navigate the national bus system. In the absence of federal or state involvement, humanitarian aid organizations have come to the aid of these families.

Multiple reasons exist for the current surge of Mexican and Central American families arriving at the US–Mexico border. Persistent economic deprivation and the resulting inability of families to adequately support themselves, as well as interminable violence are pushing people north. Recent studies indicate that the primary reason that people leave Guatemala, El Salvador, and Honduras is forced child recruitment into gangs, drug- and gang-related violence, gender-based violence, and extortion (2, 3). Violence is compounded by the lack of economic opportunities, lack of access to quality education, and the subsequent inability for families to support themselves financially in their home countries (4).

The government response to this surge is humanitarian parole, which is one of many temporary protection programs offered by the United States Citizenship and Immigration Services (USCIS). US temporary protection programs are dependent on parole, which is the primary avenue for temporarily admitting individuals into the US for extenuating circumstances, including catastrophic weather-related emergencies or violent conflict in sending countries. Humanitarian parole is a discretionary authority used sparingly in situations to grant entry to individuals who would otherwise be inadmissible into the US. The strict parameters of parole require the parolee to report to an immigration and customs appointment within 1–3 months at their final US destination, whereby their immigration status will be re-assessed. Parolees must leave the US before their parole expires, usually within 12 months, unless they gain a more permanent status given their specific circumstances (5).

In order to qualitatively assess the potential impact of the experiences of these families, we elected to assess this problem through the lens of structural vulnerability (6). The concept of structural vulnerability stems from Galtung's (7) structural violence, which he defined as "the indirect violence built into repressive social order creating enormous differences between potential and actual human realization." Kohler and Alock (8) explain that physical violence is when an actor (e.g., number of armed men) uses an instrument (e.g., ammunition) to cause a violent output (e.g., number of persons killed). They explain structural violence as systemic violence caused by structural attributes such as maldistributive policy that differentially allocates resources based on class oppression and economic injustice (6, 8). Alternatively, structural vulnerability was conceptualized to be more inclusive, encompassing maldistributive systems that are based on race, ethnicity, gender, and culture (6). Moreover, structural vulnerability refers to a positionality that imposes physical and emotional suffering on specific population groups and individuals in patterned ways. This positionality is a result of class-based economic exploitation and cultural, gender/sexual, and racialized discrimination (6). Furthermore, vulnerability results from an individual's place in a hierarchical social order and its networks of power relationships and subsequent effects (9, 10). Currently, there is no systematic documentation of the demographics, immigration trajectory, and health status of these women and children. Therefore, the aim of this assessment is to document the experiences of families granted humanitarian parole through the lens of structural vulnerability.

Materials and Methods

Setting and Participants

Investigators from the University of Arizona Mel and Enid Zuckerman College of Public Health partnered with p*roject helping hands (*PHHs) for this study. PHH provides services to migrating families who have been arrested and released by USCBP from short-term detention facilities in southern Arizona. Services include hospitality, food, water, clothing, basic medical attention, and instruction on the intercity bus system. In consultation with our research partner PHH and in order to protect the anonymity and privacy of the migrating women and children, researchers used purposive sampling to interview information-rich key informants, specifically lead PHH volunteers who serve migrating families (11). Lead volunteers hold a supervisory position, are the most likely to consistently interact with migrating families, and are required to speak Spanish fluently. PHHs volunteer coordinator provided the names and contact information of 20 lead volunteers. The investigators attempted to contact all volunteers via email on three separate occasions. Willing individuals replied to the investigators with their availability. A disclosure statement was provided to all volunteers. Face-to-face interviews took place in locations in the local community per the request of the participant. One interview was conducted over the phone. Interviews varied in length from 30 to 90 min. Data were gathered until empirical saturation was reached, i.e., participant responses ceased to vary greatly across questions (11).

Due to the non-generalizable nature of the data gathered, the authors submitted an exemption from human subject's research to the University of Arizona's Internal Review Board (IRB) and were approved on the grounds that non-generalizable data does not constitute as human research as defined by federal regulations.

Interview Guide

A semi-structured interview guide (**Table 1**) was designed to ascertain PHH volunteer perspectives of the migration experience, from departure from their home country to their arrival at PHHs. The open-ended interview questions were developed based on a literature review and consultation with border health and transnational migration field experts. The interview moderator guide was designed to elicit the following information: motivations for leaving the home country, the migration experience, experiences while in detention, PHH services and delivery, and migrating families' health challenges.

TABLE 1 | Interview moderator guide.

Domain	Questions
Reasons for leaving	What are some of the reasons that people are leaving their home country?
Experience on the journey	What are some of the stories that people have told you about the journey?
Experience in detention	Can you tell me about what the families may experience during detention, before arriving at PHH?
Family separation	Were there any health challenges of the women and children that you have served as a PHH volunteer?

Data Analysis

Interviews were audio recorded and transcribed. Two researchers with qualitative research experience independently read and coded the data for major themes using NVivo 7 Software (12). The researchers then compared notes on themes and through a process of consensus agreed on major and minor sub themes and developed a code book (**Table 2**). These same researchers again reviewed the transcripts and coded for the major and sub themes based on the codebook developed. Through face-to-face discussion, researchers developed a code memory to summarize each major and minor theme and identified illustrate quotes that best represented the themes encountered (13).

Results

Interviews were conducted with eight lead volunteers of PHHs. Six of the eight volunteers were female, and two were male. Ages in years ranged from the mid 20s to late 60s. Six of the eight volunteers were born in the US, and all but one of the volunteers was fluent in Spanish. All volunteers had been volunteering with PHH for a minimum of once per week for 4 months. Pseudonyms were assigned to each participant for de-identification purposes.

Six major themes emerged from the qualitative data: (1) reasons for leaving, (2) experience on the journey, (3) dehumanization in detention, (4) family separation, (5) vulnerability, and (6) resiliency.

Reasons for Leaving

Escaping Violence

In discussing why migrating families were fleeing their home countries, volunteers cited escaping violence as a primary cause for migrating north. Specifically, volunteers mentioned the pervasive drug violence affecting families and small businesses. Drug cartels demand money and resources, and when the families no longer have something to give, the cartels threaten them and their family members. Volunteers recalled mothers whose children had been recruited by drug cartels, and out of desperation, they gathered their belongings and fled. Volunteers stated that females often reported leaving due to domestic violence or sexual abuse by the men in their lives. Other reasons included extortion by government officials and police, kidnappings, and the high prevalence of crime in general. In one extreme case, a volunteer recalled the story of an 8-year-old boy from Honduras:

> At that moment the little boy came and he had a little bag of cookies and he offered one to me and I noticed that four of his fingers were missing. I didn't say anything. The little boy noticed that I was looking and he told me the story like matter of fact. He said, "these bad men came and they took me and they put threads around my fingers and then they pulled them and put them against a tree, and then a big truck came and went through the threads and it cut my fingers off. I ran home and I was bleeding and bleeding and they told me to tell my mom that she was going to be killed and me too because we didn't have anything more to give them. My mom was screaming and screaming and she just took me and we ran."

Economic Deprivation

Volunteers also cited economic deprivation as a reason, stating that many migrating families could no longer provide for their children with the current economic situation at home. Many families expressed that they needed better jobs with more pay in order to send their children to school.

> One of the ladies said, "I want to provide an opportunity for my children to get educated, to get a good job cause the only thing that they're going to end up doing is getting into drugs and the gangs and they won't do anything good in their lives if they stay."

Experience on the Journey

The Train or the Bus

The two overarching modes of transportation that migrating families used to arrive at the US–Mexico border from the southern border of Mexico were either by train or by bus. The trajectory through Mexico is heavily dependent on material, social, and human capital. Volunteers stated that those with sufficient means took the bus, which is generally safer than travel aboard the roof of a train. Their point of departure determined whether migrating families will either arrive at the Mexican border with Texas or Arizona. The large majority of those that arrive at the PHH house travel the route to the city of Agua Prieta, which borders Douglas, AZ, USA. The alternative mode of transportation is known as "La Bestia" (The Beast), a name that was earned by the slow moving cargo trains that cross Mexico from south to north. Migrating families told volunteers about having to remain awake on the top of the train, for risk of falling off while asleep. One volunteer reported meeting a young woman with a black eye and scratches all over her face that had been hit by a tree limb in the face while riding atop the train. As one of the volunteers mentioned:

> Even if you aren't subject to violence from the horrible people who are waiting to prey on people [riding on the train] there is still the reality of you riding on top of the cargo train for thousands of miles so that's pretty awful.

> The people who get booted off the bus and the people who ride the top of the train are [going to] be the most vulnerable to begin with you know the most destitute the most desperate and ones you maybe don't speak the language as well are probably be the ones who get put into these more dangerous categories and are probably more will likely to be taken advantage of.

TABLE 2 | Qualitative codebook.

Major themes	Sub themes	Definition	Sample quotes
Reasons for leaving	Escaping violence	Types of violence that motivate migrating families to leave home	*"He said 'these bad men came and they took me and they put threads around my fingers and then they pulled them and put them against a tree, and then a big truck came and went through the threads and it cut my fingers off. I ran home and I was bleeding and bleeding and they told me to tell my mom that she was going to be killed and me too because we didn't have anything more to give them. My mom was screaming and screaming and she just took me and we ran'"*
	Economic deprivation	Examples of economic deprivation influencing migration	*"I want to provide an opportunity for my children to get educated, to get a good job cause the only thing that they're going to end up doing is getting into drugs and the gangs and they won't do anything good in their lives if they stay"*
Experience on the journey	The train or the bus	Migrating families use different modes of transportation to reach the US depending on their social, material, and human capital	*"The people who get booted off the bus and the people who ride the top of the train are [going to] be the most vulnerable to begin with…"*
	Blending in	Success on the journey is partially dependent on how well migrating families blend in with Mexican nationals	"*But another way to do is to blend in more or less. So one woman, was actually a Honduran woman, she knew that like the government was [going to] get on the bus and be looking for suspicious looking Central Americans. So she gets on the bus and there's the Central Americans are in the back of the bus and they are cowering and avoiding eye contact and such. So she decides to sit in the very front seat and whenever the police would get on would stand a very straight and would look at them straight in the eyes, just nod at them and they would walk right by her to the back to the back of a bus and grab the Central Americans and throw them off the bus"*
	Risk at the border	Migrating families encounter various types of risk at the border	*"[The coyotes] left with all of their money. They took all their money … and they are put up in a hotel and they'll come and feed them whenever they can so they can go days without eating"*
	A confusing journey	Migrating families may lack resources, knowledge, language skills, and experience; thereby creating a sense of confusion about aspects/stages of the journey	*"For people who don't, or aren't familiar with this area, it's desolate and they don't know where they are"*
Dehumanization in detention		Participants discuss the dehumanizing experiences and/or conditions that migrating families endured while in detention facilities	"*Everyone says that the jail is way too cold and they sleep on floors they give them these like aluminum blankets and they feed them frozen burritos, which is like the worst thing you can have if you're dehydrated from being on the desert…"*
Family separation		Migrating families separated during migration or at apprehension by immigration and customs	"*…her husband got detained and ended up somewhere so she was counting on him to help her with the kids and he was detained"*
	Vulnerability	Participants report the varying degrees of vulnerability before, during, and after the migration journey	"*I think the scariest thing is that they arrive almost exclusively from ICE from what we know with no dollars no money okay so they have to make the trip across the country with no basically to me that would be very scary to be a mom traveling with young kids and not have any money and be going from Arizona to Pennsylvania or Rhode Island"*
	Resiliency	Participant perceptions regarding the resiliency demonstrated by migrating families	*"…I see these and they're not fragile these women are like incredibly resilient"*

Blending In

Additionally, even when migrating families had the economic means to avoid the dangerous trajectory of the train, their success was heavily reliant on their abilities to speak Spanish and blend in with Mexican nationals. Immigration checkpoints in Mexico often required people to bribe federal officials, or be forced off the bus. One of the volunteers exclaimed:

> So we only see the success stories here we see the people didn't get kicked off the bus and the way they do that is either they're a little wealthier, they have some pesos with them so that they can pay a bribe to the federales (federal police) … But another way to do is to blend in more or less. So one woman, was actually a Honduran woman, she knew that like the government was [going to] get on the bus and be looking for suspicious looking Central Americans. So she gets on the bus and there's the Central Americans are in the back of the bus and they are cowering and avoiding eye contact and such. So she decides to sit in the very front seat and whenever the police would get on would stand a very straight and would look at them straight in the eyes, just nod at them and they would walk right by her to the back to the back of a bus and grab the Central Americans and throw them off the bus.

Risk at the Border

Travel on the bus eventually brought migrating families to the Sonora, Mexico border-area towns of Agua Prieta, Nogales, Altar, Sonoyta, or San Luis. While in these towns, migrating families were at risk of extortion and kidnapping, according to volunteers.

> Another woman had one little kid and someone grabbed her before she got across the border someone grabbed her in Nogales and imprisoned her in some room that she had to eventually escape from out of the window, I suppose it was a coyote (human smuggler), she had like 1000 dollars or something and he took that money and imprisoned her and she didn't know what his plans were for her but she finally got out a window.

Upon their arrival by bus or train, migrating families must pay a *coyote* to get across the border undetected. Volunteers described how migrating families were at the mercy of the *coyotes*, their law evasion strategies at the border, and their route through the arid Arizona desert.

> [The coyotes] left with all of their money. They took all their money … and they are put up in a hotel and they'll come and feed them whenever they can so they can go days without eating.

A Confusing Journey

Here, a volunteer described how confused migrating families become during the journey:

> So they would be on the bus and they had there would be a series of payments made for those people and they would be riding buses until they get to the border area and in the border area depends on where they're going to be crossed. If they spent the night in Altar Sonora they were in a rural area somewhat isolated, and they really had no idea was going on, they're brought to the border, and for those who are familiar with Southern Arizona it's a very open desert. For people who don't, or aren't familiar with this area, it's desolate and they don't know where they are.

Dehumanization in Detention

Several themes related to the *treatment, feeding, sleeping*, and *health status* of the migrating families during the apprehension and detention process. According to the volunteers, US Immigration and Customs Enforcement (ICE) attempted to process humanitarian parole as quickly as possible; however, setbacks in procedures forced families to spend anywhere from a couple of nights to several weeks in detention facilities. Volunteers also mentioned that families were often jailed in cold, windowless rooms, and were forced to sleep on the floor with only an emergency Mylar blanket for warmth. Volunteers described that the women and children often left ICE detention in a state of dehydration, not because of the journey prior to apprehension, but because they were not allowed to adequately hydrate while in detention. Moreover, they noted that most migrating families were not aware than the water available in the cells was potable, a fact that Border Patrol did not always share with their charges. Finally, the volunteers mentioned that the food provided to migrating families while in detention exacerbated their dehydration and made them sick.

> Everyone says that the jail is way too cold and they sleep on floors they give them these like aluminum blankets and they feed them frozen burritos, which is like the worst thing you can have if you're dehydrated from being on the desert … They feed them burritos, Austin crackers, and juices. They don't eat the burritos, they eat the Austin crackers and the juices. So its funny when people were getting dropped off to us and they were dehydrated and they said they hadn't eaten in a while I thought it was because they had been out in the desert but it was because they had been in the jail.

> Many of them had no idea what was it just went through. The border patrol wakes people up at two in the morning and 'processes them'. Meaning they interview them about the reasons why they left and they make some judgment legally about what that means at two in the morning. That's normal procedure.

Family Separation

Another service provided by PHH was the location of missing family members. The parameters of humanitarian parole mandate that only one adult may remain to accompany any children, and any other adult is to be placed in short-term detention for deportation proceedings. This manifested itself in family separation; for example, a mother and father and their children may have been apprehended and the mother and children were released to PHH, while the father was detained. If they were not aware of where other members of the family were sent, PHH attempted to make contact with detention facilities to locate the men. Another situation that separated families is that some migrating families knew that as a male family member, if they crossed with women and children and were apprehended, they would be put in longer-term detention and separated from their families. As a result, that person may have attempted to enter the US separately. If this occurred, apprehended families were desperate to contact the missing members, and PHH worked to locate them with the Mexican or Guatemalan consulate. If they were able to communicate, this may have been an extreme relief, especially during the months of May through mid-September as that was the hot season and lives may be at stake in the desert.

> These women take off. They just have to be so desperate to have to head off when she's about to deliver a baby and then this other woman was there who had a 15 month old and she had a newborn and she was coming through and her husband got detained and ended up somewhere so she was counting on him to help her with the kids and he was detained.

Vulnerability

Another emergent theme that arose from the interviews was the vulnerability of the migrating families both during their journey and upon their arrival in the US. Volunteers cited language barriers, lack of money, and a general lack of understanding of their immigration status as significant concerns for the migrating families. Language barriers were major obstacles for the migrating families as they moved through Mexico and into the US. Volunteers reported that the majority of families arriving at PHH were from rural areas of Guatemala and spoke indigenous languages. Their

limited Spanish skills and inability to communicate added to their vulnerability and made it difficult to navigate through risky areas of Mexico. If they made it across the border, the inability to speak English added to their isolation when they were apprehended by the border patrol and detained by ICE. Understanding the process of apprehension, detention, the parameters of their humanitarian parole, and their future journey through the US became increasingly difficult when communication was impossible. Upon their arrival at PHH, the families were about to embark on yet another journey through an unfamiliar country, and may have spent up to 4 or 5 days navigating buses and stations before reaching their final destination. Another issue was that most migrating families arrived with no money for a variety of reasons. Some were robbed on the journey, while others fled imminent danger from cartel violence and had limited time for preparation and saving.

> They're just dropping these people off that don't speak any English and don't have any money and I thought that's really horrible.

> I think the scariest thing is that they arrive almost exclusively from ICE from what we know with no dollars no money okay so they have to make the trip across the country with no basically to me that would be very scary to be a mom traveling with young kids and not have any money and be going from Arizona to Pennsylvania or Rhode Island.

Resiliency

While volunteers commented on the state of vulnerability of the migrating families, they also overwhelmingly remarked on the courage and resiliency of these individuals. They stated that in contrast to the manner in which immigrants are usually portrayed in the media as victims or as weak, their experience with migrating families has shown these individuals to be strong, resilient, and brave. They described them as individuals who are willing to do whatever it takes and overcome adversity in order to make a better life for them and their children.

> There was a woman who walked, somewhere from Mexico, she had scratches all over her and she had a one year old little girl on her back. She was by herself and she wasn't with a group. And they arrived just exhausted, just right on the edge. You wouldn't know it because they're just so tough, they wouldn't have made it all the way here if they weren't so tough but they were just right on the edge.

> I would say that the people I've talked to do not fit the stereotype image that people coming of being super traumatized and you know almost shaky or anything like that. I see these and they're not fragile these women are like incredibly resilient.

Discussion

These findings elucidate the different physical and psychological distresses that migrating families from Mexico and Central America experience before, during and after their arrival at the Tucson sector of the US–Mexico border. We posit that these distresses are a result of, or exacerbated by, structural vulnerability. Structural vulnerability argues that inequality results from systemic political, economical, and material marginalization that contributes to oppression through gender, ethnic, and class-based discrimination (6, 9, 10). Migrating families find themselves in a particularly vulnerable situation due to the intersections of their status as economically marginalized indigenous women and children. Thereby, their status subjects them to class- and gender/sex-based exploitation, as well as culture- and race-based discrimination (6).

Our findings show that migrating families in question are fleeing situations characterized by structural vulnerability. Consistent with literature on the topic (2, 4, 6), we found that the primary motivation for women and children to flee their home country is persistent violence, specifically drug, gang, and gender-based violence, which largely occurs as a result of economic deprivation and maldistributive economic policy. Moreover, it has been found that children from Guatemala, El Salvador, and Honduras cited their primary reason for leaving their homes as forced child recruitment for gangs, and drug- and gang-related violence. Girls specifically have cited gender-based violence, including rape as a means of control by local gangs. Guatemalan children mentioned increasing poverty, poor agricultural yields, and unemployment as their reasons for leaving (2). Central American families overwhelmingly named deep structural conditions of economic security and chronic violence as reasons to migrate. Furthermore, the persistent threat of violence elicits fear and anxiety in children, increased risk of post-traumatic stress disorder (PTSD) and depressive symptoms in pre-adolescent and adolescent youth (14, 15).

In addition to experiencing violence at home, migrating families experience abuses while on the journey. Consistent with our findings, studies suggest that each year, hundreds of thousands of people from Guatemala, El Salvador, and Honduras attempt to cross Mexico, where they are regularly subjected to abuse, police brutality, extortion, rape, dismemberment, and death (16–18). However, violence does not cease upon their arrival at the US–Mexico border as migrants are vulnerable to violence from US immigration and law enforcement (19–21). Our findings illustrate the impact of USBP policy that separates, detains, and eventually deports men, and releases the women and children of the same family unit. While, there are many implications for all parties involved, research indicates that children suffer the greatest consequences from family separation. The immediate consequences of parental incarceration include traumatic separation, stigma, and isolation (22). Moreover, the effects of parental deportation are similar to that of other recognized negative childhood experiences, including family violence, a parent's death, parental drug abuse, and neglect (19).

Turning to the issue of maltreatment while in custody of the USBP, volunteers reported that once they are apprehended, migrating families are subject to inhumane treatment, including verbal abuse, exposure to unbearably low temperatures, prohibited use of warm clothing, inadequate food, and limited water. Our findings are consistent with recent studies that found that migrants reported persistent abuse during USCBP apprehension, detention, and

deportation proceedings (20, 21). Moreover, studies have shown that mistreatment during the apprehension and detention process may be psychologically distressful; data indicate that detention and adverse mental health are causally associated. Detention of asylum seeking migrants, even for short periods of time, results in acute psychological distress, the cause of new mental health disorders, and or the exacerbation of existing conditions (23–25). Additionally, children asylum seekers can suffer life-long psychological consequences as a result of detention, including acute psychological distress, anxiety depression, affective PTSD, and intentional self-harm (26–28).

Our findings elucidate that before, during, and after the migration journey, these migrating families are subject to class- and gender/sex-based exploitation, as well as culture- and race-based discrimination (6), thereby defining them as a structurally vulnerably population. It is important to note that their structural vulnerability is a result of systemic issues without simple solutions, and without broad-based political, economical, and social change, the US will not likely see a decrease in migration from these countries in the near future. For this reason, it is important to establish a public health framework for understanding these vulnerable populations as they transition into US society. The current immigration status of humanitarian parole provides little protection to vulnerable families. We believe that given the circumstances from which they flee, migrating families merit a more permanent state of protection than what is currently offered. We recommend that the US expand its capacity to admit migrating families who are at risk of violence or harm in their home countries, specifically by establishing a non-immigrant "protection" visa that would be made available to members of vulnerable groups (29).

Based on our findings and supporting literature, we recommend that Tucson sector USCBP detention conditions drastically improve in order to prevent the perpetuation of trauma, and subsequent negative health outcomes among migrating families. Processing of detainees should be expedited in order to reduce the time that families spend in detention. If USCBP custody is to become more humane, detention facilities must meet basic health needs. Families must have access to water in a sanitary manner and in sufficient quantities to ensure safe hydration, access to adequate foods that to not exacerbate dehydration, and adequate access to medical care. Moreover, detention facilities should have more adequate regulation of temperatures, allowance of more than one article of clothing per person in order to promote the recuperation and not exacerbate conditions of physical exhaustion and emotional trauma. Additionally, policies that promote the necessary separation of families should be eradicated, as they only serve to distress families and perpetuate trauma (17, 18, 22).

We recognize that this study has some limitations. Although we believe our methods provided adequate contextual understanding, second-hand inquiry limits the data given that we were unable to interview families directly. However, collecting volunteer perspectives was also a strength of the study, given that they are front-line humanitarian aid volunteers that work one on one with migrating families. Another potential limitation was the inclusion of data from a participant who was not fluent in Spanish. However, the researchers considered the contributions of this participant to be meaningful due to her consistent interactions with migrating families and simultaneous interpretation by Spanish-speaking volunteers. Finally, interviews were conducted with PHH volunteers serving only one site; thereby, the findings and related implications cannot be generalized to other migrating families that are crossing and being processed at other points of the US–Mexico border without further research.

Structural vulnerability has resulted in life-long health implications for a sub-population of young mothers and their children. The number of migrating families who have experienced traumatic events before, and during their migration experience continues to expand and thus warrants consideration of mental health surveillance and intervention efforts for these families. Although immigration policy-based solutions are beyond the scope of this article, we recognize that immigration and USCBP policy has critical public health implications, and therefore, should be considered in future investigations. Additional public health research is needed to better understand and combat the health challenges of this growing vulnerable population.

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Risk factors and current health-seeking patterns of migrants in northeastern Mexico: healthcare needs for a socially vulnerable population

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This study identified risk factors for health and access to healthcare services of migrants during their journey across Mexico to the United States. Data were collected in shelters located in Monterrey, the largest city of northeastern Mexico, through a basic clinical examination and a survey completed by 75 migrants; 92% of them were undocumented Central Americans. During their transit, they are at a high risk of contracting, developing, and transmitting diseases. The need of working to survive affects health-seeking behavior and a constant fear of being traced keeps migrants away from public health services, which delays diagnosis and treatment of diseases. Negligent lifestyles, such as smoking, drinking (31.8% of men and 11.1% of women), and drug abuse (13% of men and 11% of women), were found. Regarding tuberculosis (TB), undocumented migrants are usually not screened, even though they come from countries with a high TB burden. Besides, they might be overexposed to TB because of their living conditions in overcrowded places with deficient hygiene, protection, and malnutrition (54.7% of the sample). Possible comorbidities like acquired immune deficiency syndrome (AIDS; 4%) and diabetes (2.7%, but probably under-diagnosed) were referred. Migrants have little TB knowledge, which is independent of their level of education or a previous experience of deportation. About one-third of the migrants were totally unfamiliar with TB-related symptoms, while 36% had correct knowledge of basic TB symptoms. We conclude that a shortage of information on the highly vulnerable migratory population combined with a lack of social support and health education among migrants may play a significant role in the spread of communicable diseases. We recommend that health authorities address this urgent, binational, public health concern in order to prevent outbreaks of emerging infections.

Keywords: risk factors, undocumented migrants, social vulnerability, tuberculosis knowledge and perceptions, barriers to health

Abbreviations: AIDS, acquired immune deficiency syndrome; BCG, Bacillus Calmette–Guérin; DM, diabetes mellitus; HIV, human immunodeficiency virus infection; INM, National Institute of Migration; KAP, knowledge, attitude and practices; NGO, no governmental organization; SD, standard deviation; TB, tuberculosis; US, United States; WHO, World Health Organization.

Introduction

In 2013, 214 million migrants lived for at least 1 year in a country different from their home country (representing 3.1% of the world population), against 150 million migrants in 2000 (1). Apart from a rapidly increasing migration number, migration also involves a wider diversity of cultural groups. About 82 million people per year migrate from a developing country to a developed one. Furthermore, the latest estimations suggest that around one-third of migration from developing countries could be irregular (2). With migration being a growing tendency, migrants experience a unique diversity in health needs and profiles.

Worldwide, migrants are more vulnerable than nationals, as they have fewer rights than people with a citizenship. In Mexico, the life style, journey, and work of migrants, especially the undocumented migrants from Central and South America, lead to considerable risks to personal, physical, and mental well-being (3–5). Migrants' well-being is further compromised by irregular access to social and health services, immigrant status, and a prevailing anti-migrant attitude of the general public (6–8). Indeed, legal and practical obstacles limit access to health services on both sides of the Mexican–United States (US) border, and the consequential late detection of illnesses negatively affects the health of immigrants (9).

Transnational migration through Mexico affects the public health situation by connecting areas with diverse disease prevalence and other socioeconomic factors. Most of these health issues represent challenges for the limited territorial public health systems, because migrants are by definition mobile and hard-to-reach persons. Thus, the interest of our research is to determine to what extent the migration process affects the health of both the migrants and the general population. Hereto, the present pilot study aims to identify the risk factors of illnesses among migrants, as well as to get insight into the health-seeking patterns and TB knowledge among North, Central, and South American (im)migrants who pass through the city of Monterrey, Mexico, in their quest to reach the US. To our knowledge, this is the first report on current patterns of migration and their impact on health in this specific population in northeastern Mexico. Our results provide a basis for rethinking the specific healthcare needs in order to protect the health status of the general population.

Materials and Methods

This study is an observational, transversal, and descriptive study realized from September 1st to November 30th, 2014, at temporary shelters for migrants in Monterrey. Data were collected through a basic clinical examination and a survey.

Population Definition

We adopted the definition of the International Organization for Migration's definition for "undocumented immigrants": "Persons who change their place of usual residence" but without having a legal residence situation (10).

Ethics and Consent

The research protocol followed principles of the Declaration of Helsinki and was approved by the University of Monterrey under the project code UIN15012. Written informed consent was obtained from all participants. In case of minors, informed consent was obtained from the parents or accompanying adults. No unaccompanied minor participated in the study.

Sample

The sample consisted of 75 temporal immigrant volunteers of any age and gender who attended one of the two migrant shelters managed by the Catholic Church in the Monterrey Metropolitan Area; the "Centro de Apostolado San Nicolás de Tolentino – CasaNicolás" and the "Casa Santa Martha." It is important to underline that in México the shelters for undocumented migrants are mostly managed by different churches, the majority of them were managed by the Catholic Church. Rather than realizing evangelization, these shelters provide help and assistance to the (im)migrants. They do this independent of their religious beliefs or those of the migrants. Therefore, we consider that the formal religious characteristic of the shelters does not affect the origin or representativeness of the population sample.

Subjects with incomplete information or immigrants who dropped out the study before completion were not considered. The sample encompassed 71 undocumented South and Central American immigrants and 4 North Americans. We decided to include the latter because they complied with the definition of migrant and suffered the same mental and physical health stressors and social vulnerability similar to undocumented immigrants (11) (**Table 1**).

Sampling Location

Monterrey is a cosmopolitan city located in northeastern Mexico and is the capital city of the state of Nuevo Leon. Over 4.4 million people live in this metropolitan area. It is one of the most important cities of the country and it represents one of the traditional routes of migrants coming from southern states of Mexico and from the other Central and South American countries (12).

The Questionnaire

Our team, which included experts in TB and migration, designed a semi-structured, Spanish questionnaire with closed and open-ended questions, which included quantitative and qualitative methods. The questionnaire was based on previous national and international validated questionnaires (13–18), recommendations from a literature review (19), and the guidelines of the WHO "Tuberculosis PREVALENCE SURVEYS: handbook" (20).

To ensure that the survey is in accordance with the education level of the participants, the questionnaire was adapted to the education level specified in the Program of the last level of the Elementary School in Mexico (21). The questions were focused on specific topics, contained congruency control, and were limited in scope to avoid exhaustion of the participants; all to promote the reliability of the responses. A draft version was

TABLE 1 | Demographic data.

Variable	Observation	Frequency
Gender (males)	75	66 (88%)
Age in years (mean ± SD)	75	32.5 ± 1.1
Migrant shelter		
CasaNicolás	64	85.3%
Casa Santa Martha	13	14.7%
Religion		
Catholic	28	37.3%
Protestant	27	36.0%
Other	2	2.7%
None	13	17.3%
No answer	5	6.7%
Nationality		
Honduras	41	54.6%
Guatemala	15	20.0%
El Salvador	12	16.0%
Mexico	3	4.0%
Ecuador	1	1.3%
USA	1	1.3%
Nicaragua	1	1.3%
Venezuela	1	1.3%
Marital status		
Single	40	53.3%
Cohabiting	20	26.7%
Married	12	16.0%
Divorced	3	4.0%
Education level		
Elementary		
Incomplete	15	20.0%
Complete	25	33.3%
High school		
Incomplete	3	4.0%
Complete	17	22.7%
University or technical carrier	9	11.9%
None	6	8.0%

piloted in a 12-person group, and pointless, duplicated, or unsuitable questions were eliminated. The resulting succinct, clear, and unequivocal questionnaire was reorganized into logical sections and standardized. The reliability of the survey was confirmed by supplying the survey questionnaire twice to the same individuals with a long enough time difference to make it highly unlikely the respondents remember their first responses. Translation from Spanish to English was used once.

Procedures

The survey was applied at the shelters during 45-to-60-min, face-to-face interviews in a relaxed atmosphere, which enabled to clarify the eventual unclear answers. Random surveys were cross-checked for continuous reliability. As a result, we collected a limited, but consistent and trustworthy amount of information, which was analyzed for the following characteristics:

1. Socio-demographic profile (age, sex, ethnicity, place of origin, education, and occupation).
2. Reasons for immigration and history of their journey (transports used, type of housing, and experiences with authorities and criminal groups).
3. Medical history.
4. Personal habits and lifestyle (tobacco, alcohol, and substance use).
5. Baseline dietary assessment.
6. Emotional well-being and social support.
7. Perceived barriers to health services and health-seeking practices.
8. Basic TB knowledge and attitudes.

In the same session, we determined anthropometric measures (height, weight, waist, and hip circumference) and blood pressure. Furthermore, we performed walk-through inspections of the shelters, to be familiar with the dormitories and the living spaces. Data collection and interpretation followed confidentiality procedures.

Data Analysis

All data were collected in an Excel Spreadsheet and subsequently fed into a Stata Software v11.0 database (College Station, TX, USA). The data were then coded and displayed according to Miles and Huberman's methods (22), before being processed through descriptive statistical analyses. Outcomes were reported as means ± standard deviation (SD) or frequencies.

Results

In our sample, most of the immigrants were males (88%) and their mean age was 32 ± 11.1 years (range: 14–60 years); the predominant age group was from 20 to 30 years (43%). More than half of the migrants came from Honduras (54.6%), whereas other Central American countries (Guatemala, El Salvador, and Nicaragua) represented 37.3% of the sample (**Table 1**).

As a matter of fact, this sample is consistently similar to the total population of undocumented immigrants in the Monterrey Metropolitan Area during the year 2014, according to the annual report of CasaNicolás (the unique liable and available source of information on undocumented migrants). In fact, during 2014, CasaNicolás studied 87% of male immigrants including 63% from Honduras (23).

More than half of the volunteers (53%) had only elementary school education, either complete or incomplete. One-third (25 subjects, 34%) had high school or baccalaureate education, and only four subjects (5.3%) had higher level education, of either a technical or professional career. Religion and marital status are reported in **Table 1**.

The weight, height, and body mass index (BMI) of the participants were 69.6 ± 10.6 kg, 164.7 ± 8.5 cm, and 25.7 ± 3.9 (mean ± SD), respectively. Almost half of the subjects were overweight (46.6%) or obese (10.6%). None of them was underweight, despite the fact that more than half of the immigrants referred diminished or limited food intake during their journey (**Table 2**).

With respect to personal habits, the subjects presented good hygiene (74.7%), but alcohol and tobacco consumptions were referred in the same proportions: 31.8% and 11.1% of males and females, respectively. Almost half of them (44.8%) had started drinking and 80% had started smoking as teenagers. Among males, 38% consumed both alcohol and tobacco, whereas only 11.1% of the females consumed both. Illegal drugs were

TABLE 2 | Nutritional assessments and personal habits.

Variable	Observation	Mean ± SD
Weight (kg)		
Men	66	67.8 ± 9.1
Women	9	72.8 ± 15.9
Height (cm)		
Men	66	166 ± 7.3
Women	9	155 ± 9.1
Body mass index	45	25.7 ± 4.0
Underweighted (<18.5)	0	0
Normal weight (18.5–24.9)	35	46.6%
Overweighed (25–29.9)	35	46.6%
Obesity (>30)	5	10.6%
Waist (cm)		
Men	63	87.6 ± 9.5
Women	9	100.7 ± 11.9
Hips (cm)		
Men	27	98.6 ± 6.5
Women	6	107 ± 12.4
Hygiene (interviewer criteria)		
Good	56	74.7%
Regular	10	13.3%
Bad	7	9.3%
No answer	2	2.7%
Alcohol		
Men	21	31.8%
Women	1	11.1%
Tobacco		
Men	21	31.8%
Women	1	11.1%
Drugs		
Men	9	12.0%
Women	1	1.3%
Food intake during last month		
Increased	12	16.0%
Equal	22	29.3%
Diminished	35	46.7%
Limited	6	8.0%

TABLE 3 | Health status.

Variable	Observation	Frequency (%)
Health issues		
Men	63	10.7
Women	8	22.8
Diseases		
Respiratory (upper)	10	15.2
Gastrointestinal	3	4.6
Urinary	2	3.0
Trauma & Lesions	4	6.1
Other	3	4.6
No answer	53	66.7
Medical insurance	10	13.3
% of men with insurance	8	12.1
% of women with insurance	2	22.2
Frequency of contact with healthcare system		
≥2 times over the past year	19	25.3
Once over the past year	12	16.0
1–2 over the past 5 years	8	10.7
Once over the past 5 years	11	14.7
Never in the past 5 years	24	32.0
No data	1	1.3
Type of health service sought when necessary (various possible answers)		
Public med. in home country	8	10.7
Public medicine in Mexico	7	9.3
Public medicine in the US	2	2.7
Private medicine in Mexico	1	1.3
Migrant shelter	3	4.0
Drugstore	8	11.0
Self-medicated	34	45.0
No medical attention	11	14.7
No answer	42	56.0
High blood pressure		
Men		17.0
Women		20.0
Tuberculosis		
BCG vaccine	74	98.7
TB	75	1.3
TB contacts	75	14.7
Known TB contact		
Yes	11	14.7
No	64	85.3
AIDS	3	4.0
Diabetes	2	2.7

referred in 13.6% of males and 11% of females. Of them, 66% referred using marihuana at least once and 22% referred cocaine (**Table 2**).

Moreover, 10.7% of men and 22.8% of women mentioned having health problems, with upper respiratory disease being the most common (15.2%); there were trauma or lesions in 6.1%, gastrointestinal disease in 4.6%, and urinary disease in 3% of the sample. More women than men had medical insurance (22.2% and 12.1%, respectively). Most preferred public health services (22.7%) and 14.7% did not seek medical attention even when sick (**Table 3**).

Twenty percent of women and 17% of men had high blood pressure, and most of them declared to have had visited the health-care system rarely. One quarter (25.3%) affirmed having been in touch with the healthcare system two or more times over the past year, and 12 of them (16%) once, but more than half (57.4%) had contacted less than once over the past year. In addition to this poor pattern of healthcare seeking behavior, 14.7% referred to be close to a patient with TB, 4% referred to have acquired immune deficiency syndrome (AIDS) and 2.7% diabetes mellitus (DM); 98.7% referred having received the Bacillus Calmette–Guérin (BCG) vaccine (**Table 3**).

Participants understood that TB is a disease associated with significant morbidity and mortality, and 81.3% of the subjects considered TB a serious or very serious disease. While 17.3% mentioned vague symptoms that may relate to any kind of discomfort; only 30.7% correctly identified coughing for more than two weeks and 13.3% mentioned fever for more than one week, but none mentioned shortness of breath and weight loss. Also, 30.7% mentioned at least one wrong symptom and 33.3% had no idea at all (**Table 4**). Besides, less than one-fifth (18.7%) thought they were infected. Physicians and television were cited as the two most important sources of information on TB (**Table 4**).

It was the first migratory journey for 57.5% of our sample. Poverty and economic reasons had been the motive of emigration for the majority (65.3%), violence for 22.7%, family reunion for 8%, and political persecution for 4%. A quarter had had a previous undocumented experience and 21.3% had been deported from the US back to their home country (**Table 5**). For over half

TABLE 4 | TB knowledge and perception.

Variable	Observation	Frequency (%)
Can you contract TB	75	18.7
TB symptoms knowledge		
Correct answer	27	36.0
Incorrect answer	23	30.7
Does not know	25	33.3
TB symptoms knowledge without misconceptions (various possible answers)		
Cough >2 weeks	23	30.7
Fever >1 week	10	13.3
Vague symptoms	13	17.3
Shortness of breath	0	0.0
Weight loss	0	0.0
How serious is TB		
Very serious	45	60.0
Serious	16	21.3
Not too serious	1	1.3
Do not know	13	17.3

TABLE 5 | Emigration Experiences.

Variable	Observation	Frequency (%)
Reason for emigration (various possible answers)		
Poverty and economic reasons	75	65.33
Violence	75	22.66
Family reunion	75	8.00
Political persecution	75	4.00
Other reasons	75	13.33
First immigration travel	73	57.53
Previous experience in the US as an undocumented migrant	19	25.33
Previously deported from Mexico to home country	2	2.66
Previously deported from the US to home country	16	21.33
Final destination	73	57.53
USA	40	53.30
Other	9	12.00
No answer	26	34.60
Place to go in the US	68	90.70
Problems during travel (various possible answers)		
Criminal organization	17	22.60
Police/migration	28	37.30
"Pollero" scam	4	5.30
Others (civil population)	4	5.30
None	18	24.00
No answer	9	12.00
Type of problem (various possible answers)		
Violent assault	20	26.66
Oral and physical threats	15	20.00
Extortion	20	26.66
Kidnapping	6	8.00
Other kind of problems	11	14.66
Journey funding (various possible answers)		
Savings	46	61.33
Temporary work	23	30.66
Assistance (NGO/local population)	15	20.00
Help of the shelters	24	32.00
Other	12	16.00
Had to borrow money?		
Yes	21	28.00
No	45	60.00
No answer	9	12.00

of them (53%), the journey's endpoint was the US; the majority of them (90.7%) had an exact destination.

Almost two-thirds (64%) reported problems during their travel, most often with the authorities (37.3%), criminal organizations (22.7%), and with the smugglers ("polleros"; 5.3%). Over a quarter (26.7%) reported violent assaults and a similar percentage had suffered economic extortions. Verbal and physical threats were reported by 20% of the cases and 8% of the migrants mentioned being victims of kidnapping.

To fund their journey, 28% had borrowed money from a relative or friend and 61.3% had used their savings, but most depended on work or financial support during their trip (**Table 5**).

Discussion

Socio-Demographic General Overview

Undocumented migration represents 5–30% of the total immigrant population depending on the country (24). Unauthorized migration through Mexico is a major and growing issue for both Mexico and the US. The number of undocumented migrants in the US increased from around 3 or 4 million in 1993 to 12.2 million in 2007, and 11.2 million in 2012 (25). In US, the Latin American undocumented immigrants have greater problems to access the healthcare system and consequently use it less than undocumented immigrants from other parts of the world (26). However, the exact burden of undocumented immigrants in northeastern Mexico and the impact on public health are not known.

The socio-demographic profile of our population sample is in line with the available data on the 1,112 persons who attended the CasaNicolás between February and October 2014; the others' shelters have not been registered. Most immigrants were male (88% in our sample and 73% in the CasaNicolás register) and from Honduras (55% and 63%, respectively). Together with other Central American countries, they represented 92% of our sample (**Table 1**), versus 84% of the shelter's total population.

Likewise, the reasons for migration are similar between our 75-person sample and the total population of CasaNicolás. In both the groups, poverty and economic reasons were the most frequent causes of emigration: unemployment, salaries too low to mitigate high inflation, debts, and economic crisis (65.33% of our sample and 61% of the total CasaNicolás population). Violence was mentioned in second place (22.66% of our sample; 7% of the total population), followed by family reunion (8 and 2%, respectively) (**Table 5**).

Migration and Health Interaction

Monterrey is an economically growing city where the undocumented immigrants live temporarily and where they usually do not struggle to find a job. However, this population lacks adequate healthcare due to their immigrant status. Accordingly, their only access to healthcare generally limited to some local clinics at best, when they accept to treat them for free.

Migration and health interact and cause a decline in the general health of migrants. Undoubtedly, migrants' health depends on

individual characteristics (gender, age, education, substance use, etc.), but it is also determined by contextual factors that cover far more than the individual health aspects. The migrant's well-being is vulnerable because of a complex interaction among the aforementioned individual characteristics, lifestyles (e.g., dehydration, habits, and food shortages), personal beliefs and attitudes, living and working conditions, and environmental characteristics (27).

Migrants face complex problems ranging from housing shortage to overcrowded shelters with poor ventilation, propitious conditions for the transmission of diseases (TB, influenza, fungi). They are also confronted with cultural and psychosocial obstacles, such as poor education and knowledge on health issues, which impede their access to health services. Another challenge is maintaining their personal safety and security within an unfriendly environment that combines food insecurity, social vulnerability in general, and overexposure to violence. When arrested by the Mexican or US migration authorities, they are usually imprisoned in overcrowded places that serve as incubators for contagious diseases and infections (28). Lastly, some of their behaviors, like untreated substance abuse and mental illness, might affect their physical health status.

Smoking, and alcohol and substance abuse are known risk factors for many diseases, including infections, because they compromise the immune response. However, adopting healthier habits may be harder for migrants than for the general population, because they have to handle much more stressful situations they rely with the use of tobacco, alcohol, and substances (29). For this reason, migrants need special counseling and medication to help them quit.

Regarding TB, we suspected TB in a volunteering migrant, but chest radiography excluded such a diagnosis. Still, TB is an excellent illustration of the complexity of healthcare issues in relation to migration. The failure to detect TB, or its late diagnosis, and the inadequate treatment follow-up in migratory TB patients precisely reflect the underlying educational/cultural factors (absence of information), economical (shortage of resources for transportation and housing), and psychosocial factors (e.g., feeling ashamed or guilty about the disease, or failure to establish a strong doctor–patient relationship), and several other social barriers (professional, familiar, etc.) (30–32).

TB prevalence is higher in socially vulnerable populations (33–35). Our study displays the high burden of health issues in the undocumented immigrant population, with pronounced conditions of social vulnerability and epidemiological risks. Undocumented migrants should be considered a focal point of health attention for being overexposed to risk factors, especially in the case of AIDS patients (4% prevalence in our population against 0.2% in the general population of Nuevo Leon in 2013) (36) and migrants suffering diabetes (only 2.7% of our sample).

The Living Conditions During Transit as a Complication to Health Access

Since migrants usually face structural socioeconomic needs (which is the most common reason for migration), they tend not to spend money on their health. In most cases, cough, weight loss, and tiredness are considered normal and not a reason to seek medical care; 32% of our sample had no contact with any healthcare system in the past 5 years and more than half (57.4%) had not seen a physician at least once over the past year (**Table 3**). Regular medical consults were uncommon under normal conditions, but are even more unlikely during their migration process. This unfortunate habit, combined with a poor knowledge on health issues, increases the delay in health seeking.

Moreover, undocumented Central American immigrants in northeastern Mexico are undoubtedly a hard-to-reach population. By definition, they are a "moving population". Their itinerant lifestyle complicates the detection of diseases and the eventual follow-up of any treatment. Their relatively bad health condition (almost one-third with a health issue of any kind and 78% reported at least one dental problem in the past 6 months) can be explained by: (1) the accumulation of risk factors during their trip (e.g., overcrowding, malnutrition, violence; women being particularly vulnerable), (2) fear of deportation, and (3) the uncertainty about where to access healthcare.

As compared to legal immigrants, undocumented migrants are more vulnerable, face more inequality situations based on the economic, political, and institutional frameworks, and confront higher structural barriers (37). Understanding the situation of an undocumented immigrant journey enables the understanding of health inequalities. Many migrants had had limited access to the health system in their home countries due to their socioeconomic limitations on the one hand and the scarcity of community healthcare facilities on the other hand. Also during their stay in Mexico, they remain outside mainstream social systems (e.g., housing, work, health) and may suffer major social stigma and psychological issues. The same might be said for TB. Migrants not only have a greater risk of prior infection (38), but are also exposed to a high risk during the transit. For this reason, the transnational strategies developed to address the situation of TB in the border should be applied during every step of the migration process (origin, transit, temporary stays, final destination, and eventual return) and overcome territorial boundaries.

Finally, insufficient and inadequate nutrition is an important issue affecting health during the migration process. Due to insufficient economic strength and lack of physical liberty, the food consumed by migrants does not cover their dietary needs or hygiene and safety aspects (**Table 2**). Only during stays at temporary shelters like CasaNicolás or Casa Santa Martha, they get balanced and quantitatively sufficient food that provides adequate intake of protein, fat, and carbohydrates. A healthy diet is important to improve and guarantee an immigrant's general condition.

Living with the Fear of Deportation

In 2014, the *Instituto Nacional de Migración* (INM) registered 127,149 immigrants that had been presented to the Mexican migratory authorities, of which 1,477 in Nuevo Leon. Most of them were Central Americas: 119,714 (94%) and 1,365 (92%), respectively (39). The main concern for undocumented migrants is their legal status, as they are subject to deportation when they are caught. They are not only exposed to violence in the streets with physical and mental consequences, but they also feel the stigma of being perceived as possibly dangerous people, addicts, or burglars. Furthermore, they are far more vulnerable to be

exploited, socially marginalized, and discriminated in everyday life, including their access to health services. It is well-known that fear of deportation withholds them from seeking health support (40–42). They usually associate the healthcare facilities with a place that exposes their undocumented status. The control of infectious disease and the decrease of community risk will only be possible by including the undocumented immigrants into the public health programs without discriminating them because of their legal status.

An Overexposure to Violence

Generally speaking, since the beginning of the "Mexican Drug War" in 2006, which empowered the criminal groups, vulnerable immigrants are one of the main victim groups, especially in the northeastern states of Tamaulipas, Coahuila, and Nuevo Leon. Organized crime has increased personal insecurity among both the undocumented migrants and Mexican emigrants.

In addition, the consciousness of their own social stigmatization discourages migrants to look for help when required. Their illegal status interferes with medical follow-up, as it implies providing personal and delicate information that may identify them as subjects for deportation. Moreover, the psychological trauma of violent episodes lived during their migration process (64% reported some kinds of problems – i.e., extortions, assaults, and kidnapping) might provoke mistrust on the use of their personal information.

Considering, furthermore, that they are separated from their families and are without social networks to provide protection and help when needed, they are more likely to fall into alcohol and substance abuse. For all the above, we recommend offering them systematic, psychological support in the shelters. Psychological support should be focused on solving depressive disorders and socio-emotional problems and on establishing commitment to personal healthcare issues. This kind of attention would help the immigrants to understand their health issues and to consequently develop the search of medical attention when necessary and to improve the adherence to eventual treatments when sick (especially, in lengthy treatments such as the one required for TB).

Socioeconomic Barriers

Despite the fact that most of them are below the line of poverty, migrants have to develop financial strategies to cover journey expenses (mainly transport and food), even if this implies deepening the financial burden they structurally suffer. In our sample, more than half depended to a certain extent on others: 20% benefited from the assistance of the general population or social organizations that support migrants, and 32% from the punctual help of the shelters that gave them some money to cope with the economic cost of their journey. Besides, almost one-third (28%) had arranged a loan before their departure to cover (**Table 5**). This economic dependence increases their vulnerability.

Poverty and inequality are interconnected, and the most vulnerable groups represent a huge health challenge (43). Apart from their illegal status, socioeconomic barriers were the main obstacles for proper healthcare seeking in our sample. In this respect, our data confirm similar results reported for (undocumented) Latin American immigrants in the US (44). When sick, undocumented immigrants seek primarily cheap, low-quality healthcare resources before attending a healthcare center or a general hospital. They first tend to look for medical help in the immigrant shelters, and when this is not possible, they tend to self-medicate (45% of immigrants who had a health problem during past year), or go to drugstores where they get medicines without seeing a physician (11%), because they considered that health services are expensive and unfriendly for immigrants (**Figure 1**).

The absence of social support also weakens their health status, as there is no family member or friend to encourage them to go to a health center when necessary. Employment opportunities may rely on physical, mental, emotional, and spiritual wellbeing, and combined with the fact that migrants compete for obtaining the best jobs, the subsequent delay in health seeking is easily understandable. In many cases, migrants only look for medical assistance when they are completely incapacitated and suffer advanced disease (45–47). This behavior not only involves a delay in diagnosis, but also increases costs of treatment and a major public health burden (48).

Undocumented migrants are usually employed in the lowest paid jobs such as construction work, car washing, subway maintenance, food service, household cleaning, agriculture labor, and fruit picking. Especially in the construction sector, migrants are exposed to high labor risks, which are even increased because they are untrained for this kind of dangerous work and unprotected, as they have neither an accident nor a valid healthcare insurance in Mexico. Only 13.33% of the immigrants had a health insurance of any type in their home country.

Despite the fact that most migrants work in low-skilled and precarious, informal jobs, a daily wage in Nuevo Leon – the most competitive Mexican state with the highest per capita income after the capital city Mexico City and the highest average wage (49, 50) – may be equal to several days of pay in their home country. Although migrants identify economic factors as one of the main barriers to healthcare services, they may be unaware of the impact of education-related factors, such as knowledge and attitude, on their health-seeking behavior (51).

Education, Literacy, and Health

Previous studies on the impact of education on health practices in other Hispanic populations have shown that a high educational level is associated with better healthcare practices (52–54). In our sample, one-third had completed elementary school, 22.7% had completed high school level, and only 5.2% had studied at least one year of superior education (**Table 1**). Low literacy may be an obstacle in adherence to medical treatments, since the physician's written or oral recommendations may result incomprehensive. For the same reason, information campaigns may result unsuccessful (55). Unexpectedly, in our study, immigrants with a lower level of education had better information on TB symptoms ($r = 0.4$; **Figure 2**), indicating that regular education may not be the main determinant of TB knowledge, which suggests that a specific personal experience may compensate for lack of school knowledge.

Additionally, 25.33% of the sample had had a previous experience of being undocumented in the US, and 84% of those had undergone a deportation process. However, migrants with a

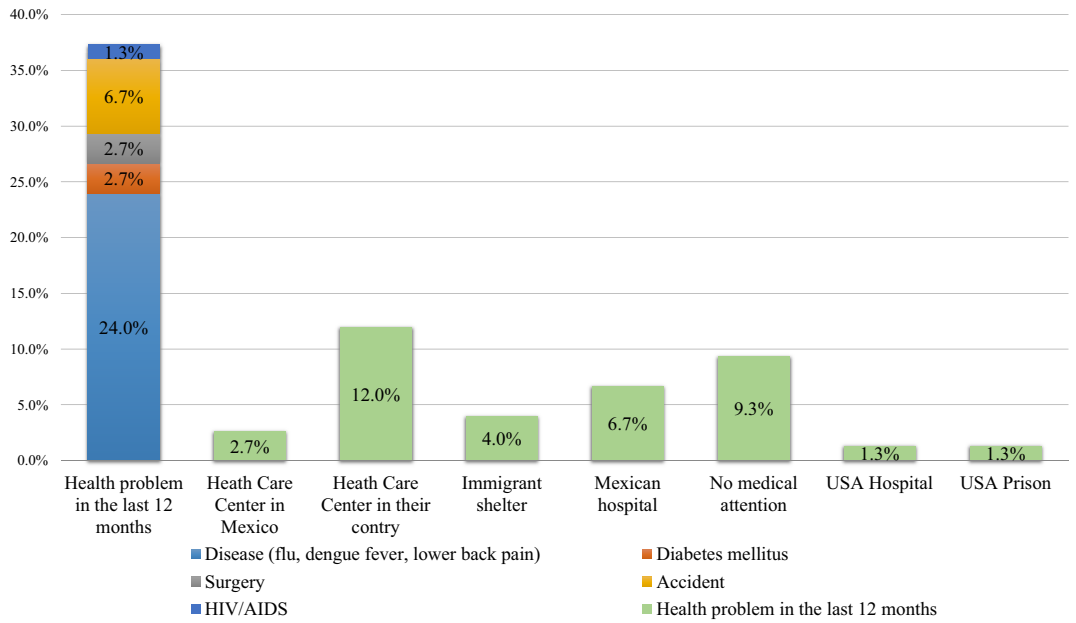

FIGURE 1 | Type of health problems in the past 12 months and medical attention received.

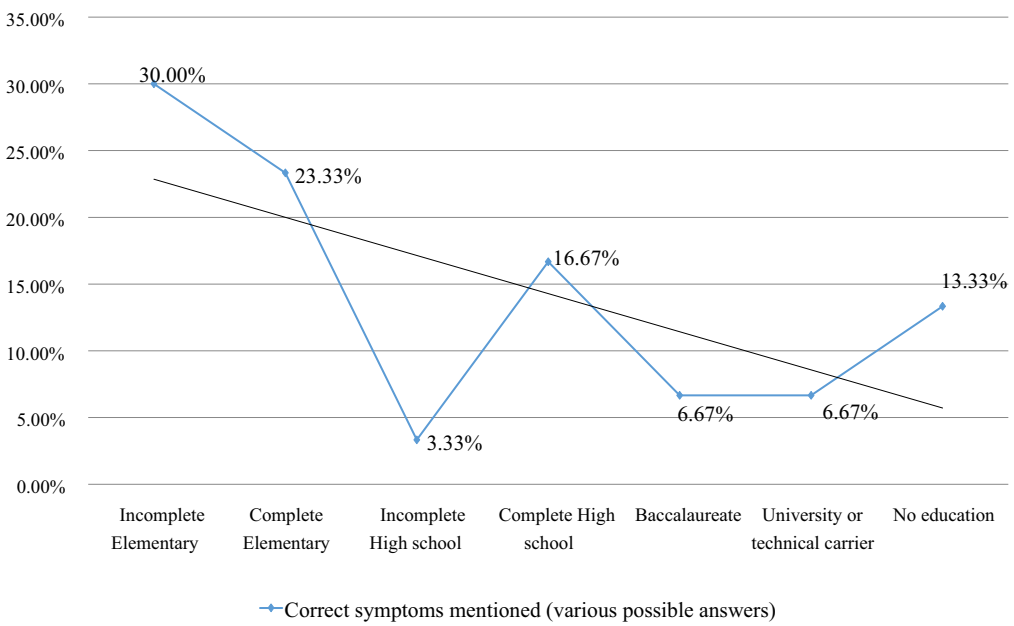

FIGURE 2 | Education level and TB symptoms knowledge.

previous deportation experience did not have more knowledge on TB ($r = 0.8$; **Figure 3**), even though a tuberculin test had been applied to them during the deportation process.

Considering that (1) deported migrants may intend another migration process, as evidenced by this study, (2) their knowledge on TB is insufficient (despite a previous deportation) process), and (3) their health status may be worse on a second or later intention of migration toward the US, we recommend health education, especially on TB, to be included in the deportation process. In Mexico, TB cases are concentrated at the borders and migration routes; and in the US, the US–Mexican border also demonstrates increased TB prevalence. In most countries, 10–15% of TB cases were related to undocumented migrants (24). Therefore, health issues of attending migrants may diminish contagious diseases and improve the health status of the general population (56).

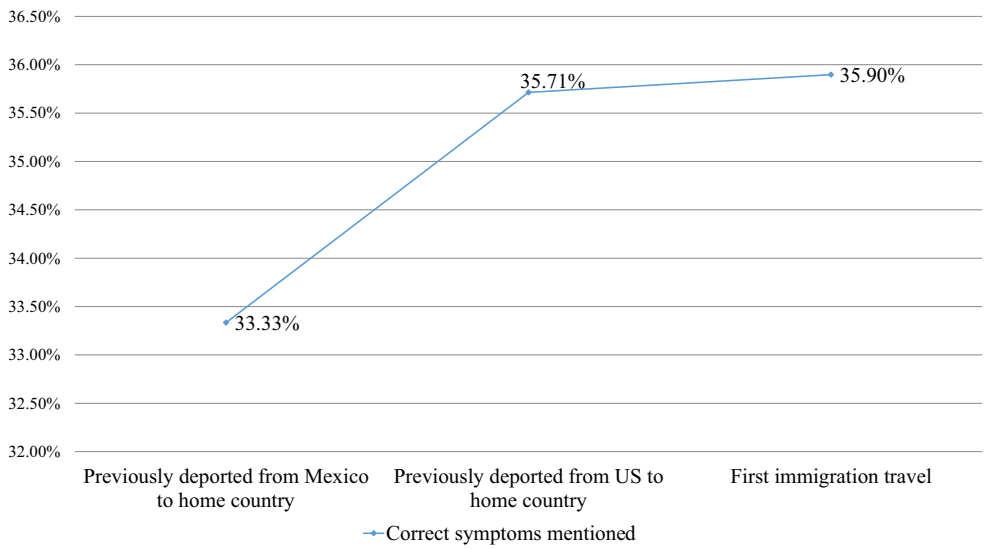

FIGURE 3 | Immigration experience and TB symptoms knowledge.

Inadequate Information and Wrong Perceptions may lead to Detection Delays

Health access is also determined by the risk perception of contracting illnesses. Our results show an inadequate education and attitude toward health issues, especially TB. While 11 persons (14.7%) had been in contact with a TB patient and the infection was perceived as "serious" or "very serious" by most migrants (81.3%), there was confusion about TB symptoms and a shortage of knowledge of TB. This lack of concern is preoccupying, because it seems highly unlikely they were to seek healthcare in case of presenting TB symptoms. Once again, it underscores the need for culturally adequate, affordable, and accessible healthcare.

This low level of information is consistent with previous studies on different populations, such as Latinos migrants (57), immigrant farm workers (58), and Vietnamese refugees (59). The combination of a strong belief of not being infected, a 10–20 times higher exposure to TB, and little knowledge on TB symptoms forms an important reason for delayed TB detection in the migrant population delays a TB diagnosis (60–63).

For all the above reasons, adequate health education may (1) improve knowledge on TB among migrants, (2) stimulate appropriate health-seeking patterns, (3) lower risk factors, (4) increase compliance with treatment beyond the disappearance of symptoms, as is needed to treat TB, and (5) prevent the formation of resistant *Mycobacterium tuberculosis* strains (64). As personal health is not the main concern of many migrants, the use of incentives and enablers could contribute to stimulate the participation commitment to health-seeking behavior.

Implications and Recommendations

The increased relative risk of latent and active TB in the undocumented population of the Monterrey Metropolitan Area represents a health threat for the general population because of the frequent and prolonged interactions between the migrants and local inhabitants. Indeed, most migrants in our sample traveled through Mexico step-by-step, or city-by-city, and they frequently lived and worked for days, weeks, or longer in the cities they crossed. A shelter is considered a short-term lodging solution upon arrival to a new city, which is replaced by another accommodation for longer stays. The average stay of the migrants in our study in Mexico was 249.69 ± 1249.65 days (mean ± SD) (range: 1–11315 days). Furthermore, 71% of them would rather stay and live in Mexico than return to their home countries in case they could not cross the Mexican–US border. Almost three quarters considered the Monterrey Metropolitan Area to be a privileged place of residence because of job opportunities and a relatively good payment.

In summary, the combination of migrants' vulnerability and inadequate health-seeking patterns, the length of their stay, and the lack of dedicated public policies may represent a health threat not only to the migrants, but also for public health in general. Our study confirms global evidence that transmission of infectious diseases, such as TB, may be intimately linked to migration issues (65–68). This constitutes a major difference with other vulnerable, but non-migrant populations, who may also suffer poverty and low educational attainment, but do have access to the social security system, for example, 77.1% of the Nuevo Leon inhabitants have social coverage, whereas undocumented migrants do not (69).

So far, there have been few publications on health issues among undocumented migrants. Further investigations on current health status and disease consequences should be encouraged. Our research provides a good starting point to identify broad outlines of public policy implications and recommendations. In addition to physical health issues, attention should be given to social-economical and emotional aspects, as the latter have a great impact on health-seeking behavior of migrants during the long, traumatic, and solitary experience of their often-violent journey.

Migrants' health behaviors are the result of consciously planned decisions and thoughtless habits; the latter are probably harder to be modified than the former. A successful policy to improve migrants' health status and diminish the threat to public health in general needs to go beyond the current bio-medical model toward a bio-psychosocial model. To improve efficiency and circumvent migrants' self-exclusion from health services, migrants' healthcare should be compatible with the immigrants' specific characteristics: low level of health literacy, need of anonymity, and availability outside their working hours.

The migration process has a negative impact on health issues, which are reinforced by inequality between migrants and the general population in access to medical services. If securing public health would become an objective, the focus might be on the fundamental determinants of health through multi-sectoral policies involving both private and public sectors at local, national, and international levels. Preventive efforts are indispensable to foster health monitoring in the migrant population, and transnational teamwork is crucial to enforce cross-border cooperation to develop referral strategies and appropriate mechanisms for undocumented migrants beyond the local scale, and much before they arrive to the Mexican–US border.

Because of the harsh economic situation of migrants, healthcare has become a luxury for them because of its high financial cost, thus representing a powerful barrier to health-seeking behaviors. To ensure proper health access to migrants, a mechanism should be created to facilitate free access to health services, regardless of their legal status. The cost of these healthcare mechanisms should be fully covered by the local and binational authorities, given the potential implications for public health of not considering this highly vulnerable population (undetected diseases and infections, delay in diagnosis, increased costs of future treatments, transmission to healthy subjects) (70–72).

Future studies could implement Knowledge, Attitude, and Practices (KAP) analysis to deepen the understanding of the migrants' values and beliefs on the one hand and a targeted screening on several border health issues on the other hand. Actually, our research team plans to start a TB-screening campaign in summer 2015, in order to estimate the burden of latent tuberculosis infection in undocumented immigrant and to eventually offer them prophylaxis before offering treatment (73), as many countries do (62, 74–77). Migrants might be an exposed-to-TB group, due to their social vulnerability (78, 79), but we cannot address this potential problem without measuring it first.

Likewise, we aim to measure the prevalence of DM in subsequent studies, as we detected that, although most individuals in our sample suffered poor nutrition, more than half (55%) were overweight or obese and only 44.7% had a normal BMI. This dichotomy is suggestive of a high prevalence of DM, even though only two migrants explicitly referred to suffer from DM, possibly due to an under-diagnosis of DM or a failure to detect it in this population.

In fact, the World Health Organization (WHO) announced a conditional recommendation of systematic testing of immigrants from high TB burden countries (Honduras had a TB prevalence of 74/100,000; Guatemala: 110/100,000; El Salvador: 48/100,000) (80), although, there is no clear evidence of benefits of systematically screening immigrant population (81). For this reason, we aim to generate more epidemiologic knowledge of TB burden among undocumented migrants and, afterward, on cost-effectiveness of TB-related interventions (education, detection, and treatment), in order to create better fitting strategies to migrants requirements and to prevent possible active disease (82–84).

We propose practical ways to improve health equality for migrants and diminish social exclusion through recommendations to policy-makers, like tracking and preventing disease strategies in immigrant communities, and educating and building communication; since the main reason for the spread of infections like TB is their unawareness (85). We expect that health education will increase adequate health-seeking patterns among (undocumented) migrants.

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The California border health collaborative: a strategy for leading the border to better health

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There are hundreds of people and organizations working on border health issues in the California–Baja California border region trying to protect and improve health. These efforts are being conducted without a collaborative structure that integrates jurisdictions and organizations. Thus, there is a need to coordinate these organizations to work together and benefit from their collective effort and each other's best practices. The outcome of such an effort could effectively improve the health in the border region. The newly developed "*California Border Health Collaborative*" unites organizations and provides the leadership and collaborative culture to positively improve the health of the border region; it is referred to as the "Collaborative." This article describes the developmental process of this Collaborative, including partner engagement, governance, strategic planning, key elements for success, the roles of multi-level jurisdictions, and policy implications. This paper focuses on describing the preparation and processes that created the U.S./California side of this binational collaborative effort and is a strong reflection of the theory of border collaboration as described by Denman and De Sonora (1) in "Working beyond Borders: A Handbook for Transborder Projects in Health."

Keywords: border health, collaboration, live well San Diego, border collaborative, U.S.–Mexico border, U.S.–Mexico border health commission, border collective impact

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Background

Defining the Border Region

The California–Baja California border includes two counties on the U.S. side, San Diego and Imperial and spans approximately 322 km along the Baja California border.

Imperial County has a total area of 4,482 mi^2 or about twice the size in total square miles as the State of Delaware. Imperial County is located in the Imperial Valley, in the far southeast of the U.S. State of California, bordering Arizona and Mexico (http://www.co.imperial.ca.us/index.asp). In contrast, San Diego County is large and diverse and serves as a microcosm of the country. With a population of 3.2 million, San Diego is the fifth largest county in the United States. The San Diego and Tijuana border region is home to the busiest land border crossing in the world, the San Ysidro border crossing. There are six ports of entry on the California–Baja California border with

63,048,683 northbound border crossings in 2010, with San Ysidro having 44,009,770 (70%) of these total northbound crossings in 2010.

In addition to the nearly 400,000 San Diego County residents of Hispanic origin, people crossing the California–Baja California border are a major part of the San Diego County economy and culture. This is a daily, highly mobile population that traverses two distinctly different countries. Due to these and other variables, the border region has significant health challenges and a great need for a collaborative approach to health.

According to the California Department of Public Health (CDPH), Office of Binational Border Health (OBBH) *Border Health Status Report* to the Legislature, 2011, 2012 and others; tuberculosis (TB), obesity, and diabetes are significant health issues affecting the border region (2–5).

Precursors to and Key Players in the Collaborative

From 2009 to 2010, there was a convergence of factors among several San Diego organizations that perform border health work, which were precursors to the development of the California Border Health Collaborative. These events and key organizations are outlined below and contextualize the Collaborative's formation and evolution.

County of San Diego Health and Human Services Agency

In July 2010, The San Diego County Board of Supervisors' commitment to regional wellness across jurisdictions, systems, and populations led to the development of *Live Well San Diego*, a long-term vision to support healthy, safe, and thriving communities throughout San Diego. The foundation of *Live Well San Diego* is based on the concept of collective impact – the idea that health and well-being for all residents could be achieved more effectively by establishing collaborative partnerships rather than individual organizations working alone.

California Department of Public Health, Office of Binational Border Health

The CDPH, OBBH worked closely with HHSA as both a conduit and partner to federal and local health departments. With a mission to facilitate communication, coordination, and collaboration among California and Mexico health officials, health professionals, and communities in order to optimize border and binational health, their expertise in border health issues and ability to convene partners was instrumental in the development of the Collaborative and its inception.

Local Academia

Both San Diego State University (SDSU) and the University of California San Diego (UCSD) host numerous well-established research teams that examine border issues. These academics were well-versed in doing cross border research and had success in building binational, collaborative partnerships needed to carry out their projects. These successes were increasingly intersecting with the County of San Diego HHSA, OBBH, and local non-profit organizations. Examples include UCSD's TB prevention research exploring the use of video direct observation therapy (VDOT) in the border region, a project in collaboration with County HHSA TB Control, HIV, and STD surveillance and treatment and cross border research that utilized the County HHSA's Public Health Laboratory for specimen testing. It was deemed that academia would be an important partner in the Collaborative.

U.S.–Mexico Border Health Commission

In parallel to the examples listed above, the U.S.–Mexico Border Health Commission (USMBHC) had been supporting the San Diego County Public Health Department, as well as OBBH on specific health issues such as TB, communicable disease surveillance as well as combating chronic diseases in the region. The USMBHC provided technical assistance, conferences, trainings, and regional planning support to state and local government branches.

In 2010, the USMBHC sponsored what would prove to be a turning point for border collaboration in California, the *Leaders Across Borders (LAB)* program. *LAB* is a yearly, 10-month long program that teaches and mentors health professionals and community leaders to design and implement projects to address the needs of underserved communities in the U.S.–Mexico Border region. Participants learn how to effectively collaborate with one another by developing skills in health diplomacy and gaining a deeper understanding of cultural differences and binational health care systems.

Several leaders from the County of San Diego, OBBH, local Universities, and local non-profit organizations were participants and/or facilitators in the inaugural LAB program. Through the training and mentorship of the USMBHC program, coupled with the County's *Live Well San Diego* framework, OBBH's integration approach and local academia expertise, a collaborative paradigm of border health leadership was evolving. Furthermore, the California border region's leaders were adhering to what researchers throughout the entire U.S.–Mexico border had been finding: due to the health challenges in our border region, adequately addressing the needs of a border community requires effective transnational communication, beginning at the local level and then involving regional/state and federal governments (1).

Texas Provides an Example

Up until this point, the above San Diego and California border health actors and their organizations were working on various health issues, divided by topic, jurisdiction, or specific interest (e.g., research vs. service provision). In June 2010, many of these same border health organizations were in Washington, D.C., for an annual Border Health conference and participants attended a reception sponsored by the Texas Medical Association. The dual purpose of this conference was to share expertise on relevant border issues in which all the U.S. Border States participated and Texas specifically utilized it as an opportunity to educate their national legislators and the U.S. Congress on border health issues. Texas was extremely organized and effective in accomplishing these goals. They presented a structured, united front, having their representatives and senators engaged and working for the betterment of the health of their border region. The San Diego County HHSA, OBBH, Project Concern International (PCI), and UCSD participants took note and, in witnessing this example, reflected on what was possible in the border region of California.

Approach/Methods

According to *Working Beyond Borders*, building an effective binational approach and/or organization takes the right people, the right environment, and the right organizational structure (1). In San Diego, with the right people and environment taking shape, in order to develop the right organizational structure, ensuring trust was an essential step toward achieving success. To continue building trust among present and future border partners, the following were necessary: collaborative leadership at a high level, transparency, USMBHC support, and an initial team-building project. Additionally, strategic alignment and a common vision for border health were important in order to move forward.

Between June 2010 and January 2011, County of San Diego HHSA and OBBH started to discuss the possibility of trying to develop a collaborative that would have the ability to unite the experts and champions working in the California border region and eventually engage our partners in Baja California, Mexico. Early discussions identified possible ideas/benefits of a collaborative group:

1. Increase understanding and knowledge of the different programs working in the local border region.
2. Increase ability to collaborate/partner toward common goals and priorities.
3. Combine efforts to attract and apply for financial resources for our border region.
4. Streamline efforts, while building partnerships that would produce powerful and effective results in addressing public health issues.
5. Increase efficiency in our regional response to public health emergencies or urgent issues.
6. Integrate Imperial County, San Diego County, OBBH, and USMBHC in strategic planning efforts for our border region.

Convening this group would build on the Border Childhood Obesity Forum that took place in August 2010, which emerged as an outcome of a LAB project and successfully brought together organizations and people working on the obesity issue in the California–Baja California border region. In addition, it was agreed that if successful, once the California side was working effectively in collaboration, the group would then approach and engage counterparts in Baja California. The Public Health Officer for the County of San Diego and the Chief of OBBH were the conveners/facilitators of this new collaborative with both organizations' staffs working to coordinate its presence in the community.

Selection of Target Partners

The San Diego County HHSA and OBBH completed an informal stakeholder analysis and identified individuals and organizations that needed to be at the table. A broad cross-section of stakeholders from various levels of government (e.g., Federal, State, Local) and from diverse organizations (e.g., academic, non-profit, coalitions, advocacy groups) were invited to the first meeting to discuss the possibility of forming a local border health collaborative.

Along with these foundational or "convening" governmental stakeholders, other organizations brought powerful expertise to the collaborative. Many researchers from UCSD and SDSU had been performing significant border health research for years and have built effective working relationships with organizations on both sides of the border. The same can be said of non-government organizations or non-governmental organizations (NGOs), like PCI, San Ysidro Health Center, and others with direct service programming on both sides of the border and/or in the shared border region. Their leadership and link with academia was a key to successful border health work in the region. It was felt that this collaborative could provide an excellent avenue and opportunity to bridge research and operations in government and NGOs to affect the health of the region. Reiterating that effectively impacting the health of the region cannot be done by government alone, other organizations are needed to share their expertise in order to achieve the collective impact that this collaborative hopes to achieve (6).

Collaborative Stakeholder Survey

Following the first meeting, a survey was emailed to all the attendees. The survey aimed to obtain information, identify, and share a list of all entities involved in border health work in the California border region and secondly, to obtain participants' opinions regarding involvement in the group (e.g., how to structure the group, how often to meet, how best to communicate), and finally, whether they would be interested in participating in a trip in June 2011 to Washington, D.C., as part of the California Caucus representing the region and the Collaborative at the Border Conference, organized by the Texas Medical Association.

Results

Over 20 organizations and 40 attendees were identified and participated in the Collaborative's first meeting on Feb 17, 2011. There was representation from all three organizational sectors of government, non-profit, and academia. The number of border actors currently on the list of participants has swelled to over 183. At the conclusion of this first meeting, participants agreed by consensus to move forward and develop the collaboration, have the County Public Health Officer and Chief of OBBH lead the meeting, and lastly to send out a survey with key questions about how to move forward.

Stakeholder Survey Results

Results to the survey demonstrated overwhelming support to move forward with developing the Border Health Collaborative. There were 25 respondents to the survey and 100% of those surveyed voted to participate in the Collaborative going forward, over half of the respondents wanted the group to be formally governed as opposed to an informal networking group only, 85% wanted to meet quarterly or bi-monthly, 85% wanted to meet in person with the ability to call in if needed, and 60% would plan to or might attend the Border Health Conference in June in Washington, D.C.

Initial Project Identified by the Survey

During discussions and per the survey, participants agreed to prepare for the upcoming Border Health Conference in Washington, D.C. in June (4 months away). Approximately, 10 conference participants represented government, academia, and non-profit.

Preparation for the conference involved gathering information about our California border region and our newly formed Collaborative and sharing it during the conference. While the Collaborative consisted of many different organizations attending from our region, the group would attempt to speak in one voice. This translated to developing a one page document that presented vital information about the newly formed collaborative and health information about the region (see Supplementary Material on *California Border Health Collaborative Information Sheet)*.

Collaborative Evolving

The Collaborative decided to meet monthly for the first year. Each meeting had a defined theme and guest speaker, based on the interests of Collaborative members. After the first year, meetings were taking place every 2 months. After an "initial project" of preparing a Collaborative information sheet for a border conference in Washington, D.C. was completed in June 2011, the Collaborative next produced a Mission, Vision, and Strategic Goals (7). This California Border Health Collaborative Strategic Plan was based on and completed after reviewing and considering the World Health Organization Millennium Goals, Centers for Disease Control and Prevention (CDC) Healthy People 2020, USMBHC Healthy Border 2020, OBBH Strategic Goals as well as the HHSA County of San Diego *Live Well San Diego* Framework. The Collaborative ensured that all strategic plans from all levels of government were considered. This commitment to strategic alignment was also reflected when the Collaborative members developed a strategic plan to include a vision, mission, and strategic objectives (See Supplementary Material on California Border Health Collaborative Strategic Plan). Upon finishing the Collaborative Strategic Plan, on December 16, 2011, the team developed four sub-committees that reflected the priorities of the collaborative:

- *The Steering Committee* – goals include developing agendas, strategic direction, alignment, and decision-making authority.
- *The Communications Committee* – goals include facilitating communication, through the development of a bilingual and binational web platform that is a hub for sharing resources.
- *The Resource Development Committee* – goals include promoting funding collaboration between public, private, and academic institutions that are submitting grant proposals focused on border health issues.
- *The Binational Engagement Committee* – goals include seeking appropriate and effective methods for engaging our Baja California partners to create an efficient and mutually beneficial binational collaborative.

By April 2012, just over a year after initially forming, the California Border Health Collaborative began developing a strategy for engaging Baja California to form a local *binational consortium*.

Until this point, the California Border Health Collaborative had built a strong, cohesive collaborative on the U.S. side of the border. It was effectively sharing and leveraging local expertise to address many border health issues. Even more importantly, the Collaborative had reached a key stage in which it was ready to effectively engage its Baja California, Mexico counterparts in a manner that would prove extremely powerful (**Table 1**). Discussion of the process of engaging the Baja California partners is outside the scope of this paper.

TABLE 1 | Timeline – California border health collaborative process and results.

11/02/10	Generated action items at the HHSA Quarterly Border Health meeting which evolved into the Border Health Collaborative (now Border Health Consortium of the California)
2/17/11	First meeting of local border organizations, regional universities and colleges, community agencies, and government
6/11	10 Participants attended the border conference in Washington, D.C.
8/18/11	Began strategic planning
10/20/11	Completed strategic plan
12/16/11	Formed four sub-committees
4/19/12	Binational engagement committee developed strategy to engage Baja California; first draft of charter reviewed
6/26/12	Overview of final strategic plan
10/12/12	The first binational engagement meeting with Mexico occurred in Baja

Discussion

Building Trust

In subsequent meetings, there was an overarching focus on building trust between each other and in the process of developing the collaborative. There were four key contributing factors that helped build trust in the group: transparency, collaborative leadership, USMBHC support, and an initial project. These are outlined below.

Transparency

In striving for transparency, there was a conscious decision made that all aspects of developing this collaborative needed to be discussed with the group in open meetings. The group agreed and decided the structure of the collaborative to include wanting to have the two local government agencies (San Diego County Public Health Department and OBBH) leading the meetings. In addition, all members of the group wanted to share in the coordination of the Collaborative. This meant the forming of a leadership steering committee with participation open to all members.

Collaborative Leadership

According to Madeleine Carter, from the Center for Effective Public Policy, one of the key qualities of a collaborative leader is the ability to share knowledge, power, and credit (8). As noted above, key, convening, government organizations were leading in this way and brought these leadership characteristics to the Collaborative and the process of developing it. In addition, there was great optimism by the leaders in addressing the health needs of the border region. The leadership and members of the Collaborative understood that in order to advance as a region, it would be essential to foster opportunities for authentic cross border communication and collaboration. As defined in *Working Beyond Borders*, true collaboration involves the sharing of power, responsibilities, decision-making, and accountability, in order to achieve positive outcomes defined by mutual goals (1).

USMBHC Support

Up until this point, the USMBHC had been instrumental in at least three ways in the formation of the Collaborative. The USMBHC has supported the training of leaders via the LAB program. This Collaborative is the type of project or initiative that the LAB program challenged its graduates and affiliates to undertake. Secondly, during this time, the local San Diego border health community, as well as the rest of the border had a champion collaborative leader. This leader was the General Manager of the U.S. Section of the USMBHC, the late Dan Reyna; he had forged effective working relationships in the San Diego region with OBBH, the County of San Diego and others and had mentored and supported key staff in a way that fostered collaboration. In all of his interactions with local border health staff, he espoused a core belief that the power and impact of border health work occurs at the local level. He did this in a way that empowered and inspired staff and their local leaders. He is often remembered by local border staff as saying, "...this is your sandbox, you're in charge...tell me how I can help."

Dan provided an ongoing operational example that epitomized the role of the USMBHC, ...the roles of the Commission include: institutionalize a domestic focus on border health which can transcend political changes, become a venue of broad participation by health professional and others interested in improving border health, promote social and community participation, be a catalyst, be a policy advocate, increase resources for the border, encourage self-responsibility for health (9).

Initial Project

By developing the *California Border Health Collaborative Information Sheet* (see Supplementary Material) to share in Washington, D.C., the members began identifying priorities and visualizing themselves as one unified Collaborative. The team members also had an appreciation for the expertise and information that the San Diego/Imperial area held. The process itself was effective in helping the Collaborative team members connect and build trust.

Policy Implications

Reflecting on the ongoing Collaborative building process, there are at least three policy recommendations that can be derived. These include institutionalizing the Collaborative in government agencies, ensuring a commitment to training border leaders via programs like *LAB* and ensuring governments consider each other's strategic goals and objectives when developing their own strategic plans.

- Ensuring this Border Health Collaborative continues to be a recognized piece of the working infrastructure of the County and OBBH. This is accomplished by solidifying the commitment from the top leadership that this Collaborative serves as an integral tool to approaching border health. This has been done in San Diego with the Director of HHSA, the Public Health Officer, the Chief of OBBH, as well as the California Public Health Officer, all demonstrating commitment to this Collaborative. This Collaborative has already adjusted to leadership replacement and continued just as strong when the Chief of OBBH retired and his successor did not miss a step in continuing their commitment. This robust infrastructure also continued when the County of San Diego, Public Health Chief of Operations left and moved to another position in HHSA. Ensuring institutionalization of the group is vital.
- Commitment to participating in *LAB* on a yearly basis with new leader participants and facilitators is a key to the success of the Border Health Collaborative and enhances our ability to be effective. The *LAB* assists the collaborative in building capacity and training health professionals to be effective leaders in the border region. The Border Collaborative leadership encourages its members and their organizations to send staff to participate in the program. These graduates then in turn serve as succession potential in their own organizations as well as for the Border Health Collaborative. This all serves as building the institutionalization of the Collaborative. Also, the *LAB* requires participants to work on a binational health project. The Collaborative could participate in the project selection process by offering suggestions or ideas to the *LAB* participants that help support the local border health landscape. These project possibilities can be strategically developed from the Collaborative's strategic plan.
- Lastly, requiring government organizations to consider each other's strategic planning when developing their own is key. When the county and state health departments develop their strategic goals, they should review Federal CDC and USMBHC goals and objectives. In turn, the federal government should be seeking input of state and local border stakeholders The USMBHC has recently done this by using the advisory board of the State Office of Border Binational Health and seeking their input in strategic and priority planning. This should be imbedded in the process of strategy development. With more strategic alignment comes the ability to leverage resources and a more profound impact on the regions health (10).

Conclusion

As discussed throughout this paper and according to previous work by Denman and her colleagues, collaboration among U.S. border partners to impact the health of the border region can be achieved (1, 11, 12). This can be done by forming a Collaborative that seeks to harness the expertise of various levels of government, academia, and NGOs in local border regions. In order to be successful, transparency, trust, collaborative leadership, and support from the USMBHC are essential components. To ensure sustainability, supportive policies should be considered, such as, institutionalizing the Collaborative within government agencies, demonstrating commitment to training border leaders and lastly, aligning government organizations strategic goals and objectives. When all of this occurs, then the local, U.S. side of the border is effectively aligned to engage the local Mexico side of the border. The Collaborative is now ready to expand and become binational in its health efforts. This current binational engagement process will be described in a future article.

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Supplementary Material

The Supplementary Material for this article can be found online at http://journal.frontiersin.org/article/10.3389/fpubh.2015.00141

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Improving pediatric cancer care disparities across the United States–Mexico border: lessons learned from a transcultural partnership between San Diego and Tijuana

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In 2007, the 5-year survival rate for children with acute leukemia in Baja California, Mexico was estimated at 10% (vs. 88% in the United States). In response, stakeholders at St. Jude Children's Research Hospital, Rady Children's Hospital San Diego, and the Hospital General de Tijuana (HGT) implemented a transcultural partnership to establish a pediatric oncology program. The aim was to improve clinical outcomes and overall survival for children in Baja California. An initial needs assessment evaluation was performed and a culturally sensitive, comprehensive, 5-year plan was designed and implemented. After six years, healthcare system accomplishments include the establishment of a fully functional pediatric oncology unit with 60 new healthcare providers (vs. five in 2007). Patient outcome improvements include a rise in 5-year survival for leukemia from 10 to 43%, a rise in new cases diagnosed per year from 21 to 70, a reduction in the treatment abandonment rate from 10% to 2%, and a 45% decrease in the infection rate. More than 600 patients have benefited from this program. Knowledge sharing has taken place between teams at the HGT and Rady Children's Hospital San Diego. Further, one of the most significant outcomes is that the HGT has transitioned into a regional referral center and now mentors other hospitals in Mexico. Our results show that collaborative initiatives that implement long-term partnerships along the United States–Mexico border can effectively build local capacity and reduce the survival gap between children with cancer in the two nations. Long-term collaborative partnerships should be encouraged across other disciplines in medicine to further reduce health disparities across the United States–Mexico border.

Keywords: pediatric cancer, transcultural partnership, US–Mexico border, international oncology, health systems strengthening, global health, border health

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Introduction

According to the World Bank, Mexico was the 11th most populated country in the world in 2011 with roughly 122,330,000 citizens, and spent $620 US per capita on healthcare [6.2% of its gross domestic product (GDP)], ranking 70th worldwide. Based on published data, Mexico's health outcomes seem to underperform its healthcare expenditure rankings and GDP earnings, with some healthcare outcomes ranking low, such as infant mortality rate (97th), under-five mortality rate (87th), and access to improved sanitation facilities (104th) (1).

In contrast to Mexico, the United States (US) is the third highest healthcare spender at $8,895 US per capita (17.9% of its GDP – the most of any country) (1). While increasing healthcare expenditures does not necessarily correlate with better outcomes, significant health disparities exist between the US and Mexico. Nowhere are these disparities more obvious than in the 47 border-straddling metropolises along the 1,989 mile-long US–Mexico border.

Two of these border cities, San Diego, California, and Tijuana, Baja California (a state also known as "Baja California Norte"), share a 24 km-long border. Close to 60 million people cross this border annually; therefore, it is the busiest land-border crossing in the world. Two of the largest hospitals that provide care to patients in these cities are Rady Children's Hospital San Diego (RCHSD), the largest children's hospital in California and the sixth largest children's hospital in the US, and the Hospital General de Tijuana (HGT), the largest public hospital in northwestern Mexico. These two institutions are separated by only 43 kilometers – a short 30-minute drive – and although the international boundary is very distinct, this border region is culturally, linguistically, demographically, and economically blurred.

With more than 160,000 new cases of childhood cancer diagnosed annually worldwide, the survival gap for children with cancer in high-income countries (HIC) and low- or middle-income countries (LMIC) is astounding (2, 3). Although we recognize that grouping low- and middle-income countries together can be problematic in making comparisons among diverse nations, which include recently emerging economies such as Mexico, we are grouping LMIC together in this report, as in published, related literature elsewhere, due to the fact that these countries tend to have similarly poor outcomes for children with cancer.

Five-year overall survival rates for children with cancer in HIC, like the US, are often 80–90% as compared to anywhere between 5 and 60% for children in an LMIC like Mexico (2–7). This survival gap reflects the great disparities that exist between the healthcare infrastructures of these two categories of countries regarding effective pediatric cancer care.

Mortality due to cancer constitutes an increasingly large proportion of total childhood mortality in LMIC (8–10). Mexico is no exception, and although the incidence of cancer has increased from 150.3 per million children per year in 2010 to 156.9 in 2012, the mortality rate has been reported as 5.3 per 100,000 children and as high as 8.6 in adolescents (11, 12). Reasons for increased morbidity and mortality related to childhood cancer in Mexico and other LMIC are described in **Table 1** (12, 13). In these countries, pediatric cancer mortality represents a significant source of largely preventable deaths. As the proportion of deaths due to communicable diseases decreases, the proportion of deaths due to cancer increases (2, 13).

TABLE 1 | Differences in pediatric cancer care between high-income countries (HIC) and low- or middle-income countries (LMIC).

Feature	HIC – 20% of population	LMIC – 80% of population
Access to Care	Virtually 100%	10–70%
Causes of treatment failure	Relapse Toxicity Cancer resistance	Late referrals Advanced disease at presentation Abandonment of treatment
Major current focuses	Finding cures Improving quality of life posttreatment	Increasing access to care Improving survival Reducing suffering
Activities	Discovering disease mechanisms Development of targeted therapies Mitigating long-term complications	Preventing abandonment Educating the community Adapting curative therapy to local resources and populations

Given the need for improved pediatric cancer care in the Mexican border region and the proximity to San Diego, leaders at RCHSD reached out to numerous hospitals in Tijuana to assess interest in engaging in a binational, collaborative partnership to establish a pediatric oncology unit in Tijuana and improve outcomes for children with cancer. Among the institutions contacted, the HGT responded and expressed its willingness. Subsequently in 2008, RCHSD, the St. Jude Children's Research Hospital International Outreach Program (St. Jude IOP), and the HGT engaged in this long-term partnership to find a sustainable, local solution for the children with cancer of Baja California in need of life-saving oncology care. To the best of our knowledge, as of 2008, a transcultural partnership in pediatric oncology had not yet been established between institutions located in such close proximity of the same border.

Materials and Methods

Implementation: Initial Setting and Action Plan

Physicians from RCHSD performed an initial site visit assessment at the HGT in May 2008. The St. Jude IOP had previously developed tools to aid in performing needs assessments (14). One of these tools was adapted to the local setting in Tijuana to include elements needed to obtain national accreditation from the Mexican Ministry of Health. (This tool and budgetary guidelines can be requested from the corresponding author.) The assessment analysis showed that, even though the hospital had a basic infrastructure, the essential elements of a pediatric cancer unit, including dedicated hospital space, uniform treatment protocols, supportive care, trained physicians, nurses, and allied staff, were lacking.

A bilingual and bicultural pediatric hematologist/oncologist from RCHSD (PA) was designated to work with the leadership at the HGT and designed a 5-year action plan to facilitate the implementation of the new pediatric oncology program. PA worked in

close collaboration with RCHSD and St Jude IOP leadership. In addition, she directly interacted with hospital leadership and key stakeholders at the HGT at all levels. PA monitored the progress by close collaboration and follow-up with all key stakeholders. Careful attention was made to the suggestions and guidelines previously published in the literature in regards to transcultural partnership implementation (3, 10, 15–17) and the Health Systems Strengthening principles were followed (18). The specific objectives of the St. Jude IOP-RCHSD-HGT partnership became the following:

1. Infrastructure and clinical outcomes improvement by establishing a fully functional pediatric oncology unit within the HGT in a culturally sensitive manner and tailored to the local needs and healthcare system and developing a quality assurance plan.
2. Capacity building by appointing a local program coordinator at the HGT, maintaining frequent communication between RCHSD and the HGT, and establishing and training a local, dedicated team of physicians, nurses, and ancillary staff to provide high-quality, specialized care.
3. Ensuring the long-term financial sustainability and provision of medications, supplies, and equipment by facilitating the pediatric oncology unit's national accreditation and identifying and supporting a local grassroots foundation affiliated with the HGT to build a fundraising program aimed at subsidizing the cost of expenses not covered by the public health system.

Results

Infrastructure and Clinical Outcomes Improvements

Infrastructure Improvements

Before the partnership, it was not uncommon for the HGT to assign 10–20 pediatric patients to a single room on the pediatric ward. By August 2008, construction of a temporary pediatric oncology unit with five rooms was completed. In this temporary unit, cancer patients were able to receive care in an isolated environment. The current oncology unit in use today was constructed in 2011 and includes 10 isolated patient rooms, two intensive care rooms, and adequate bathroom facilities; an outpatient clinic was also completed with a procedure room, clinic rooms, an infusion center, and a school for the children.

Table 2 shows some of the clinical workflow enhancements and quality assurance components that were implemented in order to improve the delivery of clinical care in these new facilities.

TABLE 2 | Clinical workflow improvements and quality assurance components at the Hospital General de Tijuana pediatric oncology unit.

Adjustments to the process for lab draws
Provision of vital equipment and utilities: computers, internet, and phone service
Process optimization regarding medication administration
Reorganization of the space in the outpatient clinic and infusion center
Medical record documentation and establishment of a medical record archive
Development of local institutional guidelines and protocols, an institutional cancer registry and a data management program

Four factors were essential to the infrastructure developments:

1. The creation of a start-up budget between St. Jude IOP, RCHSD and the HGT to provide initial funding.
2. Assisting the HGT with its application for national accreditation from the Mexican Ministry of Health. Such accreditation ensured that the HGT would receive future funding from Seguro Popular.
3. The close working relationship between key stakeholders at RCHSD and at the HGT to create a large-scale, feasible plan.
4. The extra $1 million US provided by the Mexican federal government to enhance the infrastructure at the HGT.

Patient Clinical Outcomes

The patient population tripled soon after the inception of the program. Leukemia, lymphoma, and brain tumors have constituted the most common cancers diagnosed in this population, and the disease breakdown seems to be a representative sample of the tumor burden in Mexico (11, 12) as well as in HIC (19). Significant improvements in patient outcomes are the direct result of the establishment of a fully functional pediatric oncology unit, a dedicated team that has worked to improve access to care for those underserved patients who previously could not have afforded it, the establishment of infection management, supportive care, and transfusion protocols, and the implementation of a data management program that has subsequently been used to guide clinical decision making.

Figure 1 includes the Kaplan–Meier curves for overall survival and event-free survival for patients treated at the HGT cancer unit from 2008 to 2014. The 3-year overall survival rate for acute lymphoblastic leukemia achieved at the HGT in less than 4 years (from 2008 to 2011) was 70% and the event-free survival was 50%, remarkable feats in such a short-time period.

Table 3 includes other patient outcome accomplishments at the HGT. For example, deaths related to infections have dropped

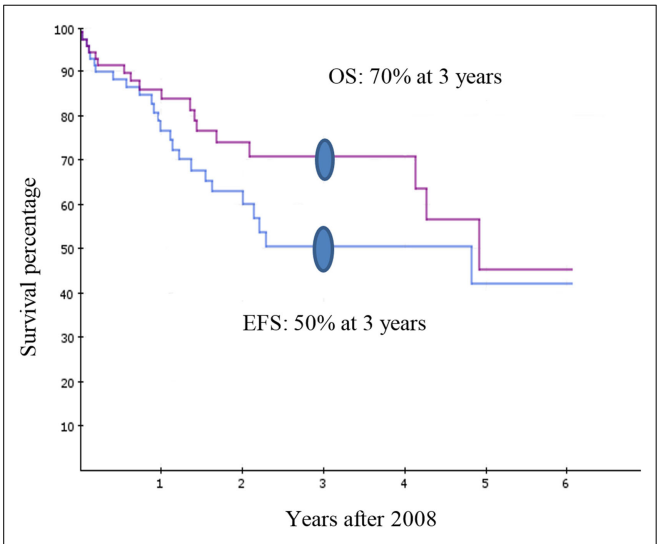

FIGURE 1 | Kaplan–Meier overall survival (OS) and event-free survival (EFS) curves for the patients with acute lymphoblastic leukemia at the Hospital General de Tijuana pediatric cancer unit from 2008–2014.

TABLE 3 | Selected clinical outcomes in pediatric oncology at the Hospital General de Tijuana.

Category	2008	2014
New cases per year	21	70
3-year survival rate for acute lymphoblastic leukemia	10%	70%[c]
Relapse rate	Unknown	22%
Abandonment rate	10%	2%
Mortality rate during induction therapy	Unknown	5.3%[a]
Infection rate (# infections × 100/inpatient days–month)	3.3	1.8
Infection-related mortality rate	27%	0%[b]

[a]*Higher rate when compared to institutions in high-income countries, but lower when compared to other low- or middle income countries (20, 21).*
[b]*Data from 2013.*
[c]*Data from 2011.*

TABLE 4 | Healthcare professional development progress at the pediatric oncology unit, Hospital General de Tijuana, 2007–2015.

Position	2007 (*N* = 5)	2008 (*N* = 27)	2015 (*N* = 60)
Pediatric oncologists	0	1	3[a]
Pediatric hematologists	0	0	1[a]
Pediatric intensive care specialists	0	1	1
Anesthesiologists	0	0	1
Pediatric infectious disease specialists	1	1	1[a]
Trained pediatricians	0	6	8[a]
Nurses	1	10	31[a]
Psychologists	0	1	3[a]
Social workers	1	1	1[a]
Dieticians	0	1	1
Pharmacists	0	1	1[a]
Teachers	0	0	2[a]
Pathologists	1	1	1
Surgeons	1	1	1
Administrative assistants	0	1	2[a]
Ambulance drivers	0	1	1[a]
Data managers	0	0	1[a]

[a]*Exclusive to the Hospital General de Tijuana pediatric oncology unit.*

dramatically from 25% in 2008 to 0% in 2013. Also, there has been a 45% reduction in the infection rate over the same period. In regard to the highly curable cancers like acute lymphoblastic leukemia and lymphomas, the leaders of the program on both sides of the border expect to achieve similar survival rates as those for children in San Diego by 2020.

Capacity Building

Team Building Accomplishments

The establishment and training of a multidisciplinary healthcare team is one of the most effective ways to achieve a high-quality pediatric cancer program where resources are constrained (10, 16, 22), and the same has held true for the St. Jude IOP-RCHSD-HGT partnership. A local pediatric oncologist was appointed as the on-site coordinator to oversee the emerging projects. **Table 4** reports the enhancements made to the team makeup as viewed by snapshots taken in 2007, 2008, and currently in 2015 that display the type and number of healthcare professionals employed by the HGT pediatric cancer unit in those years.

Training

Training for the physicians, nurses, and ancillary staff, including social workers, psychologists, and data managers, has been one of the pillars of this project. Training has taken place on-site and in other partner sites affiliated with the St. Jude IOP, such as Guatemala and Chile (3, 8). For the staff fluent in English and able to cross the border, training has been conducted at RCHSD. More than 6,000 hours of on-site and online training have been provided to various staff members. Patients and families have also benefited from education and counseling about nutrition, oral health, and infection prevention.

One initial problem was the scarce number of pediatric oncologists trained to care for children with cancer. A "physician-extender" model was used as a solution, where a physician with training in one area pursues additional, specialized training to expand the care he or she can provide (23). Within the HGT's pediatric cancer unit, there are currently eight general pediatricians who obtained further pediatric oncology and infectious diseases training to work as "physician-extenders" to provide specialized care to critically ill patients.

Community outreach education and cancer workshops to educate local and regional healthcare providers and the general public about pediatric cancer have been one of the principal goals of the educational program. To date, nearly 2,500 community health care providers in Baja California have been reached by this initiative.

Each of these training efforts has notably changed the skill level, dynamic, and culture of the multi-disciplinary team. Physicians are now well-trained to care for patients with cancer; nurses now feel respected as vital members of the team; and doctors and nurses now work together with other professionals and provide standard of care to their patients. A powerful change has taken place within a relatively short period of time.

Financial Sustainability

National Accreditation

One of the priority action items since the planning stages of the program has been the facilitation of the national accreditation to ensure federal financing. None of the accomplishments related to infrastructure and clinical outcomes would have been possible without the constant funding provided by the Mexican national government through Seguro Popular. Seguro Popular provides a fixed amount of monies per patient per year based on the diagnosis. For example, for a patient with acute lymphoblastic leukemia, Seguro Popular disburses to accredited centers about $10,000 US annually. This fund covers for the majority of medications, including chemotherapy and antibiotics, supplies, and direct hospital costs. The local state government through its Ministry of Health supports the salary for personnel, equipment, and additional operational costs.

This model has ensured a stable and predictable funding stream to provide comprehensive care for pediatric cancer patients, an essential element to the long-term success of any health system's strengthening effort (18).

Grassroots Foundation

Despite the immense financial contributions made by Seguro Popular, the funds have not been sufficient to meet the HGT's needs. Therefore, local grassroots efforts have offered immense support to the patients and their families. Patronato Pro-Hospital de Tijuana – Patronato – is a local, apolitical organization founded

in 2000 to support all patients at the HGT, which are often vulnerable. Given that the HGT is the largest public, community hospital in Northwestern Mexico, it serves as a safety net for the poorest in Baja California; as a result, nearly all families that seek care at the HGT live below the effective poverty line of $200 US per month. Among other services, Patronato provides food subsidies, funding for some medications not covered under Seguro Popular and lodging for families who reside outside Tijuana (about 35% of families). This strategy facilitates access to care and helps prevent abandonment of treatment. Thus, without Seguro Popular and the philanthropic efforts of Patronato, patients at the HGT could not have access to treatment and would more frequently be lost to treatment abandonment, since the majority of patients receiving care at the HGT cannot afford the high expenses associated to oncology care, including the cost of travel to the HGT, food, missing work for one or both parents to support their child, and many other expenses. Since the inception of the partnership program, cancer care has been provided free of all costs to all patients younger than 18 years of age receiving care at the HGT regardless of their income or socio-economic status. Moreover, Patronato has been the vehicle for the disbursement of funds provided by the St. Jude IOP-RCHSD partnership to sponsor all training activities and salary supplementation for key personnel at the HGT.

In addition, close relationships between leadership of the partnership program and Patronato have led to effective community advocacy contributions to strengthen relationships with local government leaders. This focus has been instrumental to the successful launching and sustainability of the program.

Discussion

Collaborative partnerships in pediatric oncology between institutions in HIC and LMIC may overcome health disparities by strengthening health systems and improving clinical outcomes for children with cancer. Innovative and dynamic collaborative models, where an academic pediatric oncology center in a HIC establishes a long-term partnership with an emerging center in a LMIC have been successful in improving survival rates for children with cancer (13). One of such programs was established in 1986 between La Mascota Pediatric Hospital in Managua, Nicaragua, and hospitals in Monza and Milan, Italy, and Bellinzona, Switzerland, with successful outcomes (10). Since then, the Monza International School of Pediatric Hematology/Oncology and the St. Jude IOP have become pioneers in facilitating new collaborative programs throughout the world. To date, the St. Jude IOP has established more than 20 programs in 15 countries. As a result, 5-year survival rates for children with cancer have significantly increased in the regions where these partnerships have been established (8, 15, 22), particularly for children who suffer from acute lymphoblastic leukemia. In addition, these programs help develop and strengthen local healthcare infrastructures in comprehensive, sustainable ways from the ground up (2, 8). These partnerships are often based on proven Health Systems Strengthening principles, like holism, context and collaboration, social mobility, capacity enhancement, equity, financial protection, and evidence-informed action (18).

The Ethics of Transcultural Partnerships in Healthcare

Numerous ethical principles have been at work throughout the successful St. Jude IOP-RCHSD-HGT collaborative initiative. In general, transcultural partnerships elicit several ethical issues that should be addressed prior to engaging in the relationship. They are not necessarily the classical principles of ethics such as beneficence, maleficence, justice, or autonomy, but center around an understanding of intercultural aspects and communications. There should be an understanding of the dynamics between each party with sensitivity to specific cultural norms and behaviors. There can be ethical conflicts that relate to relationships and trust. Is the trust based on signed agreements or does it depend on the relationship between the two parties? If the trust is based on relationship, when and how does the relationship begin and end?

One also needs to be aware of the differences between autonomous decision making and paternalism. One partner should not expect to come in and direct decisions. Rather, all parties involved should guide each other and have a common motivation, similar perspectives, and unifying goals. Specific ethical issues will include potential sources of conflict such as emotions, assumptions and perceptions, values, needs and goals, lack of information or clarity, and individual styles of communication and behavior. To achieve a successful working relationship, stakeholders would benefit by separating any conflicts from concepts of right and wrong, and considering looking at or doing things in different ways that would be acceptable to all parties.

Overcoming Disparity in Mexico

Health disparities in pediatric oncology are well-documented, as are the epidemiology and burden associated with childhood cancer in developing countries (4, 13–15).

In 2012, the Mexican census reported 32,972,300 children aged 0–18 years, comprising 37% of the total population (11). Of those, less than 8% are covered with commercial insurance and around 40% have access to healthcare through their employed parents who are insured via social security programs (Instituto Mexicano de Seguridad Social-IMSS). The overwhelming majority – over 50% – are uninsured children, whose parents are not salaried workers, are rural residents, or unemployed. All Mexicans who are uninsured are eligible for Seguro Popular coverage (11, 12).

In Mexico, cancer is the sixth leading cause of death in children 1–4 years old and the second leading cause of death in children 5–14 years old (11, 12). Prior to 2008, outcomes were very poor for children with cancer in Baja California (20, 21, 24), and because a comprehensive pediatric cancer center did not exist in Baja California at that time, newly diagnosed pediatric oncology patients from the region traveled long distances to other hospitals in Mexico to seek care, or sadly, died in their local communities (20, 24). Some reasons why pediatric cancer care was still poor in Baja California as compared to other regions of central Mexico were because of the high poverty rate of the citizens of Tijuana (25), the relative insufficient number of academic institutions in Baja California, the scarcity of philanthropic initiatives supporting patients with chronic diseases, and the geographic isolation that characterizes states not located on central Mexico (26–28).

In addition, the Seguro Popular program created to cover for oncology care only started in Mexico in 2007.

The economic differences between the US and Mexico have contributed in part to some of the healthcare disparities that extend into the discipline of pediatric oncology. Before 2008, there was neither a pediatric oncology unit nor a pediatric oncologist in all of Baja California. Lack of pediatric cancer care is a problem that has extended beyond the San Diego–Tijuana border. In 2012, Mexico had 3.6 pediatric oncologists per million children under the age of 18 (2), while the US had 29.2 total pediatric cancer specialists per million children (3). Large regional staffing inequalities exist in Mexico (4), as 44% of oncologists are concentrated in Mexico City, and 18% are in Guadalajara and Monterrey, the second and third largest cities (11, 12). On average, a pediatric oncologist in Mexico provides care to 65 new cancer cases per year (11, 12), whereas in the US, an oncologist provides care to 10 new cases annually (29).

The Mexican government acknowledged improvements needed to be made to its healthcare system, including improvements in pediatric cancer care; thus in 2006, the highly-acclaimed Seguro Popular legislation was passed. Seguro Popular is more properly known as the System of Social Protection for Health, and within it exists the Fund for Protection against Catastrophic Expenditures that specifically covers pediatric oncology medical care. The Fund for Protection against Catastrophic Expenditures was expanded in 2008 to include full payment for all types of childhood cancers (9, 12, 24).

These initiatives targeted to Mexican children with cancer represent a major effort toward providing appropriate care for these traditionally underserved patients and represent a model for other LMIC across the world (9, 24, 30).

Program Success Based on the Health Systems Strengthening Principles

In addition to recognizing cultural differences in the St. Jude IOP-RCHSD-HGT partnership, we employed several guiding Health Systems Strengthening principles as outlined by Swanson et al. (18) during the implementation of the program. These principles include:

1. Holism: One takes a holistic approach when one considers all systems components, processes, and relationships simultaneously. A successful transcultural partnership ultimately succeeds based on a true bilateral relationship, one where both institutions work through and improve the processes of the new oncology unit. Leaders at RCHSD took a holistic approach with the HGT by making at least weekly site visits from 2008 to 2010 and monthly visits afterward and by serving as accessible day-to-day mentors as problems arose.
2. Context and collaboration: One considers the context when one considers global, national, regional, and local culture and politics. Collaboration takes place when long-term, equal, and respectful relationships are fostered between mentors and mentees, in all sectors and organizations involved. Since the inception of the program, one of the priorities has been to foster an equal, long-term relationship with the leadership at the HGT, the state government, and the healthcare team in Tijuana. This spirit of cultural and political sensitivity in relationships with Mexico's Secretary of Health, the HGT leadership, local staff, and patients has been crucial to the success of various aspects of the program.
3. Social mobilization: Social mobilization refers to efforts that advocate for social and political change to improve health systems and social determinants of health. In Tijuana, Patronato has played a major role, as the main advocate of the children, impacting the local community and society and leading to a successful development of the new HGT pediatric cancer program.
4. Capacity enhancement: This occurs when individuals, communities, ministries of health, and other stakeholders in the health system become better able to provide for the various levels of healthcare and accept ownership for doing so. This is one of the greatest strengths of this particular partnership, as capacity enhancement has taken place at all levels, such that there now exists an independently operating pediatric cancer unit in Baja California for the first time. The Secretary of Health has become more engaged in supporting the development of pediatric cancer services in Mexico, and community pediatricians and primary care providers in Baja California are better able to diagnose cancer and refer patients promptly to the HGT.
5. Equity: One strengthens health systems in an equitable way when one focuses on and empowers those who are marginalized. The very purpose of this transcultural collaboration is to reduce health disparities for children with cancer in the border region and to improve access to care and, ultimately, clinical outcomes. This mission continues to expand as the HGT has become a regional referral center and agent of healthcare change. The HGT recently has begun mentoring the Hospital General de La Paz, Baja California Sur, Mexico, as they seek to establish the first pediatric cancer unit in the state of Baja California Sur.
6. Financial protection: Predictable funding streams dramatically affect the way an organization is able to operate and plan. The initial shared and realistic budget between St. Jude IOP, RCHSD, and the HGT was vital to the long-term planning, local sustainability, and success of the partnership. Specific training in budgeting and management RCHSD physician leaders had received prior to the partnership was invaluable. Predictable funding through Seguro Popular has been crucial to the success and sustainability achieved thus far.
7. Evidence-informed action: This is when systems and processes are put in place to gather, analyze and apply local data, make decisions based on evidence, monitor programs, and strive for transparency. The HGT has implemented a new data management system that allows for analyses of data and helps with decision-making activities. Also, the transcultural partnership process was guided according to previously established best practices from earlier collaborative programs and the team at the HGT now has access to treatment protocols and therapy guidelines already developed at RCHSD and St. Jude IOP.

Challenges

The establishment of this partnership has faced some challenges, including cultural differences between the RCHSD and the HGT

teams. Appointing a bilingual and bicultural physician from RCHSD (PA) to serve as the project medical director was the first step in overcoming those barriers. More effective communication in the language spoken at the partner site facilitated mutual understanding. The net result of this dynamic was that the HGT hospital administrators, physicians, nurses, and staff were empowered to take ownership of the evolving cancer program.

A crucial element of the new unit that required creativity and commitment was the constant adaptation of the delivery of care by the HGT staff to the constantly changing amount of resources available to them; during these uncertain times, it was important to find ways to move forward and make improvement, and not wait for situations outside the hospital to change (10).

Despite their commitment to the cause, individual healthcare workers still face their own limits while caring for children with complex, life-threatening treatment complications. These professionals often have a high work load, may receive lower salaries, and often feel undervalued. Employee motivation and morale can suffer as a result. One of the solutions has been the implementation of innovative incentive programs for nurses and allied staff to reward their efforts to provide excellent care.

A limitation of the interpretation of our results is that we were not able to compare the survival rates at the HGT with other similar pediatric oncology units in Mexico in an individualized manner or to those obtained in well-established pediatric oncology centers such as Instituto Nacional de Pediatria, Hospital Infantil de Mexico, or Instituto Mexicano de Seguro Social, given the scarcity of published data in the field (24). In addition, there is no national cancer registry in Mexico; however, there are emerging efforts that started in 2007 to obtain epidemiological data at least for the cases identified through the Seguro Popular system (11, 12). Moreover, we could not assess differences on clinical outcomes in private institutions such as Hospital ABC or Hospital Angeles given that only 5–7% of children in Mexico are privately insured, thus data on these patients would be insufficient for meaningful comparisons.

Knowledge Sharing

Engaging in this transcultural partnership has not only benefited cancer patients in Baja California. As stakeholders of the St. Jude IOP-RCHSD-HGT partnership learned a unique body of knowledge, such as techniques to reduce treatment abandonment rates in Tijuana, physicians in San Diego applied those principles to help with their patients with high risk for abandonment of therapy among their own underserved Hispanic population. Abandonment is not a problem frequently encountered by pediatric oncologists in the US, thus providers often lack the training to deal with families, especially large, involved Hispanic families, when this difficult situation arises. The team in San Diego has learned from the team in Tijuana to adequately address issues with these families in a culturally sensitive and tailored way; they are now cognizant of and respectful of their specific beliefs and Hispanic family values.

In addition, when made aware of the realities faced in resource-restrained settings through the close working relationships with the pediatric cancer service in Tijuana, the team and leaders in San Diego have grown to better appreciate the precious and sometimes perceived as "unlimited" resources in the US. This realization has resulted in more cost-conscious medical care by the team at RCHSD.

Going Forward

Despite all these improvements, 50% of the total expected number of new cases of pediatric cancer in Baja California are still not diagnosed or treated in the current pediatric cancer unit at the HGT. The distribution of the pediatric cancers currently treated at the HGT mimics the epidemiology of pediatric cancers in other areas of the world (11, 12, 19). According to recent Mexican Census data, one would expect about 200 new pediatric cancer cases per year in Baja California (7, 31). There may actually be even more annual cases because about 130,000 new immigrants move to the state each year and thus Census population data may not reflect these additional inhabitants.

Based on data obtained from the HGT's newly established institutional registry between 2008 and 2014, the number of new cases per year has risen from about 20 to about 70, which is the number of expected cases solely for the population of Tijuana. About 35% of patients treated at the HGT come from outside the city, so while access to care has increased for children with cancer in Tijuana and Baja California, there are still children both in the city of Tijuana and in the state who are not receiving the life-saving care they need.

Looking to the future, efforts will concentrate around improving further the care, the infrastructure, and promoting awareness of pediatric cancer in Baja California. The community outreach programs will continue to train pediatricians, primary care providers, and health "promotores" throughout the state in order to prepare them to detect pediatric cancer earlier in communities state wide.

Initiatives going forward include:

1. Completing the HGT pediatric cancer unit's transformation into a regional referral center that provides high-quality pediatric oncology care in Mexico and becoming a mentor for the Hospital General in La Paz, Baja California Sur and other hospitals in the region.
2. Furthering innovations to retain the nursing staff and other healthcare workers and keep them motivated.
3. Continuing to grow the "physician–extender" training and retention program, with the hope that palliative care and neurosurgery services can be added to those available to patients and their families at the HGT in the future.

Conclusion

One of the critical factors for the long-term success of any collaborative transcultural program is to pursue healthy, long-term, and culturally sensitive relationships with government leaders and other stakeholders in the LMIC. Budgeting training and managerial skills are essential, as well as predictable and sustainable funding sources. Adherence to other Health Systems Strengthening principles enhances the likelihood of program success.

One of the short-term goals of all transcultural partnerships in pediatric oncology should be to improve clinical outcomes for children in LMICs. The long-term goal of all collaborative partnerships should be to transform an emerging pediatric

oncology unit into an independent, high-quality, referral center that can initiate other local and regional collaborations.

There is a vast need for overcoming health disparities along the border region for both adults and children with various health conditions such as cardiac, infectious, metabolic, and surgical, among others; this represents a remarkable opportunity for improvement among clinicians, government officials, public health professionals, and other stakeholders on both sides of the border. The process that transcultural partnerships have developed to overcome health disparities is proven and could be applied to other disciplines of medicine.

Even within the HGT, where pediatric cancer care has already experienced dramatic improvements and where other physicians and departments have witnessed the success of this program, there are several opportunities to establish similar collaborations. Next steps could include engagement of key stakeholders on both sides of the border with a willingness to overcome any cultural and system barriers.

We invite pediatric cancer centers and academic institutions in LMIC and HIC to consider taking action regarding this ethical dilemma by initiating culturally sensitive, long-term collaborations with a sister organization in any discipline of medicine. We also encourage the enactment of policies that promote and facilitate such equitable, long-term transcultural partnerships.

Author Contributions

PA, SF, RR, DB, RCR, and WR made substantial contributions to the conception, design, interpretation, and/or analysis of the project and data, the drafting and revising of the manuscript for important intellectual content, and the final approval of the published article.

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Improved cardiovascular risk among Hispanic border participants of the Mi Corazón Mi Comunidad Promotores de Salud Model: the HEART II cohort intervention study 2009–2013

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Background: Community resources (parks, recreational facilities) provide opportunities for health promotion, but little is known about how to promote utilization of these resources and their impact on cardiovascular disease risk (CVD).

Methods: This cohort study evaluated the impact of an intervention called Mi Corazon Mi Comunidad (MiCMiC), which consisted of promoting use of community physical activity and nutrition resources by Promotoras de Salud/Community Health Workers. Participants were assessed at baseline and following the 4-month intervention. Attendance records were objectively collected to assess utilization of intervention programing.

Results: A total of five consecutive cohorts were recruited between 2009 and 2013. Participants were mostly females (86.0%), on average 46.6 years old, and 81% were low in acculturation. Participants who completed follow-up ($n = 413$) showed significant improvements in reported health behaviors and body composition. Higher attendance significantly predicted greater improvements. The baseline to 4-month *change* for the *highest* vs. the *lowest* attendance quartiles were for weight (−5.2 vs. +0.01 lbs, $p < 0.001$), waist circumference (−1.20 vs. −0.56 inches, $p = 0.047$), hip circumference (−1.13 vs. −0.41 inches, $p < 0.001$); hours of exercise/week (+3.87 vs. +0.81 hours, $p < 0.001$), proportion of participants eating five servings of fruits and vegetables/day (+54.7 vs. 14.7%, $p < 0.001$).

Conclusion: Following the Promotora-led MiCMiC intervention, substantial improvements in health behaviors and modest improvements in cardiovascular risk factors were found. Greater utilization of community resources was associated with more favorable changes. This study provided preliminary evidence for the effectiveness of Promotora-led interventions for promoting use of existing community resources in CVD risk reduction.

Keywords: community resources, parks and recreation, community health workers, U.S.–Mexico border, Hispanic, cardiovascular disease, cohort

Introduction

From 2000 to 2010, the Mexican-American population in the U.S. increased rapidly from 20.6 million to 31.8 million and in 2010 represented an estimated 63% of the total U.S. Hispanic population (1). More than 85% of the Mexican-American population is geographically concentrated in the West and South. The four U.S.–Mexico Border States (New Mexico, Texas, California, and Arizona) have the highest proportion of residents of Hispanic descent at more than 30% of the total population (1). Addressing the health care needs of the Hispanic border population presents unique challenges, given the bilingual, bi-national environment, the limited resources of the population (2), and the high risk for cardiovascular and metabolic conditions (3–5). To address cardiovascular risk factors among Mexican-American border residents, several programs have been developed such as the health promotion curriculum called Salud Para Su Corazon (SPSC; for the health of your heart) (6–8). SPSC is aimed at Mexican-Americans and utilizes Community Health Workers/'Promotores de Salud' (9, 10) to function as links between health care providers and community members for outreach and curriculum delivery.

Recently, ecological approaches that take into account the environment have been suggested for common chronic disease prevention and control (11). Evidence supporting the impact of environmental factors on health behaviors and outcomes has strengthened this approach. For example, it has been found that proximity to and access to recreational facilities and grocery stores impacts physical activity and nutrition behaviors and consequently cardiovascular and metabolic risk (12, 13). To date, however, few evidence-based projects have prospectively evaluated the extent to which community interventions can promote utilization of community resources, and whether increased resource utilization is associated with beneficial cardiovascular disease risk (CVD) outcomes.

To this end, the Health Education Awareness Research Team (HEART) Phase II cohort study was implemented in a large metropolitan U.S.–Mexico border area from 2009 to 2013 (14, 15). In partnership with the local parks and recreations department and Promotores de Salud employed by a local clinic, five cohorts of high-risk Mexican-American residents were recruited with the aim of promoting utilization of existing community resources and evaluate CVD risk outcomes. It was found that Promotores were able to successfully facilitate using the community resources, as evidenced by an average attendance of over 21 physical activity and nutrition sessions over a 4-month period (Balcazar et al., under review). Using the HEART Phase II data, the current paper describes the behavioral and CVD outcomes of the study. The primary hypothesis that was tested for the current paper was that increased utilization of community resources, as measured by attendance of a larger number of health sessions, was associated with a greater improvement in cardiovascular risk factors as well as dietary and physical activity behaviors.

Materials and Methods

Study Setting

The study was conducted in El Paso, TX, USA, located directly at the U.S.–Mexico border. Approximately 80% of residents in the area are Mexican-American (16). Educational attainment and median income are lower than state and national averages, and the proportion of residents without health insurance is higher (16). The intervention was implemented in two zip codes, selected by a community leadership council formed in HEART Phase I (17, 18). These zip codes were in the lower valley area, which is characterized by a greater proportion of Mexican-American residents (almost 95%), a lower socio-economic status and less access to health care compared to the rest of El Paso (19). In prior research, residents of these zip codes have been found to have a very high prevalence of CVD risk factors (17, 20).

Study Design and Programing

The HEART Phase II study was a cohort study with two measurement times: at baseline and 4-month follow-up. The decision to not build a randomized trial was guided by the HEART Community Health Advisory and Leadership Council, which oversaw the implementation of HEART Phase I (17, 18). From 2009 to 2013, a total of 753 Mexican-American border residents participated across 5 cohorts, 413 of whom completed all the 4-month follow-up measures. These 413 participants are the focus of the current analyses.

The programing for the intervention was called *'Mi Corazon Mi Comunidad'* (MiCMiC; My Heart My Community), which integrated best practice methods from the CDC Task Force on Community Preventive Services (21, 22). MiCMiC programing focused on facilitating access to resources that can promote heart-healthy behaviors available in the community. This consisted of increasing access to existing facilities, and promoting participation in organized activities led by Promotoras de Salud. Three partners in the community supported the implementation of the MiCMiC intervention. These partners included: the YWCA, the city's Parks and Recreation department, and Centro San Vicente, a community health clinic located in the study area. Three Promotoras de Salud were hired to guide the implementation of the program.

Activities focused on physical activity, dietary intake, and heart-healthy education. For physical activity, the focus was on facilitating use of parks and recreational facilities (the YWCA) through a free membership to the YWCA for the duration of the study and organized activities such as walking groups and dance classes. For dietary behaviors, nutrition-related activities such as cooking classes, grocery store tours, and coffee talks were led by the Promotoras. The Su Corazon Su Vida (SCSV) curriculum (8), a comprehensive Promotora outreach program aimed at promoting heart-healthy behaviors and tailored toward Mexican-American populations, was also taught by the Promotoras to facilitate the promotion of heart-healthy behaviors.

For each of the five study cohorts, a 4-month calendar of activities was developed by the research team. This calendar outlined weekly activities including YWCA activity classes, activity sessions in the parks (i.e., walking groups), SCSV curriculum classes, and other nutrition activities (i.e., grocery store tours, cooking demos). The weekly calendar typically consisted of between four and five structured activities per week including at least one nutrition-focused activity, two physical fitness-focused activities, and one SCSV class or family activity. Structured sessions were held both at the YWCA and at the parks. In addition, participants

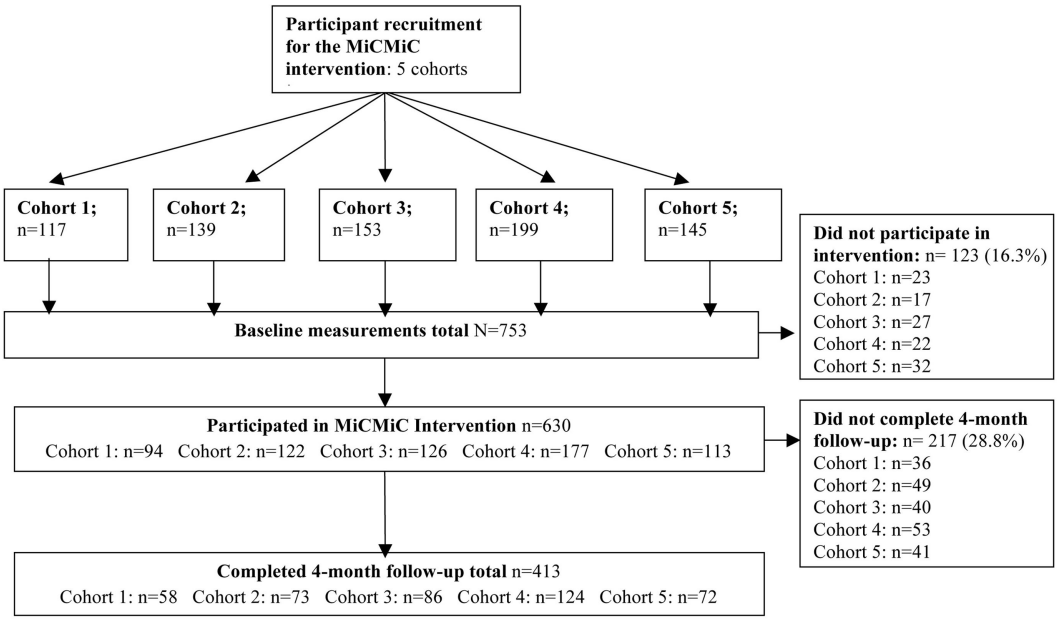

FIGURE 1 | Flowchart of participants in the HEART Phase II community-based cohort study on the U.S.–Mexico border from 2009 to 2013.

were encouraged to engage in other unstructured activities such as using the YWCA during non-class hours or engaging in activities in the parks at any time.

Attendance goals were developed by the Promotoras de Salud in collaboration with the research team and community partners. The total goal that was agreed upon was to aim for a total of 28 sessions for each participant over the 16-week period. To record utilization of community resources, total attendance was recorded for all activity and nutrition sessions. At the YWCA (where Promotores de Salud were located during the study period), a record-keeping system (using an electronic card system) tracked use of the facilities. Attendance was also recorded by the Promotores de Salud for the other study activities (SCSV classes, activity sessions in the parks, grocery store tours, etc.) (15).

Across all cohorts, on average, 21.6 total sessions were attended during the 4-month period, with 5 of 6 (83.6%) of participants attending at least one session, and 75% attending at least 3 sessions (Balcazar et al., under review). Small incentives (water bottles, t-shirts, cooking materials) were provided to facilitate continued program attendance.

Participants and Recruitment

Participants for the current study were recruited through snowball sampling, recruitment flyers, and door-to-door knocking. Participants were recruited by Promotores de Salud at community health fairs, the YWCA, recreation centers, community health clinics, through personal contacts, and through Spanish speaking radio and TV programing (15). A list of interested eligible participants was developed by community health workers from these recruitment activities. No records were kept to distinguish how many participants were approached and recruited through each technique. Inclusion criteria were that participants were residents of the two study zip codes, they were adults (18 and over), not pregnant, of Hispanic descent, and able to participate in all MiCMiC activities. Five subsequent cohorts were recruited. The intervention was implemented from 2009 through 2013. **Figure 1** describes participants and recruitment. All procedures were approved by the Institutional Review Boards of the University of Texas Health Science Center at Houston and the University of Texas at El Paso.

Although 83.6% of participants attended at least one session, complete data were only available on 16-week follow-up from 413 of the 753 participants. The proportion of participants completing follow-up did improve with every cohort from cohort 1 through cohort 4, but still remained below expectations. Although the numbers are comparable to other similar studies [e.g., Ref. (24)], the lack of completion of follow-up may have been related to the structure of the project incentives, which emphasized attendance over completion of follow-up measures. Participants who completed follow-up were not different on any of the indicators of insurance, income, education, employment status, and gender from participants who did not complete follow-up (data not shown). However, they were about 2 years older ($p < 0.001$), and were slightly lower in indicators of acculturation, as 83.1% were low on the SASH acculturation scale vs. 75.9% of those who did not complete follow-up, $p = 0.017$.

Measures

At baseline and 4 months, participants completed clinical measurements including height, weight, waist circumference, hip circumference, and blood pressure (the average of the last two of three measurements was taken). Measures were completed following standard procedures (i.e., American Heart Association). To make it easier to translate and disseminate the data to the participants and the community, a sum score of CVD risk factors including screening practices, presence of chronic conditions, and

health behaviors was calculated (0–11, with 1 assigned for each of the unhealthy options). Items included (1) recent screening for diabetes, and (2) high cholesterol (not screening counted as 1, screening a 0); baseline measurements of (3) BMI (overweight or not), and (4) waist circumference (abdominal obesity or not), (5) high blood pressure, (6) reported diabetes, (7) reported high cholesterol; and behaviors including (8) physical activity at least 30 min five times/week, (9) smoking, (10) consumption of five daily fruits and vegetables, and (11) whether participants had attended a class to improve their health in the past 6 months.

A survey (available in Spanish and English) included items about demographic characteristics (age, sex, gender, socio-economic status) and a series of questions assessing health habits. Bilingual interviewers administered the survey. Acculturation was assessed with the SASH acculturation questionnaire (23). Fruit and vegetable consumption was assessed through asking participants if they ate five servings of fruits/vegetables per day. For physical activity, participants were asked if they exercised 30 min/day three times per week, and the number of hours per week they engaged in exercise. Finally, using items from the 2008 National Survey on Drug Use and Health (25), participants were asked if they currently smoked cigarettes and if they had smoked in the past 30 days.

Analyses

All primary analyses were conducted using SPSS version 21.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics and frequency distributions were used to describe demographic characteristics. Regression analyses using Generalized Estimating Equations (GEE) to take into account the "nested" data structure (participants within cohorts) were used to compare baseline to 4-month comparisons. Finally, we tested whether a larger number of total sessions attended were associated with a greater change in health outcomes. Attendance was categorized into quartiles, and it was tested whether changes in health outcomes from baseline to follow-up were significantly different between each quartile. In all regression models, covariates included sex, age, gender, acculturation, and socio-economic status.

Results

Demographic Characteristics and Baseline Health Status

Participants who completed follow-up ($n = 413$) were mostly female (86% were female) and had an average age of 46.6 years (SD = 12.8). Socio-economic status was low, as about 70% had an annual household income under $20,000, and almost half did not have health insurance. More than 80% of participants were low in acculturation, the majority were born in Mexico (65.9%), and about five out of six participants (86.0%) chose Spanish as their preferred interview language. At baseline, 75% of participants had abdominal obesity and almost 65% had hypertension or pre-hypertension (see **Table 1**).

Change from Baseline to Follow-Up

Findings for all 413 participants from baseline to 4-month follow-up are presented in **Table 1**. Self-reported health behaviors showed significant improvements. Whereas at baseline, just over 40% of participants reported exercising three times a week for 30 min, at follow-up this was five out of six participants ($p < 0.001$) and average hours per week of reported exercise increased by almost 3 hours (from 2.51 to 5.44 hours, $p < 0.001$). Intake of at least five daily servings of fruits and vegetables increased from 33.3% at baseline to 67.4% at follow-up ($p < 0.001$). Smoking declined from 8.4 to 6.8% ($p = 0.002$).

TABLE 1 | Clinical characteristics at baseline and 4-month follow-up of 413 Mexican-American participants in the HEART Phase II community-based cohort study on the U.S.–Mexico border from 2009 to 2013.

Variable	Baseline	4-Month follow-up	*p*-Value[a]
Height (inches)	63.11 (3.16)	N/A	
Weight (pounds)	178.17 (38.00)	175.97 (37.52)	<0.001**
BMI (mean kg/m^2)	31.39 (6.19)	31.07 (6.20)	<0.001**
Underweight	0.2%	0.5%	<0.001**
Healthy weight	13.9%	14.7%	
Overweight	32.0%	32.3%	
Obese	53.9%	52.5%	
Waist (inches)	38.72 (5.27)	37.80 (5.50)	<0.001**
Abdominal obesity males (40″)	55.0%	50.8%	0.494
Females (>35″)	75.3%	67.7%	0.004**
Hip circumference (inches)	44.14 (5.14)	43.41 (5.11)	<0.001**
Systolic BP (mm Hg)	126.87 (18.90)	126.19 (16.76)	0.535
Diastolic BP (mm Hg)	76.70 (9.52)	75.64 (9.25)	0.257
Any pre-hypertension or hypertension	63.7%	63.3%	0.943
CVD risk sum score (of 11 factors)	5.60 (1.78)	3.74 (1.66)	<0.001**
Health behaviors			
Exercise 30 min 3×/week (% yes)	43.2%	85.2%	<0.001**
Hours per week	2.51 (3.85)	5.44 (3.20)	<0.001**
Eat five fruits/vegetables/day (% yes)	35.8%	66.1%	<0.001**
Do you currently smoke cigarettes	8.4%	6.8%	0.002**

[a] *p-Values based on linear (for continuous variables), logistic (for dichotomous variables), or ordinal probit regression analyses (for categorical variables) using generalized estimating equations (GEE) controlling for cohort membership. These analyses included a predictor variable "time," which was included in the model to test whether the value at time 1 was significantly different from the value at time 2. *Significant difference on $p < 0.05$, **significantly different on $p < 0.01$.*

For clinical indicators, on average for all participants, weight (2 lbs), waist circumference (1″), and hip circumference (0.75″) all significantly decreased (p-values <0.001). About 5% fewer participants were categorized as abdominally obese. Systolic and diastolic blood pressure were slightly lower at post-test (about 1 mm Hg), but these changes were not significant. Finally, the CVD risk sum score was reduced by about two points from 5.6 risk factors at baseline to and average of 3.7 risk factors at follow-up ($p < 0.001$).

Number of Sessions Attended and Changes in Health Outcomes

Finally, we tested whether greater participation in the MiCMiC intervention was associated with greater improvements in behavior and CVD. Greater participation was defined as greater attendance at the health programing. Participants were grouped into quartiles by median attendance, which was 0 sessions for participants in the lowest quartile, a median of 6 sessions for quartile 2, a

TABLE 2 | Clinical changes of Mexican-American participants in the HEART Phase II community-based cohort study on the U.S.–Mexico border from 2009 to 2013, grouped by quartiles of intervention attendance.

Variable	Weight (pounds)				Hip circumference (inches)				Waist Circumference (inches)			
	Pre	Post	Change	*p*-Value[a]	Pre	Post	Change	*p*-Value	Pre	Post	Change	*p*-Value
TOTAL ATTENDANCE												
Quartile 1 (reference)	184.55	184.56	+0.01		44.11	43.70	−0.41		39.68	39.10	−0.56	
Quartile 2	179.92	178.76	−1.16	0.121	44.37	43.94	−0.43	0.850	39.04	38.25	−0.79	0.491
Quartile 3	168.80	166.35	−2.45	<0.001**	43.45	42.78	−0.67	0.344	38.07	36.49	−1.58	0.008**
Quartile 4	179.76	174.61	−5.15	<0.001**	44.39	43.26	−1.13	<0.001**	38.83	37.63	−1.20	0.047*
	Hours of exercise per week				**Exercise 30 min 3 days per week (% yes)**				**Eat five fruits/vegetables per day (% yes)**			
	Pre	Post	Change	*p*-Value	Pre	Post	Change	*p*-Value	Pre	Post	Change	*p*-Value
TOTAL ATTENDANCE												
Quartile 1 (reference)	2.48	3.29	+0.81		38.0%	65.3%	+27.3%		31.6%	46.3%	+14.7%	
Quartile 2	2.49	4.03	+1.54	0.174	42.6%	82.4%	+39.8%	0.002**	33.3%	69.4%	+36.1%	<0.001**
Quartile 3	1.91	4.75	+2.84	0.003**	43.1%	94.1%	+51.0%	<0.001**	32.0%	68.9%	+36.9%	0.008**
Quartile 4	2.76	6.63	+3.87	<0.001**	48.5%	99.0%	+51.5%	<0.001**	35.5%	80.2%	+54.7%	<0.001**

[a]*p-Values are based on regression analyses using generalized estimating equations (GEE) taking into account nested data structure, controlling for: baseline value, age, sex, income, and acculturation. To assess whether greater attendance is associated with greater improvements in health outcomes changes are compared across quartiles of attendance (Quartile Preference). *Significant compared to reference group on $p < 0.05$, **significant on $p < 0.01$.*

median of 22 sessions for participants in quartile 3, and a median of 55 sessions for participants in the highest quartile of attendance over the 4-month period. Quartile 1 was used as the reference group, and it was tested whether improvements in outcomes among participants in quartiles 2, 3, and 4 were significantly different from quartile 1.

It was found that greater attendance was significantly associated with improvements in body composition (see **Table 2**). Compared to quartile 1 (0.01 lbs increase), quartiles 3 (2.5 lbs reduction), and 4 (5.2 lbs reduction) showed significantly greater weight reduction ($p < 0.001$) at 4-month follow-up. For waist and hip circumference, findings were similar. Compared to quartile 1 (0.56″ waist reduction), participants in quartiles 4 (1.58″ reduction, $p = 0.008$) and 3 (1.20″ reduction, $p = 0.047$) had significantly greater reductions in waist circumference at 4-month follow-up. For hip circumference compared to quartile 1 (0.41″ reduction), quartile 4 had a significantly greater reduction (1.13″ reduction, $p = 0.001$). Greater attendance was not associated with changes in blood pressure.

Greater attendance was further consistently associated with greater improvements in health behaviors related to dietary intake and physical activity (see **Table 2**). Participants in quartile 1 increased their hours of exercise per week by 48 min/week (0.81 h), whereas participants in quartile 4 increased almost 4 h ($p < 0.001$ compared to quartile 1). The proportion of participants in quartile 1 who reported eating five fruits and vegetables daily increased by 14.7% (from 31.6 to 46.3%) compared to 54.7% increase in quartile 4 (from 35.5 to 80.2%; $p < 0.001$ for comparison).

Discussion

The current study evaluated whether participation in an intervention aimed at facilitating use of community resources resulted in changes in health behavior and CVD risk. The study was implemented among Mexican-American residents of the U.S.–Mexico border area, who were mostly low in socio-economic status and acculturation. Promotores de Salud were employed to facilitate use of community resources, which included parks and YWCA recreational facilities. Findings indicate that participants improved their health behaviors substantially from baseline to follow-up, including improvements in hours per week of exercise and reported nutrition intake. Statistically significant, but clinically small improvements in indicators of body composition were found, including weight, BMI, waist, and hip circumference. Greater improvements were found among participants who attended more intervention sessions. These findings provide support for the effectiveness of Promotora-led interventions aimed at facilitating access to community resources among high-risk underserved Mexican-American border residents.

Our findings confirmed that the study population was at very high risk for CVD. For example, 85% were overweight, 75% had abdominal obesity, and almost 65% had pre-hypertension or hypertension. The population was also low in socio-economic status and acculturation. These demographics are characteristic of the U.S.–Mexico border population and illustrate the need and opportunity for interventions tailored to these populations such as the MiCMiC program.

As a result of the MiCMiC intervention, substantial improvements were found in behavioral outcomes including reported physical activity and dietary intake. For example, two out of five participants reported exercising three times a week for 30 min at baseline, which improved to over four of five participants at follow-up. The increase in number of people attending health promotion related activities per week was further confirmed by objectively collected attendance data as described in greater detail elsewhere (Balcazar et al., under review). Changes were also very large between the highest and lowest attendance quartiles. Participants in the highest quartile increased their hours of weekly activity by about 3 h more compared to participants

in the lowest quartile. Also, despite having a similar baseline proportions of people meeting recommendations for fruit and vegetable intake (about one-third), 80% of participants in the highest quartile of attendance met fruit and vegetable intake at follow-up compared to just over 45% for the lowest attendance quartile.

Although the effects found for reported health behaviors and objectively collected attendance records were large, changes in clinical indicators were small. Therefore, although statistically significant, the magnitude of some of the clinical changes (for example, a 5-lb weight difference between the lowest and highest quartiles) is limited in terms of CVD. It is possible that the follow-up time was too short to detect changes large enough to be of clinical relevance. The magnitude of the changes is similar or greater, however, to prior similar studies. For example, Ayala (24) reported the findings of a Promotora model aimed at increasing physical activity by facilitating use of parks and free exercise classes. The study found reductions in waist circumference at 6 months of 0.35 cm, which increased to 2 cm at 12 months, and a weight reduction of 1 lb at 6 months and just over 2 lbs at 12 months (resulting in a 0.3 kg/m^2 BMI reduction). These numbers are similar or slightly lower than the numbers found in our study, despite the much shorter study period at 4 months. In addition, the current study expanded on the prior research by Ayala (24) in showing that greater utilization was associated with greater improvements.

The findings of the current study were similar to several other studies utilizing Promotora-led health promotion interventions such as Camina por Salud [*Walks for Health* (26)], Pasos Adelante [*Steps Forward* (27)], and Familias Sanas y Activas [*Healthy and Active Families* (24)]. Although these studies showed that Promotoras were able to increase access to care through, for example, facilitating immunizations (9) and health behavior change (24, 26, 27), little research to date had evaluated whether Promotoras can facilitate utilization of existing recreational facilities. The current study contributes to this literature by demonstrating that a Promotora-led program increased use of community resources related to heart-healthy behaviors among high-risk Mexican-American border residents with limited access to care. This study expands the previous research by showing that greater utilization predicted greater changes in self-reported behaviors and body composition, and that the findings of the current study were repeatable across five consecutive cohorts.

The findings of this study are further consistent with ecological perspectives (11, 15), which have reported that environmental restructuring, through, for example, enabling access to community resources and recreational facilities, is an essential part of widespread health promotion. The findings further demonstrate that integration of a model where Promotores de Salud shows potential in facilitating access to health resources (17, 18, 24, 26–28). This model may be particularly relevant in areas whose residents are underserved, have limited access to care and are at high risk for CVD such as the U.S.–Mexico border.

Limitations

The current study has several limitations. First, the number of participants who was measured at 4-months was relatively low compared to the number of original study participants, despite 83.6% attending at least one session, and 75% attending three or more sessions. The lack of completion of follow-up may have been due to an incentive structure that emphasized attendance over completion of follow-up. As an illustration, 33% of participants who were in the highest quartile of attendance did not complete the follow-up, suggesting that participants may have focused on session attendance over completion of the follow-up. In addition, anecdotal reports indicated that participants thought that the amount of time it took to complete all the measurements (2+ h) was prohibitive to their participation in the follow-up. Second, there was a selection bias for the cohort as the participants self-selected into the intervention. As a result, several characteristics of the sample are not representative of the area (i.e., over 80% were female and only 21.6% were employed full time). Other characteristics, however, such as the low acculturation, income, educational attainment, and limited access to care, are representative of the population in the area. Further, although the majority of Mexican-Americans in the U.S. live in proximity to the border, the unique nature of the area may limit the ability to generalize the results of the current study to other locations. Also, while some of the findings regarding clinical outcomes (particularly anthropometric data) were statistically significant, the effects were too small to have a large clinical relevance at the 4-month follow-up. In addition, many of the health behaviors were self-reported, and social desirability in answers to reported behaviors has to be taken into account. Finally, the YWCA was only provided for the duration of the study, and the authors have no knowledge about continued attendance at the YWCA after the study ended.

Conclusion

The current study demonstrates that a community health worker approach can be utilized to facilitate utilization of community resources among a cohort of high-risk Mexican-American border residents. Increased utilization of community resources was associated with modest, but significant improvements in indicators of body composition and substantial improvements in health behaviors over a 4-month period. The findings further included five consecutive cohorts, suggesting that the study may be repeatable, at least in the current setting. Further research with stronger experimental control, longer follow-up times, and additional objective cardiovascular risk factors is needed to evaluate whether facilitating access to community resources can provide sustainable health improvements among high-risk Hispanic border residents.

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The spillover of US immigration policy on citizens and permanent residents of Mexican descent: how internalizing "illegality" impacts public health in the borderlands

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Background: The militarization of the US–Mexico border region exacerbates the process of "Othering" Latino immigrants – as "illegal aliens." The internalization of "illegality" can manifest as a sense of "undeservingness" of legal protection in the population and be detrimental on a biopsychological level.

Objective: We explore the impacts of "illegality" among a population of US citizen and permanent resident farmworkers of Mexican descent. We do so through the lens of immigration enforcement-related stress and the ability to file formal complaints of discrimination and mistreatment perpetrated by local immigration enforcement agents, including local police authorized to enforce immigration law.

Methods: Drawing from cross-sectional data gathered through the National Institute of Occupation Safety and Health, "Challenges to Farmworker Health at the US–Mexico Border" study, a community-based participatory research project conducted at the Arizona–Sonora border, we compared Arizona resident farmworkers ($N = 349$) to Mexico-based farmworkers ($N = 140$) or Transnational farmworkers who cross the US–Mexico border daily or weekly to work in US agriculture.

Results: Both samples of farmworkers experience significant levels of stress in anticipation of encounters with immigration officials. Fear was cited as the greatest factor preventing individuals from reporting immigration abuses. The groups varied slightly in the relative weight attributed to different types of fear.

Conclusion: The militarization of the border has consequences for individuals who are not the target of immigration enforcement. These spillover effects cause harm to farmworkers in multiple ways. Multi-institutional and community-centered systems for reporting immigration-related victimization is required. Applied participatory research with affected communities can mitigate the public health effects of state-sponsored immigration discrimination and violence among US citizen and permanent residents.

Keywords: immigration policy, mistreatment, border health, stress, psychological, prevention and control

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Introduction

US immigration enforcement efforts grew considerably over the last few decades, with a nearly 15-fold increase in funding from 1986 to 2012 channeled into the nation's principle enforcement agencies. Customs and border protection (CBP) and immigration and customs enforcement (ICE), whose FY2012 budget totaled 17.9 billion dollars (1), contribute to the militarization of the US–Mexico border. Militarization is defined as the saturation of and pervasive encounters with immigration officials including local police enacting immigration and border enforcement policy with military style tactics and weapons (2). These enforcement measures are applied at ports of entry (POE), in the deserts, rivers, and mountains between POEs, and, increasingly, in public spaces, workplaces, and residential areas in the border region and elsewhere (3, 4).

The territorial boundary of the sovereign state has always been fundamental to the creation of social hierarchies. The intersections of ethnicity, race, class, and gender relegate people to social categories some of whose members have rights of membership, including US citizens and permanent residents and "Others" who do not possess such rights, such as unauthorized immigrants or "illegal aliens" (5, 6). In the US–Mexico border region, the process of "Othering" categorizes Latino immigrants and migrants, including their non-immigrant co-ethnics as "illegal aliens" (5, 7, 8). The symbolic violence (9, 10) or the implicit way in which cultural and social domination is maintained on an unconscious level through discriminatory practices generated by sexism, racism, and classism naturalizes the notion of "illegality." Through this process, certain groups are categorized as non-rights-bearing individuals (11, 12). The erasure of legal personhood manifests as the inability to obtain work authorization and restricted physical and social mobility, which reinforces immigrants' forced invisibility, exclusion, and sense of vulnerability to being deported (12, 13). The militarization of the border contributes to the construction of such notions of "illegality" of Latino populations by inscribing difference "upon Mexican migrants" themselves, as their distinctive spatialized (and racialized) status as "illegal aliens," as Mexicans "out of place" (5).

In the context of the "War on Terror," the regulatory policies associated with enforcement conflate migrants with terrorists, drug smugglers, and human traffickers who represent a threat to national security (14–16). The criminalization of immigration law erodes the legal protections that once covered non-citizens, subjecting ever-growing numbers to deportation (17–19). Further, there is growing evidence that border enforcement leads to maltreatment of persons that violates their civil and human rights through the excessive use of force and verbal and physical abuse (4, 14, 20).

Cumulative exposure to institutional arrangements, ethno-racial hierarchies, and citizen/non-citizen distinctions that systematically marginalize individuals create disproportionate levels of structural vulnerability (21). Defined as "a positionality that imposes physical and emotional suffering on specific population groups and individuals in patterned ways," structural vulnerability reproduces inequality by casting certain groups as less worthy of material and social protection (22). The subordinated status created through "illegality" may be internalized by Latino immigrant and migrants and detrimental on a biopsychological level (23–26). Farmworkers especially experience high levels of structural vulnerability due to their subordinate status in the social hierarchy (27). As a result, farmworkers in general experience greater prevalence of chronic disease risk factors and poorer mental health outcomes compared to non-farmworker US Hispanic populations (28–31).

This study aimed to explore ways in which a relatively large sample of immigrant and migrant farmworkers of Mexican descent who are US citizen and permanent residents and live and work in the Arizona–Sonora, Mexico border region experience "illegality" and the impact it has on their health. We hypothesized that transnational border residents, or those farmworkers who live permanently in Mexico and cross the border to work in US agriculture would be more likely to experience an internalized sense of "illegality" due to their residence outside the US and the need to cross the border for employment. Such perceptions of "illegality" could come in form of feeling as though they "belonged less" to the nation compared to those immigrant and migrant farmworkers who live in Arizona because of their residence outside the country. We contend that the need to cross the border daily and interact frequently with immigration enforcement officials at points of entry would bolster transnational farmworkers sense of being "Other" and negatively affect their well-being.

Materials and Methods

The National Institute of Occupation Safety and Health, "challenges to farmworker health (CFH) at the US–Mexico Border" is a community-based participatory research (CBPR) project conducted by the University of Arizona, Zuckerman College of Public Health, and the Binational Migration Institute located in the Department of Mexican American Studies in partnership with *Campesinos Sin Fronteras*, a community-based agency serving regional border residents and *Derechos Humanos*, a human rights organization advocating on behalf of Arizona immigrant families (32). A detailed discussion of this partnership is reported elsewhere (4, 33).

Challenges to farmworker health is a cross-sectional, population-based survey using a randomized proportionately representative household sample ($N = 299$) and a convenience sample ($N = 200$) of men and women of Mexican descent aged 20 years and older who were farmworkers during the 12 months preceding the survey. To obtain the household sample, researchers randomly selected census blocks for three adjacent Arizona-border communities; all were low income and typically medically under-served communities in which agricultural workers were the dominant residents. A modified survey was then utilized as an opportunistic survey conducted at specific pick-up points for farmworkers with the same enrollment restrictions mentioned, who may have been missed in the primary survey. This survey targeted those farmworkers not living in local household but rather commute from a distance, live in their automobiles, live across the border (including US residents), or live in "colonias" not yet mapped to the existing city and county neighborhood plots. For the purposes of this paper, the household and opportunistic samples were merged and stratified by transnational farmworkers who did not live in the US but crossed the Mexico border daily or weekly to work in US agriculture ($N = 140$) and those farmworkers whose primary residence was in Arizona ($N = 349$) referred to herein as Arizona-based farmworkers.

Essential to this study, were community health workers or *Promotoras*, who shared cultural and linguistic history of participants, contributed to survey modification and provided insight into cultural and regional relevance of interview questions. *Promotoras* were trained by UA research staff to conduct interviews and collected the majority of the survey data over the summer months of 2006–2007. *Promotoras* contacted a total of 323 adults who met study criteria, of which 299 agreed to participate, resulting in a 93% response rate. We believe CBPR, which equitably engaged affected community members throughout the research process, and the full engagement of *Promotoras* as trusted members of the community, increased the likelihood of participation and quality of the self-reported data. A detailed description of the CFH study sampling frame and partner agency relationships in CBPR is found elsewhere (33).

To examine the existing level of structural vulnerability within the population, descriptive statistics were calculated for variables shared by both the household and the abbreviated opportunistic survey instruments, these include selected demographics (age, years working in US agriculture), immigration status, access to health care coverage, and immigration encounter and immigration-related stress. Drawing from survey items from the Immigration and Border Interaction Survey conducted over a 15-year period in one Southern Arizona-border community (34, 35), respondents were also asked about their experiences with immigration officials and the perceptions of how immigration officials differentiate between US citizens and individuals unauthorized to be in the US. Stress was measured with items from the Border Community and Immigration Stress Scale (BCISS), a 21-item scale that considers the presence and intensity of culturally and contextually relevant stressors (33). BCISS stress domains include migration, acculturation, and barriers to health care, discrimination, economic strains, and family separation. For this study, we explored four border community and immigration-related stressors, including stress caused by encounters with immigration officials, local police, and the presence of military in the region. The BCISS is a 5-point Likert scale, which measures the level or intensity of the stress experienced for each given domain. For the domains of interest, we created a dichotomous variable to categorize respondents by self-reported feelings of very or extreme stress and those that experienced low to moderate stress. Data reported here illustrate those respondents who self-reported very or extreme stress, which is narrated in text as intense stress. Full description of the 21-BCISS can be found elsewhere (33).

Most importantly, we wanted to explore how such cumulative immigration-related surveillance, encounters and stress might contribute to a sense of undeservingness of social protection from immigration-related mistreatment or discrimination among study participants. To do so, we analyzed Arizona and transnational participants' short narratives of reasons to file and not to file a formal complaint with immigration authorities regarding an immigration related mistreatment episode.

Analysis

We explored differences between the two samples through Fisher's Exact for demographic and experiences with immigration officials. All statistical analyses were performed using STATA 10.0 software. We used grounded theory to code themes that emerged from the short narratives and stratified that analysis by Arizona and transnational participants (36). The UA Office of Human Subject Protection approved this research.

Results

There were no significant differences between the two samples in terms of immigration status as approximately 90% of all participants were self-identified US citizens or permanent residents. Only one participant self-identified with an undocumented immigration status and this participant was in the Arizona-border sample (**Table 1**). The remaining 8% of participants had a temporary residency status, meaning that they were in the process of permanent residency status or had a border-crossing card, which allowed them to cross into the US and work in US agriculture. Transnational farmworkers were significantly more likely to be male, older and employed for more years in US agriculture compared to Arizona-based border farmworkers.

Experiences with US Immigration Officials, Including Local Police

Although the Arizona-border sample was significantly more likely to see immigration officials in their neighborhoods, both study

TABLE 1 | Demographic characteristics of Arizona-border and transnational farmworkers.

	Total	Arizona border	Transnational	*p*-Value
	% (*n*/489)	% (*n*/349)	% (*n*/140)	
Gender				
Female	40 (194/489)	47 (166/349)	20 (28/140)	**0.000**
Male	60 (295/489)	52 (183/349)	80 (112/140)	
Age, mean year (SD)	46 (11.2)	45 (10.8)	49 (11.0)	**0.001**
Immigration status				
US born or naturalized citizen	14 (66/484)	15 (52/344)	10 (14/140)	0.437
Permanent resident	80 (389/484)	79 (272/344)	84 (117/140)	
Temporary	6 (28/484)	6 (19/344)	6 (9/140)	
Undocumented	0.2 (1/484)	0.3 (1/344)	0 (0/140)	
Years in US agriculture, mean (SD)	19 (12.2)	19 (12.2)	21 (12.1)	**0.006**
Current health care coverage	57 (276/486)	55 (192/347)	60 (84/139)	0.313
Lacked coverage in last year	45 (151/332)	41 (92/225)	55 (59/107)	**0.018**

Boldface p values indicate p < 0.05 from Fisher exact tests. Ns differ according to available data.

samples were as likely to observe immigration officials at the worksite, corner store, and the local supermarket. Arizona border respondents were significantly more likely to believe immigration officials, including local police, used individual characteristics of clothing and the type of vehicle to identify undocumented persons (**Table 2**). Although not statistically significant, Arizona border residents were more likely to be detained and questioned by local police regarding their immigration status compared to the transnational participants. Among those participants who were detained by local police, local police called immigration officials and detained Arizona and transnational farmworkers at almost equal rates.

Almost all Arizona and transnational farmworkers believed negative immigration encounters should be reported. However, only about one-third of both populations reported knowing how to file a formal complaint of immigration mistreatment.

In terms of self-reported immigration-related intense stress, approximately one-third of all participants experienced intense stress due to military patrolling the border region. No <20% of all respondents experienced this same level of intense stress in anticipation of encounters with local police or encounters with immigration officials. There were no significant differences in the levels of stress produced by such encounters among the two samples.

Complaint Making Regarding Immigration Mistreatment

Farmworker short narratives illuminated several themes regarding reasons to file a complaint of mistreatment by immigration officials (**Table 3**). Prevention of future mistreatment accounted for 29% of all narratives. According to farmworkers, filing a complaint of immigration-related mistreatment contributed to the prevention of mistreatment in several forms. First and foremost by filing a formal complaint one could contribute to raising awareness of immigration-related mistreatment. Complaints also served to elicit corrective action among those immigration officials who engaged in behavior beyond the scope of their mandate. More broadly, farmworkers believed formal complaints could contribute to the elimination of existing systems of discrimination.

The second major thematic category within the reasons to file a complaint of mistreatment was protection of overall well-being. Protection of well-being came in many forms including acknowledgment of civil and human rights, and avoidance of abuse. Farmworkers described in detail their inherent civil and human rights, which they believe should protect them and their community members from such mistreatment. Although far less mentioned, in some cases, farmworkers described the forms of resistance individual and community members engage in to monitor mistreatment.

When comparing the two groups, Arizona-border residents more often identified prevention of future mistreatment and human and civil rights compared to transnational participants who were more literal in their rational for complaint making who most often abuse of any kind. Both sets of participants reported formal complaint making about immigration-related mistreatment could contribute to positive changes in the larger immigration and police system.

We shift now to the reasons farmworkers would choose not to make a formal complaint of immigration-related mistreatment. Approximately 31% of the total sample stated fear as the number one reason not to file a formal complaint of mistreatment (**Table 4**).

TABLE 2 | Comparisons of experiences and encounters with US immigration and local police among Arizona-border and transnational farmworkers.

	Total % (*n*/*N*)	Arizona border % (*n*/*N*)	Transnational % (*n*/*N*)	*p*-Value
Daily immigration official sightings in community settings (non-US port entry)	84 (373/443)	86 (285/330)	24 (88/113)	0.037
Neighborhood	68 (334/489)	89 (312/349)	16 (22/140)	**0.000**
Worksite	59 (287/489)	58 (203/349)	60 (84/140)	0.761
Corner store	20 (98/489)	20 (71/349)	19 (27/140)	0.901
Supermarket	42 (204/489)	44 (152/349)	37 (52/140)	0.224
Public bus	14 (70/489)	15 (53/349)	12 (17/140)	0.475
Characteristics used by immigration officials to identify undocumented persons				
Clothing	78 (382/487)	82 (284/348)	71 (98/139)	**0.010**
Type of car	70 (338/486)	73 (252/347)	61 (86/139)	**0.022**
Mexican appearance	65 (317/485)	67 (234/347)	60 (83/138)	0.139
Foreign-looking	65 (318/486)	68 (235/347)	60 (83/139)	0.113
Skin color	64 (311/486)	64 (223/347)	63 (88/139)	0.835
Immigration detention experiences				
Local police questioned immigration status, last 24 months	9 (43/489)	10 (36/349)	5 (7/140)	0.076
Local police called immigration	6 (20/346)	6 (16/269)	5 (4/77)	1.0
Detained by immigration	3 (12/348)	4 (10/272)	3 (2/76)	1.0
Border community immigration stress scale (BCISS)a				
Military patrolling the border	32 (154/484)	31 (108/348)	34 (46/136)	0.588
Encounters with local police	23 (113/487)	23 (81/348)	23 (32/487)	1.00
Encounters with immigration officials	20 (99/484)	19 (66/347)	24 (33/137)	0.214
Reporting immigration encounters				
Should report negative encounter	97 (471/482)	99 (341/346)	96 (130/136)	0.082
Knows how to report	33 (161/487)	34 (117/347)	31 (44/140)	0.667

Boldface p values indicate p < 0.05 from Fisher exact tests.

[a]*Frequency of intensely reported stressors from the border community and immigration stress scale (BCISS).*

TABLE 3 | Summary of reasons to file a formal complaint of immigration-related mistreatment among Arizona and transnational farmworkers of Mexican descent.

	Illustrative quotes	
	Arizona farmworkers	**Transnational farmworkers**
Prevention of future mistreatment		
Prevent the abuse of others	Para evitar que vuelva a pasar una injusticia/to prevent an injustice from happening again	Para que ya no sigan abusando ni maltratando las personas/so they stop mistreating the people
Receive better treatment	Para evitar las injusticias para que no les pase lo mismo/to prevent injustice from happening so it does not happen	
	Para prevenir maltratos en el future/to prevent future abuse	
	Para que no nos sigan tratando mal a las personas/so they (immigration officals) will stop mistreating people	
	Para tener un mejor trato!/to be treated better!	
	Para ayudar a parar la discriminacion/To help stop discrimination	
	Para que nos trate mejor y seamos escuchados/so we are treated better and they listen to us	
Raise awareness of immigration-related mistreatment	Para dar a saber las cosas que estan pasando/to make people aware of things that are occurring	Para evitar las malos frutos/to eliminate the bad apples (immigration officals)
	De esa forma dariamos a saber el maltrato que se les da a las personas/through this (formal complaint) we make known the mistreatment that they (immigration officials) enact on the people	Para que las autoridades mas altas se den cuenta de las injusticias que cometen/as so the upper level immigration officals understand the injustices that are being committed
	Para que se enteren los superiores de lo que esta pasando/so that the leadership or supervisors (immigration officals) know what is occurring	
Encourage corrective action	Para que un oficial abusivo sea castigado/so an abusive officer will be punished	
	Para correjir el maltrato de los oficiales/to correct the abusive behavior of the officers	
	No deben permitir que se maltrate a las personas/maltreatment should not permitted	
	Para evitar las malos frutos/to remove the bad apples (immigration officials)	
Eliminate systems of discrimination	Para componer el sistema/to fix the system	Por injusticias por descriminacion/because of injustice and because of discrimination
	Para que no nos descriminen/so they (immigration officals) will stop discriminating us	Si no comete uno algo malo, no tienen por que tratarnos mal/if you have not done anything wrong then they (immigration officials) have no reason to treat you badly
	Para que haiga mas democracia en este lugar/so there is more democracy in this place'	Todas somas iguales; debemos ser tratados por igual/we are all equal and should be treated equally
	Para que se acabe toda la discriminacion/to stop the discrimination	
	Porque estan legales/because they [people being mistreated] are "legal" (authorized to be in the US)	
Protection and well-being		
Recognition of rights	Porque tenemos derechos si tengamos documentos o no/because we have rights, whether we have papers (US citizenship or legal permanent residency documents) or not	Tenemos derechos y hay que reclamarlos/we have rights and we must reclaim these rights
	Porque somos personas igual que ellos/because we are people just like them (immigration officials)	Por el humanismo; por que no debe haber injusticias/because of humanism, because there should not be such injustices
	Porque roban a la gente de sus derechos/because they (immigration officials) rob the people of their rights	Somos person/as y tambien tenemos derecho/we are people and we also have rights
	Tenemos los mismos derechos que un ciudadano/because we have the same rights as a US citizen	
	Todos somos legales somos humanos con los mismos derechos/because we are all authorized to be in the US with same rights (as any US citizen)	
	Porque nadie tiene derecho de maltratarte/because no one has the right to mistreat you	
Well-being of the individual and the collective community	Por el propio bien de uno/for ones own good	Por el bien de nosotros mismos/for the good of all of us

(continued)

TABLE 3 | Continued

	Illustrative quotes	
	Arizona farmworkers	**Transnational farmworkers**
Individual and community resistance	Para que nos escuchen y no se nos siga ignorando/so they (immigration authority) listen to us and stop ignoring us) Para que nos respecten mas; y debemos defender nuestros derechos/so they (immigration authorities) respect us and we should defend out rights Deberiamos hablar para defender nuestros derechos; no ser atropellados/we should speak up to defend our rights, and not be overtaken	Para que sepan que la gente sabe sus derechos/so they (immigration authority) know that the people know their rights Por que debemos quejarnos, todos somos iguales/because we should complain, because we are all equal
Mistreatment and abuse		
	Es algo illegal si se debe reporter/its illegal (mistreatment) and it should be reported	Abuso de autoridad/abuse of power
	Porque en ocaciones abusan de las personas y los intimidan/because on occasions immigration officials abuse the people and intimidate them	Por violencia, abusos verbales,falta de respeto, abuso fisico/because of violence, verbal abuse, lack of respect, and physical abuse

Fear came in many forms including fear of retaliation by immigration officials, fear of losing current immigration status, and fear of being deported (**Table 4**). Although a nuanced form of fear, other farmworkers described not filing a report because they wanted to avoid problems with officials, suggesting that by virtue of filing they may experience some form of investigation. Others expressed the sense that their complaint would not be taken seriously even if they reported it. The intensive work hours among farmworkers was also a deterrent from filing a report, as some farmworkers described not having enough time in the day to do so. This sense of not having enough time to file was often linked to the idea of wasting time in filing as if their complaint would not be acted upon.

Discussion

We show that in the border region, immigrants and migrants of Mexican descent with US permanent residence and citizenship feel vulnerable to being identified as "out of place" and, subsequently, the target of immigration enforcement. Immigration officials' presence was pervasive and not confined to the US port of entry but was experienced by participants in public spaces, including neighborhoods, worksites, and local markets. Arizona border and transnational immigrant and migrant farmworkers experience high levels of stress associated with encounters and or anticipated encounters with immigration officials. Furthermore, participants believed that these officials used personal characteristics to differentiate the population and identify individuals with an undocumented or "illegal" immigration status. We were unable to confirm our hypothesis, as there were only a few consistent differences between the two samples that would suggest that any one group would internalize "illegality" more or less than the other. Lack of difference between the two groups suggests that US immigration enforcement permeates the public spaces where both Arizona resident and transnational farmworkers conduct their lives constituting an imminent threat of state-sponsored violence to both of these authorized populations.

Most notable of the ways in which the two populations may internalize a sense of "illegality" or "undeservingness" for social protection from immigration-related discrimination and mistreatment is the high proportion of respondents reporting fear as the primary reason why they themselves or others in the community may not report immigration mistreatment. Immigration enforcement in the borderlands relies heavily not only on undocumented status but also on legal status as perceived through ethno-racial profiling of subjects. In the context of militarized border enforcement and the criminalization of immigration, the distinctions between rights-bearing subjects and those without any rights are blurred. While farmworkers indicate that they know their rights to file complaints and the positive potential of doing so (**Table 3**), their fears indicate that they do not believe their rights can protect them within the militarized climate of the border (**Table 4**). Permanent residents and citizens of Mexican descent internalize their subordinated racialized status, fearing that their legal status can be easily revoked if they file complaints of maltreatment by immigration officers or local police. Deportability – an essential dimension of "illegality" – is not only implicated in creating an exploitable workforce (5) but also is a key site of the production of state power and the ability of the US to govern its citizens and permanent residents (37). The social cost of the symbolic and material fortification of the border can be measured in its effects upon farmworkers' sense of exclusion and fear of losing "that which has been established," that is, their basic rights as residents and citizens. This study provides further evidence of the "spillover" effects of immigration enforcement onto groups who are not the target of immigration enforcement. The resulting biopsychological harm demonstrates how the current enforcement regime is detrimental to society (38).

Public Health Policy Implications and Future Research

As border security remains compulsory to the US immigration reform policy debate, and persuasive in public discourse, our study confirms that immigration policy and specifically those polices aimed at border enforcement is a structural determinant of health. Defined by the WHO Commission on Social Determinants of Health, structural determinants are those distal policy and systems levels phenomena that directly and indirectly affect the public's health (39, 40). Such structural determinants require large-scale political and social change. Institutional practices of discrimination within US immigration and border enforcement political systems

TABLE 4 | Summary of reasons not to file a formal complaint of immigration-related mistreatment among Arizona and transnational farmworkers of Mexican descent.

	Illustrative quotes	
	Arizona Farmworkers	Transnational Farmworkers
General fear		
Fear of retaliation	Por miedo a que tomen la queja en nuestra contra/for fear they (immigration officials) will use the complaint against us	Por miedo a que haiga represarios/for fear of retaliation
	Por miedo a en contrarse nuevamente con la persona que lo maltrato/for fear of encountering the person (immigration officer) who mistreated you	Por miedo a tener otro problema mas uno nunca sabe si al hacer una queja como te vaya/for fear of having one more problem because you do not know how making a complaint with effect you later
	Porque las personas tienen miedo a lo que pueda pasar despues no conocen las leyes/because the people are afraid of what could happen after (they make a complaint) because they do not know the law	Por miedo despes vayan a decir el nombre de quien los dijo relaliaton against person on his family/out of fear they (immigration officials) may say the name of the person who complained and they will retaliate against your family
	Por precaucion a lo que pueden hacer en contra de la familia (represalias)/out of precaution because of what could potentially happen to the family (retaliation)	
Fear of losing current immigration status	Por miedo a que les quiten los papeles/for fear they (immigration) will take away legal documents	Por miedo a perder su estatus migratorio/out of fear that you might lose your immigration status
	Por miedo a perder papeles o a ser ignorados/for fear of losing papers (legal immigration papers) or be ignored	
Fear of being deported	Por miedo a que los deporten/for fear of being deported	Por miedo a una deportacion/fear of being deported
	Por miedo, a que los detengan o los deporte/for fear that you will be detained and deported	
	Por miedo de que los manden para Mexico o que no los tomen en cuanta/for fear they will send you to Mexico or they will not take your complaint seriously	
Other themes		
Desire to avoid problems	Por miedo a enfrentarse a si mismo rasismo/for fear of confronting the same type of racism	Por miedo o simplemente no quiere uno meterse en problemas/for fear of simply not wanting to become involved in problems
Waist of time	El miedo a perder tiempo y papeles y dinero por dejar de trabajar/the fear of losing time, your papers, and money because you had to leave work	Por que nunca hacen nada las autoridades/because the authorities will never do anything
	Piensan que no se les va a hacer caso… como que no vale la pena/the people think that the immigration officals are not going to do anything and it is not worth making a complaint	Por miedo a que no hagan caso o no te tomen en cuenta/the fear of no one doing anything and not taking your complaint seriously
Not enough time	Por no perder el tiempo de trabajar y las vueltas que tendrian que dares/to not loose time at work with all the paperwork you will have to do	
	Por falta de tiempo; sale uno bien cansado y pensado que va a ser ignorado si va/Due to lack of time, you leave work so tired, and think you will be ignored if you go (to make a complaint)	
Rights	Por miedo por pensar que no tiene el derecho de reclamar/the fear that one thinks they do not have the right to complain Porque las personas no se sienten con el valor de hacerlo/because people may not have the courage to make a complaint	Porque si uno no ha hecho nada incorrecto y tiene sus documentos en regla las autoridades no deben de maltratara las personas/because if one has not done anything wrong and you have your papers in order the authorities should not be mistreating people

have only recently emerged as determinants of health inequality (41) and few studies have linked these experiences to poor mental health outcomes (33). Broadly, restrictive or punitive immigration policies are known to limit access to health and social services (42, 43), education opportunities, and adequate employment remuneration (41, 44). In Arizona, anti-immigrant policies have been documented to limit mobility among Mexican immigrants to engage in normal activities and create fear of accessing health and social services among the population (43).

Our study provides strong evidence for the Department of Homeland Security (DHS) to enact and enforce policies that benefit public health, such as; (1) articulate and make transparent CBP training, oversight, investigation protocols, and the disciplinary actions taken against CBP officers and local police who breach their scope when enforcing immigration law (20, 45); (2) create a transparent, community-centered oversight system to document and monitor immigration-related victimization, including corruption and excessive use of force by CBP and local

police enacting immigration law; (3) develop an accountability plan by CBP and local law enforcement to systematically report and respond to community concerns of corruption and excessive use of force.

Participatory action research that fully engages affected border communities is necessary to monitor immigration-related victimization and locate the points of community and policy-level intervention to decrease victimization within border communities. The Southern Border Communities Coalition's, "Revitalize, Not Militarize" is one example of a grassroots effort in which border community members have mobilized to reframe the issue of border security as an issue of economic development. Calling for investment in all border communities to improve the quality of life of the region and trade between the US and Mexico, the campaign engages a multi media platform for border residents to share their testimonies, monitor immigration-related mistreatment, and civil and human rights abuses and advocate at state and national levels for oversight and accountability by the Department of Homeland Security and Customs and Border Patrol Agents (46). Such community-driven campaigns linked to advocacy can contribute to empowerment of affected communities and have the potential to begin to repair the detrimental effects of immigration-related structural vulnerability, which includes the internalization and normalization of such violence.

Limitations and Strengths

This study may not be generalizable to non-border communities; study participants may be more likely to be in frequent contact with immigration authorities compared to those individuals in non-border communities. These results may also underestimate the prevalence of immigration-related mistreatment and associated stress in highly militarized and policed communities, as those individuals with an undocumented immigration status may be less likely to participate. Data are self-report and the potential for social desirability may also contribute to over or under estimation of mistreatment experiences. The CBPR approach, however, contributed to the overall strength of the study, specifically, in survey development, data collection, and the validity of the study constructs to community identified health issues. Study partners were uniquely embedded in the community, and shared many of the cultural and immigration trajectories of study participants thus giving UA researchers invaluable insight and access to a highly vulnerable population. This historical and trusting relationship between University researchers and study partner agencies, and the utilization of *Promotoras* as primary data collectors contributed to increased cultural salience of sampling procedures, survey instrument development and implementation as evidenced by a 93% response rate and limited missing data in the household survey data.

Conclusion

US citizens and permanent residents of Mexican descent living in the border region experience frequent encounters with immigration officials in public spaces at almost equal rates. These encounters are not confined to the point of entry. Anticipation of such encounters is experienced as intense stressors. Moreover, the primary reason for not reporting immigration-related abuse or mistreatment is fear and specifically the fear of losing existing immigration status. Such mistrust in the system and fearing retaliation by the state is evidence of a population who has potentially normalized mistreatment as a form of coping in the face of a broken system in which justice and retribution could only occur at a cost. Multi-institutional and community-centered systems for reporting and mitigating immigration-related victimization are required. Applied participatory research with affected communities can mitigate the public health effects of state-sponsored immigration discrimination and violence.

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Racial/ethnic and socioeconomic disparities in mental health in Arizona

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Background: Mental health issues are a rapidly increasing problem in the US. Little is known about mental health and healthcare among Arizona's Hispanic population.

Methods: We assess differences in mental health service need, mental health diagnoses, and illicit drug use among 7,578 White and Hispanic participants in the 2010 Arizona Health Survey.

Results: Prevalence of mild, moderate, or severe psychological distress was negatively associated with SES among both Whites and Hispanics. Overall, Hispanics were less likely than Whites to have been diagnosed with a mental health condition; however, diagnosis rates were negatively associated with SES among both populations. Hispanics had considerably lower levels of lifetime illicit drug use than their White counterparts. Illicit drug use increased with SES among Hispanics but decreased with SES among Whites. After adjustment for relevant socio-demographic characteristics, multivariable linear regression suggested that Hispanics have significantly lower Kessler scores than Whites. These differences were largely explained by lower Kessler scores among non-English proficient Hispanics relative to English-speaking populations. Moreover, logistic regression suggests that Hispanics, the foreign born, and the non-English language proficient have lower odds of lifetime illicit drug use than Whites, the US born, and the English-language proficient, respectively.

Conclusion: The unique social and political context in Arizona may have important but understudied effects on the physical and mental health of Hispanics. Our findings suggest mental health disparities between Arizona Whites and Hispanics, which should be addressed via culturally- and linguistically tailored mental health care. More observational and intervention research is necessary to better understand the relationship between race/ethnicity, socioeconomic status, healthcare, and mental health in Arizona.

Keywords: Hispanic, disparities, drug use, mental health, nativity

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Introduction

Mental health issues are a rapidly increasing problem in the US. The US Department of Health and Human Services defines mental health conditions as characterized by persistent, abnormal alterations in thinking, mood, or behavior associated with distress and impaired functioning (1). Over 24% of the American population lives with a diagnosed mental health condition, and over 45% will experience at least one diagnosable condition in their lifetime (2).

Some adults who suffer from mental health conditions meet diagnostic criteria for serious mental illness (SMI). SMI refers to adults who currently or at any time during the past year have a diagnosable mental, behavioral, or emotional disorder that has resulted in *functional impairment that limits major life activities*. Major depression, bipolar disorder, and schizophrenia are among conditions that typically meet this definition. The annual costs associated with SMI are estimated to be in excess of $300 billion as of 2012, excluding the cost attributable to physical health comorbidities (3). The National Survey on Drug Use and Health (NSDUH) found that there were estimated 9.6 million US adults aged 18 or older in the U.S. with a SMI in 2012. American Indian/Alaskan Natives (8.5%) suffer from the highest prevalence of SMI, followed by Hispanics (4.4%) Whites (4.2%), and African Americans (3.4%) (4).

The prevalence mental health conditions are comparable between Hispanic and Whites; however, 18% of Whites use mental health services compared to just 7% of Hispanics (4). Estimates suggest that over 11 million adults aged 18 or older have an unmet need for mental health care (4). Access and use of mental health services is related to household poverty, living in impoverished neighborhoods, and lack of insurance or sufficient money to pay for necessary services (5–9). However, while lack of economic resources are a factor, Ojeda et al. found that service use among Hispanics is also affected by social barriers (e.g., stigma) (10). Furthermore, Hispanics that live in poor neighborhoods have less access to mental health services than their White counterparts (5, 11). Nevertheless, even when services are readily available, they often are not culturally or linguistically appropriate (6), and Hispanic patients are less likely to obtain adequate care when compared to their non-Hispanic counterparts (12). This phenomenon has been attributed to unavailability of Spanish language services (13), the lack of interpreters (6), scarcity of culturally competent service providers (6), and perceived discrimination (11). While many studies have found that those who do not speak English have lower probabilities of receiving needed services, an even more dramatic relationship was found between non-English speaking Hispanics and English-only Hispanics (14). Moreover, an even greater gap was found between non-English speaking Hispanic immigrants compared to US-born English-speaking Hispanics (15).

Hispanics make up 16.9% of the national population and 30.2% of the population of the state of Arizona (16). Projections suggest that the Hispanic population will double in the next 40 years and that by 2050 one in every three people living in the US will be Hispanic (16, 17). The large growth of the Hispanic population, coupled with its disproportionate burden of mental health issues and poor access to mental health services, underscores the need to identify proactive, comprehensive solutions. Thus, it is critical to understand the prevalence of diagnosed and undiagnosed mental health conditions, and access and use of mental health services among Hispanics. Because of the dire effects of mental health conditions, a first step toward developing effective strategies to improve mental health services among Hispanics is to further understand the extent and nature of disparities faced by this population. Moreover, it is imperative that the health of the Hispanic population in the state of Arizona, specifically, is further explored due explicitly to the sociopolitical implications of its proximity to the US–Mexico border, which have been found to have a detrimental impact on mental and physical health outcomes (18, 19).

In this study, our objectives are to (1) assess need, access, and utilization of mental health services as well as illicit drug use among Hispanic and White adults in Arizona, (2) assess whether disparities in mental health and illicit drug use are explained by socio-demographic, acculturative, and economic differences between Hispanic and White adults in Arizona.

Conceptual Framework

We present the conceptual framework that guides our analyses in **Figure 1**. As per previous studies (4–15) we posit that there is a relationship between race/ethnicity and mental health. Specifically, literature suggests that there are Hispanic–White disparities in need, access, and use of mental health services and substance abuse (4–6, 8–15). Since previous studies have documented a relationship between age, marital status, and behavioral health (1–3), we further posit that a portion of these disparities can be explained by demographic differences between the Hispanic and White populations. Furthermore, the acculturation literature has documented different risk profiles between US-born, more acculturated Hispanics and their foreign-born, less acculturated counterparts (20–25). Therefore, it is also important to understand whether Hispanic–White disparities are explained by nativity and factors related to acculturation (e.g., language use). We further posit that the comparatively lower socioeconomic status of Hispanics places them at increased risk of behavioral health issues relative to Whites. Our final (exploratory) hypothesis is that socioeconomic status may moderate the relationship between race/ethnicity and behavioral health. Specifically, we believe that Hispanics' behavioral health risk will vary based on SES through a number of potential (but unspecified) pathways. For example, low-income Hispanics frequently live in "ethnic enclaves" with high levels of social cohesion and social support, which may act as a buffer against a range of negative physical and mental health

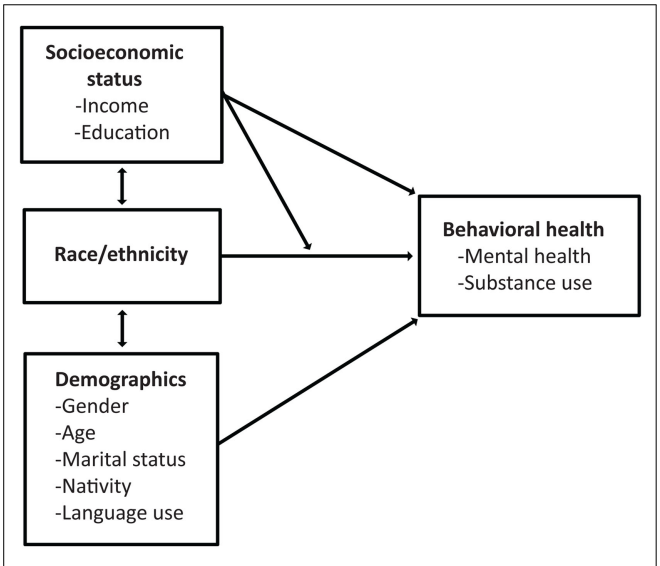

FIGURE 1 | Conceptual framework.

consequences (26, 27). Literature also shows differences in the benefits of educational attainment based on race/ethnicity, specifically showing that African Americans and Hispanics may see greater benefits from educational attainment that non-Hispanic Whites (28, 29).

Materials and Methods

Data Source

Data for this study are from the second wave of the Arizona Health Survey (AHS), conducted from May through August of 2010. The AHS was designed to collect data on a range of indicators, including physical and mental health status, health-related behaviors, insurance coverage, and access to services. In brief the AHS was a population-based, list-assisted random-digit-dial telephone survey representative of the Arizona population living in households (30). Researchers selected residential telephone numbers from six geographic strata defined by counties or groups of counties. One adult respondent (age 18 and over) was selected from each household (30). In households with children (age 6 and under), one child was randomly selected and the adult most knowledgeable about the child's health completed a child interview (30). Samples were selected to obtain at least 8,100 (although 8,215 were collected) adult interviews and 2,000 child interviews (30). AHS data are de-identified and publicly available. Secondary analysis of these data therefore does not constitute human subjects research as defined by federal regulations and does not require IRB review. Further details regarding the AHS study design and data collection are available elsewhere (30).

Sample

The 2010 AHS included 8,215 adult respondents (30). For this study, we restricted our analyses to 7,578 White ($n = 6{,}022$) and Hispanic ($n = 1{,}556$) participants. Black or African American ($n = 216$), Asian/Pacific Islander ($n = 99$), Native American/American Indian ($n = 243$), and a small fraction ($n = 79$) of participants who refused to divulge race/ethnicity information were not included because our primary aim was to assess Hispanic–White disparities in mental health and drug use. Additionally, we further restricted our multivariable analyses to the subsample of participants with complete information about age, marital status, income, education, illicit drug use, mental health diagnosis, nativity, and English-language proficiency resulting in a multivariable analytic sample of $n = 6{,}503$.

Measures

We assessed mental health service need using the Kessler K6 measure of psychological distress. The K6 has been validated for identification of current mental health problems and need for treatment (31, 32). The K6 consists of six questions about anxiety and depressive symptoms that a person has experienced in the most recent 30-day period (31, 32). For example, "During the past 30 days, about how often did you feel hopeless?" Each question is assessed on the following scale: 0 = none of the time, 1 = a little of the time, 2 = some of the time, 3 = most of the time, 4 = all of the time. All six questions are mandatory and total response scores can range from 0 (indicating no distress) through 24 (indicating severe distress) (31, 32). According to K6 diagnostic criteria, participants scoring from 0–6 (low range) are likely to be healthy but may benefit from early education-based prevention in order to prevent future mental health issues (31, 32). Participants that score 7–14 (mid range) are likely to have mild to moderate mental health disorders and are encouraged to access information and self-help treatment programs (31, 32). Participants that score between 15 and 24 (high range) are likely to have a severe mental health disorder and are encouraged to seek immediate help from a mental health professional (31, 32). We assessed mental health diagnoses based on participant self-report of diagnosis of bipolar or manic-depressive disorder, anxiety disorder, and clinical depression rates. Illicit drug use was assessed through self-reported lifetime illicit drug use, illicit drug use in the previous 12 months, and in the last 30 days. However, 12-month and 30-day drug use data yield insufficient power to examine between-group disparities, because if participants reported to never have used drugs, omitted questions about more recent drug created a skip pattern that resulted in a small prevalence of self-reported recent drug use. As a result, we elected to use lifetime drug use data. Marijuana, cocaine, crack cocaine, heroin, and methamphetamines were considered illicit drugs for this analysis. We categorized participants' race/ethnicity as Hispanic or White. Federal Poverty Limit (FPL) is a combined measure of household income and family/household size (30). Federal poverty guidelines stipulate that a family of four living on a household income under $24,250 lives in a state of poverty (33). FPL was defined based on the following categories present in the AHS data file:<100% FPL, 100–199% FPL, 200–299% FPL, and ≥300% FPL. We categorized marital status as married, single, and widowed/separated/divorced. We separated educational attainment into less than high school, high school/equivalent, and more than high school. We also categorized English language proficiency as (1) native speaker or speaks very well, (2) speaks well, (3) not well, and (4) not at all. Lastly, nativity was categorized into US born and foreign born.

Statistical Analyses

We present means and 95% confidence intervals of all continuous variables and the percentage distribution of all categorical variables. We use conditional means and cross-tabulation to assess whether mental health outcomes and illicit drug use vary by race/ethnicity (i.e., Hispanic vs. White). We use t-tests to assess the statistical significance of variation across groups. We use multivariable regression models to examine the relationship between race/ethnicity and behavioral health outcomes. For each outcome (i.e., Kessler K6 scores and self-reported lifetime drug use), we present a series of four regression models. Consistent with our conceptual framework, we conduct "stepwise" analyses whereby additional sets of explanatory variables are added to each subsequent model. In the first model for each outcome, we adjust for race/ethnicity and demographic factors that vary between Hispanics and Whites (i.e., gender, age, and marital status). In the second model, we further adjust for socioeconomic characteristics (i.e., household income, measured as a percentage of FPL, and educational attainment). In the third model, we further adjust for English language proficiency and nativity to understand the extent to which Hispanic–White disparities that remain after adjustment

for other factors may be attributable to nativity and acculturation. In the fourth model, we include an interaction between race/ethnicity and household income to assess whether Hispanics' level of behavioral health risk varies across income strata. In the final model, we include an interaction between race/ethnicity and educational attainment to assess whether Hispanic's level of behavioral health risk varies by educational attainment level.

The outcome in the multivariable linear regression models is the square root of the Kessler K6 score. We use the square root because the K6 is right tailed and violates the normality assumption of linear regression; using the square root transformation results in a more normally distributed outcome. We elected not to use the 12-month and 30-day drug use data because the number of self-reported drug use in the last 12 months and 30 days, respectively, yields insufficient power to examine between-group disparities. To account for non-response, probability of selection, and the complex survey design, we used weights present in the AHS data file. All data analyses were conducted using STATA 13 (34).

Results

Table 1 contains demographic characteristics for the 1,480 Hispanic and 4,590 White participants in the sample. Hispanic respondents were significantly ($p < 0.001$) younger than White respondents. Over 75% of Hispanic respondents were under the age of 50 compared to 51% of Whites. Nearly 25% of Hispanic respondents were single compared to 15% of Whites ($p = 0.002$). Only 10% of Whites lived below the 100% FPL compared to 33% of Hispanics ($p < 0.001$). Over 55% of Whites lived above the 300% FPL while only 21% of Hispanics fell into the same category ($p < 0.001$). Approximately 95% of Whites were born in the US compared to 44% of Hispanics ($p < 0.001$). Nearly all Whites considered English to be their primary language compared to only 36% of Hispanics ($p < 0.001$). Finally while nearly all Whites were native speakers or speak English *very well,* only 49% of Hispanic respondents reported that they speak English *very well* ($p < 0.001$). No significant differences were found in the gender distribution of the two populations.

Table 1 also includes measures of psychological distress, mental health diagnosis, and self-reported lifetime use of illegal substances. There were differences in calculated K6 scores, diagnosis rates, and illicit drug use between Hispanics and Whites ($p = 0.022$). Nearly 76% of Whites reported a low K6 score compared to 69% of Hispanics. The mild/moderate/severe K6 score was also higher for Hispanics at 26% compared to 20% for Whites. *Severe* K6 score was similar for both populations. Hispanics had significantly lower rates of mental health diagnosis at 13% compared to Whites at nearly 18% ($p = 0.014$). Hispanics had lower rates of lifetime illicit drug use than Whites ($p < 0.001$). Hispanics also had lower rates of illicit drug use in the last year at 15% compared to nearly 30%. However, Hispanics had slightly higher use within the last month compared to Whites ($p < 0.001$).

Table 2 shows measures for psychological distress, mental health diagnosis and self-reported lifetime use of illegal substances stratified by FPL. When stratified by FPL, prevalence of K6 scores indicating mild/moderate/severe psychological distress decreased along with increased FPL for both populations. Hispanics improved from 38.74% when under the 100% FPL to 19.87% at or above 300% FPL ($p = 0.003$). Whites improved from 42.64% at under the 100% FPL to 16.89% when living at or above 300% FPL ($p < 0.001$). While Hispanics had lower rates of mental health diagnosis across all FPL levels when compared to Whites, diagnosis decreased along with increased FPL for both populations. Diagnosis rates for Hispanics decreased by nearly half, rising from 15% when living below the 100% FPL to 8% when living at or above the 300% FPL ($p = 0.103$). Similar trends are seen for Whites that went from nearly 29% while under 100% FPL to 14% at or above 300% FPL ($p < 0.001$). When living under the 100% FPL Hispanics have considerably lower levels of lifetime illicit drug use than their White counterparts at 8% compared to nearly 42%. However, illicit drug use levels change along with FPL. Hispanics show an increase from 8% at <100% FPL to 36% ($p < 0.001$) when living at or above the 300% FPL, while Whites decreased from nearly 42% at <100% FPL to 35% ($p = 0.205$) at 300%+.

Table 3 includes the results of five multivariable linear regression models that assess the relationship between race/ethnicity and the square root of the Kessler score after adjustment for gender, age, and marital status (Model 1), adjustment for family income and educational attainment (Model 2), further adjustment for nativity and English language proficiency (Model 3). The fourth model includes interaction terms between race/ethnicity and household income. The final model includes interaction terms between race/ethnicity and educational attainment. Model 1 suggests that after adjustment for gender, age, and marital status, there is no significant relationship between race/ethnicity and Kessler score. After further adjustment for their comparatively lower levels of income and education, however, Model 2 indicates that Hispanics have significantly lower Kessler scores than Whites ($p < 0.01$). Model 3 suggests that lower Kessler scores among Hispanics could be explained by differences in English language proficiency between Hispanics and Whites. The fourth model reveals that Kessler score decreases with age ($p < 0.001$), is greater among the widowed/divorced/separated than among the married ($p < 0.001$), and decreases with household income ($p < 0.001$) and participants' educational attainment ($p < 0.01$). However the fourth model does not reveal a significant effect of the interaction between race/ethnicity and family income. Moreover, the final model does not reveal a significant effect of the interaction between race/ethnicity and educational attainment. Finally, we assessed the *variance inflation factor* to test for variables that may introduce multicollinearity (i.e., English language proficiency, nativity) and found that all variance inflation factors were below 2.30 and were not a cause for concern.

Table 4 includes the results of five multivariable logistic regression models that assess the relationship between race/ethnicity and lifetime illicit drug use. The first three models include the same sets of covariates as presented in the previous table. The fourth model adjusts for all covariates, but also includes interaction terms to assess whether the relationship between household income and illicit drug use varies between Hispanics and Whites. The fifth model also adjusts for all covariates, and includes interaction terms to assess whether the relationship between educational attainment and illicit drug use varies between Hispanics and

TABLE 1 | Demographic characteristics, mental health indicators, diagnosis rates, and illicit drug use of White and Hispanic respondents of the 2010 Arizona health survey ($n = 6,070$).

	White		Hispanic		*p*
	%	95% CI	%	95% CI	
Gender					0.782
Female	48.93	[46.52, 51.34]	49.68	[44.95, 54.42]	
Male	51.07	[48.66, 53.48]	50.32	[45.58, 55.05]	
Age					<0.001
<39	33.77	[31.07, 36.58]	52.62	[47.95, 57.24]	
40–49	17.43	[15.73, 19.26]	22.48	[19.11, 26.20]	
50–59	18.48	[16.97, 20.09]	14.52	[11.98, 17.50]	
60–69	15.13	[13.96, 16.38]	6.10	[4.73, 7.85]	
70–79	9.10	[8.34, 9.93]	3.38	[2.60, 4.39]	
80+	6.09	[5.44, 6.81]	0.89	[0.50, 1.43]	
Marital					0.002
Single	15.40	[13.18, 17.91]	19.96	[15.99, 24.63]	
Married	67.38	[64.92, 69.74]	69.29	[64.60, 73.62]	
Wid/div/sep	17.23	[15.81, 18.74]	10.74	[8.61, 13.33]	
Living in poverty					<0.001
Below 100% FPL	10.58	[8.90, 12.53]	33.47	[29.16, 38.07]	
100–200% FPL	16.70	[14.99, 18.57]	28.74	[24.47, 33.41]	
200–300% FPL	16.89	[15.20, 18.73]	15.90	[12.53, 19.97]	
More than 300%	55.82	[53.38, 58.24]	21.90	[18.56, 25.65]	
US-born	94.58	[93.27, 95.65]	44.24	[39.70, 48.88]	<0.001
Primary language					<0.001
English	96.93	[95.83, 97.75]	36.31	[32.08, 40.75]	
Spanish	1.02	[0.64, 1.62]	63.15	[58.69, 67.41]	
English language prof.					<0.001
Native/very well	98.53	[97.62, 99.10]	49.54	[44.81, 54.27]	
Well	0.46	[0.24, 0.85]	14.12	[11.15, 17.73]	
Not well	0.68	[0.28, 1.61]	24.45	[20.36, 29.05]	
Not at all	0.34	[0.14, 0.78]	11.89	[8.81, 15.87]	
Kessler K6					0.022
Low	75.68	[73.47, 77.76]	69.73	[65.15, 73.94]	
Mild/moderate	20.83	[18.84, 22.97]	26.46	[22.35, 31.02]	
Severe	3.49	[2.76, 4.41]	3.81	[2.74, 5.28]	
Diagnosed mental health condition					0.014
Diagnosed	17.97	[16.24, 19.84]	13.28	[10.56, 16.58]	
Last illicit drug use					<0.001
Never	64.97	[62.52, 67.34]	80.10	[76.33, 83.40]	
>12 Months	29.31	[27.07, 31.65]	15.59	[12.78, 18.88]	
Within last year	3.02	[2.17, 4.20]	1.39	[0.74, 2.58]	
Within last 30 days	2.70	[1.92, 3.79]	2.92	[1.52, 5.56]	
Sample size	6,022		1,556		

TABLE 2 | Kessler score, mental health diagnosis, and illicit drug use by race/ethnicity and federal poverty limit (FPL) of White and Hispanic respondents of the 2010 Arizona health survey ($n = 6,070$).

Hispanic/White	FPL	Kessler K6 score mild/mod/severe		*p*	Diagnosed with any behavioral health condition		*p*	Ever use Illicit drugs		*P*
		%	[95% CI]		%	95% CI		%	95% CI	
Hispanic	<100%	38.74	[31.16, 46.91]	Ref.	15.49	[10.64, 22.02]	Ref.	8.45	[5.57, 12.60]	Ref.
	100–199%	29.92	[22.16, 39.03]	0.143	11.93	[7.82, 17.79]	0.351	15.92	[10.87, 22.74]	0.025
	200–299%	27.41	[17.95, 39.47]	0.144	18.44	[11.28, 28.68]	0.568	28.63	[18.87, 40.89]	<0.001
	300%+	19.87	[12.88, 29.36]	0.003	7.99	[3.80, 16.01]	0.103	36.26	[28.07, 45.33]	<0.001
White	<100%	42.64	[33.92, 51.84]	Ref.	28.98	[22.33, 36.67]	Ref.	41.94	[32.80, 51.68]	Ref.
	100–199%	34.79	[29.28, 40.75]	0.148	20.59	[16.69, 25.13]	0.041	30.50	[25.27, 36.29]	0.038
	200–299%	27.09	[22.25, 32.55]	0.003	21.42	[17.12, 26.44]	0.076	34.33	[28.72, 40.41]	0.178
	300%	16.89	[14.63, 19.41]	<0.001	14.06	[11.94, 16.48]	<0.001	35.60	[32.63, 38.69]	0.205

TABLE 3 | Linear regression models predicting the square root of the Kessler K6 score of Hispanic and White adults in the 2010 AHS ($n = 6,070$).

	(1) b [95% CI]	(2) b [95% CI]	(3) b [95% CI]	(4) b [95% CI]	(5) b [95% CI]
Race/ethnicity					
White	Ref.	Ref.	Ref.	Ref.	Ref.
Hispanic	0.0205	−0.128**	−0.0357	0.049	−0.186
	[−0.0681, 0.109]	[−0.229, −0.0263]	[−0.142, 0.070]	[−0.194, 0.293]	[−0.419, 0.048]
Female	0.0636	0.057	0.0579	0.057	0.063
	[−0.004, 0.131]	[−0.009, 0.124]	[−0.008, 0.123]	[−0.008, 0.122]	[−0.003, 0.127]
Age (y)	−0.0094***	−0.00887***	−0.0087***	−0.009***	−0.009***
	[−0.0112, −0.0073]	[−0.0109, −0.0067]	[−0.011, −0.0066]	[−0.011, −0.007]	[−0.011, −0.006]
Married	Ref.	Ref.	Ref.	Ref.	Ref.
Single	0.0083	−0.0213	−0.0401	−0.038	−0.044
	[−0.104, 0.121]	[−0.136, 0.094]	[−0.153, 0.073]	[−0.15, 0.073]	[−0.156, 0.068]
Wid/div/sep	0.310***	0.228***	0.205***	0.204***	0.201***
	[0.214, 0.406]	[0.132, 0.322]	[0.109, 0.299]	[0.109, 0.299]	[0.107, 0.295]
Household income (% FPL)					
≤100%		Ref.	Ref.	Ref.	Ref.
101–200%		−0.0927	−0.116	−0.075	−0.108
		[−0.233, −0.048]	[−0.255, −0.023]	[−0.261, 0.11]	[−0.245, −0.290]
201–300%		−0.113	−0.159*	−0.115	−0.156*
		[−0.272, −0.045]	[−0.317, −0.016]	[−0.308, −0.078]	[−0.310, −0.002]
>300%		−0.318***	−0.361***	−0.322***	−0.353***
		[−0.457, −0.179]	[−0.501, −0.221]	[−0.494, −0.15]	[−0.49, −0.215]
Education					
<High school		Ref.	Ref.	Ref.	Ref.
High school		−0.0872	−0.164*	−0.166*	−0.276**
		[−0.235, 0.0602]	[−0.310, 0.018]	[−0.311, −0.021]	[−0.481, 0.015]
>High school		−0.158*	−0.236**	−0.239***	−0.313**
		[−0.302, −0.0134]	[−0.381, −0.091]	[−0.383, −0.094]	[−0.500, −0.118]
Foreign born			−0.091	−0.091	−0.09
			[−0.229, −0.046]	[−0.218, 0.183]	[−0.227, 0.071]
English language					
Native/very well			Ref.	Ref.	Ref.
well			−0.01	−0.025	−0.019
			[−0.215, −0.195]	[−0.133, 0.183]	[−0.227, 0.188]
Not well			−0.14	−0.163	−0.122
			[−0.364, 0.083]	[−0.389, 0.064]	[−0.342, 0.098]
Not at all			−0.39**	−0.418**	−0.342**
			[−0.655, −0.126]	[−0.686, −0.149]	[−0.613, −0.071]
Interaction terms					
Hispanic* 101–200%				−0.088	
				[−0.356, 0.180]	
Hispanic* 201–300%				−0.115	
				[−0.426, 0.194]	
Hispanic* >300%				−0.107	
				[−0.382, 0.167]	
Hispanic* high school					0.258
					[−0.015, 0.531]
Hispanic* >high school					0.132
					[−0.127, 0.392]
Constant	2.43***	2.77***	2.877***	2.848***	2.94***
	[2.286, 2.583]	[2.55, 2.99]	[2.667, 3.089]	[2.602, 3.09]	[2.696, 3.196]

*95% confidence intervals in brackets. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.*

Whites. The results presented in Model 1 suggest that, after adjustment for gender, age, and marital status, Hispanics are much less likely than Whites to have used illicit substances in their lifetimes. This relationship endures after further adjustment for income and educational attainment (Model 2), but is attenuated after further adjustment for nativity and English language proficiency (Model 3). However, adjustment in model 3 suggests that Hispanics ($p < 0.05$) the foreign-born, ($p < 0.001$), and the non-English proficient ($p < 0.001$) have lower odds of illicit drug use when compared to Whites, the US-born, and the English language proficient, respectively. Interestingly, the household income odds ratios in Model 4 suggest that there is no significant relationship between household income and illicit drug use among Whites; however, the interaction terms suggest that illicit drug use increases with

TABLE 4 | Logistic regression models predicting lifetime illicit drug use among Hispanic and White adults in the 2010 AHS.

	(1) OR [95% CI]	(2) OR [95% CI]	(3) OR [95% CI]	(4) OR [95% CI]	(5) OR [95% CI]
Race/ethnicity					
White	Ref.	Ref.	Ref.	Ref.	Ref.
Hispanic	0.359***	0.399***	0.786	0.331***	0.444*
	[0.275, 0.469]	[0.293, 0.544]	[0.581, 1.06]	[0.169, 0.649]	[0.222, 0.888]
Female	0.612***	0.623***	0.613***	0.615***	0.616***
	[0.504, 0.743]	[0.513, 0.758]	[0.504, 0.746]	[0.506, 0.747]	[0.507, 0.748]
Age	0.972***	0.971***	0.972***	0.971***	0.971***
	[0.966, 0.978]	[0.964, 0.977]	[0.966, 0.978]	[0.965, 0.9778]	[0.966, 0.977]
Marital status					
Married	Ref.	Ref.	Ref.	Ref.	Ref.
Single	0.731	0.746	0.655*	0.655*	0.649*
	[0.511, 1.045]	[0.515, 1.07]	[0.455, 0.945]	[0.455, 0.941]	[0.451, 0.933]
Wid/div/sep	1.271*	1.391**	1.234	1.235	1.217
	[1.001, 1.601]	[1.109, 1.77]	[0.981, 1.573]	[0.964, 1.582]	[0.950, 1.561]
Household income (% FPL)					
≤100%		Ref.	Ref.	Ref.	Ref.
101–200%		1.067	0.95	0.749	0.963
		[0.679, 1.369]	[0.635, 1.42]	[0.466, 1.204]	[0.642, 1.444]
201–300%		1.476*	1.13	0.872	1.131
		[0.926, 1.918]	[0.754, 1.69]	[0.545, 1.395]	[0.756, 1.689]
>300%		1.627**	1.27	0.99	1.277
		[1.040, 2.36]	[0.871, 1.697]	[0.649, 1.52]	[0.878, 1.858]
Education					
<High school		Ref.	Ref.	Ref.	Ref.
High school		1.032	0.685	0.693*	0.564*
		[0.696, 1.356]	[0.453, 1.035]	[0.458, 1.047]	[0.340, 0.934]
>High school		0.909	0.604**	0.609**	0.498**
		[0.611, 1.35]	[0.404, 0.903]	[0.409, 0.908]	[0.306, 0.81]
Foreign born			0.388***	0.392***	0.387***
			[0.243, 0.619]	[0.245, 0.625]	[0.243, 0.615]
English language					
Native/very well			Ref.	Ref.	Ref.
Well			0.537	0.624	0.583
			[0.257, 1.126]	[0.296, 1.32]	[0.285, 1.189]
Not well			0.212**	0.278**	0.258*
			[0.078, 0.575]	[0.099, 0.734]	[0.094, 0.701]
Not at all			0.02***	0.026***	0.027***
			[0.005, 0.099]	[0.006, 0.13]	[0.006, 0.128]
Interaction terms					
Hispanic* 101–200%				2.417*	
				[1.101.5.73]	
Hispanic* 201–300%				2.815**	
				[1.214, 6.526]	
Hispanic* >300%				2.949**	
				[1.36, 6.395]	
Hispanic* high school					1.88
					[0.826, 4.28]
Hispanic* >high school					2.016
					[0.937, 4.335]

*95% confidence intervals in brackets. *p < 0.05; **p < 0.01; ***p < 0.001.*

household income among Hispanics. For example, Hispanics with annual household income >300% FPL have nearly three times the odds of having ever used illicit substances relative to those with income ≤100% FPL ($p < 0.001$). The final model does not uncover a significant effect of the interaction between race/ethnicity and educational attainment. Finally, we also assessed the variance inflation factor to test for variables that may introduce multicollinearity (i.e., English language proficiency, nativity) and found that all variance inflation factors were below 2.31 and were not a cause for concern.

Discussion

We found that although mental health diagnosis rates for Hispanics were lower, more Hispanics reported a higher K6 score than their White counterparts, which may indicate a disproportionate

and unmet need for mental healthcare services. Our findings are consistent with the literature showing that Hispanics face an unmet need for mental healthcare services that is more than double that of their White counterparts (6, 8, 9). Moreover, high psychological distress that does not manifest itself into proportionately high diagnosis rates can also mean that there is an underutilization of services by Hispanic respondents. This is also consistent with research showing that, even when services are readily accessible, Hispanics have lower mental health service utilization rates than Whites (6, 10, 13).

Among both Hispanics and Whites, K6 scores were negatively associated with household income. Our findings suggest that low psychological distress and good mental health may be positively associated with increases in socioeconomic position, which is consistent with findings in the available literature (6, 7). Moreover, research has also shown that foreign-born Hispanics are at significantly lower risk for psychiatric morbidity than US-born Whites (24), which is also consistent with our findings showing better K6 scores for foreign-born Hispanics than US-born Hispanics and US-Born Whites. Furthermore, research also suggests that acculturation among Hispanics is associated with an increase in the prevalence of psychiatric disorders and illicit drug use (20, 24). Although the mechanism through which acculturation affects mental health is understudied, researchers have posited that Hispanic culture may be protective and exposure to and adoption of some elements of U.S. culture may have detrimental effects on psychiatric morbidity (25).

Hispanic participants in our study reported lower rates of lifetime and current use of illicit substances than their White counterparts. This is consistent with the research showing that the prevalence of illicit drug use is lower among US Hispanics than Whites (35–37). While high-income Whites report slightly less illicit drug use than low-income Whites, the prevalence of lifetime illicit drug use is three times higher among Hispanics in the highest income stratum relative to those in the lowest. The drastic increase in illicit drug use for Hispanics indicates that increased income may be associated with potential risk factors for illicit drug use. However, studies suggest that foreign-born Hispanics are at significantly lower risk for illicit drug use than US-born Whites (25, 26), which is also consistent with our findings showing that nativity may be a protective factor for Hispanics. Hispanic and other ethnic identification has been associated with decreased illicit drug use (26). Other research has shown that close social networks and family ties are also a protective factor against illicit drug use among Hispanics (27). These studies may suggest that the lower illicit drug use among low-income Hispanics may be due to stronger social support among low-income, foreign-born Hispanics relative to their higher-income, US-born counterparts. This conclusion is supported by our multivariate results, which indicate that mental health disparities between Whites and Hispanics are largely explained after adjustment for income and nativity.

This study has several limitations. One is that we conducted secondary analyses of the AHS data, which limited our mental health outcomes and explanatory variables to those collected by AHS. Moreover, since AHS was a telephone survey, the sample may not have included those with only cell phones or those that do not have a phone. This limitation is particularly salient among lower income populations. The AHS data include sample weights that attempt to correct for the complex survey design and non-response bias, which may limit the impacts of the design on our study. A further limitation is that all measures are self-reported and thus subject to bias. The proportion of participants who self-reported as illicit drug users was small, which may have limited our statistical power to assess disparities across groups. Lastly, there were a large proportion of participants who did not provide household income information. Our analysis included only a subpopulation of those with complete information on all variables used, which may have been detrimental to our analysis. One consequence of the small prevalence of self-reported drug use was that the time frame we used in our multivariable model predicting drug use was very long (i.e., the outcome in **Table 4** was lifetime illicit drug use). Lifetime drug use is a very gross variable and may not be indicative of current need for behavioral health services. Despite these limitations, the AHS is one of very few population-based studies to assess the health of the Arizona population. Little is known about health in Arizona, particularly beyond vital statistics data and data collected in large national surveys that include substantial state samples (e.g., the Behavioral Risk Factor Surveillance System). Thus, the large sample size, population-based design, inclusion of a large number of minority (i.e., Hispanic) participants, and measurement of a relative wealth of behavioral data are strengths of AHS and, in turn, this study.

In this study, we found evidence of mental health and healthcare disparities between Whites and Hispanics in Arizona. Despite similar prevalence of psychological distress, Hispanics were much less likely to have been diagnosed with a mental health condition. Furthermore, while Hispanics on average were less likely to report illicit drug use, the likelihood of illicit drug use among Hispanics greatly increased with income and among the US-born and the non-English language proficient. These disparities, combined with the rapid growth of the Hispanic population, suggest that developing culturally- and linguistically appropriate strategies to improve generally poor access and use of mental healthcare services among Hispanics is of critical public health importance. Our work should be a guide for future surveillance and intervention research on the complex relationship between race/ethnicity, socioeconomic status, mental health, and health care.

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A border versus non-border comparison of food environment, poverty, and ethnic composition in Texas urban settings

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Purpose: The goal was to examine the relationship between the food environment and selected socioeconomic variables and ethnic/racial makeup in the eight largest urban settings in Texas so as to gain a better understanding of the relationships among Hispanic composition, poverty, and urban foodscapes, comparing border to non-border urban environments.

Methods: Census-tract level data on (a) socioeconomic factors, like percentage below the poverty line and number of households on foodstamps, and (b) ethnic variables, like percent of Mexican origin and percent foreign born, were obtained from the U.S. Census. Data at the census-tract level on the total number of healthy (e.g., supermarkets) and less-healthy (e.g., fast food outlets) food retailers were acquired from the CDC's modified retail food environment index (mRFEI). Variation among urban settings in terms of the relationship between mRFEI scores and socioeconomic and ethnic context was tested using a mixed-effect model, and linear regression was used to identify significant factors for each urban location. A jackknife variance estimate was used to account for clustering and autocorrelation of adjacent census tracts.

Results: Average census-tract mRFEI scores exhibited comparatively small variation across Texas urban settings, while socioeconomic and ethnic factors varied significantly. The only covariates significantly associated with mRFEI score were percent foreign born and percent Mexican origin. Compared to the highest-population county (Harris, which incorporates most of Houston), the only counties that had significantly different mRFEI scores were Bexar, which is analogous to San Antonio (2.12 lower), El Paso (2.79 higher), and Neuces, which encompasses Corpus Christi (2.90 less). Significant interaction effects between mRFEI and percent foreign born (El Paso, Tarrant – Fort Worth, Travis – Austin), percent Mexican origin (Hidalgo – McAllen, El Paso, Tarrant, Travis), and percent living below the poverty line (El Paso) were observed for some urban settings. Percent foreign born and percent Mexican origin tended to be positively associated with mRFEI in some locations (Hidalgo, El Paso) and negatively associated in others (Tarrant, Travis).

Discussion: Findings are consistent with other studies that suggest the effects of Hispanic concentration on the foodscape may be positive (beneficially healthy) in border urban settings and negative in non-border. The evidence implies that the effects of

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Hispanic ethnic composition on the food environment are location-dependent, reflecting the unique attributes (e.g., culture, infrastructure, social networks) of specific urban settings.

Keywords: food environment, poverty, Hispanics, Texas, urban population

Introduction

Disparities in access to healthy food and related adverse health outcomes, such as obesity, diabetes, and cardiovascular disease, are the subject of ongoing research and public policy debates in the United States (1–7). There is a growing body of evidence indicating that the local food environment – availability of and access to healthy food choices at nearby community retail stores and restaurants – is a potentially important determinant of obesity and related health problems (8–16). Research has demonstrated that the local foodscape is an independent predictor of individuals' food choices and diet quality, and that higher-income areas are associated with better access to supermarkets and a wider variety of healthful foods (9, 14, 17). Lower-income, primarily minority communities, on the other hand, are more likely to have little or no access to supermarkets, which obliges them to rely mainly on convenience stores and fast food restaurants that sell a more restricted range of healthy food items (1, 3, 10, 14, 15, 18, 19).

This reality has spawned research aimed at identifying and analyzing impacts from "food deserts" in impoverished, racially, and ethnically minority communities (1, 3, 4, 19). While there are various definitions of "food deserts' depending upon the source, the United States Department of Agriculture (USDA) defines the term as a geographic area wherein access to affordable, quality, and nutritious foods is limited" (10). Additionally, in food-desert communities, the primary source of food may be fast food restaurants or convenience stores, and with few to no supermarkets within a reasonable driving distance; poor residents are left with only limited options to purchase fresh fruits or vegetables in these areas. As a result, it is often difficult for poor people living in a food desert to maintain a healthy diet because (a) they do not live in close proximity (one-mile for urban settings – 10 miles in rural areas) to supermarkets that sell healthy food and/or (b) they lack the financial resources to buy more-expensive healthy foods even if available (1, 3, 4, 10–12, 15). One area of particular concern is the southern region of Texas along the U.S.–Mexico Border, where high prevalence of obesity and related health disorders has been documented in a population that is predominately poor, Hispanic, environmentally challenged, and lacking knowledge of and access to healthy food options (20–27).

The purpose of this article is to assess whether variations in socioeconomic and ethnic context are associated with the nature of the food environment in urban settings across the State of Texas. Food environment data from the Centers for Disease Control and Prevention's (CDC's) modified retail food environment index (mRFEI) (28) is linked to socioeconomic and ethnic census-tract attributes from the 2010 U.S. Census (29) to characterize variations among eight urban locations. A comparison is made by border/non-border location to assess the potential contextual effect of socioeconomic context on food environment. The findings inform public health policies that aim to take account of differences in socioeconomic context and ethnic makeup among diverse urban surroundings in order to reduce disparities in access to healthy food.

Materials and Methods

Study Setting

The analysis focuses on the eight most populated counties (i.e., surrogates for urban settings) in Texas. Each county represents a significant portion of the metropolitan area of one of the eight largest cities in Texas: Houston (Harris County), Dallas (Dallas County), Fort (Worth Tarrant County), Austin (Travis County), San Antonio (Bexar County), McAllen (Hidalgo County County), Corpus Christi (Nueces County), and El Paso (El Paso County). Sociodemographic characteristics, including race and Mexican ethnic concentration are summarized in **Table 1**. These metropolitan-area counties represent approximately 51.4% of the state's total population and have diverse sociodemographic characteristics and race/ethnic composition, which provides ample contrast for the analysis.

The Modified Retail Food Environment 2008

The mRFEI (28) is a measure of the total number of healthy and less-healthy food retailers in a census tract. The distinction between healthy versus less-healthy (e.g., unhealthy) is based on available food offerings from retail establishments, such as grocery stores, convenience stores, and fast-food restaurants. The mRFEI identifies the percent of all the food retailers in a given census tract, that are considered to provide healthy food choices. The potential census-tract score for the mRFEI ranges from 0 or "food desert" to 100 or "ideally healthy" – although few across the country are at this level.

U.S. Census 2010

The census-tract data were obtained through the U.S. Census Bureau, specifically the American fact finder website (29). Demographic and social characteristic tables were selected and downloaded in a delimited format together with the annotation file. The tables were screened and variables of interest selected and merged into one file in excel format. A database was created with the census-tract FIPS as the ID indicator. Variables used for this analysis were total population, median age, percent below the poverty line, percent foreign born, percent of Mexican origin, and percent of families on food stamps.

Analysis

Descriptive statistics were generated for average mRFEI Score, total population, median age, average percent below the poverty line, average percent adults 25+ with a bachelor's degree or higher, average percent foreign born, average percent Mexican origin, and

average percent of families on food stamps by each urban setting. A mixed effects (multilevel) model was used to test for significant variation between urban settings on the basis of the relationship between socioeconomic and ethnic context and mRFEI scores. We performed linear regression to identify which factors were significant for each urban setting. To account for significant clustering identified in the mixed-effect modeling, the jackknife variance estimate was used. The jackknife variance estimate accounts for clustering and autocorrelation of adjacent census tracts by running repeated models while randomly removing cases each iteration to improve the precision of the variance estimate that could be biased due to significant clustering within each urban setting. Interaction models were generated between urban settings and census-tract socioeconomic and ethnic variables.

Results

Descriptive statistics for each urban setting are presented in **Table 1**. Harris County (Houston) was selected as the reference category due to the fact it is the largest urban setting examined. Results show relatively small variation in the food environment and substantial variation in socioeconomic and race/ethnic composition across major urban areas in the state of Texas. Overall, average mRFEI scores are relatively low in each of the eight urban settings, ranging from 8.9 in Nueces County (Corpus Christi) to 14.2 in Hidalgo County (McAllen). The range for all counties is from 1.8 to 66.7, which suggests that while there are some census tracts that are closer to the "ideal," most are in the unhealthy range. Both El Paso and Hidalgo – each located on the Texas–Mexico border – had the highest average mRFEI scores: 13.8 ($p < 0.001$) and 14.2 ($p < 0.001$), respectively, and were the only counties with significantly different values from Harris County. El Paso (29.4%, $p < 0.001$), Hidalgo (34.6%, $p < 0.001$), and Nueces (25.4%, $p < 0.05$) had a significantly higher average census-tract percent below the poverty line compared to Harris County, whereas Tarrant County (Fort Worth) (15.5%, $p < 0.05$) had a significantly lower average. Hidalgo County (572.1, $p < 0.001$) and El Paso (352.7, $p < 0.001$) had the highest census-tract average households on food stamps, followed by Nueces County (340.1, $p < 0.001$), Bexar County (San Antonio) (271.7, $p < 0.001$), and Dallas County (162.9, $p < 0.05$). Travis County (Austin) had the highest average% Bachelor's degree or higher (43.3%, $p < 0.001$). Bexar (18.8%, $p < 0.001$), El Paso (17.5%, $p < 0.001$), Hidalgo (17.0%, $p < 0.01$), and Nueces (12.9%, $p < 0.001$) Counties had significantly lower average census-tract percent with a Bachelor's degree or higher compared to Harris County. While both Hidalgo (30.7, $p < 0.01$) and Travis Counties (32.4, $p < 0.05$) had significantly lower census-tract median age, Tarrant (35.2, $p < 0.05$) had significantly higher census-tract median age than Harris County.

In terms of race/ethic composition, there were no significant differences between El Paso, Hidalgo, and Harris Counties in the average census-tract percent foreign born. However, Bexar (13.7, $p < 0.001$), Dallas (22.8, $p < 0.05$), Nueces (8.3%, $p < 0.001$), Tarrant (15.7%, $p < 0.001$), and Travis (19.2%, $p < 0.001$) all had significantly lower average census-tract percent foreign born. This is contrasted with percent Mexican origin, where both El Paso (78.1%, $p < 0.001$) and Hidalgo (85.3%, $p < 0.001$) were predominantly Mexican origin. In addition, while in Bexar (59.2%, $p < 0.001$) and Nueces Counties (63.4%, $p < 0.001$) the majority population was of Mexican origin, both Tarrant (24.5%, $p < 0.001$) and Travis (29.2%, $p < 0.05$) had a significantly lower percent Mexican origin than Harris County.

Table 2 presents mixed effects and linear regression results for socioeconomic and ethnic characteristics by urban setting. In the mixed effects model, % foreign born was associated with a lower mRFEI score ($\beta = -6.94$, $p = 0.000$), whereas % Mexican origin was associated with a higher mRFEI ($\beta = 5.71$, $p = 0.000$). No socioeconomic variables were significantly associated with mRFEI in the mixed-effects model. The linear regression using jackknife variance estimate yields similar significant coefficients for % foreign born ($\beta = -7.5$, $p = 0.000$) and % Mexican origin ($\beta = 5.58$, $p = 0.000$), with no other significant results. In terms of comparing our seven urban settings (i.e., counties) to Harris County (Houston), the census-tract average mRFEI in Bexar was 2.12 less than Harris ($p = 0.001$), while the value in El Paso was 2.79 ($p = 0.004$) higher than Harris. The only other statistically significant difference ($p = 0.036$) from Harris was Neuces County, which was 2.90 less.

While county average census-tract mRFEI scores are uniformly low (range 8.9–14.2), significant county-level interaction effects were observed. **Figures 1–3** present only the significant interaction results between urban setting and (a) % foreign born

TABLE 1 | Average census-tract mRFEI score and demographic characteristics by county.

	mRFEI	% Below poverty line	Average # households on food stamps (mean + SD)	% Foreign born (mean + SD)	% Mexican origin (mean + SD)	% Bachelor's or higher (mean + SD)	Median age	Total population
Total population								
Bexar (San Antonio)	9.2 (4.7)	22.0 (12.7)	271.7 (172.4)***	13.7 (6.4)***	59.2 (23.3)***	18.8 (16.8)***	34.2 (5.6)	1,714,773
Dallas	9.9 (6.0)	18.4 (12.1)	162.9 (140.5)*	22.8 (13.2)*	34.4 (24.3)	27.0 (22.9)	33.9 (6.7)	2,368,139
El Paso	13.8 (6.9)***	29.4 (15.4)***	352.7 (223.2)***	27.5 (9.6)	78.1 (18.5)***	17.5 (14.2)***	34.3 (5.2)	800,647
Harris (Houston)	9.3 (6.4)	19.8 (13.2)	189.1 (147.3)	24.9 (12.8)	34.5 (25.5)	26.2 (23.6)	33.8 (6.3)	4,092,459
Hidalgo (McAllen)	14.2 (11.3)***	34.6 (13.6)***	572.1 (263.0)***	28.6 (7.5)	85.3 (10.3)***	17.0 (12.8)**	30.7 (5.4)**	774,769
Nueces (Corpus Christi)	8.9 (6.0)	25.4 (14.2)*	340.1 (209.9)***	8.3 (5.1)***	63.4 (20.6)***	12.9 (11.3)***	35.8 (5.9)	340,223
Tarrant (Fort Worth)	10.2 (5.1)	15.5 (12.2)***	165.3 (131.5)	15.7 (10.8)***	24.5 (21.7)***	27.6 (18.0)	35.2 (6.2)*	1,809,034
Travis (Austin)	9.4 (5.8)	22.1 (16.1)	188.6 (186.0)	19.2 (13.0)***	29.2 (20.7)*	43.3 (22.9)***	32.4 (6.1)*	1,024,266

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

TABLE 2 | Regression results for mRFEI.

	Mixed effects (clustered by county)	Linear regression w/Jackknife variance test
Sociodemographics		
% Below poverty line	−0.029 (0.102)	−0.029 (0.189)
Average # households on food stamps	−0.001 (0.324)	−0.002 (0.390)
% Foreign born	−6.94 (0.000)	−7.5 (0.000)
% Mexican origin	5.71 (0.000)	5.58 (0.000)
% Bachelor's or higher	−0.002 (0.863)	−0.002 (0.884)
Median age	−0.019 (0.571)	−0.023 (0.536)
County (Ref. Harris i.e., Houston)		
Bexar (San Antonio)		−2.12 (0.001)
Dallas		0.376 (0.403)
El Paso		2.79 (0.004)
Hidalgo (McAllen)		3.28 (0.062)
Nueces (Corpus Christi)		−2.90 (0.036)
Tarrant (Fort Worth)		0.599 (0.240)
Travis (Austin)		−0.019 (0.977)

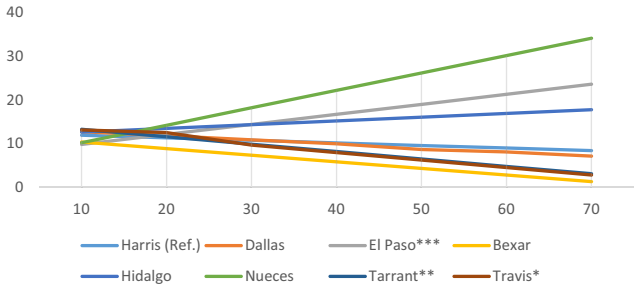

FIGURE 1 | Interaction effects between county and percent foreign born.

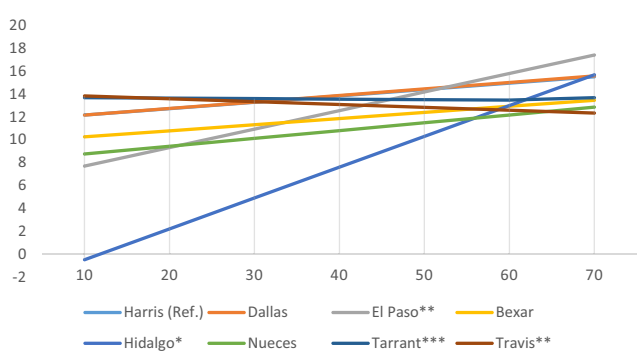

FIGURE 2 | Interaction effects between county and percent Mexican origin.

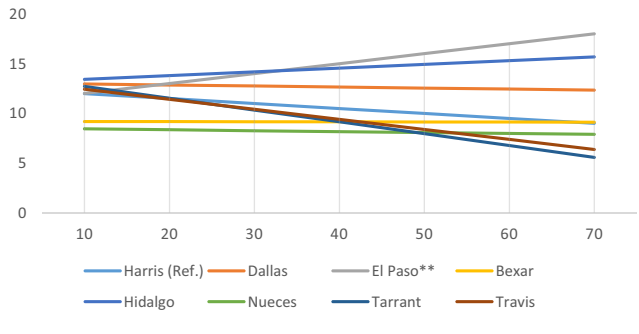

FIGURE 3 | Interaction effects between county and percent living below the poverty line.

(**Figure 1**), (b) % Mexican origin (**Figure 2**), and (c) % living below the poverty line (**Figure 3**). As shown in **Figure 1**, there is a diverging trend in the association between urban setting and % foreign born; whereas in the border (El Paso, Hidalgo) or near-border counties (Bexar, Nueces), there is a positive association between % foreign born and the mRFEI. Conversely, there is a negative association for the non-border counties (Harris, Dallas, Tarrant, Travis). Statistically significant interaction effects were observed only for El Paso ($p < 0.001$), Tarrant ($p < 0.01$), and Travis ($p < 0.05$). In **Figure 2**, % Mexican origin was only significant for Hidalgo, El Paso, Tarrant, and Travis. However, similar to what was observed in the % foreign born interaction model, % Mexican origin was positively associated with mRFEI in Hidalgo and El Paso, and negatively associated in Tarrant and Travis, although the pattern is not as salient. Percent poverty (**Figure 3**) is the only significant socioeconomic variable interaction with urban setting, and only for El Paso, where % poverty is positively associated with the mRFEI score.

Discussion

The purpose of this study was to elucidate the relationship between socioeconomic and ethnic context and food environment in the largest urban settings within Texas. Findings revealed that the relationship between socioeconomic characteristics, ethnic context and food environment varies by urban setting, and depends on border/non-border location. Access to healthy food options is said to differentially place certain race/ethnic groups and socioeconomic strata at higher-than-average risk for obesity and related adverse health outcomes (1, 3, 10, 15, 18, 19, 24–26). This is exemplified in the Texas–Mexico border region, where there is a high concentration of poverty and persons of Mexican origin, coupled with a higher–than-average prevalence of obesity (30), which places Mexican American residents in the region at increased risk for diabetes and uncontrolled hypertension (20–27). The findings from this study suggest that the impact of race/ethnic concentration and socioeconomics on food environment may be a function of context and geographic location, rather than socioeconomics and ethnic composition alone.

While few studies have compared border to non-border food environments, the findings from this study are consistent with what is known, and contribute to mounting evidence that contextual influences may differ based on geographic proximity to the border and therefore be responsible for risk variation in obesity and related chronic diseases. For example, Salinas et al. (26) using the same data by census tract across the State of Texas found that census tracts in the U.S.-Mexico border region have, on average, better food environments than non-border census tracts. Nonetheless, the relationship between the mRFEI and % foreign born and % families on food stamps varied by border/non-border location (26). In this study, the border and near-border urban

settings had higher mRFEI scores and higher Hispanic ethnic and immigrant concentration was associated with better food environments. In non-border urban settings, these same factors were associated with lower mRFEI scores.

Hispanic concentration on the Texas–Mexico border is known to be among the highest in the United States (29); at the same time, obesity rates in some areas of the region are well-above national averages (29). These statistics suggest that food environment might also be less healthy in urban settings on the Texas–Mexico border than in non-border urban settings further north. Yet, individual-level studies have found, instead, a protective effect for Hispanic ethnic concentration and health (31–33). For example, evidence from the Multi-Ethnic Study of Atherosclerois (MESA) study suggests that higher ethnic concentration may be protective from obesity, and that movement to ethnically mixed communities may be a significant risk factor for weight gain in ethnic minority groups (34). Additionally, Eschbach et al (35) using SEER data found a protective effect of Hispanic ethnic concentration and cancer, a condition known to be associated with obesity. The findings from this study provide evidence for a potential mechanism underlying the salubrious effect of very high Hispanic concentration, which may be related to contextual factors that influence food environment. It is plausible that in Hispanic-majority communities Hispanics have access to more and better resources that promote better health, compared to similar communities where they are the minority. This higher concentration may translate into greater access to fruits and vegetables; however, access alone may not reduce the risk of obesity in border urban settings relative to non-border urban settings in Texas, suggesting additional contextual factors at play, such as social context, group dynamics, and cultural traditions that become important in communities where Hispanics are in the majority.

One of the more common explanations for the health benefits of Hispanic communities or high ethnic concentration has been the potential benefit of immigrants who bring their "more healthy" beliefs or customs to their destinations. The traditions brought from their countries of origin provide resources to promote better health such as stores and restaurants that may serve or sell more traditional food. The evidence on immigrant concentration has been mixed. Some studies suggest that higher immigrant concentration can be, at the same time, both a risk factor and a protective attribute for disease and mortality (36, 37). For example, Omariba and colleagues (36) found an association between higher immigrant concentration and hospital admissions for lower cardiovascular disease in Ontario, Canada. However, while immigrant concentration in El Paso has been found to be protective from asthma symptoms (37), in Los Angeles Hispanic infants born to mothers who lived in higher immigrant concentration communities were more like to die than those whose mothers lived in non-immigrant enclaves (4). In the study presented here, the positive and marginal benefit of immigrant concentration on food environment occurred in border or near-border urban settings (El Paso and Hidalgo), while in non-border urban settings immigrant concentration was associated with a less healthful food environment. Although our study made use of aggregated data, the results are consistent with previous studies, and add to the mounting evidence suggesting that the health benefit or harm derived from an immigrant enclave may depend on the location-specific context of each community, including variations in the food environment.

Poverty is often cited as one of the largest risk factors for unhealthy urban food environments (38, 39). Evidence suggests that persons who live in poor communities need to travel further to obtain healthy or fresh food (40), and there is a strong association between fruit and vegetable availability and community socioeconomic environment (18). Most of the existing studies have examined a single urban area or focused on a specific racial or ethnic group without taking into consideration the overall ethnic environment relative to other settings. In this study, poverty was the only socioeconomic condition significantly associated with the mRFEI; but only in El Paso. Percent living below the poverty line in El Paso was positively associated with the mRFEI, which is contrary to conventional expectations that poorer communities would tend to have fewer healthy food options. While El Paso is a relatively large metropolitan area, it is still less developed that the referent category, Harris County (Houston). It may be that access to less-healthy food in poorer communities depends on geospatial factors, like the level and nature of development and infrastructure in place within a given urban setting. This is an area of research that has been under explored and more information is needed.

Although this study provides additional evidence supporting the salubrious effects of Hispanic ethnic composition, at the same it provides inconsistent results in relation to what is already known about the link between socioeconomics and food environment. It is important to keep in mind that this study has certain limitations that should be taken into account when interpreting its main findings. First, since these data were aggregated at the population level we are unable to make inferences about individual beliefs or behaviors. So while the food environment may vary between urban settings, we still do not know the impact it has on actual access or consumption. Understanding the relationship between ethnic concentration, socioeconomic context and food environment is an essential next step necessary to establish the causal chain between context, individual behavior, and obesity and chronic disease risk.

An additional limitation to take into consideration is that the mRFEI measures the proportion of food vendors that sell healthy food relative to unhealthy food. While this measure provides a picture of the geographic distribution of food availability, it does not distinguish what type of foods are actually sold at a given location or their cost. Moreover, the mRFEI provides a score for each individual census tract and does not take into consideration adjacent census tracts or travel distances to access supermarkets or healthier food vendors. Although this analysis only involved urban settings (thereby eliminating distance variation between urban versus rural differences), local ordinances and building restrictions could influence the concentration of supermarkets relative to fast food restaurants or convenience stores. Therefore, variations in local zoning in the border urban settings versus non-border settings may have influenced the findings from this study, an important factor to consider in future work.

Despite these limitations, this study does provide useful information germane to future directions in both relevant research and effective policy. Understanding how the food environment influences actual behaviors of food consumption is an important

direction to take in future research. Hispanic populations are overrepresented among those who are overweight or obese. They are also overrepresented among those living in poverty. The food environment has a direct relationship with both poverty and food access, and has implications for subsequent overweight or obesity outcomes. Still, the processes that link context to obesity risk are not well understood. In order to address the issues of obesity in Hispanic communities, particularly those on the border, it is important to acknowledge the significance of the food environment and find ways to increase access to healthy foods while at the same time limiting access to unhealthy foods. Ultimately, fighting obesity depends on making lifestyles changes, which are likely to be more successful in food environments that support healthy living.

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