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HIV Prevention among Mexican Migrants at Different Migration Phases: Exposure to Prevention Messages and Association With Testing Behaviors

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Abstract

Mobile populations are at increased risk for HIV infection. Exposure to HIV prevention messages at all phases of the migration process may help decrease im/migrants' HIV risk. We investigated levels of exposure to HIV prevention messages, factors associated with message exposure, and the association between exposure to prevention messages and HIV testing behavior among Mexican im/migrants at different phases of the migration process. We conducted a cross-sectional, probability survey of Mexican im/migrants (N=3,149) traveling through the border city of Tijuana, Mexico. The results indicate limited exposure to prevention messages (57%–75%) and suboptimal last 12-month HIV testing rates (14%–25%) across five migration phases. Compared to pre-departure levels (75%), exposure to messages decreases at all post-departure migration phases (57%–63%, $p < .001$). In general, exposure to prevention messages is positively associated with greater odds of HIV testing at the pre-departure, destination, and interception phases. Binational efforts need to be intensified to reach and deliver HIV prevention to Mexican im/migrants across the migration continuum.

Keywords

Mexican im/migrants; HIV testing; HIV prevention; migration phases

INTRODUCTION

Mexican im/migrants represent the largest immigrant population in the U.S., accounting for 29% of the nation's 40 million immigrants (Migration Policy Institute, 2013; Passel, Cohn, & Gonzalez-Barrera, 2012). Previous research has indicated that Mexican im/migrants, and

especially those who engage in circular migration, face an elevated risk of HIV infection (Apostolopoulos et al., 2006; Hernández et al., 2004; Organista & Kubo, 2005). Understanding and addressing the factors that contribute to this heightened risk is an important public health goal.

Migration is a complex process involving multiple phases, such as pre-departure, transit, destination, interception, and return to sending communities (Zimmerman, Kiss, & Hossain, 2011). Each phase is characterized by a different constellation of individual and environmental factors that may alter the risk for HIV. In general, studies have shown that risk behaviors for HIV infection, such as multiple sex partners, unprotected sex with non-steady partners, and substance abuse, increase among Mexican im/migrants after they leave their communities of origin (Magis-Rodriguez et al., 2009; Organista, Carrillo, & Ayala, 2004; Sanchez et al. 2012; Martinez-Donate et al. 2015). These changes in HIV-related behaviors have been attributed to exposure to risks and opportunities present at different migration phases (Martinez-Donate et al. 2015). Following the pre-departure phase, Mexican im/migrants are more likely to experience family disruption and separation from social networks (Magis-Rodriguez et al., 2009; Magis-Rodríguez et al., 2004; Parrado & Flippen, 2010), exposure to more liberal social norms regarding sexual behaviors and substance use (Carrillo, Fontdevila, Brown, & Gomez, 2008), economic hardship, low access to health care services, fear of deportation (Levy et al., 2007; Magis-Rodriguez et al., 2009), detention/incarceration (Martinez-Donate et al. 2015), and population mixing (Ruiz, Guilamo-Ramos, McCarthy, Muñoz-Laboy, & de Lourdes Rosas López, 2014).

On the other hand, acculturation to the U.S. mainstream culture and length of residence in the U.S. have also been associated with factors that may protect im/migrants against HIV. Among others, these include individualism, more education about sex, less sexual silence, more favorable attitudes about HIV testing and condom use (Organista et al. 2004), and increased access to health services (Akresh, 2009; Lara, Gamboa, Kahramanian, Morales, & Hayes Bautista, 2005; Vargas Bustamante, Laugesen, Caban, & Rosenau, 2012). Relatedly, research has documented higher rates of HIV testing and condom use among Mexican im/migrants at the destination, interception, and return phases compared to pre-departure levels (Magis-Rodriguez et al., 2009; Organista, Carrillo, & Ayala, 2004; Martinez-Donate et al. 2015).

Given their vulnerability, it is important to ensure Mexican im/migrants are exposed to HIV prevention messages and have access to prevention services across different migration phases. These conditions may help improve HIV/AIDS related knowledge, reduce risk behaviors for HIV infection, and promote HIV testing along the migration continuum. Consistent with this idea, interventions to reach Mexican im/migrants with HIV prevention messages and services have been implemented in both the U.S. and Mexico. In the U.S., interventions comprise a diversity of HIV prevention and testing programs funded through the Centers for Diseases Prevention and Control (CDC) (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, Division of HIV/AIDS Prevention, 2014). Similarly, “Ventanillas de Salud” (Health Windows), a program of the Government of Mexico operating in the 50 Mexican consulates and the “Binational Health Week”, a large initiative spearheaded by the Mexican government and University of California, offer HIV

prevention information and testing to Mexicans im/migrants in the U.S. and their families (Department of Health and the Ministry of Foreign Affairs, Government of Mexico, n.d.; “Binational Health Week 2015: Working to Improve Health for 15 years,” n.d.). In Mexico, the “*Vete Sano, Regresa Sano*” (Go Healthy, Come Back Healthy) federal program, by the Secretariat of Health, emphasizes HIV/AIDS as one of its priority areas to protect the health of future Mexican im/migrants at the pre-departure phase (Subsecretaría de Prevención y Promoción de la Salud, 2012). Efforts have also been deployed to deliver HIV prevention, including education, condoms, and testing services, to migrants in transit along Mexico’s north border (Strathdee & Magis-Rodriguez, 2008), south border (La Agencia Francesa de Desarrollo (AFD) y Médicos del Mundo (MdM), 2011) and at deportation stations in the border cities of Tijuana and Matamoros, Mexico.

Despite substantial work to deliver HIV prevention to Mexican im/migrants in the U.S. and Mexico, little is known about the extent to which prevention messages are effectively reaching the im/migrant population and the factors that facilitate or impede exposure to HIV prevention messages at different migration phases. Likewise, the effectiveness of these prevention efforts to trigger adoption of protective behaviors is not well established. Health behavior theories, such as the Health Belief Model and the Theory of Reasoned Action, predict that prevention messages can serve as cues to action, activating readiness and stimulating health behaviors (Glanz, Rimer, & Viswanath, 2008). Health communications can also influence attitudes and convey social norms regarding health behaviors (Ajzen & Fishbein, 1980). While numerous other individual and environmental barriers may still obstruct adoption and maintenance of health behaviors among vulnerable populations (Albarrán & Nyamathi, 2011), health education still represents an important element of HIV prevention targeting at-risk groups.

In this study we focused on this particular element of HIV prevention and sought (1) to describe the level of exposure to, and sources of, HIV prevention messages among Mexican im/migrants at different migration phases; (2) to identify factors associated with exposure to HIV prevention messages within each migration phase; and (3) to test the association between exposure to HIV prevention messages and the likelihood of HIV testing along the migration continuum.

Our conceptual framework posits that im/migrants’ HIV related behaviors, such as HIV testing, are the result of the interaction between individual (e.g. age, gender, ethnicity, education, acculturation, etc.) and contextual factors (e.g. health care access, exposure to HIV prevention messages). As im/migrants undergo different migration phases these contextual factors and the role they play as determinants of HIV related behaviors will change. Based on this conceptual framework, we set the following hypotheses:

Hypothesis 1: Compared to pre-migration levels (i.e. pre-departure), exposure to HIV prevention messages will decrease after im/migrants initiate the migration process due to limited access to health care, language barriers, and reduced cultural sensitivity of prevention messages available during post-migration phases (i.e. transit, destination, interception, and return).

Hypothesis 2: Migration relies on social networks, with new im/migrants following relatives and acquaintances who have “gone North” prior to them (Boyd, 1989; Massey & Espinosa, 1997). In receiving communities, messages originating from media and health care settings may not be as culturally and linguistically congruent with im/migrants’ cultural background and language skills as they are in sending communities. For this reason, we hypothesize that as im/migrants leave their communities of origin, they may rely more on informal and interpersonal sources of HIV prevention messages (e.g. family, friends, co-workers) and less on mass media (e.g. TV, radio, etc.) or health care professionals than they did prior to migrating.

Hypothesis 3: Health insurance is an indicator of access to health services and may facilitate exposure to prevention messages in health care settings. At all migration phases, we hypothesize that exposure to HIV prevention messages will increase with availability of health insurance.

Hypothesis 4: Time in the U.S. can result in improved English fluency, increased access to health services, and greater assimilation into the U.S. culture. On the other hand, it is possible that im/migrants who have spent more time in the U.S., have less access to health services in Mexico and are less responsive to prevention messages designed for non-migrant populations in that country. For those reasons, we hypothesized that time in the U.S. will be positively associated with the likelihood of exposure to HIV prevention messages in the U.S. Inversely, among return im/migrants, time in the U.S. is expected to decrease exposure to HIV prevention messages in Mexican sending communities.

Hypotheses 5–6: Based on previous research, HIV testing rates will be higher among im/migrants with a history of migration to the U.S. compared to pre-departure migrants. As predicted by health behavior theory, we also hypothesize that exposure to HIV prevention messages will be positively associated with adoption of protective behaviors, such as HIV testing, at all migration phases.

Information resulting from the testing of these hypotheses can contribute to a better understanding of individual and contextual factors influencing the health of Mexican im/migrants at different migration phases. The results will help to identify HIV prevention gaps and opportunities to increase the reach and effectiveness of HIV prevention campaigns targeting Mexican im/migrants on specific phases of the migration process.

METHODS

Study Design and Procedures

We used data from *Project Migrante*, a binational Mexico-US collaboration involving a series of population-based probability surveys of Mexican migrant flows conducted since 2007 (Amuedo-Dorantes, Puttitanun, & Martinez-Donate, 2013; Martinez-Donate et al., 2014, 2015; Rangel et al., 2012) in the Mexican border City of Tijuana, Mexico (www.migrante.weebly.com). Tijuana concentrates about 30% of the Southbound migration flow between Mexico and the U.S. (El Colegio de la Frontera Norte, 2013). Migrante sampling venues include the Tijuana International Airport, the largest bus station, and the

main deportation station in Tijuana. Within these venues, sampling points include the passport/security control and the luggage claim gates at the airport; the ticket desk and the luggage claim areas at the bus station; and the exit area of the deportation station. *Migrante* surveys sample from four migration flows representing distinct spatial trajectories: 1) the *Northbound* flow comprising of im/migrants arriving to the border from other Mexican areas; 2) the *Border* flow comprising of im/migrants who are returning to their communities of origin after a stay in the Mexican border region; 3) the *Southbound* flow comprising of im/migrants returning from the U.S. to Mexico voluntarily; and 4) the *Deported* flow comprising of im/migrants returning from the U.S. via deportation. During each survey shift, individuals crossing by the sampling points are consecutively approached by *Migrante* staff and screened for eligibility using a short survey. Eligible individuals are 18 years and older, born in Mexico or other Latin American countries, fluent in Spanish, not Tijuana residents (except for deported im/migrants), traveling for labor reasons, change of residence, or without specific plans to return to their community of origin, and without a history of previous participation in the survey. Eligible, consenting participants complete an anonymous, interviewer-administered questionnaire using Questionnaire Development System computer-assisted personal interview (QDS™ CAPI).

Specifically, we used data from the *Migrante HIV Risk Survey*, which focused on HIV infection and behavioral risk factors and was implemented from June 2009 to August 2010. This survey included an FDA-approved rapid finger-stick blood HIV test. Estimates of HIV infection and selected risk factors based on this survey have been presented elsewhere (Martinez-Donate et al., 2015; Rangel et al., 2012; Zhang et al., In press). Survey methods and procedures have also been described in detail elsewhere (Martinez-Donate et al., 2015a; Zhang et al., 2015). A copy of the study measures can be found at <http://migrante.weebly.com/waves-and-questionnaires.html>. All study procedures were reviewed and approved by the authors' institutional review boards in both the U.S. and Mexico.

Measures

Last 12-month exposure to HIV prevention messages—The questionnaire included a checklist to determine whether study participants had seen or heard messages promoting protective behaviors against HIV, including: a) safe sex or use of a condom, b) testing for sexually transmitted infections (STIs), c) testing for HIV/AIDS, d) being faithful to their sex partners, and e) reducing the number of sexual partners. Questions focused specifically on exposure during the last 12 months and in their most recent migration context (i.e. key context). For northbound im/migrants, questions focused on exposure in their communities of origin in Mexico. For migrants in the border flow, questions focused on exposure on the Mexican border region. For southbound and deported im/migrants, questions focused on exposure in the U.S. Dummy variables (1=exposed, 0=not exposed) were created to represent exposure to each of these possible messages in the last 12 months. An additional dummy variable (1=exposed to one or more of these messages, 0=not exposed to any of these messages) was created to represent exposure to *any* of these prevention messages. Furthermore, a count measure based on the number of exposure questions to which the respondent answered positively was computed (possible range 0–5). This measure represented the variety of prevention messages a respondent had been exposed to.

Message Sources, Media, and Settings—For individuals exposed to *any* of the above HIV prevention messages, three additional survey questions inquired about message sources and exposure settings. The first one asked about selected interpersonal sources (e.g. family members, friends, health professionals, etc.). The second question inquired about various media sources (e.g. TV, radio, posters/billboards, etc.). The third question asked respondents about several settings where they may have been exposed to messages (e.g. clinic, street, consulate, etc.). Respondents could check any number of answers from a list of options. Response options are listed in Table 2. Dummy variables were created to reflect last 12-month exposure to messages from each source, medium, and setting (1=exposed, 0=not exposed). Count variables were also created to represent the variety of sources (range 0–5), media (range 0–4), and settings (range 0–5) from which prevention messages were received.

HIV Testing—Participants were asked whether they had been tested for HIV/AIDS in the last 12 months. A dummy variable was created to represent last 12-month HIV testing (1=tested, 0=not tested).

Migration phase and context—We classified im/migrants into five different migration phases and three geographic contexts based on migration flow and responses to migration history questions (Martinez-Donate et al., 2015). Migrants in the *northbound* flow *without* a previous migration history to the U.S. were categorized as representing the pre-departure phase, while im/migrants in the same flow *with* a previous history of migration to the U.S. were classified as representing the return phase. For the two groups, their most recent migration context was that of their sending communities. Im/migrants within the *Border* flow were considered to represent the transit phase and their experiences captured the migration context of the Mexican border region, a high risk environment with a large transient population, higher HIV incidence, quasi-legal commercial sex, and greater access to illicit drugs compared to other areas in Mexico (Brouwer et al., 2006; Strathee et al., 2008). *Southbound* flow im/migrants represented the destination phase and recent exposure to receiving communities in the U.S. Finally, im/migrants in the *Deported* flow were considered as having recently endured the detention/interception phase of migration and representing recent exposure to receiving communities in the U.S.

Health insurance—A survey question was used to assess health insurance status in most recent migration context, with possible answers being always, sometimes, never insured. These responses were recoded as 1=always insured or 0=never/only sometimes insured.

Time living in the U.S.—Survey respondents were asked about the total length of time they had lived in the U.S. over their lifetime. Respondents were allowed to use any time units in their responses. For this study, responses were rounded up to years and recoded into a nominal variable with five levels (0=never lived in the U.S., 1=lived for less than 1 year, 2=lived between 1 and 5 years, 3=lived between 6 and 10 years, 4=lived for more than 10 years). This measure was used as a marker of acculturation to the U.S. mainstream culture.

Control Variables—Several sociodemographic, behavioral, and contextual measures were used as control variables in our study. *Sociodemographic* factors included self-reported age

(years), gender (coded 1=male, 0=female), education (recoded into 1=high school or higher degree, 0=less than high school), marital status (recoded into 1=married/cohabiting, 0=other marital status), and Mexican indigenous ethnicity (1=yes, 0=no). For *sexual behavior*, we combined information from several questions inquiring about lifetime and last 12-month sexual activity (e.g. type of sexual partners, type of sex with each type of partner, and use of condom). A dummy variable reflecting last 12-month unprotected sex with casual partners or sex workers was created. This variable was equal to 1 if the respondent reported having had vaginal or anal sex with a casual partner and/or sex worker without a condom during the last 12 month; the variable was equal to 0 otherwise. For *contextual factors*, we included incarceration or detention history during the last 12 months (1=yes, 0=no), respondents' self-rated risk for HIV infection in the most recent migration context (recoded into 0=low/moderate risk and 1=high risk), and time spent in the most recent migration context during the last 12 months (months).

Statistical Analysis

Data were weighted to account for the complex survey design and response rates (Amuedo-Dorantes et al., 2013). Simple descriptive statistics were computed using weighted data. To test hypotheses 1–2, adjusted logistic regressions with unweighted data were conducted. Indicators of exposure to prevention messages were used as outcomes for these models. Dummy variables representing each migration phase were created and included in the models as main predictors. Consistent with our first hypothesis, pre-departure im/migrants were used as the reference group to test whether exposure levels decreased after im/migrants departed from their communities of origin and whether reliance in informal, interpersonal sources versus mass media increased at post-versus pre-departure phases. To exclude the possibility that these changes respond to the different make up of im/migrants at different migration phases or length of time spent in the key context, models were adjusted for sociodemographics, incarceration/detention history, perceived HIV risk, and time in the key migration context.

To test hypotheses 3–4, additional adjusted logistic regressions were performed to examine the role of health insurance and time in the U.S. as predictors of exposure to HIV prevention messages. Separate models were run for each migration phase. Finally, to test hypotheses 5–6, logistic regression models were estimated to investigate the association between different indicators of message exposure (main predictors) and last 12-month HIV testing (outcome) within each migration phase. To reduce confounding, these regression models were adjusted for sociodemographics, sexual behavior, and contextual factors. All analyses were completed using STATA/MP 13.1 statistical software packages (StataCorp LP, College Station, TX).

RESULTS

A total of 6,594 individuals met eligibility criteria for inclusion in the survey, and among them, 3,390 participated in the survey, resulting in an overall response rate of 51.4%. After excluding cases with missing data for the variables of interest, the final analytical sample included 3,149 participants. The sample represented a weighted population of 977,065

Mexican im/migrants travelling through Tijuana, Mexico during the study period. The sociodemographic, migration, behavioral, and contextual characteristics of the study population by migration phase are presented in Table 1.

Hypotheses 1–2: Exposure to Prevention Messages and Migration Phase

Message exposure—Last 12-month exposure to prevention messages across phases ranged from 57.2% among return im/migrants to 75.3% among pre-departure im/migrants. Consistent with our first hypothesis, individuals at the post-migration phases (i.e. return, transit, destination and interception) phases were significantly less likely to be exposed to prevention messages than their peers at the pre-departure phase, after adjusting for basic sociodemographic factors and time in the key migration context ($p < 0.001$, Table 2).

Content of messages—Exposure to messages promoting condom use was the most prevalent (54.1% to 73.2%), followed by messages promoting or advertising STI and HIV testing (45.0% to 60.1% and 45.2% to 59.7%, respectively; Table 2). Im/migrants at all post-departure phases were less likely to see or hear messages about condom use, STI testing, and reducing number of sex partners compared to im/migrants at pre-departure and the differences were statistically significant for im/migrants at destination and interception compared to pre-departure ($p < 0.05$). Return im/migrants also had a significantly lower likelihood of being exposed to messages promoting condom use compared to pre-departure im/migrants ($p < 0.01$). These results were as expected according to our first hypothesis.

Message sources and channels—Across all migration phases, family members (45.1% to 67.0%) and friends (43.1% to 66.7%) were the leading interpersonal sources from which im/migrants received prevention messages, followed closely by health professionals (31.0% to 45.5%; Table 2). As predicted by our second hypothesis, im/migrants at all post-migration phases were more likely to hear messages from informal, interpersonal sources, such as family members, friends, and religious leaders, than im/migrants at the pre-departure phase ($p < 0.01$). On the other hand, also as hypothesized, exposure to messages from health professionals tended to decrease after the pre-departure phase ($p = .006$), except for deported im/migrants. Television was the single most frequently reported medium of exposure to prevention messages across the migration continuum (47.0% to 68.5%). Pre-departure im/migrants were more likely to be exposed to messages on television than im/migrants at other phases ($p < 0.01$).

Exposure settings—Across phases, im/migrants reported hearing or seeing messages most often in the street and in clinical settings. Compared to pre-departure im/migrants, individuals at most of the other four phases were significantly more likely to be exposed while in the street ($p < 0.05$). Exposure in schools was also significantly more likely among im/migrants at the transit, destination, and interception phases compared to those at pre-departure ($p < 0.001$). In contrast, compared to pre-departure im/migrants, those at the return and destination phases were less likely to be exposed to HIV prevention in clinics ($p < 0.05$). This is also consistent with our second hypothesis. Notably, a subset of im/migrants reported exposure in Mexican consulates in the U.S. (5.6% and 8.8% of im/migrants at destination and interception phases, respectively).

Hypotheses 3–4: Health Insurance and Acculturation As Predictors of Exposure to Prevention Messages

As predicted by hypothesis 3, having health insurance was positively associated with last 12-month message exposure at four of the five migration phases, including the pre-departure (AOR=1.86, 95% CI: 1.22, 2.82), return (AOR=1.78, 95% CI: 1.13, 2.80), transit (AOR=2.36, 95% CI: 1.54, 3.62), and interception (AOR=2.40, 95% CI: 1.51, 3.80) phases. At the destination phase, a similar trend was found, but the positive association did not reach statistical significance.

Length of time in the U.S. was positively associated with the odds of exposure to HIV prevention at the destination and interception phases (i.e. exposure in the U.S.), as predicted by our fourth hypothesis. At the destination phase, compared to individuals who had been in the U.S. less than 1 year, those who had spent 1–5 years (AOR=2.14, 95% CI: 1.14, 4.03), 6–10 years (AOR=3.33, 95% CI: 1.76, 6.30), and more than 10 years (AOR=4.38, 95% CI: 2.38, 8.05) were significantly more likely to be exposed to HIV prevention messages. The odds became increasingly greater with longer periods in the U.S. Likewise, at the interception phase, a dose-response association between time living in the U.S. and exposure to HIV prevention was also observed. Compared to individuals who had been in the U.S. for less than 1 year, those living 1–5 years (AOR=3.96, 95% CI: 2.12, 7.38), 6–10 years (AOR=7.67, 95% CI: 4.13, 14.2), and more than 10 years (AOR=9.16, 95% CI: 4.99, 16.8) were increasingly more likely to report exposure to any prevention messages. On the other hand, as we had also hypothesized, at the return phase, time in the U.S. was negatively related to exposure to prevention messages in sending communities. Among return im/migrants, having lived in the U.S. for more than 10 years significantly reduced the odds of exposure to HIV prevention in sending communities compared to having been in the U.S. for less than 1 year (AOR=0.49, 95% CI: 0.26, 0.91).

Hypotheses 5–6: HIV Testing Rates and Exposure to HIV Prevention As A Predictor of HIV Testing

Last 12-month HIV testing rates ranged from 13.9% for im/migrants in the transit phase to 24.5% for im/migrants at the interception phase. Consistent with Hypothesis 5, return, destination and interception im/migrants ($p < 0.01$), were more likely to be tested than their pre-departure peers. In turn, transit im/migrants were significantly less likely to be tested in the last 12 months compared to im/migrants at pre-departure ($p < 0.05$; Table 1).

We found mixed support for Hypothesis 6, predicting that exposure to HIV prevention would be positively associated with the odds of HIV testing (Table 4). Among im/migrants at the pre-departure phase, exposure to general prevention messages (AOR=2.05, 95% CI: 1.05, 4.00) and to messages specifically promoting HIV testing (AOR=3.30, 95% CI: 1.81, 6.01) in sending communities were significantly related to the odds of having been tested for HIV during the last 12 months. In addition, the greater the variety of messages an individual had been exposed to, the higher the odds of reporting HIV testing at this phase (AOR=1.32, 95% CI: 1.15, 1.51). For im/migrants at the destination phase, last 12-month exposure to HIV testing messages (AOR=1.73, 95% CI: 1.22, 2.44) and greater variety of messages (AOR=1.11, 95% CI: 1.03, 1.20) in destination communities were also significantly related

to the odds of last 12-month HIV testing. At the interception phase, last 12-month exposure to general messages was also associated with HIV testing within the same time period (AOR=1.62, 95% CI: 1.08, 2.43, respectively). In general, across these three migration phases, odds ratios for different markers of exposure were consistently greater than one (signifying a positive association) and, in most cases, statistically significant. The association was particularly strong at the pre-departure phase with significant odds ratios for each of the three exposure markers. In contrast, for im/migrants at the transit and return phases, no significant associations were found between exposure to prevention messages in their most recent migration contexts (i.e. border region and sending communities, respectively) and last 12-month HIV testing.

Discussion

We investigated levels of, and factors associated with, exposure to HIV prevention messages among Mexican im/migrants across five distinct migration phases. This study indicates that a substantial percentage of im/migrants, ranging from 25–43%, has not been exposed to any HIV prevention message in their most recent migration context. Furthermore, significant variations exist in recent message exposure depending on the migration phase. Im/migrants are more likely to receive prevention messages before leaving their communities of origin for the first time (i.e. pre-departure phase) compared to any other subsequent migration phase (i.e. transit, destination, interception, return). Within sending communities in Mexico, exposure to prevention messages is also higher among im/migrants prior to their first migration trip compared to im/migrants with a history of migration to the U.S. (75.3 % versus 57.2%), even after controlling for the amount of time spent in these communities during the last 12 months and their sociodemographic characteristics. The reduction in exposure to prevention messages observed after migration is consistent with our hypothesis and with previous research indicating increased HIV risk and deterioration of contextual factors as Mexican im/migrants leave their communities of origin and transition through different migration phases in Mexico and the U.S. (Martinez-Donate et al., 2015; Ruiz et al., 2014). Our findings call for additional research to understand the reasons behind differences in exposure to HIV prevention across migration phases and for actions aimed at increasing exposure to prevention messages along the migration continuum.

Our study also reveals important information regarding the sources from which im/migrants receive HIV prevention messages, as well as the settings where exposure takes place. Across migration phases, im/migrants receive messages mostly from TV, in health care clinics, in the streets, and/or from relatives and friends. Television is the main media source of HIV prevention across all migration phases, with more than half of im/migrants in any of the phases reporting seeing or hearing an HIV prevention message on this medium in the last 12 months. The findings demonstrate the potential high reach of TV public service announcements and programming to deliver HIV risk prevention messages to a sizable portion of Mexican im/migrants. In the past, the Kaiser Family Foundation has partnered with Univision, the broadcast television network with the world's largest Spanish-language audience, to launch "Soy" ("I am"), a campaign aimed at reducing stigma surrounding HIV/AIDS within the Latino community. Similar partnerships with this and other Spanish-language television networks serving Mexicans in the U.S. and Mexico should be pursued to

encourage risk reduction and promote HIV testing among Mexican im/migrants across all migration phases (Kaiser Family Foundation & Univision, 2008).

We hypothesized that the role of social networks and informal interpersonal sources such as relatives, friends, and religious leaders would intensify at post-departure phases compared to the pre-departure phase. Our findings supported this prediction. Previous studies have shown that interventions that rely on peer counseling, lay health advisors, and population opinion leaders, such as HoMBReS-2 (Rhodes et al., 2011) and A-SEMI (Sánchez, De La Rosa, & Serna, 2013), are effective to reach, and reduce risk behaviors, among low-acculturated Latino im/migrants in the U.S. (Rhodes, Hergenrath, Bloom, Leichter, & Montañó, 2009; Somerville, Diaz, Davis, Coleman, & Taveras, 2006; Vissman et al., 2009). In contrast, and as predicted by our second study hypothesis, exposure through mass media (e.g. TV, radio, and billboards) and exposure in health care settings and from health care professionals decreases markedly after im/migrants leave their communities of origin to travel north. These changes may reflect linguistic and cultural barriers to HIV prevention and low access to health care among im/migrants in transit and receiving communities.

Overall, this study suggests the need to identify effective strategies to increase exposure to HIV prevention among Mexican im/migrants across different migration phases. Research has suggested the feasibility and effectiveness of social marketing campaigns to reach and deliver HIV prevention to Latino im/migrant populations. Yet, few HIV prevention marketing campaigns have been developed specifically to reach this population. An exception is “Hombres Sanos / Healthy Men”, a social marketing campaign implemented in North San Diego County, California, and targeting recently immigrated, mostly Mexican, heterosexually-identified Latino im/migrant males (Martinez-Donate, Zellner, Fernandez-Cerdeño, et al. 2009). Another radio-based, Spanish-language social marketing campaign targeting Mexicans in California was the “Tu No Me Conoces /You Don’t Know Me” campaign in the San Diego – Tijuana border region (Olshefsky, Zive, Scolari, & Zuñiga, 2007). In 2014, the CDC launched the “Mis Razones/My Reasons,” campaign targeting Latino men who have sex with men and with emphasis on HIV testing (www.gettested.cdc.gov/reasons/es). The extent to which this campaign reaches Mexican im/migrants will need to be investigated. The use of theatrical presentations (Hovey, Booker, & Seligman, 2007) and information technology (Grieb, Desir, Flores-Miller, & Page, 2013), with special attention to social media, should also be explored as potentially effective media to increase HIV/AIDS knowledge among im/migrants. Prevention efforts at Mexican consulates should be amplified to reach more Mexican im/migrants in the U.S.

The study findings also support the hypothesized role of health insurance and time in the U.S. as factors associated with the likelihood of receiving HIV prevention messages across migration phases. In general, our study suggests that health insurance significantly increases the odds of exposure in sending, transit, and receiving communities. This is consistent with previous research demonstrating a positive association between health insurance and access to prevention services among Latino im/migrants (Martinez-Donate et al., 2014). Notably, our study also shows that the percentage of im/migrants who have health insurance decreases dramatically after im/migrants leave their communities of origin in Mexico to travel North, which could explain the reduction in message exposure at post-migration

phases. These results underscore the importance of increasing access to health care among Mexican im/migrants and expanding insurance options, including developing binational insurance policies to provide at least a basic level of health insurance to this transnational population (Bustamante, Laugesen, Caban, & Rosenau, 2012).

Previous research has found a positive association between acculturation and access to health services among Latino im/migrants in the U.S. (Akresh, 2009; Lara et al., 2005; Vargas Bustamante et al., 2012). Consistent with that literature and our study hypotheses, we found that time in the U.S. was associated with exposure to prevention among im/migrants in the U.S. (i.e. destination and interception phases) and in sending communities in Mexico (i.e. return phase). At the destination and interception phases, the likelihood of receiving HIV prevention messages in receiving communities increased with longer time spent in the U.S. In contrast, among return im/migrants, longer residence in the U.S. was associated with lower prevention exposure in their communities of origin, even after controlling for health insurance status and other important sociodemographic and contextual variables. With more time in the U.S., im/migrants may acquire language and cultural traits that would render them more likely to be reached by prevention messages in host communities. Conversely, more acculturated im/migrants may be less easily reached by messages designed and implemented for local audiences in Mexican sending communities. In all, these findings underscore the need to tailor prevention strategies to better reach, and appeal to, low acculturated im/migrants in receiving communities and return im/migrants in sending communities.

Partially consistent with our hypothesis, we found that exposure to HIV prevention messages is positively associated with the likelihood of reporting a recent HIV test for im/migrants at some, but not all migration phases. In particular, associations between markers of exposure to prevention and HIV testing were stronger at the pre-departure phase. This may indicate greater effectiveness of prevention messages catering to soon-to-be im/migrants in sending communities and fewer barriers for translation of messages into actions at this migration phase. On the contrary, we did not find an association between exposure to prevention messages and testing for im/migrants at the *transit* and *return* phases. The low levels of message exposure found for return im/migrants in sending communities and the lack of a clear association between exposure to HIV prevention communications and HIV testing among this subset of im/migrants calls for additional research to better understand the prevention needs of a highly mobile population seemingly experiencing a loss of resources in both countries.

Consistent with previous research (Magis-Rodriguez et al. 2009), rates of last 12-month HIV testing tended to be higher among im/migrants with a recent stay in the U.S. compared to im/migrants at the pre-departure or transit phases. Ranging from 14% to 25%, recent testing rates were generally low across migration phases and much lower than levels of exposure to prevention messages, including messages promoting HIV testing. This indicates that message exposure does not translate well into preventive actions among Mexican im/migrants regardless of the migration phase they are at and suggests the need to identify and remove barriers preventing this vulnerable population from receiving HIV testing regularly, particularly at the pre-departure and transit phases. Increased efforts to make HIV testing

more available and acceptable in sending communities and the Mexican border region are warranted.

This study has several limitations. Data rely exclusively on self-report and may therefore be subject to recall and social desirability bias. The cross-sectional design prevents any insights into the direction of the associations found. For example, the association between exposure to HIV prevention and HIV testing could reflect, at least partially, reverse causality (i.e. receiving an HIV test increases exposure to HIV prevention messages). Future longitudinal studies need to be conducted to better understand the influence of exposure to HIV prevention on HIV testing behaviors. We collected raw markers of exposure to prevention messages and basic indicators of sources, media, and settings from where messages originated. The content and appeal of prevention messages, as well as the frequency of exposure, can vary substantially and these factors can affect message awareness, recall, and effects among exposed audiences. More research needs to be conducted to increase the resolution of our findings regarding exposure to HIV prevention among Mexican im/migrants. External validity is limited by a moderate response rate and collection of data solely in Tijuana. A comparison of respondents and non-respondents based on limited data available for both subsets suggested that respondents were significantly younger (i.e. about 2 years younger on average), more likely to be male and less likely to be married (See Supplemental Table S1). Finally, our methodology samples migrant flows, allowing us to reach circular and undocumented im/migrants, who may represent a hard-to-reach, more vulnerable sector of the Mexican im/migrant population. This sampling strategy provides a snapshot of HIV-related risk and prevention needs among im/migrants at different migration phases of the migration process. However, the methods exclude im/migrants who arrive in or depart from Tijuana by private car or on foot and those who fly directly from sending to receiving communities and vice versa. Exclusion of some individuals due to self-selection or eligibility criteria may influence estimates of HIV prevention exposure rates.

Conclusions

This study provides estimates of exposure to HIV prevention among Mexican im/migrants and reveals population level variations in rates of exposure to, and types of, prevention messages reaching im/migrants across different migration phases. Despite significant efforts targeting im/migrants in both the U.S. and Mexico, a large segment of the Mexican im/migrant population is not being effectively reached by HIV prevention messages. Furthermore, exposure to HIV prevention messages decreases and sources of messages change after im/migrants leave their communities of origin. Our findings have important implications for HIV prevention research and practice focused on Mexican im/migrants in Mexico and the U.S. Limited exposure to HIV prevention messages and suboptimal testing rates observed for this at-risk population call for binational policies and programs to increase HIV education and testing across the migration continuum. HIV prevention research must identify opportunities to reach and strategies to effectively deliver HIV prevention messages to im/migrants across different migration phases and contexts.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Sociodemographics, contextual factors and testing behavior of Mexican im/migrants by migration context and phase, Tijuana, 2009–2010 (n=3,149)

Table 1

	Sending Communities			Receiving Communities			p ^d
	Pre-departure Phase (Weighted N=139,395)	Return Phase (Weighted N=100,809)	Transit Phase (Weighted N=284,642)	Destination Phase (Weighted N=414,490)	Interception Phase (Weighted N=37,727)		
Age, Mean (SD)	33.2 (11.1)	35.7 (10.7) **	32.9 (10.8)	35.2 (12.1) **	31.6 (9.2) *	<0.001	
Male, %	79.5	92.4 *	83.9	89.5 *	91.3 *	<0.001	
High school or more, %	60.4	25.9 *	51.7	21.4 *	14.4 *	<0.001	
Married/cohabiting, %	48.6	59.6 *	49.6	50.0 *	48.9	0.009	
Indigenous ethnicity, %	2.1	7.4 *	1.5	4.8 *	4.8	0.004	
Years in the U.S., Mean (SD)	N/A	9.6 (9.6) <i>R</i>	1.6 (3.8) **	12.1 (9.6) **	9.0 (8.9)	<0.001	
Months in key context ^e , Mean (SD)	7.7 (4.9)	4.7 (4.8) **	4.6 (4.8) **	9.3 (4.1) **	8.2 (5.0)	<0.001	
Health insured in key context ^f , %	63.2	31.5 **	57.8	39.6 **	27.2 **	<0.001	
Perceived high HIV risk in key context ^f , %	8.9	15.7 *	33.0 **	17.4 **	29.8 **	<0.001	
Unprotected sex with casual partners/sex workers in last 12 months, %	15.4	22.1	19.4	17.7	17.1	0.089	
Incarceration in last 12 months, %	4.9	25.4 **	11.3 **	33.7 **	32.3 **	<0.001	
Last 12-month HIV tested, %	15.7	19.0 **	13.9 *	16.7 **	24.5 **	<0.001	

R Reference category.

* p<0.05 for comparison to the reference category based on adjusted regression models.

** p<0.01 for comparison to the reference category based on adjusted regression models.

^a *P* value for overall effect of migration phase, based on logistic (for binary outcomes) and multiple linear (for continuous outcomes) regression models. Models for sociodemographics were unadjusted. Models for behavioral, contextual, and testing behaviors were adjusted for age, gender, marital status, education, and ethnicity. The referent category was pre-departure unless otherwise indicated.

^b Key context refers to the migration environment represented by each flow: sending communities for pre-departure and return migrants, Mexican border region for transit migrants, and receiving communities for migrants at destination and interception phases

Table 2

Last 12-Month exposure to prevention messages among Mexican im/migrants by migration context and phase, Tijuana, 2009–2010 (n=3,149)

	Sending Communities			Border	Receiving Communities			p ^d
	Pre-departure Phase (Weighted N=139,395)	Return Phase (Weighted N=100,809)	Transit Phase (Weighted N=284,642)		Destination Phase (Weighted N=414,490)	Interception Phase (Weighted N=37,727)		
Exposed to prevention message ^b , %	75.3	57.2 *	68.0	61.9 **	62.7 **	<0.001		
Exposure by Message Content:								
Condom use, %	73.2	54.1 **	61.3	53.8 **	56.4 **	<0.001		
STI testing, %	60.1	45.0	52.3	50.5 **	47.3 *	0.005		
HIV/AIDS testing, %	59.7	45.2	57.0	52.0 *	47.2 *	0.084		
Monogamous relationship, %	55.5	40.7	49.8	40.5 **	45.0 *	<0.001		
Reducing number of sex partners, %	54.9	38.7	44.8	41.3 **	42.3 *	0.003		
Number of messages by content, Mean (SD)	3.0 (2.1)	2.2 (2.2)	2.7 (2.2)	2.4 (2.2) **	2.4 (2.1) **	<0.001		
Exposure by Interpersonal Source:								
Family member, %	45.1	58.7 **	58.3 **	60.3 **	67.0 **	<0.001		
Friends, %	43.1	55.7 **	59.6 **	59.0 **	66.7 **	<0.001		
Health professional, %	40.1	31.0	38.5	32.4 **	45.5	0.006		
Religious leader, %	27.2	48.2 **	36.9 **	43.1 **	43.0 **	<0.001		
Other personal sources, %	27.0	18.7	33.5 **	27.0	34.6 **	<0.001		
Number of interpersonal sources, Mean (SD)	1.8 (1.3)	2.1 (1.2) **	1.7 **	2.2 (1.3) **	2.6 (1.1) **	<0.001		
Exposure by Media Channel:								
Television, %	68.5	47.0 \$	61.9	55.7 **	57.0 **	<0.001		
Radio, %	38.2	24.7	39.4	31.2 *	38.3	<0.001		
Posters/billboards, %	38.3	23.9 **	31.3	24.7 *	27.2 **	<0.001		
Other ^c , %	43.0	32.5	40.5 *	34.0	41.3	<0.001		
Number of media sources, Mean (SD)	1.9 (1.5)	1.3 (1.5) *	1.7 (1.5)	1.5 (1.5) **	1.6 (1.6)	<0.001		
Exposure by Setting:								
Clinic, %	48.4	35.6	45.3	40.4 **	50.4	<0.001		

	Sending Communities			Border		Receiving Communities		p ^d
	Pre-departure Phase (Weighted N=139,395)	Return Phase (Weighted N=100,809)	Transit Phase (Weighted N=284,642)	Destination Phase (Weighted N=414,490)	Interception Phase (Weighted N=37,727)			
Consulate, %	0.0	0.0	2.4 ^R	5.6	8.8 ^{**}	<0.001		
School, %	9.1	8.5	19.5 ^{**}	11.8 [*]	21.2 ^{**}	<0.001		
Street, %	53.4	63.3	60.5 [*]	62.9 ^{**}	64.3 ^{**}	<0.001		
Other, %	36.3	25.3	40.0	32.8	35.7	0.021		
Number of settings, Mean (SD)	1.5 (1.0)	1.3 (0.9)	1.7 (1.2) ^{**}	1.5 (1.1)	1.8 (1.2) ^{**}	<0.001		

^RReference category.

^{*} p<0.05 for comparison to the reference category based on adjusted regression models.

^{**} p<0.01 for comparison to the reference category based on adjusted regression models

^a P value for overall effect of migration phase, based on logistic (for binary outcomes) and multiple linear (for continuous outcomes) regression models. Models were adjusted for age, gender, marital status, education, ethnicity, and time in the key context during last 12 months. The referent category was pre-departure unless otherwise indicated.

^b Exposure in key migration context during the last 12-months. Key context refers to the migration environment represented by each flow: sending communities for pre-departure and return migrants, Mexican border region for transit migrants, and receiving communities for migrants at destination and interception phases.

^c Other media sources include newspapers, magazines, internet, fliers, comic books, and other written media.

Table 3

Factors associated with last 12-month exposure to prevention messages among Mexican im/migrants within each migration phase (n=3,149)

	Sending Communities			Border		Receiving Communities	
	Pre-departure Phase AOR	Return Phase AOR	Transit Phase AOR	Destination Phase AOR	Interception Phase AOR		
Age	0.99	1.02	0.98	0.98 *	0.99		
Male	0.69	0.88	0.74	1.01	0.87		
Married	1.17	1.20	0.65 *	0.79	1.02		
Completed high school	0.74	1.41	1.40	1.38	1.06		
Indigenous ethnic	0.52	0.53	4.39	0.80	1.54		
Have health insurance last 12 months	1.86 **	1.78 *	2.36 **	1.11	2.40 **		
Time spent in the U.S. during lifetime							
• No migration history	NA	NA	Ref	NA	NA		
• Less than 1 year		Ref	1.35	Ref	Ref		
• 1 to less than 5 years		0.95	1.76	2.14 *	3.96 *		
• 5 to less than 10 years		0.68	1.40	3.33 **	7.67 **		
• >10 years		0.49 *	2.43	4.38 **	9.16 **		
Perceived high risk for HIV in key context	1.56	0.53 *	1.12	1.16	0.76		
Incarceration in last 12 months	0.49	1.39	0.83	0.53 **	0.89		

AOR: Adjusted odds ratios based on logistic regression models with exposure to any prevention message as outcome and all variables included in the table as predictors. Models were stratified by migration phase.

* p<0.05 for comparison to the reference category.

** p<0.01 for comparison to the reference category.

Association between prevention message exposure indicators and HIV testing behavior among Mexican im/migrants by migration phase (n=3,149)

Table 4

	Sending Communities			Mexican Border		Receiving Communities	
	Pre-departure Phase AOR	Return Phase AOR	Transit Phase AOR	Destination Phase AOR	Interception Phase AOR		
<i>Testing for HIV Last 12 Months¹</i>							
Model 1: Last 12 months general prevention messages	2.05 *	1.15	1.11	1.39	1.62 *		
Model 2: Last 12 months HIV test prevention message	3.30 **	1.15	1.58	1.73 **	1.42		
Model 3: No. of prevention messages in last 12 months	1.32 **	1.02	1.06	1.11 **	1.06		

¹ Table shows adjusted odds ratios based on logistic regression models with exposure to testing for HIV during the last 12 months as the outcome and different exposure indicators as main predictors. Models were stratified by migration phase. All models were controlled for age, gender, marital status, education, ethnicity, health insurance, perceived risk for HIV infection, sexual risk, and incarceration history in the last 12 months.

* p<0.05 for comparison to the reference category based on adjusted regression models.

** p<0.01 for comparison to the reference category based on adjusted regression models.