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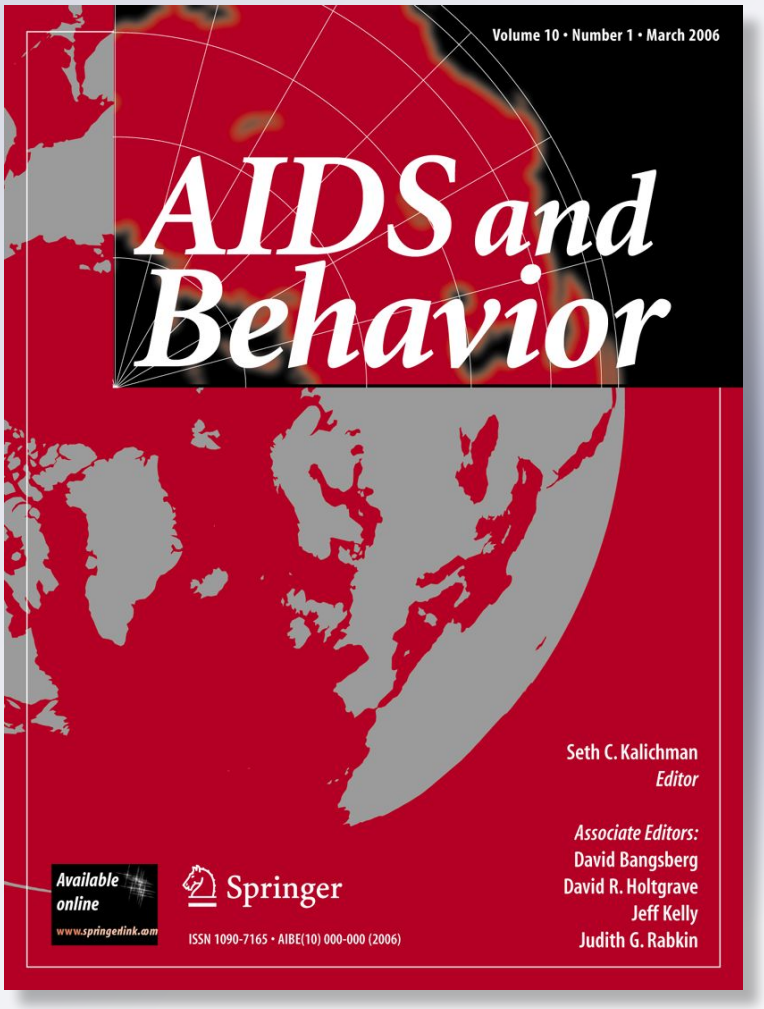

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ORIGINAL PAPER

A Two-Way Road: Rates of HIV Infection and Behavioral Risk Factors Among Deported Mexican Labor Migrants

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Abstract A large number of Mexican migrants are deported to Mexico and released in the North Mexican border region every year. Despite their volume and high vulnerability, little is known about the level of HIV infection and related risk behaviors among this hard-to-reach population. We conducted a cross-sectional, probability survey with deported Mexican migrants in Tijuana, Mexico ($N = 693$) and estimated levels of HIV infection and behavioral risk factors among this migrant flow. The sample and population estimated rates of HIV for deported males were 1.23 and 0.80 %, respectively. No positive cases were found among the female sample. We found high lifetime rates of reported sexually transmitted infections (22.3 %) and last 12-months rates of unprotected sex (63.0 %), sex with multiple sexual partners (18.1 %), casual partners (25.7 %), and sex workers (8.6 %), compared to U.S. and Mexico adults. HIV prevention, testing, and treatment programs for this large, vulnerable, and transnational population need to be implemented in both the U.S. and Mexico.

RESUMEN Un gran número de migrantes Mexicanos en los Estados Unidos son deportados y liberados en la región fronteriza de Mexico cada año. A pesar de su volumen y grado de vulnerabilidad, existen pocos datos sobre la prevalencia de infección por VIH y conductas de riesgo asociadas con el VIH entre esta población de migrantes. Se realizó una encuesta transversal con muestreo probabilístico de 693 migrantes Mexicanos deportados en la ciudad fronteriza de Tijuana, Mexico. Se estimaron niveles de infección for VIH y conductas de riesgo asociadas con esta infección. La prevalencia de VIH calculada para la muestra y poblacion de varones deportados fue de 1.23 % y 0.80 %, respectivamente. No se encontro ningún caso positivo para el VIH entre mujeres. Comparado con adultos en Estados Unidos y México, las tasas de infecciones de transmisión sexual a lo largo de la vida (22.3 %) y tasas de sexo sin protección (63.0 %), con múltiples parejas (18.1 %), parejas casuales (25.7 %) y trabajadoras sexuales (8.6 %) durante los 12 meses previos a la encuesta fueron relativamente altas. Los resultados indican la necesidad de implementar programas para prevenir, diagnosticar, y tratar el VIH entre esta población transnacional y vulnerable.

Keywords HIV · Risk behaviors · Mexican migrants · Deportation

Palabras Clave VIH · Conductas de riesgo · Migrantes Mexicanos · Deportación

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Introduction

Migration has been identified as a structural factor associated with increases in HIV incidence and vulnerability [1]. Previous studies on Mexican labor migrants in the U.S. have found high rates of sexually transmitted infections (STIs) [2, 3] and behavioral risk factors, including unprotected sexual practices, sex with multiple partners and sex workers, and needle sharing practices [4–6]. The risk for HIV infection extends to non-migrant individuals in communities of origin, as Mexican labor migrants traveling back and forth between Mexico and the U.S. may serve as a bridge population from high incidence to low incidence populations. Data from Mexico have suggested a link between migration to the U.S. and the HIV/AIDS epidemic, including increased numbers of AIDS cases in rural communities and a high concentration of AIDS cases in those states that send the highest number of migrants to the U.S. [7–9]. Although the prevalence of HIV infection among Mexican labor migrants is not known, data from studies in both the U.S. and Mexico raise concern about the possibility for the rapid spread of the HIV epidemic in this population and the implications for the migrants and their sexual partners in the communities of origin and destination [10, 11].

Not all Mexican migrants stand the same risk for HIV infection. Every year, approximately half a million Mexican labor migrants are apprehended and deported, or otherwise repatriated, to the North border of Mexico [12, 13]. Although not all repatriations involve a legal deportation process, for simplicity, we henceforth use the term "deported" to refer to migrants who have been repatriated by immigration authorities with or without a legal deportation hearing.

Deported Mexican migrants represent a sizable and, possibly, the most vulnerable segment of all Mexican labor migrants. After deportation, some migrants try to reestablish their lives in Mexico, but most seek to re-enter the U.S. shortly after deportation [14] and many succeed [15]. Deported Mexican migrants are largely unauthorized to enter and/or work in the U.S. and, as such, they frequently resort to illegal border crossing practices that may expose them to high economic cost and perils such as environmental hazards, encounters with thieves and criminals, and apprehension and detention by the U.S. Border Patrol. After deportation, migrants are dropped off in the Mexican border to fend for themselves, often without money, food, or shelter [14]. If successful at crossing, unauthorized Mexican migrants in the U.S. experience insecure legal standing, marginalization, social isolation, poor living and working conditions, and limited access to medical, legal, and other basic resources [16–18]. Exposure to multiple stressors, limited availability of material and social resources to cope with stress, disruption of family and romantic relationships, and lack of social controls created by these structural and situational factors can increase the possibility of engaging in risky behaviors [5], such as high rates of alcohol use and binge drinking, and sex with sex workers, casual, and other risky partners [18–21]. Such behaviors can facilitate HIV transmission to and among unauthorized and deported migrants in the U.S. and the Mexican border region.

The volume and high mobility of deported Mexican labor migrants have important implications for HIV prevention and control in both the U.S. and Mexico. At present, little is known about the prevalence of HIV infection and risk factors among deported Mexican migrants. Deportation from the U.S. has been identified as a risk factor for HIV infection among male injection drug users (IDUs) in the US-Mexico border [22] and is associated with incarceration [23], financial instability and physical danger [24], riskier drug use patterns, and less interaction with public health services [25]. However, there are scarce data on HIV risk among the general population of deported Mexican migrants. Information on immigration status is often unavailable in epidemiological studies on Mexican migrants in the U.S. Estimates of HIV infection and related risk factors among deported Mexican migrants are further challenged by methodological difficulties to reach representative samples of this highly-mobile and geographically widespread population in both the U.S. and Mexico [26]. A 2002 survey found high rates of HIV risk practices among deported Mexican migrants released in the Mexican border city of Tijuana, but the small size of deported sample of this study limits the generalizability of these findings [27]. Accurate estimates of HIV rates and levels of risk among deported Mexican labor migrants can inform the need for HIV prevention and treatment programs targeting this large, disenfranchised, and transient population moving back and forth between the U.S. and Mexico.

The present study examines the prevalence of HIV infection, behavioral risk factors for HIV and other STIs, and access to HIV/STI testing and treatment services among a large, population-based sample of deported Mexican labor migrants. We hypothesize that this highly vulnerable population will present higher rates of HIV infection and behavioral risk factors compared to non-migrant populations in the U.S. and Mexico.

Methods

Sampling and Recruitment Procedures

From August to November 2009, a cross-sectional, population-based survey was conducted with deported Mexican labor migrants in Tijuana, Mexico. The San Diego—Tijuana border region accounts for 22 % of all U.S. Border Patrol

apprehensions [12] and 40 % of all deportations to the Mexican border region [28]. Approximately 135,000 migrants were deported through Tijuana in 2010 [28]. Recruitment and data collection took place in the area immediately outside the only operating deportation facility in Tijuana. A probability-based sampling design was used to produce reliable estimates of the volume and characteristics of the deported Mexican labor migrant population returned to Mexico through the border city of Tijuana. Sampling dates and times where randomly selected. Information on number of deportations through the Tijuana facility during previous years and for different time periods (e.g., quarter, day of the week, and time of the day) was obtained from the Mexican Institute of Migration and the Survey of Migration at the North Border of Mexico (EMIF, as per its Spanish acronym) [29]. This information was used to create a sampling framework and compute survey weights for the current study. During each 8-h survey shift, individuals were consecutively approached by trained project staff as they exited the Mexican deportation facility and screened for eligibility. Two project staff members recruited participants simultaneously during each survey shift. Eligible individuals were 18 years and older, born in Latin America, returned to Mexico by U.S. immigration authorities, fluent in Spanish, and with no history of previous participation in the survey. A project staff member explained the study and its components, including the HIV testing, to each potential participant and obtained verbal consent from eligible individuals prior to their inclusion in the study. Study participants received a $10 phone card incentive. The screening and recruitment procedures described above were repeated consecutively from the beginning to the end of each survey shift. These sampling methods have been used in the past by the EMIF to recruit representative samples and generate population estimates of the volume and characteristics of deported Mexican labor migrants [29, 30].

Measures

Participants completed an anonymous questionnaire administered by an interviewer using QDS™ Questionnaire Development System computer-assisted personal interview (CAPI) and an FDA-approved rapid finger-stick blood HIV test. Depending on availability and price, Clearview® HIV 1/2 STAT-PAK (Inverness Medical Professional Diagnostics, Princeton, NY) or Hexagon® HIV 1 + 2 (Human GMBH, Wiesbaden, Germany) was used. Sensitivity is reported as 99.7 and 100 %, respectively. Specificity is reported as 99.9 and 99.3 %, respectively [31, 32]. For participants with positive or invalid results to the rapid test, we used the Orasure HIV-1 Oral Specimen Collection Device (Orasure Technologies, Inc., Bethelem, PA) to collect oral mucosal transudate samples subjected to enzyme-linked immunosorbent assay (ELISA, 99.9 % sensitivity) and confirmatory testing by means of the Western blot procedure (98 % specificity) [33]. A binational, toll-free phone line was set up to communicate the results of confirmatory testing to the anonymous study participants. Project staff tending the call center was trained by personnel from the local Outpatient Center for HIV/AIDS Prevention and Treatment (CAPASIT, as per its acronym in Spanish) and followed standard protocols established by CENSIDA, the National Center for AIDS Prevention and Control in Mexico. A comprehensive binational directory of HIV/AIDS prevention and treatment resources was developed, continuously updated, and used to refer callers for follow-up testing and treatment based on their location. Callers were prompted to provide a unique numeric code given to them separately from the toll-free number at the time of the survey. Participants were counseled not to share this information or their results with anyone other than a medical provider. All study procedures were reviewed and approved by the authors' institutional review boards in both the U.S. and Mexico.

Sample

A target sample size of 600 was set based on power estimates necessary to detect small HIV prevalence rates. Following the sampling and recruitment procedures described in the previous section, 775 individuals were approached as they exited the deportation facility. Of them, 705 answered the screening survey, 702 met eligibility criteria for study inclusion, and among these, 693 agreed to participate. Response rates, calculated according to standard definitions [34], were 88.5 % for the questionnaire and 79.9 % for the HIV test. The final sample included 642 males and 51 females, with an average age of 31.9 years (SD = 9.1, range 18–73).

Data Analyses

Observations were weighted for estimation of population parameters. Survey weights were computed for each observation, following the general principles to estimate survey weights with multi-stage sampling procedures and to account for the survey design, eligibility rates, and response rates. The equations used for computation of survey weights have been described elsewhere [29, 30]. Weighted data were used to compute descriptive statistics and characterize the socio-demographic and migration profile of the study population. Point prevalence estimates and 95 % confidence intervals (CI) were computed for HIV infection and related risk factors. We used Chi-square tests and *t*-tests for independent samples to test for significant differences between study participants tested for HIV

Table 1 Estimated sociodemographic and migration characteristics of deported labor Mexican migrants and immigrants, Tijuana, Mexico, 2009

	Males $N = 36{,}971$	Females $N = 3{,}494$	All $N = 40{,}465$
Sociodemographics			
Age (years), Mean (SD)	31.8 (9.2)	30.6 (9.4)	31.8 (9.2)
Completed high school or higher, %	13.7	19.6	14.2
Married/cohabiting, %	49.3	50.1	49.3
Migration history			
Time spent in the US during lifetime (years), mean (SD)	9.2 (8.8)	7.1 (9.5)	9.0 (8.9)
Considers the U.S. their current place of residence, %	29.0	30.4	29.1
Crossed the border illegally last time they entered in the U.S., %	96.4	89.5	95.8
Previous history of migration to the US, %	62.7	47.4	61.5
Previous history of deportation, %	53.8	37.8	52.5
Plans to return to the US, %	70.5	66.7	70.2
Last 12 months in the US			
US state they lived in most time[a], %			
California	79.2	80.2	79.2
Other West states	13.2	7.3	12.9
Other states	2.8	8.4	3.2
Time spent in the US during last 12 months, %			
≤24 h	18.4	46.8	20.9
More than 24 h, less than 6 months	14.6	12.2	18.2
≥6 months, but less than 12 months	21.4	13.8	26.3
12 months	45.7	27.3	34.7
Full time employed most of the time in the US during last 12 months[b], %	72.3	53.9	71.0
Last occupation industry in the US[a,c], %			
Construction	33.4	0	32.9
Agriculture/landscaping	15.0	19.8	15.1
Leisure/hospitality	12.0	36.4	12.4
Manufacturing	9.4	15.5	9.5
Retail trade	7.7	6.1	7.6
Services	4.0	22.2	4.3

[a] Percentages may not add up to 100 because of omitted categories

[b] Among individuals who were in the U.S. for more than 24 h

[c] Among individuals who were full-time, part-time, or self-employed in the U.S

infection and those who refused to be tested. All analyses were conducted using STATA/SE 10.0 (StataCorp LP, College Station, TX).

Results

The study sample represented a weighted population of 36,971 males and 3,494 females deported to Tijuana during the study period. The results that follow, as well as those displayed in the tables, reflect the characteristics of the study population, based on analysis using weighted data.

Socio-demographics and migration profile of the deported Mexican migrant population

Deported Mexican labor migrants were mostly male (91.4 %) and relatively young (Mean = 31.8 years [SD = 9.2] for males; Mean = 30.6 [SD = 9.4] for females; Table 1). Only 13.7 % of males and 19.6 % of females had completed high school or a higher level of education. On average, they had spent 9.0 years in the U.S. (SD = 8.9) during their lifetime (Mean = 9.2 years [SD = 8.8] for males; Mean = 7.1 [SD = 9.5] for females). Close to two-thirds of males (62.7 %) had a previous history of migration to the U.S. and more than half (53.8 %) had been deported at least once previously by U.S. immigration authorities. For females, these rates were 47.4 and 37.8 %, respectively. The majority of deportees (96.4 % of males and 89.5 % of females) crossed the border illegally the last time they entered the U.S. Time spent in the US during the last 12 months varied from 24 h or less (18.4 % of males; 46.8 % of females) to 12 months (45.7 % of males; 27.3 % of females). The majority of the males (72.3 %) and more than half of the females (53.9 %) had been employed full time while in the U.S. Construction (33.4 %), agriculture/landscaping

Table 2 Estimated last 12-month behavioral risk practices for HIV infection among deported labor Mexican migrants and immigrants, Tijuana, Mexico, 2009

	Males $N = 36{,}971$ % (95 % CI)	Females $N = 3{,}494$ % (95 % CI)	All $N = 40{,}465$ % (95 % CI)
Number of vaginal or anal sex partners			
Zero	14.2 (10.6–17.7)	18.2 (5.0–31.4)	14.5 (11.1–17.9)
One	48.7 (43.7–53.8)	64.8 (48.5–81.1)	50.1 (45.4–54.9)
2–5	29.0 (24.5–33.4)	17.0 (4.0–30.1)	27.9 (23.6–32.1)
6–10	5.2 (3.2–7.1)	0	4.7 (3.0–6.5)
More than 10	3.0 (0.9–5.0)	0	2.7 (8.4–4.6)
Unprotected vaginal or anal sex	62.6 (57.8–67.3)	67.5 (52.4–82.5)	63.0 (58.5–67.5)
Anal sex with same-sex partners (men only)	1.1 (0.2–1.9)	n.a.	1.1 (0.2–1.9)
Unprotected anal sex with same-sex partners (men only)	0.2 (0.0–0.4)	n.a.	0.2 (0.0–0.4)
Vaginal or anal sex with casual partners	27.0 (22.7–31.3)	12.7 (1.9–23.6)	25.7 (21.7–29.8)
Unprotected vaginal or anal sex with casual partners	15.3 (11.7–18.9)	10.4 (0–20.9)	14.9 (11.5–18.3)
Vaginal or anal sex with sex workers	9.4 (6.4–12.3)	0.8 (0–2.4)	8.6 (5.9–11.3)
Unprotected vaginal or anal sex with sex workers	3.9 (1.9–6.0)	0	3.6 (1.7–5.5)
Sex with partners who have other sexual partners	19.2 (14.9–23.6)	6.5 (0.0–12.5)	18.1 (14.1–22.1)
Sex with injecting drug user	6.4 (3.9–8.8)	2.7 (0.0–7.9)[a]	6.0 (3.7–8.3)
Sex in exchange for money or other goods	4.2 (1.9–6.4)	0	3.8 (1.8–5.8)
Sex against their will	0.9 (0.0–2.0)	4.1 (0.0–12.2)[a]	1.2 (0.0–2.4)
Use of illegal drugs	21.4 (17.2–25.6)	2.2 (0.0–4.8)[a]	19.8 (15.9–23.7)
Sex under the influence of alcohol	35.9 (31.1–40.8)	15.7 (5.3–26.1)	34.1 (29.6–38.7)
Sex under the influence of other drugs	10.6 (7.6–13.7)	0	9.8 (7.0–12.6)

CI confidence interval

[a] Due to small cell sizes, 95 % CI lower bound was negative and was rounded to 0

(15.0 %), leisure/hospitality (12.0 %), and manufacturing (9.4 %) were the main occupation sectors for males. Females were employed mostly in leisure/hospitality (36.4 %), services (22.2 %), agriculture/landscaping (19.8 %), and manufacturing (15.5 %). Most deported Mexican migrants (70.5 % of males; 66.7 % of females) were planning to return to the US in the future.

Behavioral risk factors for HIV infection during the last 12 months

Reports of last 12-month multiple sex partners, defined as two or more sex partners, (37.2 % of males; 17.0 % of females), unprotected vaginal or anal sex (62.6 % of males; 67.5 % of females), sex with casual partners (27.0 % of males; 12.7 % of females) and sex with sex workers (9.4 % of males; 0.8 % of females) were common, particularly among males (Table 2). Approximately, 56.7 % of males and 81.9 % of females who had sex with casual partners in the previous 12 months did not use condoms consistently or at all with these partners (data not shown). Among those who had sex with a sex worker, rates of inconsistent or no condom use were 41.5 % for males and 0 % for females (data not shown). Other less prevalent behavioral risk practices included sex with injecting drug user partners (6.4 % of males; 2.7 % of females), sex with individuals who had other sexual partners (19.2 % of males; 6.5 % of females), and sex in exchange for money or other goods (4.2 % of men; 0 % of females). An estimated 1.1 % of males had engaged in anal sex with same-sex partners and 0.2 % (i.e. 18.2 % of those who had same-sex anal sex) had not used condoms consistently or at all with their male sex partners. Illegal drug use (21.4 % of males; 2.2 % of females) and sex under the influence of alcohol (35.9 % of males; 15.7 % of females) or other drugs (10.6 % of females; 0 % of females) were also relatively prevalent practices, particularly among males.

History of HIV/STI Testing and Access to Medical Services

Lifetime rates of HIV testing were 51.1 and 54.3 % for male and female deportees, respectively, while last-12 month HIV testing rates were 25.5 % for males and

Table 3 Estimated rates of HIV/STI testing and access to health care among deported labor Mexican migrants and immigrants, Tijuana, Mexico, 2009

	Males $N = 36{,}971$ % (95 % CI)	Females $N = 3{,}494$ % (95 % CI)	All $N = 40{,}465$ % (95 % CI)
Ever tested for HIV	51.1 (46.0–56.1)	54.3 (37.3–71.4)	51.4 (46.5–56.2)
Tested for HIV during the last 12 mos.	25.5 (21.3–29.7)	17.6 (5.3–29.9)	24.8 (20.8–28.8)
Tested for HIV while in the U.S.	19.4 (15.4–23.3)	11.2 (0.9–21.4)	18.7 (15.0–22.4)
Knew where to get tested for HIV in the US[a]	46.0 (40.1–51.8)	61.8 (41.5–82.1)	47.3 (41.6–52.9)
Lifetime history of STI	21.7 (17.6–25.9)	27.7 (12.3–43.2)	22.3 (18.2–26.3)
Tested for STI during the last 12 mos.	11.5 (8.3–14.8)	19.8 (6.5–33.1)	12.2 (9.1–15.4)
Had a STI during the last 12 mos.	9.8 (6.5–13.0)	13.3 (1.2–25.5)	10.1 (7.0–13.2)
STI was treated by health professional[b]	33.3 (17.2–49.3)	78.7 (19.2–100.0)[5]	38.6 (22.6–54.5)
Had a STI while in the U.S.	7.6 (4.6–10.6)	0	7.0 (4.2–9.7)
STI was treated by health professional in the U.S.[c]	37.1 (17.2–57.1)	NA	37.1 (17.2–57.1)
Health insurance in the US			
None of the time	73.0 (68.3–77.7)	65.7 (47.6–83.9)	72.4 (67.9–77.0)
Some of the time	9.4 (6.4–12.3)	21.8 (5.6–38.1)	10.4 (7.3–13.4)
All of the time	17.6 (13.6–21.7)	12.4 (0.2–24.7)	17.2 (13.3–21.6)
Type of health insurance in the U.S.[d]			
Public program	17.7 (9.4–25.9)	66.4 (31.3–100.0)[e]	22.6 (14.1–31.2)
Private	79.8 (71.3–88.2)	33.6 (0.0–68.7)	75.1 (66.4–83.7)
Other	2.6 (0.0–5.1)	0	2.3 (0.0–4.5)

CI confidence interval. *NA* not applicable

[a] Among those who were not tested for HIV infection

[b] Among those who had a STI during the last 12 months

[c] Among those who had a STI while in the U.S. during the last 12 months

[d] Among those who had health insurance some or all of the time

[e] Due to small cell sizes, 95 % CI upper bound exceeded 100 and was rounded to 100

17.6 % for females (Table 3). Approximately 19.4 % of deported males and 11.2 % of deported females had been tested for HIV in the U.S. Among those *not* tested for HIV in the U.S., 46.0 % of males and 61.8 % of females knew of HIV testing services available to them in the U.S.

Estimates of reported lifetime and last-12 month rates of other STIs were 21.7 and 9.8 %, respectively, for males; and 27.7 and 13.3 % for females. Approximately 33.3 % of males who had an STI during the previous 12 months received STI treatment. A substantially higher percentage of females reporting an STI (78.7 %) received treatment. About 7.6 % of males had an STI while they were in the U.S., but among them, only 37.1 % received STI treatment. No females reported having had an STI while in the U.S.

Most deported Mexican migrants did not have health insurance in the U.S. during the last 12 months (73.0 and 65.7 % of females). About 9.4 % of males and 21.8 % of females had health insurance only *some* of the time. Of those who had health insurance at some point, most males had private health insurance (79.8 %), while most females were insured through a public program (66.4 %).

Prevalence of HIV Infection

Given the low number of positive individuals, both the sample and population estimates of HIV infection were calculated (Table 4). Overall, 1.15 % of tested participants and 0.73 % of the corresponding weighted population were estimated to be HIV positive. For males, the sample and population estimated rates of HIV were 1.23 and 0.80 %, respectively. No positive cases were found among the female subsample. The seven deported Mexican migrants who tested positive for HIV were 26–35 years old (Mean = 28.9; SD = 3.6). Two reported prior testing for HIV infection; only one of them reported that the result of their last HIV test was positive. Two of the HIV + participants called the toll free line; only one received his HIV + confirmatory test results. The second individual called only once before results were available (data not shown).

Of the 83 survey respondents who were not tested for HIV in our study, 51.9 % reported having *ever* been tested for HIV infection. None of them reported a positive HIV

Table 4 Sample and population estimated rates of HIV infection among deported labor Mexican migrants and immigrants, Tijuana, Mexico, 2009

	Sample % (95 % CI)	Population % (95 % CI)
Males		
Estimate	1.23 (0.32—2.14)	0.80 (0.20—1.40)
Lower bound estimate[a]	1.09 (0.28—1.90)	0.73 (0.18—1.28)
Females		
Estimate	0.00 (NA)	0.00 (NA)
Lower bound estimate[a]	0.00 (NA)	0.00 (NA)
All		
Estimate	1.15 (0.30—2.00)	0.73 (0.18—1.28)
Lower bound estimate[a]	1.01 (0.26—1.76)	0.66 (0.16—1.17)

CI confidence interval; *NA* not applicable

[a] Assuming all non-tested participants were HIV negative

status. Tested individuals differed significantly from non-tested survey respondents, reporting (1) older age ($t = -2.95$, df = 691, $p = 0.003$); (2) more time spent in the U.S. during lifetime ($t = -2.68$, df = 670, $p = 0.008$) and in the last 12 months (unequal variance $t = -2.84$, df = 97.6, $p = 0.005$; and (3) higher rates of deportation history ($\chi^2 = 9.53$, df = 1, $p = 0.002$); Tested individuals were also more likely to report a lifetime ($\chi^2 = 5.20$, df = 1, $p = 0.023$) and last 12-month history of STIs (Fisher's Exact Test, $p = 0.001$), and a 12-month history of unprotected vaginal or anal sex ($\chi^2 = 5.13$, df = 1, $p = 0.024$; data not shown). These differences suggested a riskier profile of the tested subsample compared to non-tested study participants. If all non-tested participants had been HIV negative, the HIV prevalence in the sample and the corresponding weighted population of deported males would have been 1.01 and 0.66 %, respectively.

Discussion

This study estimated the prevalence of HIV infection and related risk factors among deported Mexican labor migrants returned by U.S. immigration authorities to the border city of Tijuana, Mexico. Our results indicated a 0.8 % prevalence of HIV infection among deported males, more than twice that estimated for the male adult population in Mexico (0.3 %) [35] and above rates of HIV infection among male adults and adolescents in the U.S. (0.7 %). The small size of the female subsample in our study, although representative of the gender distribution of the target population [37], did not allow us to estimate the prevalence of HIV infection among deported Mexican females.

Our survey revealed high rates of both lifetime and last 12-month history of STIs and behavioral risk factors among Mexican deportees. For deported males, we estimate that more than 1 out of 5 have had an STI during their lifetime and, among them, half have had an STI during the previous 12 months. No comparable data are available for Mexico adult males, but our estimate for lifetime STI rates among deported Mexican migrant males is above the 7.4 % rate estimated for males 15–44 years old in the U.S. [38]. Furthermore, our results suggest a high prevalence of sexual risk practices among Mexican male deportees, including sex with multiple partners and limited use of condom with casual partners and sex workers. Our estimated 37.2 % rate of last 12-month *multiple sexual partners* among deported migrant males contrasts with 8.5 % estimated for males 20–49 years old in Mexico [39] and 18 % for U.S. males aged 15–44 years of age [38]. Last 12-month rates of *sex with sex workers* among deported males based on our study were higher than those estimated among adult males in the U.S. (9.4 % vs. 0.7 %) [40] and heterosexual males in Mexico City (4 %) [41], but substantially lower than figures previously reported in other studies with nonprobability samples of Mexican migrants in the U.S. and Mexico (26–41 %) [8, 20, 42, 43]. Notably, among the subset of male deportees who had sex with sex workers, rates of inconsistent or no condom use (42%) were slightly higher than estimates for adult males in Mexico City (38 %) [41] and above rates found among other samples of Mexican migrants in the U.S. and Mexico (0–26 %) [20, 27, 43, 44]. Overall, these figures are consistent with previous research suggesting higher prevalence rates and increased risk for HIV and other STIs among Mexican migrant males compared to their non-migrant counterparts in the U.S. and Mexico. [2–6] Even low rates of high impact risk behavior, such as injection drug use or sex with commercial sex workers, may have major public health implications for HIV and other infections over time, given the population size involved. Once the infection is introduced to the population, it also might increase in incidence very rapidly given limited condon use and, presumably, other preventive behaviors, such as use of clean needles.

Our survey results also indicate high rates of STIs and behavioral risk factors for HIV infection among Mexican female deportees, suggesting that this population may be at similar or even higher risk for HIV infection than their male counterparts. Despite being based on a small sample, our results on HIV behavioral risk factors among deported Mexican females are important given the limited data available to date on HIV risk among Mexican migrant females [45].

Overall, our estimated prevalence of HIV infection among deported Mexican migrants is higher than the

0–0.47 % found among convenience, respondent-driven, or targeted samples of Latino migrant and recent immigrants in the U.S. [46–49]. The estimated prevalence of a lifetime history of STIs (21.7 % for males; 27.7 % for females) is also higher than those suggested by previous studies on Mexican migrant and seasonal farmworkers in California (8.3–12 % for males; 5–9.8 % for females) [46–50]. Notably, compared to the rates of HIV and other STIs found among deported Mexican migrants in 2002 by using the same sampling methods as those used in this study, the rate of and risk for HIV infection both seem to have increased over time in this population [27]. The previous survey found no positive cases of HIV among a sample of 167 deported Mexican migrants and the estimated lifetime rate of STIs was almost a third of that we have estimated in our current study [27]. The small size of the deported sample in the 2002 study may have lead to unreliable prevalence estimates for this population. Alternatively, differences may reflect increased HIV risk among deported Mexican migrants resulting from recent changes in border control efforts and immigration law enforcement [51–53], increased anti-immigration sentiments [54], and rising unemployment rates [55] in the U.S. It is possible that these structural changes have deteriorated the living and working conditions of unauthorized Mexican migrants in the U.S. and elevated their risk for HIV infection and other health problems. Measures to make illegal border crossing more difficult can result in extended periods of time in the north border of Mexico prior to entering the U.S. and after deportation. Longer periods in the north border of Mexico may increase migrants' risk for HIV, given that this region is characterized by higher HIV and AIDS rates [56] and greater availability of drugs than the rest of Mexico [57]. Previous research suggests that following deportation from the U.S., migrants face multiple economic and social stressors that may increase their risk for HIV infection [14, 25, 58]. More restrictive border control measures may also result in unauthorized Mexican migrants settling more permanently in the U.S. and being separated from their families and regular partners in Mexico for more extended periods of time [15]. Deteriorated economic conditions, increased feelings of social discrimination and isolation, exposure to higher prevalence populations, easier access to drugs, and lack of traditional family and social controls for prolonged periods of time can promote psychosocial stress and sexual risk taking, including alcohol and drug use, sex with sex workers, casual partners, and other risky partners, and sex with multiple partners among unauthorized and deported Mexican migrants in the U.S. and the North Mexican border region [5, 19]. In turn, these contextual and behavioral factors can elevate their risk of infection with HIV and other STIs [19–21].

Results from this study also indicate inadequate levels of HIV testing, little knowledge of HIV serostatus, and poor access to HIV and STI treatment among deported Mexican labor migrants. According to our data, almost half had never been tested for HIV. Their estimated lifetime rate of HIV testing is lower than that found in 2009 for Latinos in the U.S. (i.e., 60 %) [59], and it is clearly insufficient considering the prevalence of risk behaviors and the rate of HIV infection estimated for the deported migrant population. According to our survey, more than 60 % of deported Mexican migrants who suffered an STI during the previous 12 months did not receive medical treatment for that condition. Adequate access to HIV and STI testing and treatment services is a key element for HIV prevention [60, 61] and lack thereof may be contributing to higher risk of HIV infection and transmission among deported Mexican migrants. Previous studies have suggested limited use of health care services among Mexican labor migrants due to hesitation from the part of migrants and structural barriers [16]. Illegal immigration status and low rates of health insurance may explain the low levels of HIV/STI testing and treatment observed among this population. Our data show that the majority of deported Mexican migrants entered the U.S. illegally and nearly two-thirds never had health insurance while in the U.S. Effective strategies to reduce these barriers and to increase access to health care services and promote HIV/STI testing and treatment among deported Mexican migrants should be identified and implemented in the U.S. and Mexico.

This study is subject to several limitations. First, self-selection bias may have affected our estimates of HIV infection and behavioral risk factors. The differences between the profile of the tested versus non-tested participants indicated that the tested subsample had a longer history of migration and a riskier behavioral profile, suggesting that the true estimate of HIV infection for deported Mexican males may be between 0.73 % (i.e., our lower bound estimate) and 0.80 % (i.e., our estimate based on the tested sample). Second, data on risk factors and HIV/STI testing were based on self-report and may be subject to information bias, including recall and social desirability bias. The anonymous nature of the survey, its implementation in Mexico at an intermediate point between the sending and receiving communities, and the training of the field personnel to collect sensitive information may have reduced this bias. Yet, our results may underestimate the prevalence of these practices and conditions among the study population. Finally, our findings may not generalize to Mexican migrants deported through other Mexican border cities. Despite these limitations, to our knowledge, this is the only study on HIV infection that has used a large, probability-based sample of deported Mexican migrants to generate population-based estimates for this hard-to-reach

and disenfranchised population. Our weighting procedures take into account that not all individuals have equal probability of being selected and adjust for this unequal probability. Moreover, our survey weights include expansion factors to reflect the known number of deported migrants released during specific time periods and the relative influence survey participants recruited during different time periods should have on our prevalence estimates. By using probability sampling methods and survey weights for our analyses, our estimates are more likely to reflect the distribution of the sociodemographic characteristics and risk factors for HIV infection in the population of deported Mexican migrants, beyond the characteristics of the particular individuals included in the sample of this study.

Implications for Public Health Action and Research

The size and circularity of the migration patterns exhibited by the deported Mexican migrant population highlight the relevance of our findings for public health practitioners, researchers, health care providers, and policy makers in both the U.S. and Mexico. Binational, coordinated efforts to reduce the risk for HIV infection among this mobile and underserved population are necessary to address this significant public health issue.

Currently, the Mexican federal government is implementing the *Estrategia Integral de Atención a la Salud del Migrante*, a comprehensive strategy to improve access to health care services and promote the health of Mexican migrants and their families in Mexico and the U.S. [62] This initiative encompasses a variety of programs, including initiatives specifically aimed at promoting migrant health in the northern border of Mexico, such as the US-Mexico Border Health Commission, the HIV and tuberculosis surveillance programs, and several pilot programs linking migrants to health care services. Some binational efforts specifically focused on HIV prevention for Mexican migrants in communities of origin, destination, and intermediate points of the migration journey have also been implemented. The California-Mexico AIDS Initiative, a collaboration between the University of California Office of the President and the Mexican federal government, supports research on HIV and STI prevention and treatment needs of Mexican migrants in California [63]. Binational partnerships have been formed to promote high quality, culturally sensitive education and capacity building programs for HIV/AIDS prevention and clinical management services in the U.S./Mexico border region [64]. Several projects have involved the use of media to increase awareness on HIV transmission and prevention in mobile populations [8]. Local collaborative partnerships between the Mexican government, community-based organizations, public health departments, and investigators on both sides of the border have been developed to provide access to basic medical services and HIV prevention resources to deported migrants and other marginalized populations in the Mexican border region.

These efforts must be continued and expanded to ensure continuity of HIV prevention and treatment among unauthorized Mexican migrants in the U.S. and migrant deportees in the northern border of Mexico. Furthermore, these programs should be complemented with initiatives to increase the availability of financial, social, and emotional support for recent deportees as they are released in the border region of Mexico [58]. Finally, structural policies to improve the social and economic conditions that "push" Mexican migrants to leave their communities of origin, the circumstances in which they travel and enter the U.S., and their living and working conditions in the U.S. are needed for prevention of HIV among this socially disadvantaged, high-risk population. In particular, immigration policies to promote legalization and social integration of unauthorized migrants with family or professional ties in the U.S. and no criminal record could reduce social disruption and other destabilizing conditions potentially associated with risk behaviors for HIV infection after deportation. Likewise, efforts to increase access to culturally competent health care services among Mexican migrants in the U.S. have been recommended as policy-level HIV prevention strategies for Mexican migrants in the U.S. [65] Evaluation and analysis of the effectiveness and potential impact of current and future programs, strategies, and policies implemented to reduce HIV risk among deported migrants must be promoted.

Our findings warrant replication at other border crossing sites and with larger samples of deported women. If our results are replicated, it will be critical to implement tracking procedures and construct longitudinal analyses in order to better determine the incidence of HIV and their biomedical and social determinants. For deported migrants, it is imperative to determine the degree to which current immigration policies in the U.S. with regard to labor migration lead to both higher risk for HIV infection and greater damage to the U.S. and Mexican economies than might be true were employment for migrants to and from the two countries made legal. Given the severity of HIV, it is likely that the physical harm to both migrant and non-migrant populations on both sides of the border is greater in human suffering and financial costs than the savings that might be intended by restricting labor migration between Mexico and the U.S.

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