
Prevalence and Correlates of HIV and Sexually Transmitted Infections among Female Sex Workers and Their Non-commercial Male Partners in Two Mexico-USA Border Cities

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ABSTRACT *Female sex workers (FSWs) acquire HIV and other sexually transmitted infections (STIs) through unprotected sex with commercial and non-commercial (intimate) male partners. Little research has focused on FSWs' intimate relationships, within which condom use is rare. We sought to determine the prevalence and correlates of HIV/STIs within FSWs' intimate relationships in Northern Mexico. From 2010 to 2011, we conducted a cross-sectional survey of FSWs and their non-commercial male partners in Tijuana and Ciudad Juárez, Mexico. Eligible FSWs and their verified male partners were aged ≥ 18 years; FSWs reported lifetime use of heroin, cocaine, crack, or methamphetamine and recently exchanged sex (past month). Participants completed baseline questionnaires and testing for HIV, chlamydia, gonorrhea, and syphilis. We determined the prevalence and correlates of individuals' HIV/STI positivity using bivariate probit regression. Among 212 couples ($n=424$), prevalence of HIV was 2.6 % ($n=11$). Forty-two (9.9 %) tested positive for any HIV/STIs, which was more prevalent among women than men (12.7 % vs. 7.1 %, $p<0.05$). FSWs with regular sex work clients were less likely to test positive for HIV/STIs than those without regular clients. Similarly, male partners of FSWs who had regular clients were 9 % less likely to have HIV/STIs. Higher sexual decision-making power was protective against HIV/STIs for women. Men who recently used methamphetamine or reported perpetrating any conflict within steady relationships were more likely to test positive for HIV/STIs. Within FSWs' intimate relationships in two Mexican-US border cities, nearly one in ten partners tested positive for HIV/STIs. Couple-based prevention interventions should recognize how intimate relationship factors and social contexts influence HIV/STI vulnerability.*

KEYWORDS *Female sex workers, HIV, Sexually transmitted infections, Intimate relationships, Couple-based research, Mexico*

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INTRODUCTION

Female sex workers (FSWs) experience a disproportionate burden of sexually transmitted infections (STIs) including HIV.¹ Although behavioral interventions have improved FSWs' condom use with male clients,²⁻⁶ research from diverse settings suggests that 25-95 % of FSWs have non-commercial male partners with whom they are two to five times more likely to have unprotected sex compared with clients.⁷⁻¹⁷ As in other intimate relationship contexts, unprotected sex is a normative part of FSWs' relationships despite FSWs' knowledge of their intimate male partners' sexual and drug-related risk behaviors for HIV/STIs.¹⁸⁻²² However, there remains insufficient research to date on the prevalence and correlates of HIV/STIs risks within FSWs' non-commercial relationships.

In cities along Mexico's Northern border with the USA, widespread sex work, drug use, poverty, and economic inequality have promoted HIV/STI epidemics among subpopulations including FSWs.²³ Sex work is unregulated in Ciudad Juárez, Chihuahua (adjacent to El Paso, Texas), and is quasi-legal in Tijuana, Baja California (adjacent to San Diego, California), yet research by our group suggests that the current sex work registration system excludes some of the most vulnerable women who have lower socioeconomic status and reduced access to the required permits, regular health checks, and employment in indoor venues.^{24,25} In these cities, the prevalence of HIV among FSWs increased from <1 % in the 1990s to ~6 % in 2006.²³ Our research among mostly street-based FSWs in these cities has also revealed high prevalence of STIs: in 2006, 6 % tested positive for gonorrhea, 13 % for Chlamydia, and 14 % for active syphilis (titers \geq 1:8).²⁶

Drug use, including injection drug use, which are increasingly common in this region due to "spillover" from trafficking routes,²⁷ further promote HIV/STI transmission by compromising FSWs' abilities to negotiate consistent condom use.²⁸ In these cities, FSWs' HIV positivity was associated with smoking, snorting, or inhaling methamphetamine and injecting cocaine,²⁶ and among FSWs who injected drugs, 72 % tested positive for at least one STI including HIV.²⁹

Our binational research team has estimated that more than one third of FSWs in the Mexico-USA border region have steady non-commercial partners,³⁰ and unprotected sex within these intimate relationships is twice as likely compared to commercial sex contexts.³¹ Although a behavioral intervention for FSWs in Tijuana and Ciudad Juárez successfully increased condom use with FSWs' male clients and reduced cumulative STI incidence by 40 % in the intervention group,³ it did not target condom use within FSWs' non-commercial relationships.³² Additional analyses revealed that, among FSWs with non-commercial partners, the majority (74 %) reported having unprotected vaginal sex with their partners even though half believed that their partners had outside sexual partners.³⁰ FSWs with steady partners were more likely to have syphilis titers consistent with active infection,³¹ and one third (35 %) reported recently experiencing interpersonal violence (IPV).³³ Taken together, these findings suggest that HIV/STI transmission within non-commercial relationships could pose an important risk for HIV/STI acquisition in this region.³²

Despite extensive research on the health of FSWs in Tijuana and Ciudad Juárez,³⁴ no studies to date have investigated the epidemiology of HIV/STIs within FSWs' intimate relationships in these resource-poor cities. The objective of this analysis was to determine the prevalence and correlates of HIV/STIs among socially marginalized couples in the border setting. We hypothesized that HIV/STI infection would be

associated with sexual and drug-related risk behaviors within and outside of relationships (e.g., unprotected sex with clients, stimulant drug abuse).

METHODS

Study Design and Population

Proyecto Parejas is a study of the social epidemiology of HIV/STIs within FSWs' intimate relationships in Tijuana and Ciudad Juárez. As previously described,³⁵ we recruited women first in areas where sex work and drug use were known to occur using targeted and snowball sampling. Eligible women were ≥ 18 years of age; involved in non-commercial heterosexual relationships for ≥ 6 months; reported sex with their non-commercial partners and exchanged sex with clients in the past month; and ever used heroin, cocaine, crack, or methamphetamine. Women were excluded if they planned to break up with their partner or feared severe IPV as a result of participating. Eligible FSWs were then invited to bring their primary non-commercial partners to study offices to check men's eligibility and verify relationship status through additional screening.³⁵ Male partners were eligible if they were ≥ 18 years old, regardless of drug use history. Subjects provided written informed consent for all study protocols, which were approved by institutional review boards of the University of California, San Diego, Tijuana's Hospital General, El Colegio de la Frontera Norte, and the Universidad Autónoma de Ciudad Juárez.

Data Collection

From 2010 to 2011, participants were reimbursed US\$20 for completing interviewer-administered questionnaires programmed into laptop computers. Socio-demographics and personal factors included age and educational attainment in years, birthplace, history of arrest and US deportation, and monthly income. Relationship measures included relationship duration, trust,³⁶ satisfaction,³⁷ sexual satisfaction, sexual relationship power,³⁸ and conflict (psychological aggression, physical assault, injury, and sexual assault).³⁹ Relationship variables that theoretically should not vary within couples (e.g., relationship duration, age difference between partners) were averaged within dyads using both partners' responses.⁴⁰ Sexual risk behaviors included unprotected sex within study relationships, concurrent sexual partners,⁴¹ sex work factors among women (e.g., numbers/types of male clients, unprotected sex), and sex trading behaviors among men. Drug abuse behaviors included lifetime and recent (past 6 months) consumption and injection of illicit drugs, drug use before sex within and outside of study relationships, and specific injection practices (e.g., receptive syringe sharing, sharing of injection paraphernalia).

Biological samples were collected for HIV/STI testing. To ascertain HIV status, Advance Quality HIV rapid tests (InTec Products, Inc) were used. Reactive samples were tested using an HIV-1 enzyme immunoassay and immunofluorescence assay. Syphilis serology used the rapid plasma reagin (RPR) qualitative test. Positive samples were confirmed by *Treponema pallidum* particle agglutination assay (TPPA) (Fujirebio, Wilmington, DE, USA). Urine samples were self-collected for *Neisseria gonorrhoeae* and *Chlamydia trachomatis* testing with transcription-mediated amplification assays (Genprobe, San Diego, CA). Results of rapid HIV and syphilis tests were provided to participants immediately. Chlamydia, gonorrhea, and confirmatory HIV and syphilis test results (conducted by the San Diego County Health Department) were delivered to participants within 1 month. All confirmed

HIV cases were referred to municipal clinics for free treatment and follow-up care. Free STI treatment was provided based on US and Mexican guidelines.

Data Analysis

Due to the small numbers of positive cases, our binary dependent variable was combined HIV/STI status (i.e., any STIs including HIV). Two couples ($n=4$) with incomplete biological test results were excluded. Descriptive statistics compared overall sample characteristics of women and men with and without HIV/STIs. To identify factors associated with HIV/STI positivity, we used bivariate probit regression with robust standard errors, a maximum-likelihood approach to modeling FSWs' and male partners' HIV/STIs separately but simultaneously (i.e., two separate probit equations allowing correlation within couples, as assessed by the rho statistic). We first examined associations between independent variables and HIV/STI status (i.e., bivariable analyses). To build our final, multivariable model, we used a hierarchical block approach, entering variables attaining significance levels of 20 % for either women or men in bivariable analyses as well as variables that we considered theoretically relevant. We assessed plausible interactions, multicollinearity (via variance inflation factors), confounding (via ≥ 10 % changes in other estimates),⁴² and the fit of nested models (via AIC).⁴³ We calculated marginal effects to help interpret regression coefficients as predicted probabilities of FSWs' and their male partners' HIV/STI positivity. We conducted sensitivity analyses with the binary dependent variable of STI positivity (i.e., testing positive for any STI excluding HIV) following a similar analytic plan. Results were qualitatively similar; thus, we present results from our primary analysis of combined HIV/STI positivity.

RESULTS

Sociodemographics

Among 212 couples ($n=424$), men were slightly older than women (median age 37 vs. 33 years, $p<0.01$; Table 1). Participants completed a median of 7 years of education (interquartile range [IQR]: 6–9 years). Overall, 43 % reported having monthly income less than US\$200 and 29 % of male partners reported relying financially on their FSW-partners for at least some household expenses. Median relationship duration was 3.0 years (IQR: 1.6–5.4 years), and most couples reported always having unprotected sex together (median 100 % of past-month vaginal sex acts within relationships were reportedly unprotected; IQR: 80–100 %). Trust between partners was high (median ranking 9 out of 10 points; IQR: 7–10), as was relationship satisfaction (median score 15 out of 20 points; IQR: 14–15). Ninety percent reported high sexual satisfaction within their intimate relationship.

At the same time, conflict was common, with 66 % of couples reporting psychological aggression during the past year, 44 % reporting physical assault, 21 % reporting sexual coercion, and 29 % reporting physical injuries resulting from conflict (data not shown). When asked about the direction of this conflict within their relationships, 49 % reported perpetrating any form of conflict (no significant difference between women and men), and more men than women reported being the victim of any form of conflict (54 vs. 41 %, $p<0.05$). Similarly, although there were no differences between women's and men's decision-making dominance scores, women had higher relationship control scores than men (median 35 vs. 27 points out of 48 possible, $p<0.01$). Recent drug abuse was common, with 63 % of

TABLE 1 Characteristics of 212 female sex workers and their 212 non-commercial male partners in two Mexico-USA border cities (*N*=424)

Variable	Women (<i>n</i> =212)	Men (<i>n</i> =212)	Overall (<i>n</i> =424)
Sociodemographics			
Lives in Tijuana (vs. Ciudad Juarez)	104 (49 %)	104 (49 %)	208 (49 %)
Median age in years (interquartile range; IQR)	33 (26–39)	37 (31–43)	34 (29–41)***
Median educational attainment in years (IQR)	6 (6–9)	7 (6–9)	7 (6–9)***
Born in study site (vs. someplace else)	105 (50 %)	94 (44 %)	199 (47 %)
Income <2,500 pesos per month (<\$200 USD)	81 (38 %)	103 (49 %)	184 (43 %) **
Ever been arrested (lifetime)	116 (55 %)	140 (66 %)	256 (60 %)***
Relationship factors			
Median relationship duration in years (IQR) ^a	–	–	3.0 (1.6–5.4)
Median % vaginal sex acts were unprotected in past month (IQR) ^a	–	–	100 (82–100)
Median trust of partner on 10-point scale (IQR)	9 (7–10)	9 (8–10)	9 (7–10)**
Median relationship satisfaction, 20-point scale (IQR)	15 (13–15)	15 (14, 15)	15 (14, 15)*
Male financial dependence on FSW's income ^a	–	62 (29 %)	–
Median relationship control, 48-point scale (IQR) ^b	35 (31–36)	27 (24–30)	30 (26–36)***
Median decision-making dominance, 24-point scale (IQR) ^b	16 (16, 17)	16 (16, 17)	16 (16, 17)
Perpetrated/caused any conflict within steady relationship, past year ^c	98 (46 %)	108 (51 %)	206 (49 %)
Victim of any conflict within steady relationship, past year ^c	87 (41 %)	115 (54 %)	202 (48 %) **
Sexual behaviors			
Sexually satisfied with steady partner (vs. not satisfied)	185 (87 %)	198 (93 %)	383 (90 %) **
Self-identified as bisexual (vs. heterosexual)	4 (2 %)	10 (5 %)	14 (3 %)
Male partner ever exchanged sex for money, drugs, other material goods (among men only, <i>n</i> =212)	–	73 (34 %)	–
Male partner had any outside sex partners, past 6 months (among men only, <i>n</i> =212)	–	65 (31 %)	–
Had any “steady” concurrent sex partners (including regular clients), past year	54 (25 %)	13 (6 %)	67 (16 %)***
FSW had any regular clients, past month (among FSWs only, <i>n</i> =212)	186 (88 %)	–	–
FSW often/always uses condoms with clients vs. rarely/never, past month (among FSWs only, <i>n</i> =212)	118 (56 %)	–	–
Drug abuse (past 6 months)			
Used heroin	136 (64 %)	130 (61 %)	266 (63 %)
Used methamphetamine	69 (33 %)	62 (29 %)	131 (31 %)
Used cocaine use	45 (21 %)	40 (19 %)	85 (20 %)
Used crack	36 (17 %)	23 (11 %)	59 (14 %) **
Used inhalants	20 (9 %)	14 (7 %)	34 (8 %)
Injected any drugs	132 (62 %)	123 (58 %)	255 (60 %)
FSW used drugs before sex with male clients (among FSWs only, <i>n</i> =212)	63 (30 %)	–	–
“High” on drugs before/during sex with steady partner	–	–	234 (55 %)

TABLE 1 (continued)

Variable	Women (<i>n</i> =212)	Men (<i>n</i> =212)	Overall (<i>n</i> =424)
Drunk before/during sex with steady partner	–	–	132 (31 %)
HIV and Sexually Transmitted Infections			
HIV test result positive	8 (3.8 %)	3 (1.4 %)	11 (2.6 %)
Chlamydia test result positive	16 (7.5 %)	9 (4.3 %)	25 (5.9 %)*
Gonorrhea test result positive	2 (0.9 %)	3 (1.4 %)	5 (1.2 %)
Syphilis test result positive	3 (1.4 %)	3 (1.4 %)	6 (1.4 %)
STI/HIV-positive (any STI including HIV)	27 (12.7 %)	15 (7.1 %)	42 (9.9 %) **

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ (from logistic regression with clustered standard errors within couples)

^aDyad average (uses information from both partners' responses within a given couple)

^bSexual relationship power subscales

^cConflict subscales (combined) for perpetrating or being the victim of psychological aggression, physical assault, injury, and sexual coercion within relationships

participants using heroin, 31 % using methamphetamine, 20 % using cocaine, 14 % using crack, and 60 % injecting any drugs in the past 6 months.

Prevalence of HIV/STIs

Eleven participants (2.6 %) tested HIV-positive, 25 (5.9 %) tested positive for Chlamydia, five (1.2 %) tested positive for gonorrhoeae, and six (1.4 %) had syphilis titers consistent with active infection ($\geq 1:8$; Table 2). Combined HIV/STI prevalence was 9.9 % ($n=42$), which was significantly higher among FSWs than male partners (12.7 vs. 7.1 %, $p < 0.05$). HIV/STI status was highly correlated within relationships ($p < 0.001$; Table 2). Among seven couples (3.3 %) both partners were infected with HIV/STIs, and 28 couples (13.2 %) had discordant HIV/STI status, with one partner testing positive for HIV/STIs and the other testing negative.

Factors Associated with HIV/STIs

In bivariable comparisons controlling for couple status, men who were younger and reported perpetrating conflict within their steady relationships were more likely to test positive for HIV/STIs (both $p < 0.01$; Table 3). FSWs with higher decision-making dominance scores were less likely to have HIV/STIs. Most FSWs (88 % overall) reported having regular clients in the past month, which was less common among women who tested positive for HIV/STIs (74 vs. 90 %, $p < 0.05$). For all major drugs of abuse, those who used drugs in the past 6 months appeared to be more likely to test positive for HIV/STIs: among men, those who recently used

TABLE 2 HIV/STI status within 212 female sex workers' non-commercial relationships in Tijuana and Cd. Juárez, Mexico (*n*=424)

	FSWs' HIV/STI status* (<i>n</i> =212)	
	Negative	Positive
Male partners' HIV/STI status (<i>n</i> =212)		
Negative	177 (83.5 %)	20 (9.4 %)
Positive	8 (3.8 %)	7 (3.3 %)

* $p < 0.001$ from chi-square test of HIV/STI status being interdependent within couples (rejects null hypothesis that HIV/STI status is independent within couples)

TABLE 3 Characteristics of 212 female sex workers and their 212 non-commercial male partners in two Mexico-USA border cities (N=424)

Variable	HIV/STI-positive (n=42; 10 %)	HIV/STI-negative (n=382; 90 %)	Overall (n=424; 100 %)	Marginal effects (robust SE) ^a for FSWs' HIV/STI positivity (n=212)	Marginal effects (robust SE) ^a for men's HIV/STI positivity (n=212)
Sociodemographics					
Lives in Tijuana (vs. Ciudad Juarez)	21 (50 %)	187 (49 %)	208 (49 %)	-0.024 (0.046)	0.030 (0.035)
Median age in years (interquartile range; IQR)	33 (27–36)	35 (29–42)	34 (29–41)	-0.001 (0.002)	-0.006 (0.002) ***
Median educational attainment in years (IQR)	8 (6–9)	7 (6–9)	7 (6–9)	0.010 (0.007)	-0.001 (0.006)
Born in study site (vs. someplace else)	19 (45 %)	180 (47 %)	199 (47 %)	0.005 (0.044)	-0.020 (0.035)
Income <2,500 pesos per month (<\$200 USD)	14 (33 %)	170 (45 %)	184 (43 %)	-0.038 (0.047)	-0.0398 (0.035)
Ever been arrested (lifetime)	28 (67 %)	228 (60 %)	256 (60 %)	0.0168 (0.045)	0.048 (0.039)
Relationship factors					
Median relationship duration in years (IQR) ^b	3 (1–5)	3 (2–6)	3 (2–5)	-0.002 (0.006)	-0.006 (0.004)
Median % vaginal sex acts were unprotected in past month (IQR) ^b	100 (71–100)	100 (83–100)	100 (82–100)	-0.098 (0.073)	-0.001 (0.064)
Median trust of partner on 10-point scale (IQR)	9 (8–10)	9 (7–10)	9 (7–10)	0.008 (0.012)	0.006 (0.008)
Median relationship satisfaction, 20-point scale (IQR)	15 (14, 15)	15 (14, 15)	15 (14, 15)	0.006 (0.008)	-0.001 (0.007)
Male financial dependence on FSW's income ^b	9 (21 %)	115 (30 %)	124 (29 %)	-0.021 (0.051)	-0.064 (0.046) *
Median relationship control, 48-point scale (IQR) ^c	32 (26–36)	30 (26–36)	30 (26–36)	-0.003 (0.003)	0.002 (0.004)
Median decision-making dominance, 24-point scale (IQR) ^c	16 (15, 16)	16 (16, 17)	16 (16, 17)	-0.016 (0.006) ***	0.002 (0.007)
Perpetrated/caused any conflict within steady relationship, past year ^d	26 (62 %)	180 (47 %)	206 (49 %)	0.007 (0.045)	0.110 (0.042) ***
Victim of any conflict within steady relationship, past year ^d	26 (62 %)	176 (46 %)	202 (48 %)	0.034 (0.045)	0.110 (0.044) **
Sexual behaviors					
Sexually satisfied with steady partner (vs. not satisfied)	41 (98 %)	342 (90 %)	383 (90 %)	0.000 (0.000)	0.000 (0.000)
Self-identified as bisexual (vs. heterosexual)	3 (7 %)	11 (3 %)	14 (3 %)	0.254 (0.123) *	0.022 (0.058)
Male partner ever exchanged sex for money, drugs, other material goods (among men only, n=212)	9 (60 %)	64 (32 %)	73 (34 %)	-0.005 (0.046)	-0.030 (0.035)
Male partner had any outside sex partners, past	7 (47 %)	58 (29 %)	65 (31 %)	-0.042 (0.058)	-0.011 (0.045)

TABLE 3 (continued)

Variable	HIV/STI-positive (n = 42; 10 %)	HIV/STI-negative (n = 382; 90 %)	Overall (n = 424; 100 %)	Marginal effects (robust SE) ^a for FSWs' HIV/STI positivity (n = 212)	Marginal effects (robust SE) ^a for men's HIV/STI positivity (n = 212)
6 months (among men only, n = 212)					
Had any "steady" concurrent sex partners (including regular clients), past year	3 (7 %)	64 (17 %)	67 (16 %)	0.000 (0.000)	0.000 (0.000)
FSW had any regular clients, past month (among FSWs only, n = 212)	20 (74 %)	166 (90 %)	186 (88 %)	-0.126 (0.059) **	-0.095 (0.043) **
FSW often/always uses condoms with clients vs. rarely/never, past month (among FSWs only, n = 212)	15 (56 %)	103 (56 %)	118 (56 %)	0.003 (0.046)	-0.039 (0.035)
Drug abuse (past 6 months)					
Used heroin	27 (64 %)	239 (63 %)	266 (63 %)	0.046 (0.048) *	0.012 (0.036)
Used methamphetamine	17 (40 %)	114 (30 %)	131 (31 %)	0.029 (0.046)	0.056 (0.035) **
Used cocaine use	10 (24 %)	75 (20 %)	85 (20 %)	0.048 (0.053)	0.001 (0.044)
Used crack	8 (19 %)	51 (13 %)	59 (14 %)	0.040 (0.057)	0.009 (0.052)
Used inhalants	6 (14 %)	28 (7 %)	34 (8 %)	0.000 (0.000)	0.000 (0.000)
Injected any drugs	27 (64 %)	228 (60 %)	255 (60 %)	0.067 (0.048) *	0.012 (0.036)
FSW used drugs before sex with male clients (among FSWs only, n = 212)	7 (26 %)	56 (30 %)	63 (30 %)	0.001 (0.046)	0.014 (0.035)
"High" on drugs before/during sex with steady partner	23 (55 %)	211 (55 %)	234 (55 %)	-0.017 (0.046)	0.014 (0.036)
Drunk before/during sex with steady partner	18 (43 %)	114 (30 %)	132 (31 %)	0.049 (0.048)	0.040 (0.036)

*p < 0.10, **p < 0.05, ***p < 0.01

^aMarginal effects (shown with robust standard errors) represent the change in probability of having positive test result(s) for HIV/STIs associated with a 1-unit change in each independent variable; model controls for couple-specific effects

^bDyad average (uses information from both partners' responses within a given couple)

^cSexual relationship power subscales

^dConflict subscales (combined) for perpetrating or being the victim of psychological aggression, physical assault, injury, and sexual coercion within relationships

methamphetamine were ~6 % more likely to have HIV/STIs ($p < 0.05$), while among women, those who injected drugs were ~7 % more likely to have HIV/STIs, although this association was only marginally statistically significant ($p < 0.10$).

Factors Independently Associated with HIV/STIs

In our final multivariable model controlling for couple status, we identified several individual and interpersonal factors that were independently associated with HIV/STIs (Table 4). First, women with regular sex work clients (past month) were 11 % less likely to test positive for HIV/STIs than women without regular clients. Similarly, male partners of FSWs who had regular clients were 9 % less likely to have HIV/STIs. Among women, higher sexual decision-making power remained protective against HIV/STIs (2 % decrease in the probability of HIV/STIs per point increase in decision-making power score). Among men, perpetrating any conflict within steady relationships during the past year was associated with an 11 % increase in the probability of HIV/STI positivity. Finally, men who used methamphetamine (past 6 months) were 6 % more likely to have HIV/STIs, although this association was only marginally statistically significant ($p = 0.066$).

DISCUSSION

Our study is the first to date to assess the prevalence and correlates of HIV/STIs within FSWs' intimate relationships. Although the prevalence of each individual STI was low, nearly one in ten participants tested positive for any STIs including HIV, and the combined HIV/STI outcome was more common among women than men. Within couples, HIV/STI status was highly correlated, suggesting the potential for transmission within the one in eight couples who tested differently (i.e., discordantly) for HIV/STIs. Although this finding does not support earlier suggestions that FSWs' intimate male partners comprise a significant source of HIV/STI transmission into FSW-intimate partner dyads,^{31,32} our analysis was limited by the low numbers of positive cases in our sample, and additional research is needed to describe the

TABLE 4 Factors independently associated with HIV/STIs among 212 female sex workers and their 212 non-commercial male partners in two Mexico-USA border cities ($N = 424$)

Variable	HIV/STI positivity: marginal effects (robust SE) ^a	
	Women	Men
FSW had regular clients, past month	-0.11** (0.06)	-0.09** (0.04)
Sexual relationship decision-making power score (per point increase) ^b	-0.02** (0.01)	0.00 (0.00)
Perpetrated/caused any conflict within steady relationship, past year ^c	-0.01 (0.04)	0.11*** (0.04)
Used methamphetamine, past 6 months	0.03 (0.04)	0.06* (0.03)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

^aMarginal effects (shown with robust standard errors) represent the change in probability of having positive test result(s) for HIV/STIs associated with a 1-unit change in each independent variable; model controls for couple-specific effects

^bSexual relationship power subscales

^cConflict subscales (combined) for perpetrating or being the victim of psychological aggression, physical assault, injury, and sexual coercion within relationships

prevalence and independent correlates of HIV and specific STIs. Nevertheless, we believe that our findings carry important implications for future couple-based research and prevention efforts in this region.

The prevalence of active syphilis, which was associated with four times the odds of HIV infection in a previous study,²⁶ was dramatically lower among FSWs in our sample (e.g., 14 % in 2006 vs. 1 % in our sample). Although the low prevalence we identified could reflect continued HIV/STI surveillance and prevention efforts throughout the region,⁴⁴ we cannot determine from our sample whether HIV/STI prevalence is decreasing in the larger population of FSWs in these cities. Alternatively, our sample of FSWs, who are involved in relatively stable, intimate partnerships, may represent a lower risk group than the general population of drug-involved FSWs. As recently found in India, FSWs who reported having “regular” (i.e., steady) non-commercial partners engaged in fewer risk behaviors than FSWs with “non-regular” non-commercial partners.¹² Nevertheless, we believe our findings underscore the need for continued prevention efforts targeting FSWs' male clients, who were found to have higher HIV prevalence than the non-commercial male partners in our sample (e.g., 4 % in Tijuana in 2008 vs. 1 % in our study).⁴⁵

We found that testing positive for HIV/STIs was associated with several individual and relationship factors. First, women who had regular sex work clients were less likely to test positive for HIV/STIs than women without regular clients. While our past research has documented reduced condom use among FSWs and their regular clients which would imply greater HIV/STI exposure, women in this sample have described trusting regular clients, who develop closer emotional bonds and provide women with more stable forms of financial support such as rent. These clients are perceived to be less risky because, as FSWs in this population have explained, rather than frequenting multiple FSWs, regular clients are “monogamous,” in that they have only one FSW partner plus a low risk spouse.⁴⁶ In addition to this financial security,⁴⁷ FSWs with regular clients may also be able to avoid exposures to multiple, higher-risk clients. This finding implies that, rather than adopting a one-size-fits-all approach to increasing FSWs' condom use, prevention efforts should recognize FSWs' risk perceptions and occupational expertise while acknowledging the diversity of behavioral and financial norms within FSWs' commercial relationships.

Reaffirming the importance of investigating HIV/STI transmission dynamics within interpersonal relationships and other social contexts,⁴⁸ men whose female partners had regular clients were also less likely to test positive for HIV/STIs than men whose partners did not have regular clients. This lower HIV/STI positivity could be due to the lower risk profiles of regular clients described above. Alternatively, it could reflect the economic benefits that FSWs obtain from regular clients (i.e., higher, more stable income),⁴⁷ which they likely share with their non-commercial partners and families.⁴⁶ Either way, this finding highlights the importance of involving both partners in couple-based research studies which are able to better measure and assess HIV/STI transmission dynamics.⁴⁸ These effects would likely be missed in traditional epidemiologic survey research focused on individual risk behaviors and outcomes.⁴⁹ Future research is needed to assess broader social contexts (e.g., social networks).

Also related to dyadic processes within intimate relationships, FSWs with higher sexual decision-making power within their relationships were less likely to test positive for HIV/STIs than FSWs with lower power. Women's ability to negotiate safer sexual practices, including consistent condom use, has long been recognized as a fundamental component of HIV/STI prevention.⁵⁰ Recent work in India and the

Dominican Republic has shown that promoting empowerment among FSWs at the community and individual levels can greatly improve safer sex negotiation skills, contributing to improved sexual and reproductive health outcomes.^{8,51,52} Although few interventions to date have specifically targeted FSWs' noncommercial relationships, some studies suggest that promoting collectivization can improve safer sex norms beyond commercial sexual encounters and can extend into women's personal relationships.⁵³ Our finding that FSWs with higher sexual decision-making power were less likely to have HIV/STIs provides further evidence in support of HIV/STI prevention interventions addressing relationship power.^{54,55} However, it is important to note that our measurement of relationship control and decision-making power within FSWs' intimate relationships is novel. With many men in our study population reporting being financially dependent on their female partners, additional research is needed to validate the specific constructs of control and decision-making within relationships that are not exclusively characterized by the traditional, gendered divisions of labor and power.⁵⁶

We also found that perpetrating conflict within intimate relationships was associated with HIV/STIs among male partners. Nearly half of participants in our sample reported perpetrating conflict, which was not statistically different between men and women, suggesting that aggressive behaviors are highly prevalent within these relationships and may reflect the broader context of everyday violence within which our socially marginalized participants reside.⁵⁷ In our previous research, we found that experiencing IPV among FSWs was independently associated with having lower relationship power and being involved in relationships with steady partners who had outside, concurrent sexual partners.³³ Our qualitative and ethnographic work with this population has provided some indication that the underlying reasons for conflict differ for men and women in these couples, with many couples describing difficulty in disclosing HIV/STI risks, particularly regarding sex work-related risks.⁵⁸ Taken together, these findings suggest that men who perpetrate conflict in our sample may have generally higher-risk profiles including poorer communication skills, emotional instability, and impulsivity. They may also be less supportive of their female partners, particularly given women's engagement in sex work. However, it is important to note that our eligibility criteria excluded couples in which women reported fearing extreme, life-threatening IPV. While additional research is needed to better understand the complexities of conflict within FSWs' intimate relationships in these cities, our findings suggest that couples-based prevention programs should identify and work with such potentially abusive male partners. Additional resources are also needed for women involved in abuse relationships, including referrals to domestic violence resources, before addressing relationship issues with both members of the couple together.⁵⁹⁻⁶¹

Finally, although only marginally statistically significant, we found that men who used methamphetamine were more likely to test positive for HIV/STIs than men who did not. Methamphetamine is increasingly being trafficked through Northwestern Mexico where it has resulted in a high prevalence of abuse.⁶² Methamphetamine abuse has been linked to risky sexual behaviors in a variety of settings,⁶³ and has been associated with HIV/STI positivity and inconsistent condom use among FSWs and male clients in our previous research.^{26,28,45,64} Our findings imply that the association between methamphetamine abuse and HIV/STIs may also hold true for FSWs' non-commercial male partners. Effective drug treatment options, including programs that focus on stimulant abuse and co-occurring conflict within relationships, are needed in these cities in addition to more comprehensive programs that

recognize and address the co-occurrence of stimulant abuse, violence, and sexual risk among socially marginalized couples.

Our study is not without limitations. First, because our dyadic analyses were cross-sectional, our findings cannot be interpreted as causal, and we cannot distinguish the direction of associations or transmission dynamics within couples. Second, due to our recruitment and screening strategies,³⁵ our findings may not be generalized to other couples, FSWs who are experiencing extreme IPV, or FSWs with casual non-commercial partners. Our focus on stable (≥ 6 month duration), non-commercial partnerships may have also resulted in our sample being less vulnerable to HIV/STI acquisition. Future research should assess the demographic and risk behavior profiles of men in shorter-term relationships with FSWs. Similarly, other researchers may want to avoid dichotomizing partners as “commercial” or “non-commercial,” as our own research with this population has revealed a continuum of partner types with a range of behavioral norms that are relevant to HIV/STI transmission.⁴⁶ We also depended on self-report of highly sensitive topics, including sexual and drug-related risk behaviors and IPV. Finally, low prevalence of HIV/STI outcomes prevented a thorough examination of the independent correlates of HIV as compared to other specific STIs; however, sensitivity analyses performed on STIs (without HIV) yielded very similar findings. Furthermore, as a first dyadic study of HIV/STIs among FSWs and their intimate partners, we believe that our findings carry important implications for future couple-based research and prevention efforts in these cities.

As in other intimate relationship contexts,^{8,10,14,65} we have found FSWs' low levels of condom use with non-commercial partners to be linked to emotional bonds between partners including love and trust,⁶⁶ as well as social and gender norms that reinforce power imbalances between partners and place reproductive and sexual health responsibilities on women over men.^{15,67,68} Simply promoting condom use within intimate relationships could signify mistrust and ultimately threaten relationship stability.⁶⁹⁻⁷⁵ Our findings also highlight the importance of assessing relationship and social network dynamics in HIV/STI transmission research. Thus, additional dyadic, qualitative, and mixed methods studies are needed to understand how relationship dynamics can be leveraged by couple-based interventions to enhance risk disclosure, particularly among HIV/STI-discordant couples. HIV/STI prevention efforts for marginalized couples in this region should carefully assess both partners' behaviors as well as shared relationship characteristics when designing HIV/STI prevention programs.

ACKNOWLEDGMENTS

Funding for this study was provided by the National Institutes of Health (NIH) grants R01DA027772, R36DA032376, T32AI007384, T32DA023356, and K01DA026307; the NIH had no further role in study design; in the collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication. We thank the project staff and participants without whom this research would not be possible.

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