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Place of Residence Moderates the Relationship Between Emotional Closeness and Syringe Sharing Among Injection Drug Using Clients of Sex Workers in the US-Mexico Border Region

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Abstract

Injection drug-using men from the US and Mexico who purchase sex in Tijuana, Mexico are at risk for transmitting HIV to their contacts in both countries via syringe sharing. We used social network methods to understand whether place of residence (US vs. Mexico) moderated the effect of emotional closeness on syringe sharing. We interviewed 199 drug-using men who reported paying/trading for sex in Tijuana, Mexico using an epidemiological and social network survey and collected samples for HIV/STI testing. Seventy-two men reported using injection drugs with 272

network contacts. Emotional closeness was strongly associated with syringe sharing in relationship where the partner lives in the US, while the relationship between emotional closeness and syringe sharing was considerably less strong in dyads where the partner lives in Mexico. Efforts to reduce HIV risk behaviors in emotionally close relationships are needed, and could benefit from tailoring to the environmental context of the relationship.

Keywords

HIV; Injection drug use; Commercial sex work; Mobility; Social network analysis

Introduction

The role of social relationships in shaping HIV risk and transmission behaviors among people who inject drugs (PWIDs) has long been recognized [1–3]. Syringe sharing, a primary route of transmission for HIV and other blood-borne pathogens among PWIDs, has been consistently found to be more likely between individuals who have close or strong social ties [4–7]. This finding has lead some to hypothesize that, while risky in terms of HIV infection, syringe sharing may also be an indicator of trust and mutual caretaking among injection drug-using dyads [8–10].

Among people who use drugs, some sub-populations play a pivotal role in the trajectory of HIV epidemics by connecting high-risk groups through sexual and drug-related contact. Individuals involved in the commercial sex trade are one such group. Among female sex workers (FSWs) there is a significant amount of variability in the relationships FSWs have with their commercial and non-commercial partners, and different relationships confer different risks for HIV infection via unprotected sex and syringe sharing [8, 11–13]. For example, FSWs tend to use condoms less consistently with their non-commercial vs. commercial partners [14–18]. In a study of FSWs in Northern Mexico, having a steady partner who injects drugs was associated with a 2.5-fold increase in the odds of being HIV-positive [19].

Less research has sought to understand factors associated with HIV risk behavior among the clients of FSWs. Yet clients also report behaviors that are associated with risk for HIV infection (e.g., inconsistent condom use, elevated incidence of STIs, contact with multiple FSWs per year, and higher numbers of other sexual partners [20, 21]). An important research question is whether the risk behaviors of male clients also vary based on the characteristics of their relationships, similar to findings among PWIDs and FSWs.

In Tijuana, Mexico, which is located along the Western US-Mexico border, sex work is tolerated in a regulated *zona roja* (redlight zone). Drug use is also highly prevalent in this border city, which is located along a major drug trafficking route [22]. HIV seroprevalence among high-risk groups in Tijuana ranges from 2.3 % among PWIDs to 6 % among FSWs to 12 % among FSWs who inject drugs [23], considerably higher than the seroprevalence in the general population of Mexico (<0.3 %) or the US (<1.0 %) [24, 25]. In the first large study of male clients in Tijuana, half reported unprotected sex with FSWs in the previous 4 months; being married was independently associated with reporting unprotected sex with

FSWs [19]. Drug use is also highly prevalent among male clients [26]. In the aforementioned study of clients in Tijuana, 25 % of male clients reported injecting drugs in the previous 4 months and 88 % reported lifetime use of heroin, methamphetamine or cocaine [19].

Like many border cities, Tijuana is a destination for individuals from the US, Mexico, and elsewhere, including: bi-national residents of the US-Mexico border region; migrants from internal Mexico and Central and South America; deportees from the US; and tourists from the US, including those seeking to purchase sex and engage in drug use in Tijuana [27–32]. Concern about bi-directional transmission of HIV and other infectious diseases at the US-Mexico border has inspired research to elucidate the social and environmental factors contributing to increased risk for HIV in this and other border regions [29, 30, 33, 34]. Social network-based approaches, which examine the composition and function of social relationships (including drug using relationships), are ideal for helping to uncover the mechanisms underlying HIV transmission in environments characterized by high levels of mobility and population mixing [35]. In the current study we used social network methods to identify characteristics of drug using relationships that are associated with one HIV risk behavior—receptive syringe sharing—reported by injection drug using clients of FSWs in Tijuana, with attention to the environmental context of the border region. Specifically, we sought to understand whether place of residence (US vs. Mexico) moderated the effect of relationship-level characteristics on syringe sharing behavior.

Methods

From 2010 to 2012 we recruited 199 drug-using men who reported engaging in sex with FSWs in Tijuana, Mexico as part of a larger study investigating the social networks of male clients of FSWs. Spanish-speaking outreach workers recruited men in the *zona roja* area of downtown Tijuana, where the preponderance of commercial sex occurs. Eligibility criteria included: being 18 years old; reporting use of heroin, methamphetamine, or cocaine in the past 4 months; having paid or traded something of value for sex with an FSW in Tijuana in the past 4 months; and ability to speak English or Spanish.

Upon determination of eligibility, participants provided written informed consent, completed an epidemiological survey and social network inventory, and provided biological specimens for HIV and STI testing. Interviews were conducted using a Computer Assisted Personal Interview (CAPI) administered by Spanish-speaking or bilingual interviewers, depending on respondents' preferences. The Institutional Review Boards of the University of California, San Diego and the Colégio de la Frontera Norte approved the study procedures.

Measures

The CAPI contained demographic questions, including: age, race/ethnicity, location of residence (San Diego, other city in the US, Tijuana, or other city in Mexico—recoded to US vs. Mexico), deportation history, marital status, and self-reported sexual orientation. Drug use was assessed by a series of questions that asked participants to respond with the frequency with which they used heroin, methamphetamine, cocaine, crack, and alcohol in the previous four months; responses were dichotomized for this analysis into any vs. no use

in the past four months. Respondents were asked the route of administration for each drug (ingested, injected, sniffed, smoked, other), and those participants who reported injecting any drugs were retained for this analysis. Participants provided biological specimens that were tested for HIV, syphilis, *Neisseria gonorrhoeae*, and *Chlamydia trachomatis*. The Advanced Quality™ Rapid Anti-HIV (1&2) test was used to detect the presence of HIV antibodies. Reactive and indeterminate specimens were re-tested with a second rapid test and confirmed through HIV-1, 2 serum antibody enzyme immunoassay (EIA) and indirect fluorescent antibody (IFA) tests. The One Step Syphilis test (IND Diagnostic Inc., Delta, Canada) was used to conduct syphilis serology. All reactive samples were subjected to the rapid plasma reagin (RPR) test and the *T. pallidum* particle agglutination assay (TPPA). Urine samples were tested using the Gen-Probe Aptima Combo 2® Assay for *C. trachomatis* and *N. gonorrhoeae* tests.

To elicit the composition of respondents' social networks, the CAPI included an egocentric social network inventory [36]. The network inventory elicited names of sexual and/or drug-using contacts (hereafter: alters). First, we asked participants to list the names, initials, or nicknames of individuals with whom they had used drugs in the previous 4 months. Then, we asked if they had sex with any of those individuals. Finally, we asked participants to list the names of any other individuals with whom they had sex in the previous 4 months. In this way, we elicited drug use network contacts, sexual network contacts, and contacts that were in both sexual and drug use networks. We selected the first five alters listed and asked about the alters' demographics (i.e., sex, whether the alter is an FSW, relationship type), drug use behavior, place of residence, and the respondent's sexual and drug use behavior with each alter. Relationship closeness was assessed using a visual analogue scale where 1 = barely know him/her and 10 = very close. The dependent variable—receptive syringe sharing with alter—was assessed by asking participants whether they had used a syringe after the alter in the previous 4 months. It was determined that asking about five alters would provide an adequate balance between comprehensiveness and respondent burden, since asking detailed questions about more than five alters would have substantially increased the length of the interview [37].

Analysis

To describe respondents' social networks we calculated a series of summary variables, using established methods for egocentric network analysis [38]. For example, we calculated the proportion of network alters who are female by summing the number of female alters and dividing by the number named (i.e., five).

We used univariate statistics to describe characteristics of the respondents, alters, and the relationships between egos and alters. Then, to identify factors associated with receptive syringe sharing with each alter, we used the xtlogit procedure in STATA 11.2 to compute bivariate and multivariate multilevel logistic regression models [39]. This multilevel procedure allows for analysis of data in which observations violate the assumptions of independence. In this case, the dataset was comprised of five alters nested within each respondent—a “one-with-many” design—and the technique allows for the examination of factors influencing outcomes at the dyad level (i.e., syringe sharing with each alter; [40]).

The results of the initial analysis indicated that relationship closeness was a significant correlate of syringe sharing. In keeping with the aims of the study, we were interested in whether relationship closeness was associated with syringe sharing differently depending on the location of residence of the ego and alter. To test this hypothesis, we created a series of interaction terms, in which relationship closeness (mean-centered) was multiplied by: alter lives in Mexico (yes = 1 vs. no = 0), ego lives in Mexico (yes = 1 vs. no = 0), and whether ego and alter lived in the same location (yes = 1 vs. no = 0). The only interaction term to achieve statistical significance was the product term of closeness by alter's place of residence. We constructed a final multivariate model including alter and relationship characteristics significant in bivariate analysis at the $p < 0.10$ level (alter's sex, alter is sex and drug contact, alter lives in Mexico, and emotional closeness) and included the interaction term of closeness by alter's place of residence, controlling for ego's place of residence. In order to present the most parsimonious model, the model was trimmed in a manual backwards stepwise fashion until all remaining variables achieved statistical significance at the $p < 0.05$ level. We then plotted the effects of relationship closeness on receptive syringe sharing separately for relationships in which alters live in the US vs. Mexico and display the results in graphical form.

Results

Of the 199 male clients enrolled in the study, there were 72 who reported using injection drugs in the past 4 months (36.2 %) and having at least one injection drug using alter. These 72 men reported an average age of 40.5 years [standard deviation (SD): 8.1; Table 1]. Most (88.9 %) were Hispanic/Latino. Three-quarters lived in Mexico and 25.0 % lived in the US. Nearly half had been deported from the US at least once in their lifetime. The majority reported heroin use in the previous 4 months (93.1 %); use of other substances such as methamphetamine (68.1 %), cocaine (23.6 %) and alcohol (63.9 %) was also prevalent. HIV prevalence was 5.7 % and 10.1 % had evidence of lifetime syphilis infection.

On average participants' social networks were one-third female (Table 1) and were mostly comprised of drug use (68.8 %) or overlapping drug use and sexual contacts (30.3 %). Nearly one-quarter of alters were reported to be FSWs. Eighty-five percent of alters lived in Mexico. In terms of relationship types, most alters were friends (66.4 %) and acquaintances (19.4 %), and to a lesser extent casual or regular sexual partners (10.6 %) or family members (1.9 %). Average emotional closeness to alters was 7.8 (SD = 1.6) on the 1–10 scale.

The 72 men reported a total of 272 relationships with injection drug using alters. The median number of injection drug using alters listed was 4 (IQR 3, 5; data not shown). Men reported sharing syringes in nearly three quarters (73.9 %) of those relationships (Table 2). Bivariate analysis showed that respondents were more likely to share syringes with alters who were: female [odds ratio (OR) 4.48, 95 % confidence interval (CI) 1.23, 16.34, $p = 0.02$] and who were both drug use and sexual partners (OR 4.82, 95 % CI 1.26, 18.38, $p = 0.02$) compared to drug use partners only. Reporting that an alter lives in Mexico (vs. the US) was associated with a lower odds of syringe sharing (OR 0.08, 95 % CI 0.007, 0.87, $p = 0.04$), while reporting greater emotional closeness to an alter was associated with a higher odds of syringe sharing with that alter (OR 1.51, 95 % CI 1.11, 2.06, $p = 0.01$). When

entered into a multivariate logistic regression equation, only emotional closeness retained statistical significance.

We tested three interaction terms to determine whether the association between relationship closeness was moderated by the location of residence of egos or alters: closeness by alter's place of residence (US vs. Mexico; $p = 0.008$), closeness by ego's place of residence (US vs. Mexico; $p = 0.06$), and closeness by "ego and alter have the same place of residence" (yes vs. no; $p = 0.99$).

Figure 1 shows the results of the stratified analysis in which syringe sharing is regressed on emotional closeness with alters separately for alters who live in Mexico and alters who live in the US, controlling for ego's place of residence. Average emotional closeness with alters who live in Mexico ($n = 232$) was 7.9 (SD: 2.1), while average emotional closeness with alters who live in the US ($n = 40$) was 8.2 (SD: 2.1; data not shown). The relationship between emotional closeness and syringe sharing was strong and positive in dyads where the alter lives in the US (AOR 11.06), while the relationship between emotional closeness and syringe sharing is also positive but considerably less strong in dyads where the alter lives in Mexico (AOR 1.19). Because the sample size is small for the subgroup in which alters live in the US ($n = 40$ dyads), tests for statistical significance were not feasible in the stratified analysis.

To help unpack our findings we conducted a post hoc analysis to determine whether there were differences between alters based on place of residence. We found that 46 % of the alters living in the U.S. were female ($n = 18$) compared to 29 % of the alters living in Mexico ($n = 68$, $\chi^2 = 4.37$, $p = 0.04$, data not shown) and that a larger proportion of alters living in the US were casual sex partners ($n = 5$; 13 %) compared to those living in Mexico ($n = 12$, 5 %, $\chi^2 = 3.12$, $p = 0.08$, data not shown). While further stratification of the analysis on these additional variables was not feasible due to diminishing cell sizes, this finding suggests that different relationship types may cluster geographically.

Discussion

Injection drug-using clients of FSWs in Tijuana use drugs with people both within their countries of residence and across the US-Mexico border, and are at risk for acquiring and transmitting HIV via risky injection practices. In this analysis we found that receptive syringe sharing was more likely in relationships characterized by greater emotional closeness, consistent with other research among PWIDs in the US and elsewhere [4, 6, 41, 42]. It has been suggested that syringe sharing with only close friends may be protective, particularly in networks where seroprevalence is low and there is little turnover of network members [4], though changes in network membership can increase risk for HIV acquisition. In this analysis we extend current understanding through our finding that the relationship between emotional closeness and syringe sharing was not consistent across all relationships; the effect of closeness on syringe sharing was stronger in relationships in which the alter lives in the US compared to relationships in which the alter lives in Mexico, after controlling for the ego's place of residence. These findings answer calls by others to consider factors

that modify the influence of social network factors, and specifically to examine the role of geographical setting [7].

Indeed, our findings reinforce the idea that models of HIV risk behavior need to account for multiple levels of influence, including individual, social, environmental, and cultural [1, 43] and that these levels may interact. One explanation for our findings may lie in the differences in how the US and Mexico regulate syringe access. In California, the US state directly north of the Mexican state of Baja California, where Tijuana is located, syringe possession is largely decriminalized, though individuals may still be arrested if their syringes are not properly stored (California Health and Safety Code §11364.1) or if they contain drug residue. Syringes are available for sale in some, but not all, California pharmacies. In Mexico, syringes are legal to possess without a prescription and are available for purchase in most pharmacies, though barriers to purchasing syringes, extra-legal syringe confiscation, and harassment of Mexican PWIDs are common [44, 45]. It might be that relationship factors such as emotional closeness are less salient under conditions in which syringes are easier to access through retail outlets, or when enforcement of syringe possession laws is variable, thereby explaining the weaker effect when alters live in Mexico. If this hypothesis is correct, structural interventions to increase availability of syringes at a scale that empowers PWIDs to use syringes only one time are needed—a recommendation that has been in place since the earliest days of the HIV epidemic [46, 47]. In the absence of such availability, the importance of standard prevention messages regarding safe injecting practices should be reiterated, particularly for individuals in emotionally intimate injection partnerships [5].

But even in the context of increased availability of syringes, “residual” risk behavior persists [48]. Therefore, interventions that contend with the multifactorial influences on syringe sharing are also needed. The average level of emotional closeness with alters did not differ between alters who lived in Mexico versus the US, but the effect of closeness on syringe sharing was more pronounced when the alters lived in the US. Our findings suggest that men in this study might have different types of relationships with people who live in the US compared to people who live in Mexico. It appears that more of the relationships in the US were with women, and potentially more of those relationships were casual sexual relationships. These characteristics may influence the perceived risk of or trust in syringe sharing partners, and could factor into men’s willingness to share syringes. Respondents in our study may also perceive different levels of risk for HIV associated with sharing syringes with partners who live in Mexico compared to the US. It could also be that cultural and social norms related to syringe sharing differ in US- and Mexico-based drug using networks, such that social sanctions against syringe sharing operate differently in Mexico compared to the US. Findings from other social network-based research suggests that the behaviors of specific network contacts can have strong influences on individuals’ health behaviors [49–51], even if the contacts are not direct [52], lending support to the idea that social normative influences could be driving the observed association. Future research will be needed to determine what mechanisms underlie this effect. Studies comparing drug use networks in the US, Mexico, and across the US-Mexico border could help account for the influence of social norms and risk perceptions, and could provide the information needed to tailor intervention messages. Larger studies could also test a three-way interaction between place of residence,

emotional closeness, and alter's sex. In the meantime, our results suggest that injection partners in the US may benefit from interventions designed to help negotiate risk reduction within the context of emotionally close relationships, similar to safer sex interventions offered to couples [53, 54].

Limitations

Our results should be considered in light of a number of limitations. Our sample consisted of drug-using male clients of FSWs in Tijuana, Mexico, thereby limiting the generalizability of our findings. While our findings are specific to the US-Mexico border region, they have relevance to broader research questions about population mobility, border regions, and mixing of high-risk populations. Our sample was comprised of male PWIDs who were enrolled as part of a broader investigation of the social network factors associated with HIV risk among male clients of FSWs, therefore our findings may not generalize to other PWIDs who are not engaged in commercial sex or to female drug users. Other social network based research has found that social network norms related to syringe sharing have different effects for men and women [55]. The authors suggest that the differential effect of social norms for syringe sharing may signal the presence of other influential members of the social network, or could mean that women are less compelled to gain approval or acceptance through compliance with some types of norms. It may be that similar social normative processes underlie the current findings and, given the strong social component that structures female drug users' risk environment [56–59], further investigation of this phenomenon among women is warranted. We limited our social network inventory to gathering detailed information about only the first five alters. This was a pragmatic decision based on the need to balance the quantity of data collected against respondent burden associated with participating in a large epidemiological study. Therefore, we are unable to investigate structural characteristics of respondents' drug use and sexual networks, and the role of more peripheral network members (named after the first five) remains unknown. However, HIV risk behaviors tend to occur most often with strong social ties [4]. The structure of our questions for eliciting the names of network contacts biased the set of alters towards drug use networks, since we asked about drug-using contacts first. Since the aim of this analysis was to investigate drug use-related HIV risks, the effect of this bias on the current findings is likely negligible. Finally, consistent with the limitations of all non-experimental designs, we are unable to make assumptions about order of precedence or causality.

Conclusion

Multiple levels of influence shape HIV risk behaviors such as syringe sharing. Individual-level factors have been well studied [60]. Social factors including social norms [61–63], the structure of social networks [7, 64, 65], and relationships with individual network members [4, 6] have been identified as important predictors of HIV risk behavior. And, finally, environmental factors such as the availability of syringes, law enforcement practices, and the built environment have also been identified as important factors determining syringe sharing practices [66–72]. In the current analysis we uncovered an interaction between a social factor (emotional closeness) and an environmental factor (place of residence of

network alter) that adds an additional layer to our understanding of the properties of social relationships that confer the greater risk for HIV. Our findings suggest that, 30 years into the HIV epidemic, efforts to reduce HIV risk behaviors in the context of emotionally close relationships are still needed. Those efforts could benefit from tailoring based on the environmental context of the relationship, particularly in border environments characterized by different national-level policies related to syringe access.

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Fig. 1.
Effect of relationship closeness on probability of syringe sharing with alter, moderated by alter's place of residence (n = 272 dyads, 72 egos). Model is controlled for ego's place of residence

Table 1

Demographic, drug use, and social network characteristics of 72 male clients of FSWs in Tijuana who report injection drug using relationships

	N	%
Ego characteristics		
Age (mean, SD)	40.5	8.1
Hispanic/Latino	64	88.9
Lives in Mexico (vs. US)	54	75.0
Ever deported from the US	35	48.6
Married (vs. separated, divorced, widowed or single)	22	30.6
Employed	41	56.9
Heterosexual (vs. gay/bisexual)	65	90.3
Substance use (past 4 months)		
Heroin	67	93.1
Meth	49	68.1
Cocaine	17	23.6
Crack	6	8.3
Alcohol	46	63.9
Biological test results		
HIV (n = 70)	4	5.7
Lifetime Syphilis (n = 69)	7	10.1
Any STI (n = 70)	13	18.6

	Mean	SD	Range
Social network characteristics (proportion, out of 5 contacts)			
% of alters who are female	35.0	25.3	0–100
% of alters in drug network	68.0	24.6	0–100
% of alters in sex network	1.3	5.1	0–20
% of alters in both drug and sex networks	30.3	23.7	0–100
% of alters who are sex workers	22.5	25.3	0–100
% of alters who live in Mexico	84.7	26.3	0–100
% of alters who are regular sex partners	4.2	8.2	0–20
% of alters who are casual sex partners	6.4	15.7	0–80
% of alters who are friends	66.4	31.6	0–100
% of alters who are acquaintances	19.4	27.1	0–100
% of alters who are family members	1.9	6.8	0–40
% of alters who ego sees daily	47.2	35.4	0–100
% of alters with whom ego drinks alcohol	29.4	33.6	0–100
Average closeness with alters	7.8	1.6	2.8–10

Table 2

Alter and relationship-level factors associated with receptive syringe sharing (RSS) with network alters (N = 272 dyads reported by 72 egos)

	RSS with alter (n = 201; 73.9 %)		No RSS with alter (n = 71; 26.1 %)		Odds Ratio	95 % Confidence interval	p value
	N	%	N	%			
Alter characteristics							
Female (vs. male)	67	33.5	19	26.8	4.48	1.23, 16.34	0.02
Named as drug and sex contact (vs. drug only)	63	31.3	17	23.9	4.82	1.26, 18.38	0.02
Sex worker	49	24.4	14	19.7	1.07	0.28, 4.07	0.92
Alter lives in Mexico (vs. US)	168	83.6	64	90.1	0.08	0.007, 0.87	0.04
Relationship type							
Regular sex partner	8	4.0	3	4.2	10.74	0.44, 264.1	0.15
Casual sex partner	15	7.5	2	2.8	9.50	0.49, 181.77	0.14
Friend	134	66.7	47	66.2	0.69	0.20, 2.39	0.56
Acquaintance	37	18.4	15	21.1	0.72	0.18, 2.97	0.65
Family member	3	1.5	3	4.2	0.08	0.004, 1.63	0.10
Relationship characteristics							
See each other daily (vs. less than)	109	54.2	29	40.9	2.14	0.67, 6.85	0.20
Closeness (1–10; median IQR)	9	7, 10	8	6, 9	1.51	1.11, 2.06	0.01
Alter and ego live in the same country	175	87.1	61	85.9	2.96	0.50, 17.4	0.23
Drink alcohol together	55	44.7	12	30.0	1.56	0.42, 5.81	0.51