Incidence and Time-Varying Predictors of HIV and Sexually Transmitted Infections Among Male Sex Workers in Mexico City

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Abstract

Introduction: Male sex workers (MSWs) are at high-risk for HIV/STI acquisition. We quantified HIV/STI incidence rates and identified their time-varying predictors among MSWs in Mexico City.

Methods: MSWs recruited from the largest HIV clinic and community sites in Mexico City were tested for chlamydia, gonorrhea, syphilis, hepatitis, and HIV at baseline, 6-months, and 12-months. Incidence rates with 95% bootstrapped confidence limits were calculated. We examined potential time-varying predictors using generalized estimating equations for a population averaged model.

Results and Discussion: Among 227 MSWs, median age was 24 and baseline HIV prevalence was 32%. Incidence rates (per 100 person-years) were as follows: HIV (5.28; 95%CIs 2.52, 11.07), chlamydia (4.63; 95% 2.41, 8.90), gonorrhea (3.92; 95% 1.96, 7.84), syphilis (12.44; 95% 8.11, 19.08), hepatitis B (2.09; 95% 0.79, 5.58), hepatitis C (0.96; 95% 0.24, 3.85), any STI except HIV (17.61; 95% 12.51, 22.72), and any STI including HIV (19.93; 95%CI 14.78, 26.89). In the multivariable-adjusted model, incident STIs (excluding HIV) were lower among those who reported consistently using condoms during anal and vaginal intercourse (odds ratio (OR) = 0.03, 95% 0.00, 0.68) compared to those who reported inconsistently using condoms during anal and vaginal intercourse.

Conclusions: HIV/STI incidence is high among MSWs in Mexico City. Consistent condom use is an important protective factor for HIV/STIs, and should be an important component of interventions to prevent incident infections.

Introduction

The prevalence of HIV in Mexico is 0.3% in the general adult population, 16.9% among men who have sex with men, and 18.2% among male sex workers (MSWs) (Galárraga et al., 2014a; Bautista-Arredondo, Colchero, Romero, Conde-Glez & Sosa-Rubí, 2013). Studies at the global level have shown that, despite a decline in HIV infection in recent years among the general adult population, HIV acquisition among MSWs has increased (Baral et al., 2015). In part, this is a result of higher transmissibility of HIV during anal intercourse, as well as other risk factors among MSWs, including multiple sexual partnerships, membership in dense sexual networks, and limited access to healthcare services due to stigma (Muraguri et al., 2015; Sethi et al., 2006). Since these factors are predictors of acquisition of both HIV and other sexually transmitted infections (STIs), it is likely that MSWs in Mexico City are at an increased risk of all STIs, not just HIV (Finer, Darroch & Singh, 1999; Patra, 2016). However, scant information is available about the incidence of STIs among MSWs in Mexico City. This is partly due to underreporting of STIs in Latin American countries, including Mexico, because national STI programs lack consistency about which STIs they report and how they report them (Garcia, Benzaken, Galban & Members, 2011). Information is also limited because MSWs are a highly vulnerable and stigmatized population, leading few MSWs to openly disclose their occupation as sex workers (Closson, Colby, Nguyen, Cohen, Biello & Mimiaga, 2015; WHO, 2013).

Previous studies have quantified STI prevalence in MSW populations; however, no studies have examined STI incidence rates among MSWs in Mexico City, and this information is essential for health interventions. Furthermore, no studies have identified predictors of STI acquisition in MSWs in Mexico City or determined how predictors of STIs vary with time (Vuylsteke et al., 2012; Colby et al., 2015). MSWs are a high-risk population for HIV/STI acquisition and, due to their behavioral transactions with paying and non-paying male and female partners, can be at risk for transmitting HIV/STIs to other populations. For example, a recently published modeling

study (using data from the same study population described below), estimated high rates of HIV transmission from MSWs to their clients and non-paying partners (approximately 8% per year) (Monteiro et al., 2015). Identifying predictors of STI incidence is thus essential for developing and targeting interventions to reduce acquisition and onward transmission within MSW/MSM populations as well as transmission to female populations (Verma & Collumbien, 2004; Setia, Sivasubramanian, Anand, Row-Kavi & Jerajani, 2010; Hemmige et al., 2011; van Dam & Holmes, 2000; CDC & World Bank, n.d.). Therefore, our study aims to determine STI/HIV incidence rates, and identify time-varying predictors of incident STI infection among a sample of MSWs in Mexico City.

Methods

Study Setting and Population

A detailed description of the study population and methods is available elsewhere; a brief overview is provided here (Galárraga et al., 2014a; Galárraga, Sosa-Rubí, Infante, Gertler & Bertozzi, 2014b). This study is a secondary analysis of a randomized controlled trial (RCT) that evaluated the impact of conditional economic incentives on staying free of new curable STIs among MSWs in Mexico City. The RCT was not powered to analyze the effects on incident STI/HIV by study arm. Thus, we report here the incidence of STI/HIV and its determinants for the entire sample. This study took place from January 2012 to May 2014. Participants were recruited by trained research staff from community sites where MSWs were known to congregate in Mexico City, as determined in previous studies (Galárraga et al., 2014b; Infante, Sosa-Rubí & Caudra, 2009). Participants were also recruited through referral to the research team from within the Condesa HIV Testing Clinic. Participants were tested and treated for STIs, as indicated, at *Clínica Condesa*. Treatment was provided free of charge, including antiretroviral treatment for those identified as HIV-positive. All participants provided informed consent. All procedures were approved by Institutional Review Boards at Brown University in Providence, USA, and the National Institute of Public Health in Cuernavaca, Mexico.

The sample consisted of 227 cisgender men, ages 18-40, who either self-identified as MSWs (n=152) or who did not self-identify as MSW, but who declared that they were a man who had sex with a male partner in exchange for money in the past six months and who had at least 10 male sexual partners within the last month (n=75). These criteria were determined based a previous study involving observations and in-depth interviews with sex works in Mexico City (Infante, Sosa-Rubí & Caudra, 2009). Transgender women were excluded from the present study because *Clínica Condesa* has a separate program for them.

At the baseline visit, participants filled out a survey with questions regarding sociodemographic characteristics and health behaviors. At baseline (0 months) and follow-up visits one (6 months) and two (12 months), participants were tested and treated (as indicated) for syphilis, chlamydia, gonorrhea, and HIV.

Data Collection and Measures

Data collection was done in partnership with the Mexican National Institute of Public Health (INSP) and the Consortium for HIV/AIDS and TB Research (CISIDAT). Participants were administered the survey using laptop computers with audio computer assisted interviewing (A-CASI) questionnaires. Blood and urine samples were obtained from the participants using bio-safety protocols. Samples were analyzed by trained laboratory personnel.

The main outcome of interest was new, confirmed cases of STIs and HIV. Urine specimens were tested for gonorrhea and chlamydia at the INSP Laboratory (PCR Cobas-Amplicor; Roche, Basel, Switzerland); and blood

specimens served to measure the presence of HIV, hepatitis B, hepatitis C and syphilis antibodies at the Condesa Clinic Laboratory (Abbott HIV-1 and HIV-2, Ag/Ab Combo, anti-HBc, anti-HCV and syphilis TP quimioluminiscence immunoassay (Abbott Laboratories, North Chicago, IL, USA) running in Architect i2000 (Abbott); HIV-positive samples were confirmed with HIV-1 and HIV-2 CombFirm (Orgenics, Alere, Israel). Anti-HBc+ was tested with Determine HBsAg and syphilis TP+ (Abbott) with tittered VDRL test (titre ≥ 1:8 was used as the cut-off for active infection). At the baseline survey, two subgroups were defined for the markers of syphilis and hepatitis B: antibody positivity was regarded as a lifetime marker of past or present infection, whereas treponemic antibody positivity together with VDRL demonstrated active syphilis, and anti-HBc plus HBsAg positivity indicated current hepatitis B virus infection.

Based on findings from prior literature we created a conceptual framework of likely predictors, the majority of which were time-varying, and included: age, education, drug use, condom use, and frequency and types of sexual activities (Patra, 2016; Bazzi et al., 2015). The demographic variable age was continuous and reported in number of years. The other demographic variable, highest educational attainment, was categorical – it was coded as 1 for the answer response “Primary or secondary school,” 2 for the answer response “High school,” and 3 for the answer response “College or higher.” Four separate variables were included to describe sexual activity: had vaginal, anal, or oral sex with clients last week; had vaginal, anal, or oral sex with romantic partners last week; had insertive anal sex with any of 3 most recent clients; and had receptive anal sex with any of 3 most recent clients. The first two variables describing sexual activity were continuous variables, where respondents reported the number of clients or romantic partners they had sex with last week. The latter two variables describing sexual activity were also coded as 0 for the answer response “No” and 1 for the answer response “Yes.” Consistent condom use during sex in the past month and drug use with any of three most recent clients were similarly coded as 0 for the answer response “No” and 1 for the answer response “Yes.”

Lastly, since this study is a secondary analysis of a randomized controlled trial (RCT) that evaluated the impact of conditional economic incentives on staying free of new curable STIs, a variable for randomization to the four study arms of the original RCT was included in our model. This variable is called conditional economic incentives and was coded as 1 for no incentive/control, 2 for receiving a Medium incentive to stay free of new curable STIs, 3 for receiving a high incentive to stay free of new curable STIs, and 4 for receiving a medium incentive to attend study visits only. This controls for the effect of incentives and conditionalities. For further descriptions of the main covariates and outcomes variables in this study, see Appendix A1.

Income and wealth were not included in the model because nonresponse was high for these variables.

Statistical Analyses

Incidence rates were estimated using the person-time method (i.e., by dividing the total number of new HIV/STI infections observed during the study period by the total number of person years at risk). We calculated 95% confidence limits using a bias-corrected and accelerated bootstrap method with 1,000 replicates (Efron & Tibshirani, 1986; Davidson & Hinkley, 1997). We chose this method because it yields appropriate confidence intervals even with relatively small sample sizes. Participants lost to follow-up stopped accruing person years at their last known study visit. Participants with prevalent HIV infection at baseline were included in the analyses for incident STIs, but were excluded for analyses estimating HIV incidence. Participants with prevalent STIs at baseline were excluded for the STIs for which they tested positive, but were still included for calculations of incident STIs for those which they tested negative at baseline. Since HIV is an incurable STI, someone diagnosed

with HIV at 6 months would test positive again for HIV at 12 months. Thus, once diagnosed with HIV, individuals were excluded for analyses estimating HIV incidence but were included in the analyses for other incident STIs.

We estimated marginal models using generalized estimating equations (GEE) with a log link and binomial variance to examine unadjusted and multivariable-adjusted time-varying predictors of incident STIs (Liang & Zeger, 1986). The GEE model provides marginal estimates, for which the estimate is averaged over all values of the covariates, which could be correlated. All models used an unstructured correlation structure. In the main analysis, we used a composite STIs outcome, and then we excluded HIV prevalent cases in a secondary analysis to examine combined incident STIs/HIV. Data was analyzed using STATA 13.1 (StataCorp LP, College Station, Texas, USA) and SAS 9.4 (SAS Institute Inc., Cary, North Carolina, USA).

Results

Sociodemographic and behavioral characteristics are shown in Table 1. The median age among MSWs was 24 years, and HIV prevalence at baseline was 32%. The highest level of schooling for 34% of respondents was high school, while 18% of respondents had attended college or post-graduate school. The majority of MSWs (75%) were unmarried, yet 43% of MSWs reported having a stable romantic partner. MSWs had a median of three sexual partners in the last week. About a fifth of MSWs (22%) reported being intoxicated while having sex with any of their three most recent clients, and 22% reported taking drugs before sex with any of their three most recent clients. The minority of MSWs (29%) reported consistent condom use during sex in the past month. In terms of type of anal sex, 41% of MSWs had insertive anal sex with any of their three most recent clients, 51% had receptive anal sex, and 26% had both insertive and receptive anal sex with any of their three most recent clients.

The total amount of follow-up time for the study cohort was 217.25 person-years, and the average follow-up per participant was 344 days. The highest incidence rates were for active syphilis (12.44 per 100 PY; 95% 8.11, 19.08) among the entire sample, and HIV (5.28 per 100 PY; 95% 2.52, 11.07) among the HIV-susceptible sample (Table 2).

In the unadjusted GEE models, the odds of incident STIs did not vary significantly by high school education, number of clients the individual had sex with in the past week, number of romantic partners the individual had sex with in the last week, drug use, provision of insertive anal sex, or provision of receptive anal sex (Table 3). The odds of STIs did differ by age (odds ratio [OR] = 1.45, 95% 1.07, 1.96) and consistent condom use (OR = 0.08, 95% 0.01, 0.90) in the multivariable adjusted model. Sensitivity analyses including incident HIV in a combined HIV/STI endpoint did not have sufficient statistical power (because about a third of the sample was HIV-positive at baseline and was therefore excluded).

A detailed analysis of loss to follow up for this cohort was conducted in a previous study (Galárraga et al., 2017). The results of our present GEE model are conditional on returning to the Clinic for follow-up.

Discussion

In this secondary analysis of a randomized controlled trial of MSWs in Mexico City, we found that incidence rates of HIV/STI were high: incidence of HIV was 5.28 cases/100PY and incidence of syphilis was 12.44 cases/100PY. In the adjusted multivariable regression models, the only two time-varying predictors found to be significant was were age and consistent condom use. Increasing age seems to be a risk factor for incident STIs. Conversely, consistently using condoms during anal or vaginal intercourse appears to be protective for incident STIs.

The high HIV and active syphilis incidence rates are consistent with those of other MSW populations in large urban areas in various places including Kenya, Cote d'Ivoire, Vietnam and the United Kingdom (Muraguri et al., 2015; Sethi et al., 2006; Vulysteke et al., 2012; Colby et al., 2015). Previous studies of urban, MSM populations have found a similar correlation between consistent condom use and reduced incident STIs. One study of an HIV prevention program in southern India found that an increase in consistent condom use by high risk MSM with both regular male partners (from 33 percent to 46 percent) and paying male partners (from 81 percent to 94 percent) correlated with a decline in incident syphilis cases in this population (from 14.3 percent to 6.8 percent) (Subramanian et al., 2013). Another study of MSM in Australia found that, compared to men who reported consistent condom use during sex, chlamydia incidence was higher among those who reported inconsistent condom use with either regular sexual partners in the previous 6 months (uHR = 1.3; 95% CI: 0.9–1.8), or with casual sexual partners in the past 6 months (uHR = 1.6; 95% CI: 1.2–2.1) (Wilkinson et al., 2012). This study also found that incident chlamydia diagnoses was higher for MSM who self-identified as sex workers (aHR = 1.6; 95% CI 1.0-2.6). The STI incidence rates from this analysis are also consistent with, although higher than, female sex worker (FSW) incidence rates found in a study among FSWs in Mexico (Tijuana and Ciudad Juarez): HIV (1.12 cases/100 PY), chlamydia (9.47 cases/100 PY), active syphilis (4.01 cases/100 PY), and gonorrhea (1.78 cases/100 PY) (Strathdee et al., 2013).

It is important to note is that some participants were recruited into our study by referral from within Condesa HIV Testing Clinic and, furthermore, that participants had to agree to frequent HIV and STI testing as part of the research protocol. This means study participants likely have a greater concern and interest in their sexual health than the general MSW population in Mexico City. As such, we expect our estimates for protective health behaviors, such as condom use, to be overestimates, and we expect estimates for risky health behaviors, such as drug use during sex work, to be underestimates when compared to the general MSW population in Mexico City. Additionally, we expect that for some participants recruited from within *Clínica Condesa* the greater concern and interest in their sexual health, compared to the general MSW population, stems from active STI-like symptoms.

Although our original study did not involve use of PrEP, given the high incidence of HIV within our sample, availability of and willingness to use PrEP are likely key to shaping effective combination HIV/STI prevention strategies in the future (Edeza et al. 2020). Previous research in urban centers in Mexico indicates that awareness and willingness to initiate PrEP is high among MSM (Ravasi et al., 2016; Pitpitan et al., 2015). Yet PrEP is currently only available in three cities in Mexico and offered to only a limited number of male sex workers and other MSM in Mexico City. Furthermore, procurement prices continue to be higher in Mexico than other Latin American countries, which can be a deterrent to larger scale PrEP implementation (Ravasi et al., 2016; Pan American Health Organization & World Health Organization, 2013). Given the limited availability of PrEP for key populations in Mexico and the high rate of HIV observed in our sample, it is likely that MSWs in Mexico City would benefit from pre-exposure prophylaxis (PrEP) as part of a combination prevention strategy (Hankins, Macklin & Warren, 2015; Galea et al., 2011; Liu et al., 1999, Hankins & de Zalduondo, 2010; UNAIDS, 2015).

Since only a small number of MSWs reported consistently using condoms during anal and vaginal sex (28.63%), interventions that address condom use within this population are crucial for reducing STI risk. The Avahan Program – a large-scale HIV prevention program in southern India – combines peer-mediated strategies, condom distribution and STI clinical services to improve outcomes in high-risk men who have sex with men (Subramanian et al., 2013). Increased condom use with commercial and non-commercial partners, as well as decreased syphilis incidence, was strongly linked with exposure to this program. In other low and middle income countries, evidence-

based interventions for increasing condom use in sex worker populations demonstrate that reducing STI transmission is more effective when combined with the consistent and correct use of condoms (Wariki, Ota, Mori, Koyanagi, Hori & Shibuya, 2012; Ghys et al., 2001; Laga et al., 1994). This suggests that behavioral interventions for primary STI and HIV prevention may also serve to enhance the effectiveness of secondary prevention activities. We also recommend screening MSWs based on self-reported condom use frequency and providing a targeted HIV/STI prevention and treatment program to those who do not consistently use condoms in order to improve rates of STI testing, diagnosis, preventative education, and biomedical interventions, such as pre-exposure prophylaxis (PrEP).

The primary limitation of our study was the calculation of incidence rates using data from a previous randomized controlled trial of economic incentives to reduce risky sexual practices (Galárraga et al., 2014a). Although the original pilot intervention was not powered to have a strong and statistically significant effect on STI/HIV acquisition compared with the control group, they could have potentially resulted in fewer new STIs cases and incidence rates that underestimate the true risk in the overall population of MSWs in Mexico City. Therefore, our results should be interpreted as conservative estimates. Another limitation of the study was the small sample size, which decreased the precision of our estimates and increased the likelihood of type II error, a failure to detect an effect that was present within our sample. Some participants were lost-to-follow-up after the first and second study appointments, which further reduced the sample size. The smaller sample size, however, did allow us to collect higher quality data on STIs and potential predictors.

One last element we would like to note is that our final data collection took place in May 2014. Although there have inevitably been changes to the field of HIV and in Mexico City since then, the results of this study are still relevant. There continues to be a dearth of information on STI and HIV incidence rates among MSWs in Mexico City and in Latin American more generally. To the best of our knowledge, this is the only study that provides these incidence rates for MSWs in Mexico City. Furthermore, prevention and early detection of HIV are both as important as ever. Our model is key in illuminating modifiable risk factors for prevention of STI and HIV acquisition.

Conclusions

This study found that MSWs in Mexico City have a high incidence of STIs, particularly HIV and active syphilis. Consistently using condoms during anal and vaginal sex was found to be associated with a lower likelihood of STI acquisition among these MSWs. Consistent condom use appears to be a key potential predictor of STIs and is an important component of interventions to prevent infections. Additionally, targeted interventions for MSWs who report inconsistent condom use are warranted in light of these findings. Given such high HIV rates within this MSW population, the population would likely benefit from future work that assesses the feasibility, effects, and cost of incorporating PrEP in multidimensional interventions.

Abbreviations

Not applicable.

Declarations

Ethics Approval and Consent to Participate

All participants in this study provided informed consent. All procedures were approved by Institutional Review Boards at Brown University in Providence, USA, and the National Institute of Public Health in Cuernavaca, Mexico.

Consent for Publication

Not applicable.

Availability of Data and Materials

Study data is available from the authors upon request.

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Competing Interests

The authors declare they have no competing interests.

Authors’ Contributions

OG, SGSR, and DO conducted the original study that produced the dataset for the current study. OG conceived of the initial idea for this study, which was subsequently refined by the other authors. KYG, MW, and ARZ conducted the data analysis and wrote the initial draft of the manuscript. All authors provided input on the interpretation of the results, revising the work for important intellectual content, approved the final version of the work, and agree to be accountable for all aspects of the work.

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References

Baral, S. D., Friedman, M. R., Geibel, S., Rebe, K., Bozhinov, B., Diouf, D., … Cáceres, C. F. (2015). Male sex workers: practices, contexts, and vulnerabilities for HIV acquisition and transmission. *The Lancet*, *385*(9964), 260–273. https://doi.org/10.1016/S0140-6736(14)60801-1

Bautista-Arredondo, S., Colchero, M. A., Romero, M., Conde-Glez, C. J., & Sosa-Rubí, S. G. (2013). Is the HIV Epidemic Stable among MSM in Mexico? HIV Prevalence and Risk Behavior Results from a Nationally Representative Survey among Men Who Have Sex with Men. *PLOS ONE*, *8*(9), e72616. https://doi.org/10.1371/journal.pone.0072616

Bazzi, A. R., Rangel, G., Martinez, G., Ulibarri, M. D., Syvertsen, J. L., Bazzi, S. A., … Strathdee, S. A. (2015). Incidence and Predictors of HIV and Sexually Transmitted Infections Among Female Sex Workers and Their Intimate Male Partners in Northern Mexico: A Longitudinal, Multilevel Study. *American Journal of Epidemiology*, *181*(9), 723–731. https://doi.org/10.1093/aje/kwu340

CDC, World Bank. (n.d.). *Sexually Transmitted Infections in Developing Countries: Current concepts and strategies on improving STI prevention, treatment, and control* (p. 55).

Closson, E. F., Colby, D. J., Nguyen, T., Cohen, S. S., Biello, K., & Mimiaga, M. J. (2015). The balancing act: Exploring stigma, economic need and disclosure among male sex workers in Ho Chi Minh City, Vietnam. *Global Public Health*, *10*(4), 520–531. https://doi.org/10.1080/17441692.2014.992452

Colby, D. J., Oldenburg, C. E., Nguyen, T., Closson, E. F., Biello, K. B., Mayer, K. H., & Mimiaga, M. J. (2015). HIV, Hepatitis C, and Other Sexually Transmitted Infections Among Male Sex Workers in Ho Chi Minh City, Vietnam. *AIDS and Behavior*, *20*(4), 768–775. https://doi.org/10.1007/s10461-015-1247-z

Davison, A. C., & Hinkley, D. V. (1997). *Bootstrap methods and their application*. https://doi.org/10.1017/CBO9780511802843

Edeza, A., Galárraga, O., Santamaria, E. K., Sosa-Rubí, S., Operario, D., & Biello, K. B. (2020). "I Do Try To Use Condoms, But…": Knowledge and Interest in PrEP Among Male Sex Workers in Mexico City. *Archives of Sexual Behavior*, *49*(1), 355–363. https://doi.org/10.1007/s10508-019-01473-4

Efron, B., & Tibshirani, R. (1986). Bootstrap Methods for Standard Errors, Confidence Intervals, and Other Measures of Statistical Accuracy. *Statistical Science*, *1*(1), 54–75. https://doi.org/10.1214/ss/1177013815

Finer, L. B., Darroch, J. E., & Singh, S. (1999). Sexual partnership patterns as a behavioral risk factor for sexually transmitted diseases. *Family Planning Perspectives*, *31*(5), 228–236.

Galárraga, O., Sosa-Rubí, S. G., Kuo, C., Gozalo, P., González, A., Saavedra, B., Gras-Allain, N., Conde-Glez, C. J., Olamendi-Portugal, M., Mayer, K. H., & Operario, D. (2017). Punto Seguro: A Randomized Controlled Pilot Using Conditional Economic Incentives to Reduce Sexually Transmitted Infection Risks in Mexico. *AIDS and Behavior*, *21*(12), 3440–3456. https://doi.org/10.1007/s10461-017-1960-x

Galárraga, O., Sosa-Rubí, S. G., González, A., Badial-Hernández, F., Conde-Glez, C. J., Juárez-Figueroa, L., … Mayer, K. H. (2014). The disproportionate burden of HIV and STIs among male sex workers in Mexico City and the rationale

for economic incentives to reduce risks. *Journal of the International AIDS Society*, *17*(1). https://doi.org/10.7448/IAS.17.1.19218

Galárraga, O., Sosa-Rubí, S. G., Infante, C., Gertler, P. J., & Bertozzi, S. M. (2014). Willingness-to-accept reductions in HIV risks: conditional economic incentives in Mexico. *The European Journal of Health Economics: HEPAC: Health Economics in Prevention and Care*, *15*(1), 41–55. https://doi.org/10.1007/s10198-012-0447-y

Galea, J. T., Kinsler, J. J., Salazar, X., Lee, S.-J., Giron, M., Sayles, J. N., … Cunningham, W. E. (2011). Acceptability of Pre-Exposure Prophylaxis (PrEP) as an HIV prevention strategy: Barriers and facilitators to PrEP uptake among at-risk Peruvian populations. *International Journal of STD & AIDS*, *22*(5), 256–262. https://doi.org/10.1258/ijsa.2009.009255

Garcia, P. J., Benzaken, A. S., Galban, E., & Members, the A.-I. (2011). STI management and control in Latin America: where do we stand and where do we go from here? *Sexually Transmitted Infections*, *87*(Suppl 2), ii7-ii9. https://doi.org/10.1136/sextrans-2011-050177

Ghys, P. D., Diallo, M. O., Ettiègne-Traoré, V., Satten, G. A., Anoma, C. K., Maurice, C., … Laga, M. (2001). Effect of interventions to control sexually transmitted disease on the incidence of HIV infection in female sex workers. *AIDS (London, England)*, *15*(11), 1421–1431.

Hankins, C. A., & de Zalduondo, B. O. (2010). Combination prevention: a deeper understanding of effective HIV prevention: *AIDS*, *24*(Suppl 4), S70–S80. https://doi.org/10.1097/01.aids.0000390709.04255.fd

Hankins, C., Macklin, R., & Warren, M. (2015). Translating PrEP effectiveness into public health impact: key considerations for decision-makers on cost-effectiveness, price, regulatory issues, distributive justice and advocacy for access. *Journal of the International AIDS Society*, *18*(4Suppl 3). https://doi.org/10.7448/IAS.18.4.19973

Hemmige, V., Snyder, H., Liao, C., Mayer, K., Lakshmi, V., Gandham, S. R., … Schneider, J. (2011). Sex position, marital status, and HIV risk among Indian men who have sex with men: clues to optimizing prevention approaches. *AIDS Patient Care and STDs*, *25*(12), 725–734. https://doi.org/10.1089/apc.2011.0079

Infante, C., Sosa-Rubi, S. G., & Cuadra, S. M. (2009). Sex work in Mexico: vulnerability of male, travesti, transgender and transsexual sex workers. *Culture, Health & Sexuality*, *11*(2), 125–137. https://doi.org/10.1080/13691050802431314

Laga, M., Alary, M., Behets, F., Goeman, J., Piot, P., Nzila, N., … St Louis, M. (1994). Condom promotion, sexually transmitted diseases treatment, and declining incidence of HIV-1 infection in female Zairian sex workers. *The Lancet*, *344*(8917), 246–248. https://doi.org/10.1016/S0140-6736(94)93005-8

Liang, K.-Y., & Zeger, S. L. (1986). Longitudinal data analysis using generalized linear models. *Biometrika*, *73*(1), 13–22. https://doi.org/10.1093/biomet/73.1.13

Liu, A. Y., Kittredge, P. V., Vittinghoff, E., Raymond, H. F., Ahrens, K., Matheson, T., … Buchbinder, S. P. (2008). Limited knowledge and use of HIV post- and pre-exposure prophylaxis among gay and bisexual men. *Journal of Acquired Immune Deficiency Syndromes (1999)*, *47*(2), 241–247.

Monteiro, J. F. G., Marshall, B. D. L., Escudero, D., Sosa-Rubí, S. G., González, A., Flanigan, T., … Galárraga, O. (2015). Preventing HIV Transmission Among Partners of HIV-Positive Male Sex Workers in Mexico City: A Modeling Study. *AIDS and Behavior*, *19*(9), 1579–1588. https://doi.org/10.1007/s10461-014-0915-8

Muraguri, N., Tun, W., Okal, J., Broz, D., Raymond, H. F., Kellogg, T., … Geibel, S. (2015). HIV and STI Prevalence and Risk Factors Among Male Sex Workers and Other Men Who Have Sex With Men in Nairobi, Kenya: *JAIDS Journal of Acquired Immune Deficiency Syndromes*, *68*(1), 91–96. https://doi.org/10.1097/QAI.0000000000000368

Pan American Health Organization, & World Health Organization. (2013). *Antiretroviral treatment in the spotlight: a public health analysis in Latin America and the Caribbean, 2013*. Retrieved from http://iris.paho.org/xmlui/handle/123456789/31367?locale-attribute=pt

Patra, S. (2016). Socio-cultural correlates and risky sexual behaviour influencing prevalence of HIV/AIDS and STIs in Uganda: A gender perspective. *Cogent Social Sciences*, *2*(1), 1166472. https://doi.org/10.1080/23311886.2016.1166472

Pitpitan, E. V., Goodman-Meza, D., Burgos, J. L., Abramovitz, D., Chavarin, C. V., Torres, K., … Patterson, T. L. (2015). Prevalence and correlates of HIV among men who have sex with men in Tijuana, Mexico. *Journal of the International AIDS Society*, *18*, 19304. https://doi.org/10.7448/IAS.18.1.19304

Ravasi, G., Grinsztejn, B., Baruch, R., Guanira, J. V., Luque, R., Cáceres, C. F., & Ghidinelli, M. (2016). Towards a fair consideration of PrEP as part of combination HIV prevention in Latin America. *Journal of the International AIDS Society*, *19*(7 (Suppl 6)). https://doi.org/10.7448/IAS.19.7.21113

Sethi, G., Holden, B. M., Gaffney, J., Greene, L., Ghani, A. C., & Ward, H. (2006). HIV, sexually transmitted infections, and risk behaviours in male sex workers in London over a 10 year period. *Sexually Transmitted Infections*, *82*(5), 359–363. https://doi.org/10.1136/sti.2005.019257

Setia, M. S., Sivasubramanian, M., Anand, V., Row-Kavi, A., & Jerajani, H. R. (2010). Married men who have sex with men: the bridge to HIV prevention in Mumbai, India. *International Journal of Public Health*, *55*(6), 687–691. https://doi.org/10.1007/s00038-010-0173-0

Strathdee, S. A., Abramovitz, D., Lozada, R., Martinez, G., Rangel, M. G., Vera, A., … Patterson, T. L. (2013). Reductions in HIV/STI incidence and sharing of injection equipment among female sex workers who inject drugs: results from a randomized controlled trial. *PloS One*, *8*(6), e65812. https://doi.org/10.1371/journal.pone.0065812

Subramanian, T., Ramakrishnan, L., Aridoss, S., Goswami, P., Kanguswami, B., Shajan, M., … Paranjape, R. S. (2013). Increasing condom use and declining STI prevalence in high-risk MSM and TGs: evaluation of a large-scale prevention program in Tamil Nadu, India. *BMC Public Health*, *13*(1). https://doi.org/10.1186/1471-2458-13-857

UNAIDS. (2015). *Fast-Tracking combination prevention: Towards Reducing New HIV Infections to Fewer Than 500 000 by 2020*. Retrieved from http://www.unaids.org/en/resources/documents/2015/20151019_JC2766_Fast_tracking_combination_prevention

van Dam, C. J., & Holmes, K. K. (2000). STD prevention: effectively reaching the core and a bridge population with a four-component intervention. *Sexually Transmitted Diseases*, *27*(1), 9–11.

Verma, R. K., & Collumbien, M. (2004). Homosexual activity among rural Indian men: implications for HIV interventions. *AIDS (London, England)*, *18*(13), 1845–1847.

Vuylsteke, B., Semde, G., Sika, L., Crucitti, T., Ettiegne Traore, V., Buve, A., & Laga, M. (2012). High prevalence of HIV and sexually transmitted infections among male sex workers in Abidjan, Côte d'Ivoire: need for services tailored to their needs. *Sexually Transmitted Infections*, *88*(4), 288–293. https://doi.org/10.1136/sextrans-2011-050276

Wariki, W. M., Ota, E., Mori, R., Koyanagi, A., Hori, N., & Shibuya, K. (2012). Behavioral interventions to reduce the transmission of HIV infection among sex workers and their clients in low- and middle-income countries. *Cochrane Database of Systematic Reviews*. https://doi.org/10.1002/14651858.CD005272.pub3

WHO | Implementing comprehensive HIV/STI programmes with sex workers: practical approaches from collaborative interventions. (2013). Retrieved May 10, 2016, from WHO website: http://www.who.int/hiv/pub/sti/sex_worker_implementation/en/

Wilkinson, A., El-Hayek, C., Fairley, C. K., Leslie, D., Roth, N., Tee, B. K., … Stoové, M. (2012). Incidence and risk factors associated with chlamydia in men who have sex with men: a cohort analysis of Victorian Primary Care Network for Sentinel Surveillance data. *Sexually Transmitted Infections*, *88*(5), 319–324. https://doi.org/10.1136/sextrans-2011-050270

Tables

Table 1. Baseline Characteristics of Male Sex Workers (N=227) in Mexico City

Characteristic	n (%)
Demographics	
Age, years	24 (20-27), Median (IQR)
Highest educational attainment	
Primary or secondary school	92 (40.53)
High school	77 (33.92)
College or post-graduate	41 (18.06)
Marital status	
Single	171 (75.33)
Married/free union	42 (18.50)
Divorced/separated	2 (0.88)
Stable romantic partner	97 (42.73)
Sexual Behaviors	
Number of male clients in the past week	4.55 (4.98), % Mean (SD)
Number of female clients in the past week	2.53 (6.03) % Mean (SD)
Number of people individual had vaginal or anal or oral sex with last week	3 (1-6), Median (IQR)
Intoxicated while having sex with any of three most recent clients	49 (21.59)
Used drugs before having sex with any of three most recent clients	49 (21.59)
Consistently used condoms during sex in past month	65 (28.63)
Had insertive anal sex with any of three most recent clients	94 (41.41)
Had receptive anal sex with any of three most recent clients	116 (51.10)
Had receptive and insertive anal sex with any of three most recent clients	58 (25.55)

Table 1. (Continued)

Characteristic	n (%)
STI Prevalence	
Positive STI test result	
HIV	73 (32.16)
Chlamydia	23 (10.13)
Gonorrhea	4 (1.76)
Active syphilis	42 (18.50)
Hepatitis B	20 (8.81)
Hepatitis C	2 (0.88)
Any STI (except HIV)	76 (33.48)
Any STI (including HIV)	116 (51.10)
Notes: Table shows number of cases and percentage in parentheses unless otherwise noted. N = total respondents; IQR = interquartile range, SD = standard deviation	

Table 2. Incidence of HIV and STIs among Male Sex Workers in Mexico City

STI	New Cases	Rate (Cases/100 PY [95%CI][1])
HIV	7	5.28 (2.52, 11.07)
Chlamydia	9	4.63 (2.41, 8.90)
Gonorrhea	8	3.92 (1.96, 7.84)
Active Syphilis	21	12.44 (8.11, 19.08)
Hepatitis B	4	2.09 (0.79, 5.58)
Hepatitis C	2	0.96 (0.24, 3.85)
Any STI (except HIV)	44	17.61 (12.51, 22.72)
Any STI (including HIV)	51	19.93 (14.78, 26.89)
Abbreviations: STI, sexually transmitted infection; PY, person-years; CI, confidence intervals. [1]Calculated using person-clustered, bias-corrected, accelerated bootstrapping with 1000 replications. New Cases = instances of new cases during study		

Table 3. Associations between Predictors and Incident STIs*

Characteristic	Unadjusted OR (95%CI)	Adjusted OR (95%CI)
Demographics		
Age, years	1.02 (0.95, 1.09)	1.45 (1.07, 1.96)
Highest educational attainment		
Primary or secondary school	ref	ref
High school	1.30 (0.62, 2.70)	1.23 (0.13, 11.42)
College or post-graduate	0.75 (0.29, 1.94)	0.43 (0.02, 9.97)
Sexual Behaviors		
Had vaginal, anal, or oral sex with clients last week, number of clients	0.98 (0.87, 1.10)	1.35 (0.70, 2.61)
Had vaginal, anal, or oral sex with people last week, number of people	0.99 (0.94, 1.03)	0.74 (0.38, 1.42)
Used drugs while having sex with any of three most recent clients	0.33 (0.09, 1.15)	2.07 (0.18, 23.46)
Consistently used condoms during sex in past month	0.76 (0.38, 1.50)	0.03 (0.00, 0.68)
Had insertive anal sex with any of 3 most recent clients	0.65 (0.25, 1.71)	3.26 (0.44, 24.32)
Had receptive anal sex with any of 3 most recent clients	2.05 (0.75, 5.64)	2.78 (0.27, 28.34)
Conditional Economic Incentives		
Control/No incentive	ref	ref
Medium incentive for staying free of STIs	2.24 (0.80, 6.30)	0.45 (0.02, 11.93)
High incentive for staying free of STIs	2.89 (1.04, 8.01)	0.05 (0.00, 2.24)
Medium incentive for study visits only	2.32 (0.84, 6.45)	0.04 (0.00, 1.90)

Notes: Abbreviations: STI, sexually transmitted infections; OR, odds ratio; ref, reference level.

*Prevalent cases of HIV were retained in the analyses as still susceptible for other STIs. Prevalent cases of STI were retained in analyses as still susceptible for STIs for which they tested negative.

Appendix

Appendix A1. Description of Main Covariates and Outcome Variables

Variable	Question	Answer Options	Coding for the Analysis
Demographics			
Age	How old are you?	Discrete variable; 99.I don't want to answer	Discrete variable
Highest educational attainment	What is the highest level of education you have completed?	0.Didn't complete primary; 1.Primary; 2.Secondary; 3.High School; 4.College; 5.Graduate School; 99.I don't wish to answer	1.Primary or secondary school; 2.High school; 3.College or higher
Sexual Behaviors			
Had vaginal, anal, or oral sex with clients last week	With how many clients did you have vaginal or anal or oral sex with during the last week?	Number of male clients (discrete variable); Number of female clients (discrete variable); 888.I don't know; 999. I don't wish to answer	Total number of clients (discrete variable)
Had vaginal, anal, or oral sex with people last week	With how many romantic partners did you have vaginal or anal or oral sex with during the last week?	Number of male romantic partners (discrete variable); Number of female romantic partners (discrete variable); 888.I don't know; 999. I don't wish to answer	Total number of romantic partners (discrete variable)
Used drugs while having sex with any of 3 most recent clients	Before being with your last client, did you take any drugs? †	1.Yes; 3.No; 99.I don't wish to answer	0.No; 1.Yes (used drugs before having sex with at least one of 3 most recent clients)
Consistently used condoms during sex in past month	When you had sex, how often did you use condoms in the past month?	0.Never; 1.Almost never; 2.Sometimes; 3.Almost every time; 4.Every time	0.Almost every time, sometimes, almost never, or never; 1.Every time
Had insertive anal sex with any of 3 most recent clients	Did you provide the services that your most recent client requested? If yes, how many times?†	Discrete variables: 1.Talk, 2.Insertive anal sex (he penetrated you), 3.Receptive anal sex (you penetrated him), 4.Oral sex, 5.Masturbating, 6.Dance, 7.Bathing, 8.Massage, 9.Striptease, 10.Vaginal sex. 99.Do not wish to answer	0.No; 1.Yes (had insertive anal sex with at least one of 3 most recent clients)

Appendix A1. (Continued)

Variable	Question	Answer Options	Coding for the Analysis
Sexual Behaviors (continued)			
Had receptive anal sex with any of 3 most recent clients	Did you provide the services that your most recent client requested? If yes, how many times?[†]	Discrete variables: 1.Talk, 2.Insertive anal sex (he penetrated you), 3.Receptive anal sex (you penetrated him), 4.Oral sex, 5.Masturbating, 6.Dance, 7.Bathing, 8.Massage, 9.Striptease, 10.Vaginal sex. 99.Do not wish to answer	0.No; 1.Yes (had receptive anal sex with at least one of 3 most recent clients)
STI Incidence			
New sexually transmitted infections (STIs) and HIV	Participants provided blood and urine samples, collected following the local biosafety protocols by trained staff and analyzed by lab technicians. Urine specimens were tested for gonorrhea and chlamydia (PCR Cobas-Amplicor; Roche, Basel, Switzerland); blood specimens served to measure presence of HIV, hepatitis B, hepatitis C and syphilis antibodies (Abbott HIV-1 and HIV-2, Ag/Ab Combo, anti-HBc, anti-HCV and syphilis TP quimioluminiscence immunoassay; Abbott Laboratories, North Chicago, IL, USA) running in Architect i2000 (Abbott). HIV+ samples were confirmed with HIV-1 and HIV-2 CombFirm (Orgenics, Yavne, Israel); and anti-HBcwas tested with Determine HBsAg and syphilis TP (Abbott) with tittered VDRL, the Venereal Disease Research Laboratory test. Two subgroups were defined for the markers of Syphilis: antibody positivity was regarded as a lifetime marker of past or present infection, whereas treponemic antibody positivity together with VDRL demonstrated active syphilis.	0.No 1.Yes (any new STI/HIV)
Randomization			
Conditional Economic Incentives	Participants were randomized and allocated into one of four groups: control, medium incentive to stay free of new curable STIs (USD $50), high incentive to stay free of new curable STIs (USD $75), or medium incentive to attend study visits (USD $50).[§]		1.Control/no incentive; 2.Medium incentive to stay free of new curable STIs; 3.High incentive to stay free of new curable STIs; 4.Medium incentive to attend study visits

Notes: [†]The same question was asked about next-to-last client and second-to-last client; [§]Approximate average exchange rate at time of study (2012–14): 12 Mexican Pesos per $1 (USD).