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UNIVERSITY OF CALIFORNIA, SAN DIEGO
SAN DIEGO STATE UNIVERSITY

**Factors Associated with Early Initiation Into Sex Work and
Sexually Transmitted Infections among Female Sex Workers in
Two Mexico-U.S. Border Cities**

A dissertation submitted in partial satisfaction of the requirements for the degree
Doctor of Philosophy

in

Public Health (Epidemiology)

by

Oralia Loza

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University of California, San Diego

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Victoria D. Ojeda

San Diego State University

Suzanne Lindsay, Co-Chair

Ming Ji

2009

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The Dissertation of Oralia Loza is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

Co-Chair

Chair

UNIVERSITY OF CALIFORNIA, SAN DIEGO

SAN DIEGO STATE UNIVERSITY

2009

DEDICATION

I dedicate this dissertation to the individuals who provided me the opportunity and had the faith in me to complete it. To my father who, 6 months before his death, I shared my goal of achieving a PhD and promised to keep it. To my mother who supported my decision to pursue my studies, providing me her unconditional love, even if she did not understand my goal, its purpose, and my absence from her and the family all these years. For my older brothers who arrived to the U.S. to help my family, providing me the space to focus on my studies and take advantage of opportunities they had to pass up. For my Latino community and that of many immigrants to the U.S. who, despite the injustice and adversity they face, maintain a spirit of survival and struggle which inspires me greatly. Finally, I would like to dedicate this dissertation to the women who participated in *Proyecto Mujer Segura*. Without ever meeting them, their lives played a critical role and form the base of this work.

DEDICATORIA

Por la gente que me dio la oportunidad y me tuvo la fe, y confianza para llegar a este momento y alcanzar la meta de recibir un doctorado. A mi padre, a quien 6 meses antes de su muerte, me comprometí alcanzar mi meta. A mi madre por apoyarme y brindarme su cariño incondicional, sin entender mi ausencia, todos estos años. Mis hermanos que llagaron a este país a trabajar y sacar a la familia delante, brindándome la oportunidad el espacio para estudiar. A mi comunidad Latina y la de tantos emigrantes a este país, que a pesar que

sufren injusticias y adversidad, mantienen el espíritu de sobré vivencia y lucha, la cual me inspira y da vida. Finalmente, me gustaría dedicarle esta tesis a las mujeres que participaron en el Proyecto Mujer Segura. Sin haberlas conocido personalmente, conocí una parte de sus vidas la cual forma base de esta tesis y mi doctorado.

TABLE OF CONTENTS

Signature Page	iii
Dedication	iv
Table of Contents	vi
Acknowledgements	vii
Vita, Publications, and Fields of Study	ix
Abstract of the Dissertation	xvii
Introduction	1
Specific Aims	2
Background & Significance	
Study Settings: Tijuana and Ciudad Juárez	3
Female Sex Work in the Mexico-U.S. border region	4
Overlap between Sex Work and Drug Use in the Mexico-U.S. Border Region	6
Potential Correlates of Entry into Sex Work and STI Risk	
Drug Use	7
Emotional, Sexual, and Physical Abuse	9
Migration	9
Descriptive Epidemiology of HIV and STIs	
Syphilis	10
Chlamydia	15
Gonorrhea	18
HIV	21
Epidemiology of HIV and STIs in Mexico	23
Research Design and Methods	
Study Population	25
Aims and Hypotheses	27
Variables	29
Statistical Analysis	32
Manuscripts	
Manuscript 1	34
Manuscript 2	61
Manuscript 3	97
Conclusions	125
Major Findings	126
Implications for Prevention	127
Limitations	135
Strengths	138
Future Research	139
Appendix	142
References	144

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The dissertation author was the primary investigator and author of these manuscripts included in the dissertation. All have been submitted for publication. The first one has been accepted for publication.

1. Loza, O., Strathdee, S.A., Martinez, G., Lozada, R., Ojeda, V.D., Staines-Orozco, H., Patterson, T.L. Risk factors associated with Chlamydia and

- gonorrhea infection among female sex workers in two Mexico-U.S. border cities. *Sexually Transmitted Diseases*. Submitted June 2009.
2. Loza, O., Patterson, T.L., Rusch, M., Martínez, G.A., Lozada, R., Staines-Orozco, H., Magis-Rodríguez, C., Strathdee, S.A. Drug-Related Behaviors Independently Associated with Syphilis Infection among Female Sex Workers in two Mexico-U.S. Border Cities. *Addiction*. Submitted April 2009.
 3. Loza, O., Strathdee, S.A., Lozada, R., Staines, H., Ojeda, V.D., Martinez, G.A., Amaro, H., Patterson, T.L. Correlates of early versus later initiation into sex work in two Mexico-U.S. border cities. *Journal of Adolescent Health*. Accepted June 2009.

VITA, PUBLICATIONS, AND FIELDS OF STUDY

EDUCATIONAL BACKGROUND

<i>University of California, San Diego & San Diego State University, Joint Doctoral Program</i> Ph.D., Public Health, Epidemiology	2009
<i>University of California, San Diego</i> Graduate courses in international studies	2002
<i>University of California, Santa Barbara</i> M.A., Applied Statistics	2001
Mathematics Teaching Credential	1999
B.S., Mathematics	1998
<i>Universidad Complutense de Madrid</i> Education Abroad Student	1997

EMPLOYMENT HISTORY

September 2005 - Present

U.C. San Diego Division of Global Public Health, Department of Medicine,
Statistician

- * Review and provide analysis for abstracts, papers, presentations, grants and manuscripts.
- * Statistical analysis reports and data cleaning are performed using SPSS, SAS, and R.
- * Participate in questionnaire development using QDS, presenting preliminary research findings to field team members, training students and assisting with their thesis projects.
- * Coordinated open house/site visits of the field research in Tijuana for students/staff/reporters.
- * Documented aspects of the field research with photography.
- * Training fellows in statistical analysis and software (i.e. EpiInfo)
- * Database management of *Mujer Mas Segura*.

March 2003 - September 2005

U.C. San Diego Division of Biostatistics, Department of Family and Preventive
Medicine, *Statistician*

- * Performed routine statistical computations under the supervision of the Biostatistics Informatics Lab Director for investigators in the UCSD School of Medicine, Cancer Center, Stroke Center and Alzheimer's Disease

Cooperative Study and Research Center.

- * Consulted investigators and researchers on study design and plan for analysis for studies with statistical difficulty.
- * Created reports and analysis plans in a professional, clear format in Sweave.
- * Contributed to manuscript development for studies requiring routine statistical methods.
- * Statistical programming in R.
- * Worked with statistical methods and models including incorporating a limited range of variable types and statistical approaches.
- * Communication, verbal and written, with a diverse group of people including faculty, investigators and staff.
- * Managed multiple responsibilities and tasks applying organizational and time management skills.

January 2003 - May 2003

San Diego State University, *Lecturer*

- * Prepared and assessed lectures, lessons, assignments and exams.
- * Met with students on an individual and group level to review material.
- * Created interactive individual and group lessons to supplement the course curriculum.
- * Demonstrated ability to clarify difficult concepts and to inspire students
- * Received consistently glowing evaluations from students and supervising administrators

June 2001 - August 2001 and June 2002 - August 2002

Projecto ACCESS, Oxnard College, *Instructor*

- * Instructed college level math and statistics course to junior high school students as part of nine NASA funded national projects to promote math and science among underrepresented communities.
- * Presented course and program written and oral material to students and parents in Spanish and English.

June 2000 - September 2000

Farmers Insurance Group, *Actuarial Analyst Intern*

- * Responsible for developing and revising SAS code for preparing and testing of rate levels.
- * Reported comparative data utilizing SAS, ACCESS and Excel. One rate filing was completed and one rate change was tested and implemented.
- * Prepared and published operations manual for employee reference.
- * Improved efficiency of automated mechanism for standard procedures including an Excel macros, lookup tables, and data summaries. Trained staff to utilize, manage, and maintain this system.
- * Coordinated team meetings and project deadlines with project manager and senior actuary.

January 2000 - June 2001

U.C. Santa Barbara, Statistics Department, *Instructor*

- * Instructed and tutored for a variety of actuarial mathematics and statistics courses.
- * Led sections in risk theory, actuarial mathematics, elementary probability and statistics courses.
- * Managed ten teaching assistants for a 400-student course. Coordinated weekly meetings and distributed course responsibilities to fellow teaching assistants.

September 1997 - June 2001

U.C. Santa Barbara and Santa Barbara public schools, *Instructor*

- * Instructed and tutored for a variety of mathematics and outreach programs ranging from elementary to college level.
- * Led sections in statistics and risk theory actuarial mathematics courses.
- * Managed ten teaching assistants for a 400-student course. Coordinated weekly meetings and distributed course responsibilities to fellow teaching assistants.

October 1994 - June 1995

U.C. Santa Barbara, Anthropology Department, *Assistant to Professor Emeritus*

- * Maintained a high level confidentiality of operational information.
- * Conducted online and library research.
- * Restructured the organization of physical and electronic files and created a directory.
- * Managed mail from various mailboxes and e-mail accounts using Eudora.
- * Created, reproduced, and distributed newsletter regarding research team findings.
- * Maintained personal, academic, and research grant proposal calendars.
- * Coordinated lecture series and accommodations for international speakers.
- * Ordered supplies, prepared purchase orders and maintained inventory.

PUBLICATIONS

Loza, O., Strathdee, S.A., Martinez, G., Lozada, R., Ojeda, V.D., Staines-Orozco, H., Patterson, T.L. Risk factors associated with Chlamydia and gonorrhea infection among female sex workers in two Mexico-U.S. border cities. Sexually Transmitted Diseases. Submitted June 2009.

Loza, O., Patterson, T.L., Rusch, M., Martínez, G.A., Lozada, R., Staines-Orozco, H., Magis-Rodríguez, C., Strathdee, S.A. Drug-Related Behaviors Independently Associated with Syphilis Infection among Female Sex Workers in two Mexico-U.S. Border Cities. Addiction. Submitted April 2009.

Loza, O., Strathdee, S.A., Lozada, R., Staines, H., Ojeda, V.D., Martinez, G.A., Amaro, H., Patterson, T.L. Correlates of early versus later initiation into sex work in two Mexico-U.S. border cities. *Journal of Adolescent Health*. Accepted June 2009.

Volkow, P., K. C. Brouwer, O. Loza, R. Ramos, R. Lozada, R. S. Garfein, C. Magis-Rodriguez, M. Firestone-Cruz and S. A. Strathdee (2009). "Cross-border paid plasma donation among injection drug users in two Mexico-U.S. border cities." *Int J Drug Policy*. 2009 Feb 18. [Epub ahead of print]

Strathdee, S. A., R. Lozada, R. A. Pollini, K. C. Brouwer, A. Mantsios, D. A. Abramovitz, T. Rhodes, C. A. Latkin, O. Loza, J. Alvelais, C. Magis-Rodriguez and T. L. Patterson (2008). "Individual, social, and environmental influences associated with HIV infection among injection drug users in Tijuana, Mexico." *J Acquir Immune Defic Syndr* 47(3): 369-76.

Deiss, R. G., K. C. Brouwer, O. Loza, R. M. Lozada, R. Ramos, M. A. Cruz, T. L. Patterson, D. D. Heckathorn, S. D. Frost and S. A. Strathdee (2008). "High-risk sexual and drug-using behaviors among male injection drug users who have sex with men in 2 Mexico-US border cities." *Sex Transm Dis* 35(3): 243-9.

Navarro, A. M., R. Raman, L. J. McNicholas and O. Loza (2007). "Diffusion of cancer education information through a Latino community health advisor program." *Prev Med* 45(2-3): 135-8.

Kapp, N., C. S. Todd, K. T. Yadgarova, G. Alibayeva, D. Nazarova, O. Loza and G. S. Babadjanova (2007). "A randomized comparison of misoprostol to intrauterine instillation of hypertonic saline plus a prostaglandin F2alpha analogue for second-trimester induction termination in Uzbekistan." *Contraception* 76(6): 461-6.

Morris, T. A., J. J. Marsh, P. G. Chiles, C. A. Pedersen, R. G. Konopka, A. C. Gamst and O. Loza (2004). "Embolization itself stimulates thrombus propagation in pulmonary embolism." *Am J Physiol Heart Circ Physiol* 287(2): H818-22.

ABSTRACTS

Loza O, Strathdee S, Semple S, Lozada MR, Staines H, Fraga MA, Martinez GA, de la Torre A, Amaro H, Patterson T. Correlates of early initiation into sex work in two Mexico-U.S. border cities. Oral presentation at the 136th APHA Annual Meeting & Exposition (October 25-29, 2008) in San Diego, California.

Welton M, Loza O, Rodriguez-Lainz A. Lead exposure from glazed ceramics cookware and home remedies in an indigenous migrant community, Baja

California, Mexico, 2005-2007. Oral presentation at the 136th APHA Annual Meeting & Exposition (October 25-29, 2008) in San Diego, California.

Loza O, Martínez G, Lozada R, Strathdee S, Staines-Orozco H, Fraga-Vallejo M, Orozovich P, de la Torre A, Magis-Rodríguez C, Patterson TL for *Proyecto Mujer Segura*. Drug-using Behaviors are Independently Associated with Sexually Transmitted Infections among Female Sex Workers in two Mexico-US Border Cities. Poster exhibition at the XVII International AIDS Conference (August 3-8, 2008) in Mexico City, DF.

Loza O, Araneta MR, Jassal SK, Kritz-Silverstein D, Wingard D, Barrett-Connor E. Prediction of coronary artery calcium by albumin to creatinine ratio and the variation by ethnic group. Oral presentation at the 2008 San Diego Epidemiology Research Exchange Conference (May 2, 2008) in San Diego, California.

Araneta MRG, Loza O, Jassal SK, Barrett-Connor E. Kidney Function is Associated with Coronary Artery Calcium among White, but not Filipino Women. Poster presentation at American Diabetes Association's 68th Annual Scientific Sessions (June 6 - 10, 2008) in San Francisco, California.

O Loza, M Welton, A Rodriguez-Lainz, S Brodine, R Perez, M Fraga. Lead Exposure from Pottery and Home Remedies: Risks and Awareness among a Migrant Community in Mexico. Poster presentation at the Changing Faces of Public Health Symposium commemorating the SDSU Graduate School of Public Health 25th Anniversary (April 13-14, 2007) in San Diego, CA. (3rd Prize Winner)

Volkow P, Brouwer KC, Ramos R, Lozada R, Garfein R, Magis-Rodriguez C, Loza O, Firestone M, Strathdee SA. Cross-Border paid plasma donation among injection drug users in Mexico-US border cities. XVI International AIDS Conference (August 13-18, 2006) in Toronto, Canada.

Deiss R, Brouwer KC, Loza O, Lozada R, Ramos, Firestone M, Patterson TL, Magis-Rodriguez C, Strathdee SA. High risk sexual and drug-using behaviors among male injection drug users who have sex with men in two Mexico-US border cities. XVI International AIDS Conference (August 13-18, 2006) in Toronto, Canada.

Loza O, Araneta MRG, Wooten WJ, Barrett-Connor E. Ethnic Differences in Anthropometric Characteristics and Diabetes and Their Association with Subclinical Atherosclerosis (SA). Poster presentation at the 46th Annual Conference on Cardiovascular Disease Epidemiology and Prevention (March 2-5, 2006) in Phoenix, Arizona.

Araneta MRG, Loza O, Wooten WJ and Barrett-Connor E. Adiponectin:Leptin Ratio Is Associated with Subclinical Atherosclerosis (SA) in African-American But

Not Filipino Women. Poster presentation at the 46th Annual Conference on Cardiovascular Disease Epidemiology and Prevention (March 2-5, 2006) in Phoenix, Arizona.

Ramos R, Lozada R, Brouwer K, Firestone M, Ramos ME, Loza O, Magis C, Strathdee SA. High prevalence of injection risk behaviors among injection drug users in two Mexican-US border cities. 17th International Conference on the Reduction of Drug Related Harm (April 30-May 4, 2005) in Vancouver, Canada.

Brouwer KC, Ramos R, Lozada R, Firestone M, Patterson TL, Loza O, Magis-Rodriguez C, Strathdee SA. Drug use behaviors associated with border crossing among injected drug users along the Mexico/US border. 17th International Conference on the Reduction of Drug Related Harm (April 30-May 4, 2005) in Vancouver, Canada.

Loza, O. Gender Differences in Math Education. Poster presentation at the National Conference on Undergraduate Research (April 1996) at the University of North Carolina in Asheville, North Carolina.

Loza, O. Gender Differences in Math Education. Poster presentation at the Southern California Council for Undergraduate Research (November 1995) at The Claremont Colleges in Claremont, California.

Aburto F, Loza O, Salcido M, Thompson B, Au R (Mentors: Calvo JA and Millett KC). Equilateral polygonal knots and the characterization of pentagon in R^3 . Poster presentation at the Math Association of America Conference (Summer 1995) in California Polytechnic State University in San Luis Obispo, California.

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RESEARCH EXPERIENCE

July 2005 - Present

Proyecto EL CUETE, *Mujer Segura*, and *Mujer Mas Segura*

University of California at San Diego, Division of Global Public Health

- * Researched transmission of HIV and sexually transmitted diseases among injection drug users and female sex workers living in Mexico-U.S. border cities Tijuana, BC and Ciudad Juarez, CHI.
- * Findings were presented at national and international conferences (2008). Papers in progress.

November 2004 - 2006

EXPORT Grant

University of California at San Diego, Family and Preventive Medicine

- * Investigating ethnic disparities in disease prevalence among Filipina, African-American, and Caucasian women.
- * Findings presented at the American Heart Association epidemiology conference (2006). Papers in progress.

Summer 1995

UCSB-CAMP Summer Research

University of California, Santa Barbara, Mathematics Department

- * Researched Knot Theory as part of a university team of six math students.
- * Presented findings at state (UCSB Colloquium, 1995) and national (Math Association of America) conferences.

Summer 1995

Querétaro Research Project

University of California, Santa Barbara, Anthropology Department

- * Researched gender biases in math education in Querétaro, Mexico.
- * Published and presented findings at state (Southern California Council for Undergraduate Research) and national (National Conference for Undergraduate Research) conferences.

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NIDA Diversity Supplement Recipient (2006-09). San Diego Fellowship Recipient (2005-07). NHSN on Drug Abuse Fellow (2007) and Member (2006-09).

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Achievement Program and California Alliance for Minority Participation (1995-

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ABSTRACT OF THE DISSERTATION

Factors Associated with Early Initiation Into Sex Work and Sexually Transmitted Infections among Female Sex Workers in Two Mexico-U.S. Border Cities

by

Oralia Loza

**Doctor of Philosophy
in Public Health (Epidemiology)**

**University of California, San Diego, 2009
San Diego State University, 2009**

**Professor Steffanie A. Strathdee, Chair
Professor Suzanne Lindsay, Co-Chair**

Purpose: To examine correlates of early initiation into sex work and sexually transmitted infections (STIs) among female sex workers (FSWs) in Tijuana and Ciudad Juarez, two Mexican cities on the U.S. border where prostitution is quasi-legal.

Methods: FSWS aged ≥ 18 years without known HIV infection living in Tijuana and Ciudad Juarez who had recent unprotected sex with clients underwent baseline interviews and testing for syphilis, Chlamydia and gonorrhea.

Correlates of early initiation into sex work (age<18) and each infection were identified with logistic regression.

Results: Of 920 FSWs interviewed in Tijuana and Ciudad Juarez, 10% were early initiators into sex work. Median age, age initiation into sex work, and duration in sex work were 32, 26, and 4 years, respectively. Overall, 18% had ever injected drugs, 14% often/always used illegal drugs before/during sex in the past month, 38% had clients who injected drugs in the last 6 months, and 69% reported having clients from the U.S. Prevalence of HIV, active syphilis, Chlamydia, and gonorrhea were 6%, 10%, 13%, and 6%, respectively.

Conclusions: Different pathways for early versus later initiators into sex work are apparent in the Mexico-U.S. border region; which has implications for intervention strategies. Drug-using behaviors were more closely associated with active syphilis, Chlamydia, and gonorrhea than were sexual behaviors. STI eradication programs should focus on subgroups of FSWs and their partners who use and inject drugs, expanding access to sterile syringes, and assisting FSWs with safer-sex negotiation in the context of drug use.

Factors independently associated with early initiation were inhalant use, initiating sex work to pay for alcohol, and history of child abuse. Factors associated with later initiation were less education, migration, and initiating sex

work for better pay or to support children. Factors independently associated with active syphilis were having injecting drugs, using illegal drugs before/during sex, and having any U.S. clients. Factors independently associated with Chlamydia were being younger, working in Tijuana versus Ciudad Juarez, and recent methamphetamine injection. Factors independently associated with gonorrhea were working in Tijuana versus Ciudad Juarez, using illegal drugs before or during sex, and having a male sex partner who injected drugs.

**Factors Associated with Early Initiation Into Sex Work and
Sexually Transmitted Infections among Female Sex Workers in
Two Mexico-U.S. Border Cities**

INTRODUCTION

The sex industry is impacted by globalization, migration, health, employment, and public policy^[1]. Socioeconomic factors, population demographics, cultural and sexual behavior, drug use, and access to testing and care contribute to the spread of HIV and STIs. These factors may play differential roles in the risk of infection across populations and subgroups such as female sex workers (FSWs). Sex workers are not only at risk for sexually transmitted infections (STI) but are prone to stigma and blamed for spreading disease^[1].

The Mexico-U.S. border region attracts migrants from other areas of Mexico and South America who seek economic opportunities or migration to the U.S. These goals are not always achieved once they arrive to the region, thus creating populations that are displaced and vulnerable to HIV and STIs. Young women are particularly vulnerable to becoming sex workers in this region. Migration to the region, a search for better pay, or a search for means to survive or raise families may play a role in their initiation into sex work. Given the high availability of drugs in the region, drug use patterns may be influential factors relating to their decision to enter sex work.

Few studies have identified the influential factors for the acquisition of STIs such as syphilis, gonorrhea, and Chlamydia among FSWs in the Mexico-

U.S. border region, where Tijuana and Ciudad Juarez are located. The research proposed herein investigates the factors associated with early initiation into sex work and the acquisition of STIs among FSWs in Tijuana, Baja California and Ciudad Juarez, Chihuahua.

Specific Aims

The proposed study aims to:

- I. determine correlates of early versus later initiation into sex work in Tijuana and Ciudad Juarez.
- II. determine if drug-using behaviors are independently associated with syphilis infection among female sex workers in Tijuana and Ciudad Juarez, after adjusting for sexual risk behaviors.
- III. determine factors independently associated with gonorrhea and Chlamydia infections among female sex workers in Tijuana and Ciudad Juarez.

In this dissertation, the candidate will provide a literature review and background information on entry into sex work and epidemiology of STI in Mexico and specifically the border region. She will provide a description of the major factors considered in the hypotheses. She will then present the three manuscripts that have been submitted for publication, each of which addresses a specific aim of her dissertation. She will conclude with a discussion of the major findings her dissertation research, the strengths and limitations of the study, and

personal thoughts on the findings.

Background & Significance

Study Settings: Tijuana and Ciudad Juárez

Tijuana and Ciudad Juárez, Chihuahua are both cities on the Mexico-U.S. border with a large population of FSWs. The Mexican state of Baja California Norte (Northern Baja) borders the U.S. states of California and Arizona. Over 75% of the state's population (population 2,844,469) lives in the border cities of Tijuana and Mexicali, the state capital^[2]. Tijuana is the largest city along the Mexico-U.S. border with 1,410,687 residents^[2]. Tijuana has close to half of the state's population where 8.2% of the population recently (last five years) migrated into the state from other parts of Mexico^[3]. It is also the port of entry with the largest volume of northbound travelers to the U.S., adjacent to San Diego, California. In 2006, there were 41 million northbound crossings between Tijuana and San Diego^[4]. Tourism is the second largest industry in Tijuana, after the *maquiladoras* or manufacturing industry. Main attractions include bullfights, nightclubs, shopping, restaurants, and bars. This also includes sexual tourism.

The Mexican state of Chihuahua, where Ciudad Juárez is located, is primarily rural and borders the U.S. states of New Mexico and Texas. Ciudad Juárez is the largest city in the state and the second largest border city along the Mexico-U.S. Border. It shares its border with El Paso, Texas and has a population of 1,313,338^[2]. Ciudad Juárez has close to a third of the state's population where 3% of the population recently (last five years) migrated into the

state from other parts of Mexico^[5]. In 2006, there were 36 million northbound border crossings between Ciudad Juarez and El Paso^[4]. The manufacturing industry is the largest industry of Ciudad Juarez with hundreds of *maquiladoras* in industrial parks. The main attractions include archaeological sites, ecological parks, sand dunes, and historical monuments and buildings.

Female Sex Work in the Mexico-U.S. border region

Throughout Mexico, most cities have developed *zonas de tolerancia* or zones of tolerance where sex work is quasi-legal and, in some cases, regulated by the Municipal Health Department. In these zones, clients are rarely arrested or prosecuted^[6].

In 2006, it was reported that 4,850 FSWs were registered with the Municipal Health Service in Tijuana while thousands of other FSWs are thought to work without permits^[7]. Most are working in *La Zona Roja* or the red light district on “Coahuila” street and surrounding alleys near *Avenida Revolución* in the center of Tijuana’s downtown district. The Zona Roja also overlaps the Zona Norte, which is known for its heavy drug use.

There are approximately 4,000 FSWs who work in zones of tolerance in Ciudad Juarez^[7]. Unlike Tijuana, the Health Department in Ciudad Juarez does not regulate sex work^[7]. Although permits are not required in the two *Zonas Rojas* in Ciudad Juarez, FSWs can still be fined for working without one^[8]. The red light districts in Ciudad Juarez are close to the international bridge and bordered by the streets Begonias, Otumba, Degollado, Ocampo, and Mariscal^[9].

In both Tijuana and Ciudad Juarez, FSWs are found working in cantinas, bars, hotels, nightclubs, massage parlors, and street corners and their clients include men from both side of the U.S.-Mexico border. The *Zonas Rojas* in both cities attract “sex tourists” including military officers from the U.S. and other countries, who range in age from 18 to 80^[9, 10]. A significantly higher proportion of FSWs in Tijuana report having U.S. clients compared with FSWs in Ciudad Juarez (78.1% vs. 58.7%, $p < 0.001$)^[8]. FSWs with U.S. clients in these cities were significantly more likely to inject drugs, have unprotected sex for more money, and to have syphilis titers consistent with active infection compared to other FSWs^[8], which suggests the potential for cross-border STI transmission.

The legal age of consent for sexual intercourse in Mexico is 18, yet underage sex workers are common. In certain areas of the red light district in both Tijuana and Ciudad Juarez, sex workers are girls as young as 12 years old. These girls are often referred to as the “*niñas*” or “*chamaquitas*.” Many of these young girls are newcomers to border cities seeking to send money home to their families in Southern parts of Mexico or Central America, who have no social supports and nowhere to turn. Due to problems such as human trafficking, safety concerns, and the clandestine nature of sex work among young girls, there are very few research studies on young girls engaged in sex work^[11].

Some FSWs in Mexico enter sex work against their will, while others most enter prostitution out of economic necessity influenced by a failed relationship or intolerable working conditions in *maquiladoras*^[10, 12]. Some Mexican FSWs have husbands or steady partners, yet women are often sole providers^[10]. Studies

conducted among Mexican FSWs in Tijuana and Ciudad Juarez indicate that over 90% have children, with three dependents on average^[7]. FSWs who are supporting family members and for whom prostitution is the main source of income may be more likely to engage in unsafe sexual practices with clients^[13]. FSWs who desire to leave sex work are challenged by their lack of education, limited job alternatives and harsh working conditions^[10]. In a qualitative study of FSWs in Tijuana, Bucardo and colleagues reported that FSWs face low earnings, limited access to condoms, violence from clients or intimate partners, and frequent demands for unsafe sex^[10]. These conditions as well as factors related to mobility, poverty, and social support may increase their risk for HIV/STIs^[14]. These may be relevant factors influencing pathways for sex work initiation and may play a differential role for women who enter sex work at younger versus older ages.

Overlap between Sex Work and Drug Use in the Mexico-U.S. Border Region

Tijuana and Ciudad Juarez are situated on major drug trafficking routes for heroin, cocaine and methamphetamine. Among FSWs in these two cities, 18.0% reported ever injecting drugs and 12.3% reported injecting illicit drugs within the last month. The drugs injected included heroin (93.9%), “speedball” (cocaine/heroin combination; 50%), cocaine (36.0%), or methamphetamine (21.1%)^[14]. An earlier study conducted in Ciudad Juarez among 75 FSWs found that 59% were currently using drugs of which 36% initiated illicit drug use prior to entry into sex work and half were injecting drug users (IDUs)^[15]. The most

common drugs injected were cocaine (31%), heroin (31%) and speedball (38%) and one quarter of FSW-IDUs had ever used a used syringe^[15]. Among 924 FSWs in Tijuana and Ciudad Juarez, FSWs who were also IDU were more likely to have a steady partner who was an IDU, to report that their fellow FSWs were also IDUs, were more likely to often or always used drugs before sex, and had more clients with whom they had unprotected vaginal sex acts^[14]. In preliminary analysis among FSWs in Tijuana who ever used drugs (Appendix), most did so prior to their sex work initiation (ranging from 5 months to 7.5 years prior). In this study, we will examine the role of specific drug use behaviors as markers for early initiation into sex work and potential risk factors for STIs.

Potential Correlates of Entry into Sex Work and STI Risk

Drug Use

The DEA estimates that Mexico-based groups control 70–90% of methamphetamine and 30% of the heroin production and distribution into the United States. They also estimate that 65% of the South American cocaine reaches American cities via the U.S./Mexico border^[16]. The increase in the availability of these drugs in Mexico has led to an increase and experimentation in use of the local drug consumption^[17]. The highest consumption of illicit drugs in Mexico is in Baja California; Tijuana has close to 21,000 drug users of which approximately 6000 IDU were estimated to attend shooting galleries^[18]. However, since 40% of IDUs in Tijuana do not attend shooting galleries, the actual number

might be 10,000^[19]. In Ciudad Juarez, there are 3000–3500 heavy heroin users and 6000 IDUs^[18].

Substance use, including injection drug use, is a risk factor for entering sex work in many settings^[20-22]. Some FSWs may increase or change their drug use pattern after their initiation into sex work. For example, FSWs in Tijuana and Ciudad Juarez report using stimulants, such as methamphetamine or cocaine, to cope or stay awake^[14].

Recent studies have reported high levels of HIV risk behaviors among IDUs and FSWs^[7, 19]. Among 924 FSWs in Tijuana and Ciudad Juarez, factors independently associated with injecting drugs in the past month included living in Tijuana, younger age, longer duration in the sex trade, earning less for sex without condoms, often using drugs before sex, and knowing other FSWs who injected drugs^[14].

In this study, we will examine patterns of drug use (injection and non-injection) and various types of drug use (e.g. methamphetamine, heroin, cocaine, inhalants) to determine their association with early initiation into sex work as well as STI acquisition. For example, several studies have shown an independent association between STI acquisition and methamphetamine use among gay/bisexual men as a result of high-risk sexual behaviors that are commonly reported with the use of this drug^[23]. Few studies have examined the role of methamphetamine in relation to STI risk among women, although earlier studies have shown a relationship with crack use^[24-27].

Emotional, Sexual, and Physical Abuse

Initiation into sex work has been linked to childhood sexual, emotional, and physical abuse, such as forced sex and domestic violence and childhood sexual victimization^[20, 21, 28-30]. Among 1196 children processed in a criminal county court in an unnamed U.S. metro-Midwest city between 1967 through 1971 and followed-up between 1989 and 1995, early childhood abuse and/or neglect, and sexual abuse was significantly associated with initiation into sex work while physical abuse was marginally significant^[30]. Among homeless women and street youth in New York, early sexual abuse significantly associated with prostitution^[29].

Studies that consider the role of history of abuse among FSWs in the Mexico-U.S. are lacking. In this study, we will examine adult and childhood physical, emotional and sexual abuse as it relates to early initiation into sex work.

Migration

Migration may be a risk factor for both entry into sex work and STI acquisition. Rural to urban migration in the developing world exposes the migrant labor worker to experience long absences, increased family breakdown, and increased numbers of sexual partners^[31]. In Mexico, a strong relationship has been established STI/HIV, sex work, and migration^[32, 33]. A study of FSWs in Tijuana and Ciudad Juarez found that only 30% had been born in the state where they now work^[7]. Among 157 female IDU in Tijuana, HIV infection was

independently associated with the time living in Tijuana such that their odds of testing HIV-positive increased by 81% for every ten years lived in Tijuana^[34].

Mexican migrants are in large part destined for the border region. Immigrants in the U.S., particularly those concentrated in urban HIV epicenters such as Los Angeles County which includes primarily Mexicans (87%), have low HIV/AIDS knowledge, lack of access to health care as well as low access to HIV testing and care^[35]. In this study, we will examine migration as a factor associated with early initiation into sex work as well as a factor associated with the acquisition of syphilis, Chlamydia, and gonorrhea among FSWs.

Descriptive Epidemiology of HIV and STIs

Syphilis

Etiologic Agent: Syphilis infection is caused by the bacterium *Treponema pallidum*^[36]. Syphilis is an STI and can be transmitted through genital, anal, or oral sexual contact or contact with syphilitic sores in the anus, rectum, and vagina or mouth. Syphilis can also be transmitted congenitally, from mother-to-child, resulting in stillbirth and various birth defects (e.g., blindness)^[37].

Symptoms: Syphilis is prevalent throughout the world with 12 million people infected every year. It is the leading cause of genital ulcers in developing countries^[38]. Symptoms are initially mild and unnoticed and progress through the different stages of the disease. The three stages of syphilis are primary, secondary, and tertiary. During the primary stage, an indurated or punched-out ulcer that is often painless in the infection site may appear, as well as chancres

or painless open sores on the penis, vagina, anus, hands, or area near the mouth. These can be irritated during sexual intercourse^[37]. In the secondary stage, chancres appear and skin breaks into an itchless rash as the chancre is healing. This is accompanied by low fever, muscle aches, fatigue, headache, soar throat, patchy hair loss, and swollen lymph nodes^[37, 39]. The secondary stage lasts for several weeks or months and may reoccur in approximately 25% of untreated patients^[38]. Mouth sores appear in 80% of infected persons and enlarged lymph nodes throughout the body affect 50% of patients^[39]. The latent or hidden stage generally occurs after the secondary stage^[39]. In the latent stage, secondary symptoms disappear but infection remains in the body and may damage internal organs such as nerves, brain, eyes, heart, blood vessels, liver, bones and joints^[37]. Lastly, in the tertiary stage, an inability to coordinate muscle movements, paralysis, numbness, dementia, gradual blindness, or even death may occur^[37].

Laboratory Diagnosis: Initial blood tests to detect syphilis include the Venereal Disease Research Laboratory (VDRL) test and the rapid plasma regain (RPR) test; both nontreponemal tests have high false positive rates making it difficult to interpret results, particularly within the first three months of infection^[37, 39]. However, nontreponemal tests are 78% to 86% sensitive in primary syphilis, close to 100% sensitive in secondary syphilis, and 95% to 98% in latent syphilis^[40]. Confirmatory antibody tests include the fluorescent treponemal antibody-absorption (FTA-ABS) test and the *T. pallidum* hemagglutination assay (TPHA). Once a person is reactive to one test, in most cases, the person will

have a positive test the rest of their life, even after completion of treatment^[37].

There are several titer cut points used in the literature to indicate active syphilis ranging from 1:8^[41] to 1:16 or greater^[36]. In previous studies, such as those from the *Proyecto El Cuete*, a titer of 1:8 or greater was considered suggestive of active infection^[42-44]. However, 90% of cases of active syphilis have titers of 1:8 or lower^[40]. Penicillin has been the established standard for treatment of primary, secondary, and early latent syphilis for over 50 years^[36, 38].

Risk Factors: Risk factors for syphilis include unprotected sex, sexual or direct contact with syphilitic lesions, drug use, and commercial sex work^[39].

Factors related to susceptibility to syphilis in developing countries include poverty, younger age, migration of men, low status of women, lower access to acceptable health services, and minority race^[38] as well as sex work, transience, illicit drug use, poor access to healthcare^[36]. A literature review of 32 published studies evaluated syphilis infection (ranging from 0.3% to 60.3%) among drug users in middle income countries (i.e. Southeast Asia with some from Latin America, Eastern Europe, Central and East Asia, North Africa and the Middle East) and found that sexual-risk factors in drug users such as high rates of sex work, sex with sex workers and men who have sex with men (MSM), and low rates of condom use, particularly among women, are risk factors for syphilis^[45].

Although sexual behaviors are most commonly reported as risk factors for acquiring syphilis, a few papers indicate that injection drug use behaviors may also be important. Syphilis is common among women who use drugs, and thus drug use may be a marker for high-risk sexual behaviors. In a 6-year prospective

study of 790 injection drug users from the Bronx, NY, independent risk factors of early syphilis included younger age (OR: 4.7; 95% CI: 1.1, 21.0), multiple sex partners (OR: 9.6; 95% CI 1.3, 72.1), HIV seroconversion (OR: 5.5; 95% CI: 1.1, 28.2), and paid sex (OR: 4.9; 95% CI: 1.9, 12.7)^[46]. Among incarcerated women in the Connecticut state prison in 1998, 7% of 113 women incarcerated for possession of illicit drugs and 14% of the 187 women incarcerated for prostitution were infected with syphilis. Of syphilis cases, 41% reported cocaine use and 19% reported prostitution^[47].

It is plausible that syphilis can be transmitted parenterally through needle sharing during injection drug use given that it can be transmitted through blood transfusion^[39, 48, 49]. In a cross-sectional study among injection drug-using men and women in three Russian cities with fewer than 10% FSWs, syphilis antibodies were associated with daily injection (OR: 4.9; 95% CI: 2.3, 10.6), having an IDU sexual partner (OR: 3.2; 95% CI: 1.3, 8.1), and a self-reported history of STIs (OR: 2.2; 95% CI: 1.0, 4.8)^[50]. Among the women in two of the Russian cities studied, sex work was associated with testing positive for syphilis antibodies after adjusting for ever having been imprisoned in the sample from Moscow (adjOR: 4.9; 95% CI: 1.7, 14.2) and after adjusting for age, frequency of drug injection, and arrest in past 12 months in the sample from Barnaul (adjOR: 9.8; 95% CI: 2.2, 43.6)^[50]. Although the results of this study were not definitive, they suggested a potentially causal relationship between injection drug use and syphilis infection. In the proposed study, we will examine the association

between active syphilis and drug use, differentiating between injection and non-injection drug use and specifically examining the relationship with needle sharing.

Epidemic Trends in the U.S.: In 2006, there were 36,935 cases of all stages of syphilis and 9,756 primary and secondary cases reported in the U.S.^[51]. The highest rates of primary and secondary cases were in the southern states of Louisiana, Alabama, and Georgia with rates between 6.4 and 7.5 per 100,000 persons^[51]. Since 1981, men and African-Americans have consistently had the highest rates primary and secondary syphilis and the male-female rate ratio has been increasing since 2001^[52]. During this time, the increase in the male-to-female rate ratio occurred among whites, African-Americans, and Hispanics^[52]. In the United States, rates of primary and secondary syphilis among African-Americans (9.0 cases per 100,000 population) are six times greater than non-Hispanic whites (1.6 cases per 100,000 population)^[53].

Syphilis incidence has fluctuated over the last several decades. When penicillin was introduced for syphilis treatment in 1943, there was a 90% reduction in the incidence^[38]. A brief reduction in syphilis incidence was observed in the mid 1980's, particularly among MSM, possibly due to HIV awareness. This was followed by a rapid increase in syphilis incidence driven by crack cocaine use, primarily among young women and their babies. In the late 1980s and early 1990s, syphilis reemerged, predominantly affecting white MSM and heterosexual African-Americans and was followed by a dramatic decrease by early 2000. Between 2000 and 2005, unprotected anal sex among MSM drove the reemergence of syphilis^[38]. Syphilis incidence varies by race; currently, the

highest prevalence of syphilis is among African-Americans and the highest incidence is highest among Latino men^[39].

Syphilis as a Cofactor for HIV Transmission: Syphilis facilitates both the transmission and acquisition of HIV, particularly among men who have sex with men in developed countries^[38]. Syphilis produces genital lesions, or an inflammatory response, which are risk factors for HIV transmission^[39]. In a study among 360 MSM, those who had HIV-seroconverted were more likely to report syphilis (OR: 3.8; 95% CI: 1.3, 10.9)^[54]. Among 5764 18-49 yr-old participants of NHANES between 2001–2004, those who tested positive for HIV had significantly increased odds of having active syphilis (RPR titers >1:8) (OR: 13.30; 95% CI: 2.46–35.85)^[43]. Among patients enrolled in a prospective, multicenter, randomized controlled trial who were diagnosed with secondary syphilis, HIV-infected persons had higher rates of genital ulcers (25%) compared to HIV-uninfected patients (14%)^[55]. Among 541 primary syphilis patients in another prospective, randomized, double-blind, multisite study between 1991 and 1994, HIV-infected patients were more likely to be men, report having a sexual partner of the same sex, and have a history of syphilis ($p<0.05$) as well as more likely to have multiple chancres compared to other patients (70%vs. 34%) ($p<0.05$)^[56]. These studies point to the need for syphilis elimination as an HIV prevention strategy.

Chlamydia

Etiologic Agent: Chlamydia is a bacterial infection caused by *Chlamydia trachomatis*. It is transmitted through vaginal, anal or oral sexual contact with infected partner and congenitally during vaginal delivery. This bacterium can cause pelvic inflammatory disease, ectopic pregnancy, and infertility in women^[37]. Occasionally, it can also cause infections in the eyes, throat, and lungs^[39].

Symptoms: It is common for men (30-50%) and women (75%) to have no symptoms of Chlamydia infection for weeks or months after becoming infected and thus the disease is not readily treated and can be unknowingly transmitted. Women experience yellow vaginal discharge from the cervix, frequent or burning urination, low back pain, pain during intercourse, and bleeding between menstruation periods. Chlamydia can also cause swelling, inflammation of lymph nodes, pelvic inflammatory disease, and infertility among women^[37, 39]. Symptoms for Chlamydia are often confused with symptoms for gonorrhea.

Laboratory Diagnosis: Secretions from the genital area can be tested for *C. trachomatis*, whereby a dye is used to detect bacterial proteins. In recent years, DNA amplification (or nucleic acid amplification (NAT)) has been used to detect the genes of this organism in genital secretions with polymerase chain reaction (PCR) testing^[37, 39]. Using this approach, urine samples can be collected for NAT testing, representing a noninvasive approach and alternative to the pelvic exam. Results with NAT testing can be obtained within 24 hours^[37],

whereas swab tests requiring culture may take up to three days for results^[39].

Antibiotics such as Azithromycin or Doxycycline are used to treat Chlamydia.

Risk Factors: Risk factors for *C. trachomatis* include younger age, unprotected sex, a history of multiple partners, low contraception use, and a past history of STI^[36]. Those at risk and recommended for testing are women 20 years old or younger, women aged 20-24 who either had unprotected sex or had at least one new partner in the last three months, and women 24 and older who had unprotected sex and at least one new partner in the last three months^[37, 39].

There is no evidence that Chlamydia and gonorrhea can be transmitted through drug use, though it is likely that drug-related variables are a marker for high-risk sexual behaviors. A study measured prevalence and correlates of Chlamydia and gonorrhea among 788 female IDUs aged 18–30 years in five U.S. cities (n=1107) and assessed parenteral transmission of these STI. Factors associated with Chlamydia (5.2%) and gonorrhea (2.0%) were younger age at sexual debut and commercial sex, similar to other samples, suggesting Chlamydia and gonorrhea are not parenterally transmitted and IDU alone does not increase prevalence of STI^[57]. Among 517 asymptomatic young Swiss men, despite risky sexual behavior, prevalence of Chlamydia was 1.2% (95% CI: 0.4, 2.5%) and neither alcohol nor drug abuse were associated with Chlamydia^[58]. In this study, we will examine the role of specific partner types (e.g., regular and casual clients and non-paying partners, IDU sex partners) on the odds of specific STIs among FSWs.

Epidemic Trends: Chlamydia is the most prevalent STI in the U.S. and is more common among women than men^[36, 37, 39]. Three to 8 million cases are reported each year in the U.S.^[37, 39, 59]. In 2001, there were approximately 783,000 Chlamydia infections and 75% of these cases were among persons under 25 years old^[39].

Chlamydia as a Cofactor of HIV Transmission: Chlamydia is a cofactor for both HIV and gonorrheal transmission^[60-62]. STIs causing inflammation, such as Chlamydia and gonorrhea are likely to exacerbate HIV acquisition among men and women, particularly in the presence of ulcers that bleed during sex^[60]. Among 431 HIV negative FSWs in Kinshasa, Zaire, Chlamydia (adjOR: 3.6; 95% CI: 1.4-9.1) was more common in incident cases of HIV after adjusting for sexual exposure^[61]. Chlamydia and gonorrhea often co-occur. For example, among 4378 female adolescents infected with Chlamydia entering U.S. Juvenile Detention Centers Alameda, Los Angeles, and San Francisco, CA between 1997 and 2002, 18.4% were also infected with gonorrhea^[62].

Gonorrhea

Etiologic agent: Gonorrhea is a bacterial infection caused by *Neisseria gonorrhoeae* that often co-exists with Chlamydia^[36, 37]. In the U.S., it is the second most common STI after Chlamydia^[39]. This bacterium exists and grows in moist warm areas of the body including the reproductive tract (uterus, cervix, and fallopian tubes), oral cavity, eyes, anus, and rectum^[36, 37, 39].

Like Chlamydia, gonorrhea is transmitted through vaginal, anal or oral sexual contact with an infected partner and congenitally during vaginal delivery^[39]. Contact with infected area then eyes may cause infection in the eyes. *N. gonorrhoeae* can cause pelvic inflammatory disease, ectopic pregnancy, and infertility in women^[37].

Symptoms: It is common for women with gonorrhea to be asymptomatic (80%) and for symptoms to be confused with a bladder or vaginal infection^[37, 39]. Yet, women may experience symptoms within 10 to 30 days of infection that include yellowish, white or green discharge from the vagina and/or painful urination. In its primary state, the infection is in the endocervix and secondary infection occurs in the rectum or urethra. More advanced symptoms include bleeding between menstrual cycles, and vomiting^[37]. Infection through anal sex can result in rectal discharge, anal itching, soreness, bleeding, and painful bowel movements^[39].

Laboratory Diagnosis: With a small specimen from the rectum, throat, urethra, or cervix, gonorrhea can be detected by Gram stain, culture, or detection of bacterial genes, or DNA testing. The Gram stain has only 50% sensitivity among asymptomatic women but with high specificity^[63]. With a culture, a sample of discharge is placed on a culture plate and incubated for 2 days. In recent years, urine and cervical swabs can be obtained for testing and detection of bacterial genes with sensitivity of 90% or more^[37]. Specifically, urethral swabs samples can be tested with qualitative PCR to detect *Neisseria gonorrhoeae*

DNA^[39]. Antibiotics such as Ceftriaxone and Cefixime are used to treat gonorrhea.

Risk Factors: Gonorrhea is associated with poverty, increased number of sexual partners, recent new partner(s), and low contraception use^[36]. Young women aged less than 25 with more than two sexual partners in the past year, women with repeated gonorrheal infection, as well as drug users, persons having unprotected sex, and commercial sex workers are at risk for gonorrhea^[39].

Among 2129 male and female IDUs aged 18–30 years in five U.S. cities, gonorrhea was significantly more prevalent among women (2.0%) compared among men (0.2%) ($p < .001$)^[57]. Among the women ($n=788$), age at sexual debut (OR: 1.27; 95% CI: 1.04-1.56) and commercial sex (OR: 5.17; 95% CI: 1.66-16.11) were associated with gonorrhea^[57]. In a sample of 1442 persons from STD clinics in Philadelphia, Tampa, and San Diego, males ($n=879$) who were younger (OR = 0.94; CI = 0.92, 0.96), had sex with a crack cocaine user (OR = 1.99; CI = 1.36, 2.91), did not use condoms last time they had sex with a non-main partner (OR = 1.59; CI = 1.09, 2.13), and did not have sex with an IDU (OR = 0.45; CI = 0.22, 0.95) were more likely to be diagnosed with gonorrhea^[64].

Among the women ($n=563$), younger age was a risk factor for gonorrhea (OR = 0.95; CI = 0.91, 0.99)^[64].

Epidemic Trends in the U.S.: In 2004, it was reported that 650,000 new cases of gonorrhea are reported annually in the U.S. but rates are highest in the southeastern states among minorities, and adolescents of all ethnic and racial groups^[59]. African-Americans had higher rates compared than that among other

race/ethnicities; 24 times greater compared to whites^[52]. Approximately 79% of all cases are among young persons with ages between 15 and 29 years^[39].

Gonorrhea tests among 71,074 adolescents in Juvenile detention centers in Los Angeles, San Francisco, Alameda County, Maryland and Atlanta indicated that 2.9% were positive for *N. gonorrhoeae*^[62]. The prevalence was 4 times higher among the females compared to males (5.1% versus 1.3%; $p < 0.01$); among the females, gonorrhea prevalence was 3 times higher in blacks compared to non-blacks (7.5% versus 2.4%; $p < 0.01$)^[62].

Gonorrhea as a Cofactor for HIV Transmission: Gonorrhea is a co-factor for both HIV and Chlamydia. In a study among 360 MSM, those who had HIV-seroconverted were more likely to report rectal, urethral, or pharyngeal gonorrhea (OR: 2.8; 95% CI: 1.0, 5.7)^[54]. Among 431 HIV negative FSWs in Kinshasa, Zaire, after adjusting for sexual exposure, non-ulcerative STI such as gonorrhea (adjOR: 4.8; 95% CI: 2.4-9.8) were more common in incident cases of HIV^[61].

HIV

Etiologic agent: Human immunodeficiency virus (HIV) is classified as a lentivirus; subfamily of the retroviruses. HIV attacks the immune system and leads to acquired immunodeficiency syndrome (AIDS)^[36]. HIV is transmitted person-to-person from an infected individual through the exchange of bodily fluids such as blood, semen, breast milk, and vaginal fluids. It can be transmitted through unprotected anal or vaginal sex and far less often through oral sex. HIV

can also be transmitted through injection drug use, perinatal transmission, blood transfusion, and organ transplantation^[37, 39]. HIV can be transmitted from mother-to-child during pregnancy, childbirth, or breastfeeding. It can also be transmitted through the use of contaminated equipment used for piercing or tattoos^[39].

Symptoms: An HIV-infected person is most infectious during primary infection, or the period immediately after a person becomes infected. During this period, the infected person may experience flu like symptoms (e.g., fever, swollen glands, sore throat, rash on the body or face, painful muscles or joints, headache, vomiting, as well as ulcers on the mouth, genitals and esophagus). After the early symptoms, HIV can remain undetected for a number of years and damage to the human immune system, leaving the body vulnerable to infections^[37].

Laboratory Diagnosis: HIV testing consists of initial screening test. A person can be tested with an enzyme-linked immunosorbent assay (ELISA) to detect HIV antibodies followed by a retest for those who test positive. Rapid HIV tests now provide results within 30 minutes, avoiding the need for persons tested to have to return for results^[65].

Risk Factors: Social, economic, and cultural factors, which may enhance the spread of HIV, include urbanization, migration, poverty, homelessness, and poor education. Other groups at risk for HIV in the U.S. are MSM, IDU, and high risk heterosexuals^[36]. In 2005, it was estimated there were 37,367 new cases of HIV/AIDS^[66].

Epidemic Trends in the U.S.: From 2001 through 2005, in the United States, there are over 126,964 women and girls living with HIV/AIDS and account for 27% of all adults and adolescents living with HIV/AIDS^[66]. Of these, 72% had been exposed through high-risk heterosexual contact and 26% were exposed through injection drug use^[66]. Latinos are disproportionately infected with HIV/AIDS; although comprising only 13% of the U.S. population, they account for 18% of U.S. AIDS cases^[66, 67]. After the continental U.S. (35%) and Puerto Rico (25%), the majority of AIDS cases among the Latino population in 2000 were concentrated among those born in Mexico (13%)^[68].

Epidemiology of HIV and STIs in Mexico

Mexico ranks 23rd in Latin America and Caribbean in terms of HIV prevalence (0.3%)^[69]. Within Mexico, the state of Baja California, where Tijuana is located, the cumulative AIDS incidence is ranked 2nd (178.4 per 100,000)^[70]. Chihuahua, the state in which Ciudad Juarez is located, ranks 12th in terms of cumulative AIDS incidence (113.8 per 100,000)^[70]. It is estimated that up to one in every 125 persons aged 15–49 years in Tijuana is HIV-infected, which translates to an estimated HIV prevalence ranging from 0.26 to 0.80%. The largest numbers of HIV-infected persons are concentrated among MSM and IDUs^[71]. However, HIV prevalence is on the rise among FSWs in Tijuana and Ciudad Juarez^[32].

Adolescents are at increasing risk for HIV infection in Mexico. A study examining gender differences among 370 high-school students aged 14 to 25 in

Tijuana found that, after adjusting for age, male students were over three times more likely to have initiated sexual activity compared to females (49% vs 22%) while females were more likely to have unprotected sex during the last 3 months (51% vs 57%)^[72]. A binational project determined that women living on both sides of the Arizona, U.S.-Sonora, Mexico border were at increased risk for Chlamydia (prevalence of 8.2%) compared to women in non-border towns. Testing positive for Chlamydia was associated with younger age, a history of new sexual partner(s) in the previous three months, HPV infection, and proximity to the international border^[73].

Incidence of gonorrhea in Baja California (1.6 per 100,000) and Chihuahua (0.7 per 100,000) and above the 2008 national average (0.5 per 100,000)^[74], however lower than that of the bordering U.S. states (California and Texas: 66.8 and 113.8 per 100,000 respectively)^[75, 76]. Rates for Chlamydia are lacking at the state level in Mexico.

The literature on HIV and STIs in the Mexico-U.S. border region suggests a relationship between these infections and drug use, sexual behavior, and sex work. The epidemic of HIV in Baja California Norte, particularly in Tijuana, is more similar to the epidemic in the United States, with injection drug use playing a significant role^[77]. This relationship has not yet been fully investigated. In an early study of hepatitis B among women in Tijuana (N=714), non-drug abusing FSWs also had higher rates of syphilis (positive RPR/FTA-ABS test) as compared to their female controls ($p < 0.0001$)^[78]. In a recent analysis of FSWs in Tijuana (N=412) and Ciudad Juarez (N=408) FSW-IDUs had consistently higher

prevalence of HIV and STIs compared to versus other FSWs: HIV (16% vs 4%), Syphilis (49% vs 22%), Gonorrhea (15% vs 4%), and Chlamydia (24% vs 10%)^[14]. The high prevalence of STIs in this population is not surprising since one third had unprotected anal sex with clients in the past month ^[7]. Many FSWs are reportedly reluctant to ask their clients to wear condoms, did not know how to use condoms properly, and also reported that many clients refused to use a condom^[71].

Research Design and Methods

Study Population

The *Mujer Segura* project was funded by National Institutes of Health (NIH)/The National Institute of Mental Health (NIMH) (Grant Number: R01 MH065849; Principal investigator: Thomas L. Patterson, PhD). The purpose of this study was to determine if a behavioral intervention that integrates a clinical approach (motivational interviewing) with theory-based principles of behavior change (Social Cognitive Theory; Theory of Reasoned Action) is effective in reducing the sexual risk practices of female sex workers in four border cities of Mexico. Women were recruited from clinics, through personal referrals, and through direct outreach in four Mexico-U.S. border cities including Tijuana, Ciudad Juarez, Matamoros, and Nuevo Laredo. The project has been completed in Tijuana and Ciudad Juarez. For the proposed study, data were obtained from the baseline visit in Tijuana (N=465) and Ciudad Juarez (N=449) between March

2004 and March 2006 who were recruited and interviewed over a 30-month period.

Inclusion criteria: Participants were women (at least 18 years old) who self-identified as a FSW (having traded sex for drugs, money, or other material benefit), reported having had unprotected vaginal or anal sex with a client at least once during the previous four weeks and reported being HIV negative. Women were excluded if they practiced consistent use of condoms/dental dam for vaginal, oral and anal sex with all clients during the previous two weeks and if they employed as a sex worker for less than 4 weeks.

Data Collection: Measures were collected by questionnaire during a private verbal face-to-face interview by female clinic staff lasting approximately 35 to 40 minutes. Questionnaires were translated into Spanish and back-translated into English by a bilingual team of Latino/a researchers and reviewed for cultural appropriateness.

Recruitment Procedure: All recruitment was conducted at municipal clinics, NGOs, or using street outreach in each participating city.

Sexually Transmitted Infections: Trained phlebotomists obtained blood samples for HIV and syphilis antibody testing. HIV antibody was detected using the “Determine”[®] rapid HIV antibody test (Abbott Pharmaceuticals, Boston, MA); reactive samples were confirmed by HIV enzyme immunoassay (EIA and Western Blot).

The rapid plasma reagin (RPR) test was used to detect syphilis antibody (Macro-Vue, Becton Dickenson, Cockeysville, MD, USA); reactive samples were

confirmed by *Treponema pallidum* hemagglutinin assay (TPHA) (Fujirebio, Wilmington, DE, USA). Syphilis titers $\geq 1:8$ were considered consistent with an active infection.

Cervical swabs were prepared and tested with nucleic acid amplification using the Aptima[®] Combo-2 assay collection device (Genprobe, San Diego, CA) to detect *Neisseria gonorrhoea* and *Chlamydia trachomatis*.

STI tests and confirmatory HIV tests were conducted at the San Diego County Health Department (samples from Tijuana) and El Paso County Health Department (samples from Ciudad Juarez). Further details of this questionnaire and methods for this study have been previously published^[79].

Aims and Hypotheses

Aim 1: To determine correlates of early versus later initiation into sex work in Tijuana and Ciudad Juarez.

Hypotheses are as follows:

- 1.1. FSWs who initiated sex work younger will have higher rates of migration into the state compared to women who initiated sex work later.
- 1.2. FSWs who initiated sex work younger will have higher rates of drug use prior to sex work initiation compared to women who initiated sex work later.
- 1.3. FSWs who initiated sex work younger will have higher rates of physical, sexual and emotional abuse prior to their initiation into sex work compared to women who initiated sex work later.

Aim 2: To determine if drug-using behaviors are independently associated with syphilis infection among female sex workers in Tijuana and Ciudad Juarez, after adjusting for sexual risk behaviors.

Hypotheses are as follows:

- 2.1. After controlling for sexual risk behavior, FSWs with syphilis titers $\geq 1:8$ will have higher rates of injection drug use and needle sharing compared to those who have lower syphilis titers.
- 2.2. After controlling for sexual risk behavior, FSWs with syphilis titers $\geq 1:8$ will have higher rates of methamphetamine use in the past month compared to those with lower syphilis titers.
- 2.3. FSWs with syphilis titers $\geq 1:8$ will have a higher mean number of IDU sex partners in the past month compared to those with lower syphilis titers.

Aim 3: To determine factors independently associated with gonorrhea and Chlamydia infections among female sex workers in Tijuana and Ciudad Juarez.

Hypotheses are as follows:

- 3.1. FSWs who tested positive for gonorrhea and Chlamydia will report higher rates of drug use before/during sex.
- 3.2. FSWs who tested positive for gonorrhea and Chlamydia will report a higher number of non-regular male clients.
- 3.3. FSWs who tested positive for gonorrhea and Chlamydia will report a higher number of non-paying male sexual partners.

Variables

Socio-Demographic Characteristics: Data on age (How old are you?), years working as a sex worker (For how long have you been employed as a sex worker?), marital status (What is your current marital status?), living situation (Who do you live with?), having children (Do you have children?), number of children, site (Tijuana versus Ciudad Juarez) was collected.

Age at Initiation into Sex Work: The outcome measure, age of initiation into sex work, was defined as a binary variable. Early initiators will be those participants who initiated sex work before the age of 18, the regulated legal age to sell sex in Mexico. Other participants will be labeled as older initiators.

Migration and Regions: Data on migration status (Where were you born?; How long have you lived in [site]?) was collected. Mexican regions based on the participant's Mexican state of birth will be created. Northern states include Baja California, Baja California Sur, Coahuila, Chihuahua, Durango, Nuevo Leon, Sinaloa, Sonora, and Tamaulipas. Central states include Aguascalientes, Colima, Distrito Federal, Guanajuato, Hidalgo, Jalisco, México, Michoacán, Morelos, Nayarit, Puebla, Querétaro, San Luís Potosí, Tlaxcala, and Zacatecas. Southern states include Campeche, Chiapas, Guerrero, Oaxaca, Quintana Roo, Tabasco, Veracruz, and Yucatán.

Influences for Entering Sex Work: Participants were asked about 23 factors that influenced their initiation into sex work (Did any of the following influence you to be a sex worker?): A. Necessity (needed money); B. Pay the rent, utilities, food; C. Could not enter the United States; D. Did not find work; E.

Pays better than other work; F. Let go, fired from my work; G. Support my kids; H. Support my family; I. Support others (e.g. friends, acquaintances); J. Did not have other resources (e.g. money, family); K. I like being a sex worker; L. It was a way of expressing my sexuality; M. Your relatives recommended it; N. Your friends recommended it; O. To buy and pay for your use of alcohol, drugs, etc.; P. Your partner or husband abused/mistreated you; Q. Your family or other adults abused/mistreated you when you were a child/young girl; R. Your family or other adults abused/mistreated when you were an adult; S. Your mother or father got married or brought another person to live in your house; T. Your stepfather abused you; U. You had no support from your family, friends; V. You were forced (against your will); W. Other.

Substance Use: Frequency and mode of administration of cocaine, heroin, methamphetamine, speedball (heroin and cocaine) use was assessed with the following questions: Have you ever used drug type (yes, no)?; How old were you when you first used [drug type]?; During the past month, how often did you use the drug (never, ≤ 1 a month, 2-3 days/month, once a wk, 2-3 days/wk, 4-6 days/wk, everyday)?; What ways did you use this drug(s) (ingested, injected, smoked/sniffed, other)? They were also asked if in the last month, they used alcohol and drugs before or during sex with a client and how many of their sex partners had ever injected drugs. Participants were also asked if they ever shared needles or injection equipment with another person, including a regular sex partner.

The participants were asked if in the last month, they used alcohol before or during sex with a client and how often they used an illegal drug before or during sex with a client. They were also asked how many of their sex partners had ever injected drugs (None, A Few, Some, Most All Don't Know).

Participants were also asked if they ever shared needles or injection equipment (including cotton, water or needles) with another person, including a regular sex partner.

Drug Use before Initiating Sex Work: Drug use before sex work will be defined using responses for the age first use of each drug and age of initiation into sex work. We will determine if the drug use occurred prior to the age at which sex work was initiated and by how many years. Women who first used a drug at the same time they initiated sex work will be counted with those women that first used the drug after initiating sex work. Subjects' age will be used to account for changes in drug availability and drug market over time.

Emotional, Physical, and Sexual Abuse: Participants were asked about emotional, physical, and sexual abuse experienced in their lifetime and the age at which they first experienced it. Specifically, they were asked if they were abused emotionally (made to feel bad through harsh words, humiliation, manipulation), physically (caused or threatened to cause physical harm such as slapping, punching, kicking, hitting with an object, assaulting with a knife or other weapon, etc), or sexually (rape, forced sexual advances or non-consensual sexual acts).

Abuse before Initiating Sex Work: Physical, emotional, and sexual abuse before initiation into sex work was defined using responses for the age first experience the abuse and age of initiation into sex work.

Condom Use: Frequency of unprotected vaginal sex with regular and casual clients and spouse/steady partner; protected sex ratio (number of protected sex acts divided by total number of acts); amount (USD) paid for protected and unprotected sex, and having an IDU sex partner.

Male Client Characteristics: The survey assessed number, type (regular and non-regular) and origin (U.S. or Mexico) of male clients and sexual partners; number of times had vaginal sex with clients.

STI Outcomes: Participants were tested for syphilis antibodies, Chlamydia and gonorrhea, as described above. The outcome for Aim 2 will be having a syphilis antibody titer $\geq 1:8$. The outcome for Aim 3 will be participant's status for gonorrhea and Chlamydia (positive or negative).

Statistical Analysis

Crude and age-adjusted bivariate associations will be examined between the outcome (age of initiation into sex work, syphilis, Chlamydia, gonorrhea) and each potential risk factor. Group means of continuous data will be compared with two-sided t-tests and non-parametric Wilcoxon Two Sample Test, where appropriate. Frequencies of categorical data will be compared with Pearson chi-square tests and non-parametric tests Fisher's Exact Test, where appropriate.

Logistic regression models will be conducted to examine correlates of early initiation (<18 years) into sex work and correlates for each STI. Factors with medium-to-high correlation will not be included in the same model (Spearman correlation coefficient $r > 0.6$). In multivariate logistic regressions, all variables attaining bivariate significance of $p < 0.10$ will be considered for inclusion and those attaining $p < 0.05$ will be retained in the final models.

For this analysis, SPSS Version 14.0 will be used for managing the dataset and SAS Version 9.1 for conducting the analyses. PASS 2005 was used to perform power analyses^[80].

MANUSCRIPTS

Manuscript 1: Correlates of Early versus Later Initiation into Sex Work in Two Mexico–U.S. Border Cities

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Short Running Head: Early Initiation into Sex Work in Mexico

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Contributors: With the guidance and supervision of doctoral advisor S. A. Strathdee, O. Loza originated the present analysis, analyzed and interpreted data, and prepared the article. T. L. Patterson provided and interpreted data and revised the article. V.D. Ojeda guided the interpretation and discussion of migration and public health implications and revised the article. H. Amaro contributed to the discussion of inhalant use and public health implications and revised the article. R. Lozada was the Tijuana director, oversaw data collection at that site, and reviewed the paper for accuracy and cultural appropriateness. H. Staines and G. A. Martínez were co-directors of the Cd. Juarez site, oversaw data collection at that site, and reviewed the paper for accuracy and cultural appropriateness.

ABSTRACT

Purpose: To examine correlates of early initiation into sex work in two Mexico–U.S. border cities.

Methods: Female sex workers (FSWs) ≥ 18 years without known HIV infection living in Tijuana and Ciudad Juarez who had recent unprotected sex with clients underwent baseline interviews. Correlates of initiation into sex work before age 18 were identified with logistic regression.

Results: Of 920 FSWs interviewed in Tijuana (N=474) and Ciudad Juarez (N=446), 9.8% (N=90) were early initiators (<18 years) into sex work. Median age of entry into sex work was 26 years (range: 6-58). After adjusting for age, compared to older initiators, early initiators were more likely to use inhalants (21.1% vs 9.6%, $p=0.002$), initiate sex work to pay for alcohol (36.7% vs 18.4%, $p<.001$), report abuse as a child (42.2% vs 18.7%, $p<.0001$), and they were less likely to be migrants (47.8% vs 62.3%, $p=0.02$). Factors independently associated with early initiation included inhalant use (adjOR=2.39), initiating sex work to pay for alcohol (adjOR=1.88) and history of child abuse (adjOR=2.92). Factors associated with later initiation included less education (adjOR=0.43 per 5-year increase), migration (adjOR=0.47), and initiating sex work for better pay (adjOR=0.44) or to support children (adjOR=0.03).

Conclusions: Different pathways for entering sex work are apparent among younger versus older females in the Mexico–U.S. border region. Among girls, interventions are needed to prevent inhalant use and child abuse and to offer

coping skills; among older initiators, income-generating strategies, childcare, and services for migrants may help to delay or prevent entry into sex work.

Key Words: Female Sex Workers, Prostitution, Drug Use, Migration, Abuse

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INTRODUCTION

Most major cities in Mexico have developed *zonas de tolerancia* (zones of tolerance) where sex work is quasi-legal and, in some cases, regulated. Tijuana and Ciudad Juarez are cities along the Mexico–U.S. border with large populations of female sex workers (FSWs). In 2006, it was reported that 4,850 FSWs were registered with the Municipal Health Service in Tijuana, while thousands of other FSWs were thought to work without permits^[1]. Approximately 4,000 FSWs work in zones of tolerance in Ciudad Juarez^[1]. Unlike Tijuana, Ciudad Juarez does not regulate sex work. In both cities, FSWs work in cantinas, bars, hotels, nightclubs, massage parlors, and on street corners.

The legal age of consent for sexual intercourse in Mexico is 18 years, yet underage sex workers are common. FSWs are vulnerable to sexually transmitted infections (STIs), unwanted pregnancy, and physical, psychological, and emotional abuse^[2]. A review of child prostitution in Thailand reported detrimental physical and emotional effects and high risk for STIs, malnutrition, mental illness, substance abuse, complicated pregnancy, backstreet abortions, and violence^[3]. Due to such complicating factors as human trafficking, safety concerns, ethical issues surrounding research on emancipated minors, and the clandestine nature of sex work, there are very few studies on young girls engaged in sex work^[4]. Therefore, studies examining the factors that influence initiation into sex work often rely on retrospective analyses among current FSWs.

Several studies have reported associations between substance use and initiation into sex work. For example, crack use among migrants in Southern

Florida was associated with entry into prostitution^[5]. In a Danish study, early use of heroin and cocaine was a predictor for initiating prostitution^[6]. Among US street youth, “survival sex” was strongly associated with recent substance use and lifetime injection drug use^[7].

Tijuana and Ciudad Juarez are situated on major trafficking routes for heroin, cocaine, and methamphetamine^[8, 9]. Among a sample of FSWs in these cities, 18% reported ever injecting drugs such as heroin, cocaine or methamphetamine, alone or in combination^[10]. In an earlier study conducted in Ciudad Juarez among 75 FSWs, 59% were currently using drugs, and of those, 36% had initiated illicit drug use prior to entry into sex work, and half were injection drug users^[11]. To date, studies have not established whether specific drugs are more commonly used by women who are beginning sex work or whether specific drug types are associated with initiating sex work at earlier ages.

Initiation into sex work has also been linked to childhood sexual, emotional, and physical abuse, including forced sex, domestic violence, and childhood sexual victimization^[6, 7, 12, 13]. Among 1196 children processed in a criminal court in an unnamed U.S. city, early childhood abuse or neglect and sexual abuse were significantly associated with subsequent initiation into sex work. Physical abuse was marginally associated with entry into sex work as well^[13]. Among homeless women and street youth in New York City, early sexual abuse was significantly associated with entry into prostitution^[12].

Migration has also been linked to entry into sex work among women, and migration supplies workers for the sexual tourism industry in countries such as South Africa, China, and Thailand^[14-16]. In China, the prevalence of casual and commercial sex among female temporary migrants was several-fold higher compared to female non-migrants^[15]. Rural-to-urban migration in the developing world exposes migrant laborers to long absences from home, family breakdown, increased numbers of sexual partners, and sexual abuse^[14, 17]. In Mexico, migration is associated with acquisition of HIV and other STIs^[18]. The Mexico–U.S. border region attracts migrants from throughout Mexico and Central America who seek employment in foreign-owned *maquiladoras* or jobs in the U.S.^[19]. Baja California and Chihuahua remain popular destinations for Mexico’s internal migrants, possibly because of the tourism and manufacturing industries in those states, which increasingly employ women as well as young men^[20].

Half of Baja California’s population lives in Tijuana, and 8.2% of the state’s population have migrated from other parts of Mexico in the last five years^[21]. Ciudad Juarez is home to one-third of Chihuahua’s population, and 3% of Chihuahua’s population has migrated from other parts of Mexico within the last five years^[21]. Young women who lack local social networks may be particularly vulnerable to becoming sex workers. A study of FSWs in Tijuana and Ciudad Juarez found that only 21% to 30% had been born in the city where they now work^[22]. The association between entry into sex work and migration within Mexico has not yet been examined.

We cannot disregard that some of the FSWs on these border region could be victims of human trafficking. The United Nations estimates that human trafficking is the third largest source of income for organized crime, after arms and drugs^[23]. Worldwide, 800,000 to 900,000 people are trafficked across international borders each year, of whom 17,500 to 18,500 cross U.S. borders^[24]. It is estimated that 80% of victims are women and girls, 70% are forced into sexual servitude, and up to 50% are minors^[25].

Studies examining sex work initiation among the large population of FSWs in the Mexico–U.S. border region are lacking. Drug use, history of abuse, and migration may all play a role in sex work initiation; however, it is unclear if they affect initiation into sex work at younger ages. We hypothesized that pathways into sex work might differ for girls and younger women versus older women because of the additional legal barriers to sex work for women under 18.

METHODS

Study Population

As described elsewhere^[26], FSWs were recruited at municipal clinics, through personal referrals, NGOs, or using street outreach. For this analysis, we used data from baseline assessments in Tijuana (N=474) and Ciudad Juarez (N=450), which occurred between March 2004 and March 2006. Eligible participants were women 18 years or older who self-identified as FSWs (having traded sex for drugs, money, or other material benefit), reported unprotected vaginal or anal sex with a client at least once during the previous four weeks, and

reported being HIV-negative. Women were excluded if they practiced consistent use of condoms or a dental dam with all clients during the previous two weeks or if they had worked as a sex worker for less than 4 weeks.

Data Collection

Data were collected during a private, 45-minute interview. Areas examined by the questionnaire were: i) sociodemographics; ii) factors influencing initiation into sex work; iii) drug use before initiating sex work; and iv) experiences of abuse before initiating sex work.

Sociodemographics

These data included age, years working as a FSW, marital status, living situation, number of children, and migrant status.

Influences for Entering Sex Work

Participants were presented with a list of 23 factors that might have influenced their initiation into sex work. Items were derived from the literature and a prior qualitative study conducted among FSWs in Tijuana^[27]. Concerning the list, participants were asked, “Did any of the following influence you to be a sex worker?” Possible responses are shown in Figure 1.

Drug Use before Initiating Sex Work

Frequency and modes of use for marijuana, ecstasy, inhalants, cocaine, tranquilizers, methamphetamine, heroin, and combinations were assessed with the following questions: “Have you ever used [drug type] (yes, no)?”; “How old

were you when you first used [drug type]?”; “What ways did you use this drug (ingested, injected, smoked/sniffed, other)?”

Emotional, Physical, and Sexual Abuse

Participants were asked if they had ever been abused emotionally (through harsh words, humiliation, manipulation), physically (experienced actual or threatened physical harm), or sexually (through unwanted sexual advances or non-consensual sexual acts), and the age at which any of these first occurred. Victimization and trauma were measured using items from the family and social relationships section of the Addiction Severity Index (ASI-F) ^[28].

Statistical Analysis

Age of initiation into sex work was defined as a binary variable: “early initiators” who had initiated sex work before the age of 18. Drug use before sex work (yes/no) was determined by comparing the age of first use for each drug and the age of initiation into sex work. “Any drug use” includes marijuana, inhalants, ecstasy, tranquilizers, barbiturates, heroin, methamphetamines, cocaine, crack, speedball (heroin and cocaine injected simultaneously), or methamphetamine and heroin. Physical, emotional, and sexual abuse before initiation into sex work were defined by a similar comparison of reported dates. Participants’ places of origin (birth states) within Mexico were classified according to a scheme that was used in previous analyses^[22] and that consists of three regions: Northern (9 states), Central (15 states), and Southern (8 states).

Crude and age-adjusted bivariate associations were examined between age of initiation into sex work and each risk factor. Group means of continuous data were compared with two-sided t-tests. Frequencies of categorical data were compared with Pearson chi-square tests. Logistic regression models were conducted to examine correlates of early initiation into sex work. Correlations among independent variables were assessed with Spearman correlation coefficients; variables with $r > 0.5$ were not included in the same model. Variables attaining $p < 0.10$ in bivariate models were considered in stepwise logistic regression, and those with $p < 0.05$ were retained. Tolerance tests on final models were performed to assess multicollinearity. No significant differences were observed between age of initiation into sex work and site (Tijuana vs. Ciudad Juarez); hence the data for both sites were pooled.

RESULTS

Of 924 FSWs interviewed, 920 reported their age initiation into sex work; of those, 90 (9.8%) had initiated sex work before the age of 18 and hence were considered early initiators. Median age of entry into sex work was 26 years (range: 6-58); for early initiators it was 16 (range: 6-17), and for later initiators it was 27 (range: 18-58). At baseline, almost all women currently had children, while approximately half were single. Over half of the women had used some drug prior to initiation into sex work. The following proportions of participants reported histories of the different categories of abuse prior to their initiations into sex work: emotional (13%), physical (11%), and sexual (7%) (Table 1).

Bivariate Associations

After adjusting for age, early initiators were significantly younger than older initiators at baseline (27 vs 33 years old), less likely to have had a child prior to initiating sex work (27.5% vs 93.0%), and less likely to have migrated into the state in which the interview was conducted (47.8% vs 62.3%; $p < 0.05$). Median number of crude years of education was the same (6 years) for early versus older initiators, but it was significantly different after adjusting for age ($p = 0.03$) (Table 1). Early initiators were significantly more likely to report inhalant use (21.1% vs 9.6%) and less likely to report methamphetamine use (10.0% vs 17.3%) prior to initiation into sex work compared to later initiators. After adjusting for age, early initiators reported significantly higher rates of experiencing emotional (30.3% vs 10.7%), physical (28.9% vs 9.1%), and sexual (20.0% vs 5.5%) abuse prior to initiating sex work ($p < 0.0001$). Low to medium correlations between emotional, physical, and sexual abuse were indicated by Spearman correlation coefficients as follows: emotional vs. physical abuse: 0.57; physical vs. sexual abuse: 0.35; and sexual vs. emotional abuse: 0.37.

Factors Influencing Initiation into Sex Work

Regardless of age of initiation into sex work, over 90% of participants reported that needing money for rent, utilities, food, or other necessities was an important influence on their decision to begin sex work. This was followed in importance by a need for better pay, a need to support children, abuse experienced as a child or adult, and ongoing alcohol use. The frequency

distribution of influencing factors differed significantly for younger vs older initiators into sex work; however, the order of importance was generally the same for both groups (Figure 1).

Age-Adjusted Comparisons

Factors associated with later initiation into sex work included being older (OR: 0.64 per 5-year increase), having more years of education (OR: 0.66 per 5-year increase), having migrated into the state in which the participant lived at the time of interview (OR: 0.58), and having a child prior to initiation into sex work (OR: 0.03). Participants who were single (OR: 0.59) or in non-marital relationships (OR: 0.46) were less likely to have initiated sex work early as compared to those who were married (Table 2).

Participants who used inhalants before initiating sex work were twice as likely to be early initiators. A history of emotional (OR: 4.06), physical (OR: 4.84), or sexual (OR: 5.89) abuse prior to initiation into sex work was associated with initiating sex work at an earlier age. Better pay, needing to support children, and needing money for rent, utilities, food, or other commodities were influences for entering sex work at older ages. Factors associated with at least a two-fold greater odds of early initiation into sex work included needing to pay for alcohol, having been abused as an adult or child, having been forced into sex work, having a parent bring a new partner into the home, and having a relative recommend sex work as a profession (Table 2).

Factors Independently Associated with Initiation into Sex Work

After adjusting for age, factors independently associated with early initiation into sex work included prior emotional abuse (adjOR: 3.73), prior inhalant use (adjOR: 2.86), and history of childhood abuse (adjOR: 3.89). Later initiation into sex work was independently associated with less education (adjOR: 0.43 per 5-year increase), migrating to the state in which one now lives (adjOR: 0.47), initiating sex work for better pay (adjOR: 0.44), and initiating sex work to support one's child (adjOR: 0.03) (Table 3).

DISCUSSION

This study's findings suggest different pathways for entering sex work between younger versus older women living in two Mexico–U.S. border cities. We found differences in sociodemographic characteristics, history of drug use, history of abuse, and influences for entering sex work between the women who initiated sex work before the age of 18 versus those who initiated sex work later in their lives. Early initiation into sex work was independently associated with history of emotional abuse, inhalant use, and child abuse, whereas lower education, migration, and initiating sex work for better pay and to support one's children were independently associated with initiating sex work at older ages. These findings may have important implications with respect to delaying or preventing entry into sex work for women living in border communities.

After adjusting for age, we found that early initiation into sex work was independently associated with a history of emotional abuse and being abused as a child. In other countries, a relationship has been established between history of

various forms of abuse and engaging in sex work^[12, 29, 30]. Childhood abuse has been linked with entry into the juvenile criminal system, suicide attempts, diagnosis of antisocial personality disorder, alcohol abuse, and decreased quality of interpersonal relations, such as frequent divorce and partner separation, which may reflect an inability to cope with severe childhood trauma^[30, 31]. Programs aimed at preventing young girls from entering sex work must consider that those most at risk are those who have experienced parental substance abuse, absence of parental supervision, early sexual debut, or sexual or physical abuse^[6, 7, 12, 13, 29, 30].

A unique finding from our study was that early inhalant use was independently associated with early initiation into sex work. In Mexico, the most commonly abused inhalants are easily accessible solvents such as paint thinner, glues, and sprays^[32, 33]. Inhalants are often used by children working or living on the streets, by delinquent minors, school drop-outs, and those with no family ties^[33]. Among Mexican juvenile offenders (N=626), inhalant users were at increased odds of having been abused by their parents^[34]. Hence, inhalant use might serve as a coping mechanism for girls who have run away from home to avoid abuse. A national school survey conducted in 1998 in Mexico City found that among female adolescents between 12 and 17 years old, inhalants were the most common drug used after marijuana^[32]. During the same year and in the same city, a national household survey of residents aged 12-65 indicated that among those who had initiated drug use between 12-17 years old, inhalants were the drug most commonly used; 65.2% of inhalant users began using these

substances at between 12 and 17 years old^[32, 33]. In the Philippines, where the mean age of initiating inhalant use is 15 years, 40% of solvent abusers reported engaging in theft and prostitution^[35]. Beyond the association with early initiation into prostitution, inhalant users are also at increased risk of initiating injection drug use, acquiring HIV, and developing psychiatric disorders^[36]. Hence, intervening on inhalant use among high-risk children and adolescents living in Mexico and providing age-appropriate mental health care may aid them in addressing the histories of physical, emotional, and sexual abuse that may predispose them to prostitution.

Our study found that less education, dependent children, and other economic needs were associated with older initiation into sex work, which is consistent with the literature. Other studies have shown that women who had pregnancies at an early age^[37] or who had dependent children were likelier to enter sex work at a later age^[38]. In Australia, where sex work can be practiced legally, most FSWs indicate that their primary motivation for entering (76%) or staying in (61%) the sex trade is financial, yet 55% said they wanted to leave the industry^[39]. These findings indicate a strong need for alternative sources of income for women with children and other dependents.

Sex work in the border region has been shaped by numerous policy decisions and historical events. Prohibition in the U.S. in the 1920s and 1930s, the development of U.S. military bases along the border, and demand for Mexican labor stimulated the growth of border cities such as Tijuana. These cities, in turn, offered social opportunities to U.S. residents that were not as

readily available in the U.S., such as drinking, gambling, and prostitution^[40]. Since the 1960s, employment in *maquiladoras* (foreign-owned manufacturing plants) has also stimulated migration Mexico's interior to its northern border^[40]. However, there is some evidence that women have trouble supporting themselves and their families on the *maquiladoras'* low wages, whereas prostitution may offer a more viable income to some^[41]. We found that migration was independently associated with initiating sex work at older ages independent of other social factors, a finding that merits further exploration to determine whether familial or environmental vulnerabilities are influencing older women's trajectories into sex work. These results suggest a need for supportive social services for female migrants, whether newly arrived or of longer standing.

Female migrants to the border region may be at risk for sexual harassment, violence, and exploitation from employers^[16]. It is plausible that some young FSWs living in the border region are victims of human trafficking (forced migration) or sex trafficking (forced sex work). However, such activities are extremely challenging to assess, since victims are difficult to identify and reach^[2, 42, 43]. Further, the human-subjects requirements governing our research forced us to exclude FSWs who were under 18 at the baseline interview, which may limit the generalizability of our findings and our assessment of the avenues into sex work for young women. Nevertheless, this remains an important area of investigation; we expect that young FSWs are likely to experience a unique set of vulnerabilities that may influence their health behaviors and health status.

Our interpretation of the results has several limitations. While we could infer temporality based on the age at which participants reported engaging in sex work relative to other exposures, the cross-sectional nature of the data precludes definitive causal inferences. Another important limitation is the small proportion of women who reported initiating sex work before the age of 18 (9.8%), which affected the power to detect significant associations. It is possible that some FSWs who initiated sex work prior to the legal age were reluctant to report doing so, which would tend to underestimate the odds ratios we observed. Recall bias may have influenced the results given that the participants were asked to recall information about drug use and other life events that occurred years prior.

Despite these limitations, our study suggests different pathways for entry into sex work for younger versus older Mexican girls and women. These findings highlight the need for interventions among younger girls, particularly those living on the street, to prevent inhalant use and provide coping skills for abuse. Interventions for inhalant use should consider that adolescents perceive inhalant use as low-risk and that the use of inhalants is associated with problems in social or family networks^[44]. Identification of adolescents who were victims of childhood and emotional abuse is necessary to provide healthy coping strategies, which may help to deter or delay initiation of sex work, drug use, and other high-risk behaviors. For older initiators into sex work, alternative income-generating strategies (e.g., micro-financing), childcare, and migrant-oriented services (e.g., housing, employment) may help to delay or prevent entry into sex work.

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Table 1: Bivariate associations[§] by age of initiation into sex work (<18 vs 18+) among Female Sex Workers in Tijuana and Ciudad Juarez, Mexico (N=920)

Demographic Characteristics	Age at Initiation into Sex Work						p-value
	Overall		<18		18+		
	N	%	N	%	N	%	
Age at initiation into sex work			90	9.8	830	90.2	--
Median age at initiation into sex work (IQR)	26	(21, 32)					--
Median Age (IQR)	32	(26, 40)	27	(20, 34)	33	(27, 40)	<.0001
Median highest year of school completed (IQR)	6	(4, 8)	6	(4, 8)	6	(4, 8.5)	0.03
Site							0.10
Tijuana	481	51.7	41	45.6	433	52.2	
Ciudad Juarez	450	48.3	49	54.4	397	47.8	
Marital Status							0.04
Married or Cohabiting	222	24.0	31	34.4	191	23.1	
Single	460	49.7	44	48.9	411	49.6	
Other	243	26.3	15	16.7	226	27.3	
Currently have children	868	93.7	80	88.9	783	94.5	0.47
Median number of Children (IQR)	3	(2,4)	2	(1,3)	3	(2,4)	0.68
Had a child before initiating sex work	749	86.9	22	27.5	727	93.0	<.0001
Mexican Region of Birth							0.15
North	664	72.4	73	81.1	586	71.5	
Central	199	21.7	14	15.6	83	22.4	
South	54	5.9	3	3.3	51	6.1	
Migrated into this State	557	60.7	43	47.8	511	62.3	0.02
<u>Drug Use Before Initiating Sex Work</u>							
Marijuana	351	37.9	35	39.3	313	37.8	0.80
Inhalants	101	10.9	19	21.1	80	9.6	0.002
Cocaine	227	24.4	17	18.9	208	25.1	0.11
Tranquilizers	115	12.4	13	14.4	102	12.3	0.41
Methamphetamine	153	16.5	9	10.0	143	17.3	0.06
Heroin	110	11.8	7	7.9	102	12.3	0.21
Any drug use*	491	53.0	45	50.0	443	53.4	0.40
<u>Abuse Before Initiating Sex Work</u>							
Emotional abuse	114	12.6	27	30.3	87	10.7	<.0001
Physical abuse	100	11.0	26	28.9	74	9.1	<.0001
Sexual abuse	63	6.9	18	20.0	45	5.5	<.0001

Median and Interquartile Range (IQR) reported for continuous variables

§ Age-adjusted bivariate associations (p-values) between early versus later initiators with logistic regression

* Any drug use: marijuana, inhalants, ecstasy, tranquilizers, barbiturates, heroin, methamphetamines, cocaine, crack, speedball (heroin+cocaine injected simultaneously), or methamphetamine+heroin.

Table 2: Age-adjusted comparisons of factors by age of initiation into sex work among Female Sex Workers in Tijuana and Ciudad Juarez, Mexico (N=920)

Demographic Characteristics	Odds Ratio (95% CI)[§]	
Age (per 5 year increase)	0.64	(0.55, 0.75)
Site (Ciudad Juarez vs Tijuana)	1.45	(0.93, 2.27)
Education (per 5 year increase)	0.66	(0.45, 0.96)
Currently have a spouse/steady partner	1.30	(0.82, 2.05)
Marital Status		
Single vs Married or Cohabiting	0.59	(0.36, 0.98)
Other vs Married or Cohabiting	0.46	(0.24, 0.90)
Currently have children	0.76	(0.36, 1.62)
Had a child before initiating sex work	0.03	(0.02, 0.05)
Mexican Region of Birth		
Central vs North	0.64	(0.35, 1.17)
South vs North	0.44	(0.13, 1.46)
Migrated into this State	0.58	(0.37, 0.91)
Drug Use Before Initiating Sex Work		
Marijuana	1.06	(0.67, 1.68)
Inhalants	2.47	(1.39, 4.40)
Cocaine	0.63	(0.36, 1.11)
Tranquilizers	1.30	(0.69, 2.45)
Methamphetamine	0.49	(0.24, 1.01)
Heroin	0.59	(0.26, 1.33)
Any drug use*	0.82	(0.53, 1.28)
Abuse Before Initiating Sex Work		
Emotional abuse	4.06	(2.39, 6.90)
Physical abuse	4.84	(2.80, 8.36)
Sexual abuse	5.89	(3.09, 11.20)
Influences for Entering Sex Work		
Better pay	0.52	(0.30, 0.89)
To pay for alcohol use	2.43	(1.51, 3.91)
To support children	0.53	(0.32, 0.88)
Needed money for rent, utilities, food, or other	0.32	(0.12, 0.86)
Abused as an adult	2.02	(1.15, 3.54)
Abused as a child	2.92	(1.85, 4.61)
Forced into sex work against will	4.15	(2.07, 8.33)
Parent brought new partner into the home	2.58	(1.45, 4.57)
Relatives' recommendation	2.08	(1.09, 3.98)

Measure of association (OR and 95% CI) for age is not age-adjusted

§ Reference categories are <18 and 'No'.

* Any drug use: marijuana, inhalants, ecstasy, tranquilizers, barbiturates, heroin, methamphetamines, cocaine, crack, speedball (heroin+cocaine), or meth+heroin.

Table 3: Factors independently associated with early[§] versus older initiation into sex work (N=833)

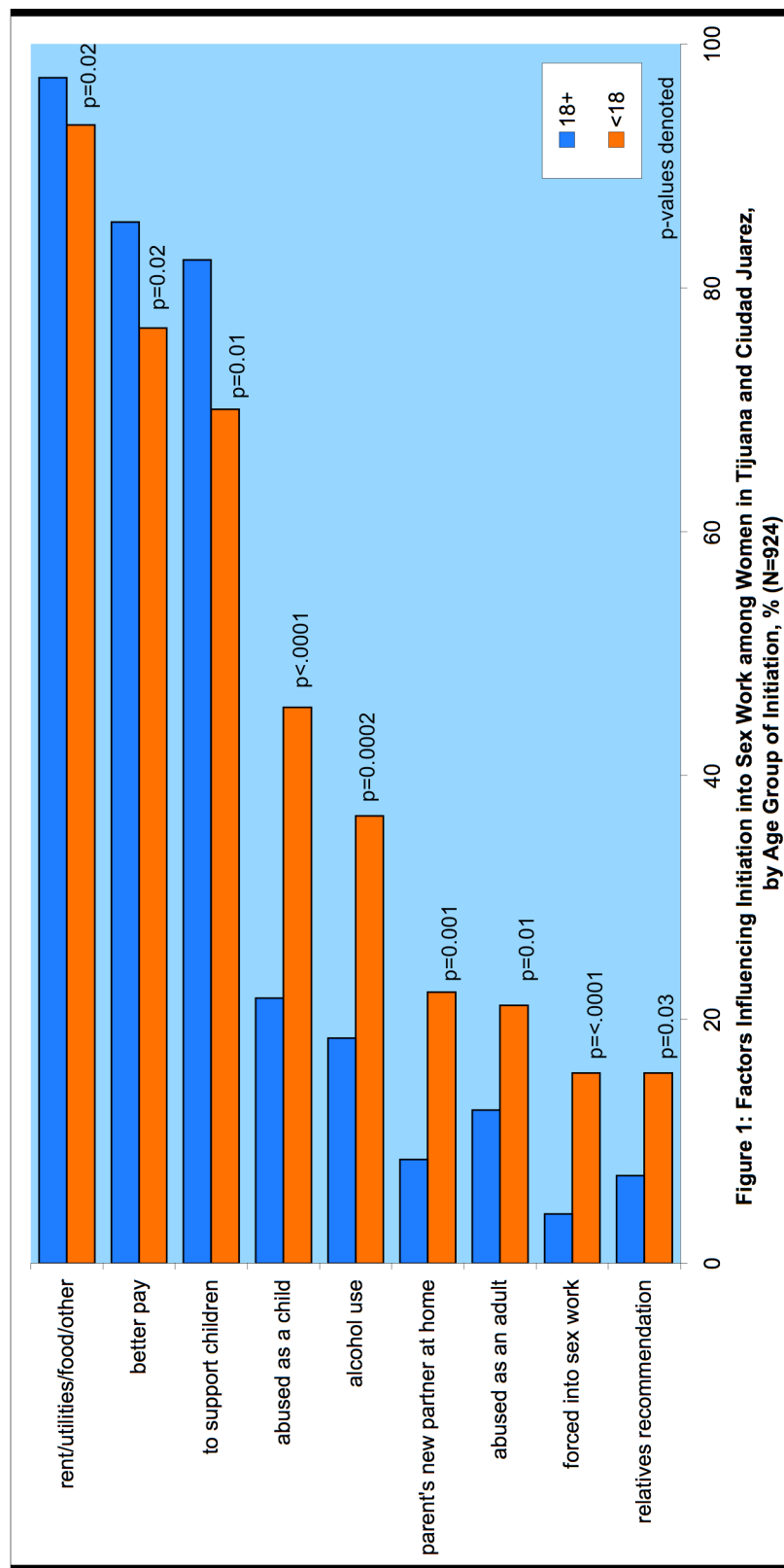
Characteristic	Beta	SE	WCS	p-value	Adjusted Odds Ratio (95% CI)
Age (per 5 year increase)	-0.09	0.02	19.6	<.0001	0.64 (0.52, 0.79)
Education (per 5 year increase)	-0.17	0.06	8.8	0.00	0.43 (0.25, 0.75)
Migrated into this State	-0.75	0.32	5.3	0.02	0.47 (0.25, 0.89)
Emotional abuse before initiating sex work	1.29	0.38	11.4	0.001	3.73 (1.76, 7.89)
Inhalant use before initiating sex work	1.07	0.40	7.3	0.01	2.86 (1.32, 6.21)
Better pay influenced sex work initiation	-1.47	0.72	4.2	0.04	0.44 (0.2, 0.96)
Abused as a child	1.29	0.33	14.8	0.0001	3.89 (2.01, 7.54)
Had a child before initiating sex work	-3.48	0.34	103.6	<.0001	0.03 (0.02, 0.06)

§ initiated sex work at <18 years

SE: Standard Error

WCH: Wald Chi-Square

* Any drug use: marijuana, inhalants, ecstasy, tranquilizers, barbiturates, heroin, methamphetamines, cocaine, crack, speedball (heroin+cocaine), or meth+heroin.



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Manuscript 2: Drug-Related Behaviors Independently Associated with Syphilis Infection among Female Sex Workers in two Mexico-U.S. Border Cities

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Running Head: Drug-related correlates of syphilis infection

Conflict of Interest Declaration:

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Clinical Trial Registration: The intervention study that provided the data analyzed in this paper is registered with the U.S. National Institutes of Health on ClinicalTrials.gov as Protocol #NCT00338845.

ABSTRACT

Objective: Prostitution is quasi-legal in Tijuana and Ciudad Juarez, two Mexican cities on the U.S. border that are situated on major drug trafficking routes. We identified correlates of active syphilis infection among female sex workers (FSWs) in these cities.

Methods: FSWs aged ≥ 18 years without known HIV infection living in Tijuana and Ciudad Juarez who had recent unprotected sex with clients underwent baseline interviews and testing for syphilis antibody using *Treponema pallidum* particle agglutination (TPPA) and rapid plasma reagin (RPR) tests. Correlates of active syphilis (antibody titers $\geq 1:8$) were identified with logistic regression.

Results: Of 914 FSWs, median age and duration in sex work were 32 and 4 years, respectively. Overall, 18.0% had ever injected drugs, 14.2% often/always used illegal drugs before/during sex in the past month, 37.7% had clients who injected drugs in the last 6 months, and 68.6% reported having clients from the U.S. Prevalence of HIV and active syphilis were 5.9% and 10.3%, respectively. Factors independently associated with active syphilis included ever injecting drugs (AOR: 2.42; 95% CI: 1.39, 4.20), using illegal drugs before/during sex (AOR: 2.05; 95% CI: 1.15, 3.66), and having any U.S. clients (AOR: 2.81; 95% CI: 1.41, 5.62).

Conclusions: Among FSWs in these Mexico-U.S. border cities, drug-using behaviors were more closely associated with active syphilis than were sexual behaviors, suggesting the possibility of parenteral transmission of *T. pallidum*. Syphilis eradication programs should consider expanding access by drug

injectors to sterile syringes and assisting FSWs with safer-sex negotiation in the context of drug use.

Key words: female sex worker, prostitution, syphilis, injection drug use, needle sharing, Mexico, women

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INTRODUCTION

Most large cities in Mexico have developed *zonas de tolerancia* (zones of tolerance) where sex work is permitted and sometimes regulated. Two such cities, both of which are situated on Mexico's northern border, are Tijuana (in the state of Baja California, opposite San Diego, California) and Ciudad Juarez (in Chihuahua, opposite El Paso, Texas). In Tijuana, nearly 5,000 female sex workers (FSWs) are registered with the Municipal Health Service, while thousands of others are thought to work without permits. Most of Tijuana's FSWs work in the *Zona Roja* (red-light district), which overlaps the *Zona Norte*, a neighborhood known for its heavy drug use. In Ciudad Juarez, approximately 4,000 FSWs work in zones of tolerance^[1]. Unlike Tijuana, Ciudad Juarez does not regulate sex work. In both cities, FSWs can be found working in cantinas, bars, hotels, nightclubs, and massage parlors, as well as on street corners, and their clients include men from both sides of the U.S.-Mexico border.

Drugs are widely available in Tijuana and Ciudad Juarez thanks to the major trafficking routes for heroin, cocaine, and methamphetamine that run through both cities^[9]. The highest consumption of illicit drugs in Mexico is in the state of Baja California, of which Tijuana is the largest city. Tijuana is home to an estimated 21,000 drug users, of whom approximately 6,000 are IDU [injecting drug users]^[8]. Ciudad Juarez is home to 3,000–3,500 heavy heroin users and an estimated 6,000 IDU^[8]. Among FSWs in Tijuana and Ciudad Juarez, stimulants such as methamphetamine and cocaine, used alone or in combination with heroin, are often used to cope with mood or to stay awake^[27, 45]. Among 924

FSWs in Tijuana and Ciudad Juarez, 18.0% reported ever injecting drugs, and 12.3% reported injecting an illicit drug within the last month, including heroin (93.9%), “speedball” (a cocaine–heroin combination; 50%), cocaine (36.0%), or methamphetamine (21.1%)^[45].

Literature on HIV and sexually transmitted infections (STIs) in the Mexico-U.S. border region suggests a relationship between drug use, sex work, and these infections. In an early study of hepatitis B among women in Tijuana (N=714), non-drug abusing FSWs had higher prevalence of syphilis compared to female controls ^[46]. In Tijuana and Ciudad Juarez, FSWs who injected drugs had consistently higher prevalence of HIV and STIs compared to other FSWs: HIV (16% vs 4%), syphilis (49% vs 22%), Chlamydia (24% vs 10%), and gonorrhea (15% vs 4%)^[45].

Although high-risk sexual behaviors are the most commonly reported risk factors for syphilis, a few studies suggest that injection drug use behaviors might also be important. Syphilis is common among women who use drugs, and thus drug use may be a marker for high-risk sexual behaviors. For example, in a six-year prospective study of 790 IDUs in The Bronx, NY, independent risk factors of early syphilis included younger age, multiple sex partners, incident HIV infection, and being paid for sex ^[47]. Among women in the Connecticut state prison system in 1998, 7% of 113 women incarcerated for possession of illicit drugs and 14% of the 187 women incarcerated for prostitution were infected with syphilis. Of syphilis cases, 41% reported cocaine use and 19% reported prostitution ^[48].

On the other hand, given that syphilis can be transmitted through blood transfusion ^[49-51], it could also be transmitted parenterally through needle sharing during injection drug use. In a cross-sectional study among male and female IDUs in three Russian cities, presence of syphilis antibody was associated with daily injection, having an IDU sexual partner, and a history of STIs ^[52]. Among women in the cities of Moscow and Barnaul, sex work was independently associated with testing positive for syphilis antibodies, and in Barnaul, daily injection was also associated with a positive syphilis test, after adjusting for potential confounders ^[52]. Although the results of this study were not definitive, the authors suggested a possible causal relationship between injection drug use and syphilis infection.

This study aimed to determine if drug-using behaviors were independently associated with active syphilis infection among FSWs in Tijuana and Ciudad Juarez. Given the intertwined nature of sex work and injection drug use in these cities, we hypothesized that FSWs with syphilis titers consistent with active infection would have higher rates of injection drug use and needle sharing, after controlling for high-risk sexual behaviors. If the evidence supported this hypothesis, that would suggest that syphilis eradication programs should include a component for promoting access to sterile syringes and teaching safer injection behaviors. Additionally, since high syphilis titers are independently associated with HIV infection among FSWs ^[53] and IDUs in these cities ^[24] and elsewhere (e.g., the U.S., Russia, India, Nepal, China) ^[54-58], interventions to reduce syphilis transmission could also favorably impact HIV prevention efforts ^[59].

METHODS

Study Population

From March, 2004 through January, 2006, FSWs in Tijuana (N=474) and Ciudad Juarez (N=450) were recruited into a behavioral intervention study as described previously^[60]. FSWs were interviewed face-to-face in a private setting by female clinic staff. All recruitment was conducted at municipal clinics, at NGOs, or by street outreach. Participants were women, at least 18 years old, who self-identified as a FSW (i.e., had traded sex for drugs, money, or other material benefit) and reported having had unprotected vaginal or anal sex with a client at least once during the previous four weeks. Women were excluded if they practiced consistent use of condoms or a dental dam for vaginal, oral and anal sex with all clients during the previous two weeks or if they had been employed as a sex worker for less than 4 weeks.

Data Collection

Data were collected by questionnaire during a private, face-to-face, spoken interview lasting approximately 35 to 40 minutes. Questionnaires had been translated into Spanish and back-translated into English by a bilingual team of Latino/a researchers and reviewed for cultural appropriateness. Measures examined in this study included four domains: i) baseline sociodemographic characteristics, ii) risk behaviors (i.e., condom use and substance use), iii) male client characteristics, and iv) detection of HIV and syphilis antibodies and testing

for Chlamydia and gonorrhea. Although the larger intervention study in which the women participated included follow-up visits, all the data for this paper were taken from the participants' baseline visits.

Baseline Sociodemographic Characteristics

Sociodemographic variables collected included current age, age at initiation into sex work, marital status, having children, study site (Tijuana versus Ciudad Juarez), migration into the state, and type of sex work (street, dance hostess, barmaid, other).

Condom Use

Condom use was assessed by the following: whether participants had condoms with them at the interview; total number of sex acts in the past 6 months; number of protected sex acts in the the past 6 months; average amount (USD) paid by clients for protected and unprotected sex; and condom use for vaginal sex with male clients in past the 6 months (never or sometimes versus often or always).

Substance Use

Participants were asked if they used alcohol before or during sex (never or sometimes versus often or always); used illegal drug before or during sex (never or sometimes versus often or always); ever injected illicit drugs; injected cocaine, heroin, methamphetamine, or speedball in the past month; number of IDU sex

partners in the past month; number of male clients in the last 6 months who ever injected drugs; and if they ever shared needles or injection equipment (including cotton, water or needles) with another person, including a client.

Male Client Characteristics

The questionnaire assessed number, type (regular and non-regular), and origin (U.S. or Mexico) of male clients, as well as the number of times the participant had vaginal sex with clients.

HIV, Syphilis, Chlamydia, and Gonorrhea

Blood samples were obtained by trained phlebotomists to test for HIV and syphilis antibodies. HIV antibody was detected on-site using the “Determine”[®] rapid HIV antibody test (Abbott Pharmaceuticals, Boston, MA); reactive samples were later confirmed by EIA and Western Blot. The rapid plasma reagin (RPR) test was used to detect syphilis antibody (Macro-Vue, Becton Dickenson, Cockeysville, MD, USA); reactive samples were confirmed by *Treponema pallidum* hemagglutinin assay (TPHA) (Fujirebio, Wilmington, DE, USA). Presence of any syphilis antibodies reflected prevalent syphilis infection, and a syphilis titer $\geq 1:8$ was considered consistent with active infection, as recommended ^[61]. Cervical swabs were prepared and tested using the Aptima[®] Combo-2 collection device (Genprobe, San Diego, CA] to detect *Neisseria gonorrhea* and *Chlamydia trachomatis*. All STI tests as well as confirmatory HIV

tests were conducted at the San Diego County Health Department or the El Paso County Health Department.

Statistical Analysis

Syphilis titers were dichotomized into $<1:8$ and $\geq 1:8$, the latter being considered reflective of active syphilis^[61]. The ratio of protected sex acts in the past 6 months was calculated by dividing the number of protected sex acts by the total number of acts in that period. Bivariate associations by active syphilis status were performed with nonparametric Fisher's Exact Test and Wilcoxon Two Sample Test, where appropriate.

Logistic regression was performed to identify factors associated with active syphilis. In multivariate regressions, all variables attaining significance ($p < 0.10$) in bivariate analysis were considered for inclusion. Factors with medium-to-high correlation were not included in the same model (Spearman correlation coefficient $r > 0.6$). Models were reduced using manual stepwise regression ($p < 0.05$). A tolerance test was performed on the final model to assess multicollinearity. No significant differences were observed by city; hence data for both sites were pooled.

RESULTS

Of 924 FSW participants, 10 did not have valid syphilis antibody test results and hence were excluded. Of the 914 participants remaining, median age was 32 years (IQR: 26, 39) and median duration of sex work was 4 years (IQR:

2, 10). Overall, 246 (26.9%) had evidence of syphilis infection, of whom 94 (38.2%, or 10.3% of the total) had syphilis titers consistent with active infection (titers \geq 1:8).

Bivariate Associations

Cases consistent with active syphilis infection differed in their substance abuse, client characteristics, and HIV/STI prevalence. A significantly greater proportion of FSWs with active syphilis were street workers (70% vs 54%; $p=0.03$). We did not find significant differences for other sociodemographic characteristics, including age, age at initiation into sex work, city of residence, migration, or condom use characteristics (Table 1).

FSWs with titers consistent with active syphilis were more likely to report often or always using illegal drug before or during sex (31% vs 12%; $p<0.001$); to have ever injected drugs (36% vs 16%; $p<0.001$) or shared needles or injection equipment (28% vs 13%; $p<0.001$); and to report having any U.S. clients (84% vs 67%; $p<0.001$). Marginally significant differences were observed between cases consistent with active syphilis infection and injecting speedball in the past month. We did not observe differences by syphilis status for using alcohol before or during sex, injecting cocaine or methamphetamine in the past month, mean number of IDU sex partners in the past month, sharing needles with clients in the past month, or having male clients in the last 6 months who ever injected drugs (Table 1).

FSWs with titers consistent with active syphilis had more than two and half times the odds of having U.S. clients (Table 2). A marginally significant difference was observed between active syphilis infection and no active syphilis infection with respect to mean number of vaginal sex acts with regular male clients; however, we found no association between active syphilis infection and the mean number of regular or non-regular male clients or the mean number of times FSWs had vaginal sex with non-regular clients (Table 1). The odds of having titers consistent with active syphilis increased by approximately 4, 2, and 6-fold for those with HIV, Chlamydia, and gonorrhea (Table 2).

Factors Independently Associated with Active Syphilis

In the multivariate model, having a syphilis titer consistent with active syphilis was independently associated with ever injecting drugs (AOR: 2.42; 95% CI: 1.39, 4.20), having used illegal drugs before or during sex within the last month (AOR: 2.05; 95% CI: 1.15, 3.66), and having any U.S. clients (AOR: 2.81; 95% CI: 1.41, 5.62) (Table 3). Model robustness was assessed by forcing age, age at initiation into sex work, or number of years in sex work into the final model. We found only minimal deviations in the significance or odds ratios and no change in the significance or direction of the association with active syphilis.

DISCUSSION

In Mexico overall, syphilis incidence is reported to be 1.2 per 100,000 ^[62], compared to 3.8 per 100,000 in the United States ^[63]. As in the United States ^[63],

syphilis rates vary considerably by state. For example, among Mexico's 32 states, the incidence of syphilis is highest in the state where Tijuana is located, Baja California (7.4 per 100,000), and fourth highest in Chihuahua (3.8 per 100,000), where Ciudad Juarez is located, indicating a need for an urgent response ^[62].

Our study's findings suggest a role for both high-risk sexual behaviors as well as parenteral risks in syphilis transmission among FSWs in two Mexico-U.S. border cities. In particular, after taking into account the use of drugs during sex acts, injection drug use was independently associated with nearly a three-fold higher odds of active syphilis infection.

Our findings extend those from a recent study suggesting that parental exposure may be an important risk factor for syphilis among some IDU populations. A cross-sectional study conducted among male and female IDUs in Barnaul, Russia found that syphilis was significantly associated with daily drug injection, duration of injection, and having IDU sexual partners ^[52]. However, this study did not differentiate between prevalent and incident syphilis infections, which compromised its ability to draw causal inferences. An advantage of our study was that we based our definition of syphilis infection on RPR titers $\geq 1:8$, which is consistent with active infections that were more likely to have been acquired recently ^[61]. In doing so, we can be more confident that factors found to be independently associated with syphilis infection in the present analyses are risks associated with active infections, as opposed to markers that may be only distally related to infection.

Our findings underscore the need for syphilis eradication programs to include a safer-injection component, ideally by providing sterile syringes to IDUs in settings where injection drug use is rife. Giving IDUs access to sterile syringes through over-the-counter sales or through needle-exchange programs (NEPs) has been a challenge in both Tijuana and Ciudad Juarez. Although syringes can be legally purchased in Mexico at pharmacies without a prescription and there are no paraphernalia laws that prevent IDUs from carrying used or sterile syringes, IDUs in Tijuana have nonetheless reported barriers to acquiring new syringes legally, including being charged higher prices or being refused purchase of syringes at pharmacies ^[64]. IDUs in both Tijuana and Ciudad Juarez have consistently reported being arrested for carrying sterile or used syringes ^[64, 65], and history of arrest for this supposed offense was independently associated with receptive needle sharing in both cities ^[65]. Similarly, among male IDUs in Tijuana, being arrested for having visible “track marks” was independently associated with HIV infection ^[24]. Indeed, fear of arrest was cited by many IDUs as a main reason why they sought to inject in shooting galleries in both cities, where they find ample access to used syringes, whether through borrowing or renting ^[64, 66]. This suggests that before widespread needle exchange programs can be implemented, interventions with legal entities are needed to remove structural barriers.

Apart from discrimination by pharmacy personnel and harassment by law enforcement officers, the wider community’s skepticism and fear about safer-injection initiatives also constitute a barrier. Qualitative interviews with

pharmacists, legal professionals, health officials, religious officials, drug treatment providers, and law enforcement personnel regarding IDU harm reduction interventions in Tijuana indicated considerable concerns about the feasibility of NEPs, syringe vending machines, and safer injection facilities^[67]. Nevertheless, NEPs are operating in both cities with the support of the Mexico's federal Ministry of Health^[68]. The first NEP in Mexico was opened in Ciudad Juarez by Programa Compañeros, A.C. in the late 1980s, and the second was opened in the Tijuana in 2006 by PreveCasa, A.C.^[69]. However, the demand for syringes appears consistently to outstrip their availability. NEPs are now offered in six Mexican states: Baja California, Chihuahua, Coahuila, Nuevo Leon, Oaxaca, Sinaloa, and Zacatecas. Of the 64,281 syringes distributed by state-sanctioned NEPs in Mexico in 2006, 99% were distributed in Tijuana^[67]. Studies examining the effectiveness of NEPs in relation to syphilis prevention could provide another line of evidence for the relationship between risky IDU behaviors and incidence of syphilis infections.

We also observed that having recently used illegal drugs before or during sex was independently associated with active syphilis among our sample. This association may reflect FSWs' compromised ability to negotiate condom use while under the influence of drugs, a phenomenon that has been reported elsewhere^[70, 71]. For example, FSWs on the Mexico-Guatemala border reported difficulties negotiating condom use when their male partner was under the influence of alcohol or drugs^[70]. In contrast, a study on African American adolescent females found that after controlling for age and self-efficacy to

negotiate condom use, young women's alcohol or drug use while having sex was not significantly associated having any STI (trichomoniasis, Chlamydia, or gonorrhea); however, there was an association between the male partners' alcohol or drug use and prevalence of sexually transmitted infections ^[72], confirming the overriding control that males have in the use of male condoms. These studies suggest that risk reduction interventions should be developed that focus on male clients; at the same time, women can be encouraged to use female condoms when a male condom cannot be negotiated ^[70, 73, 74].

We also observed that having any U.S. clients was independently associated among FSWs in Tijuana and Ciudad Juarez with having active syphilis. An earlier study with this population indicated that FSWs who had any U.S. clients had not only significantly higher rates of active syphilis (14% vs 10%) but also higher rates of gonorrhea (8% vs 2%) or any STI (gonorrhea, Chlamydia, HIV, active syphilis) (30% vs 20%) compared to those without any U.S. clients ^[25]. In the same study, FSWs with U.S. clients had higher rates of drug-using behavior, including injecting drugs in the last month. They were also more likely to often or always use drugs before or during sex, and they tended to have clients who use and inject drugs ^[25]. Since more than two-thirds of FSWs in these cities reported having clients from the U.S. ^[30], these data suggest that U.S. men seeking paid sex across the border in Mexico are at considerable risk of acquiring and transmitting syphilis and other STIs. In fact, rates for primary and secondary syphilis in San Diego County increased from 3.8 to 11.8 per 100,000 between 2003 and 2007 ^[63], and between 2006 to 2007, the County saw

a 47% increased incidence in acquired syphilis ^[75]. Interventions to reduce syphilis prevalence and incidence in Tijuana and other Mexican border cities could help mitigate syphilis epidemics in the neighboring country, which suggests the desirability of a coordinated, bi-national response.

Results of our study should be interpreted with a number of limitations in mind. In the absence of information on whether participants had recently been treated for syphilis, antibody titers alone are not sufficient to determine whether syphilis titers of 1:8 or higher accurately reflect infectious status. However, since 98% of FSWs in this study were unaware that they had an STI ^[1], it is unlikely that many of these infections were being treated. While high syphilis titers can be assumed, in settings with aggressive case-finding and partner notification, to indicate a recent infection, it is possible that despite the high titers, some of the syphilis infections we observed may not have been recently acquired. This would tend to attenuate the associations we observed towards one. Also, since our study was cross-sectional, we cannot conclusively draw causal inferences. Prospective studies are needed to further elucidate causal associations. And, although convenience sampling may limit the external validity of our findings, it should not influence the direction or the magnitude of the associations we observed.

These findings have important implications for syphilis prevention and future interventions among FSWs in general, and more specifically for those living in Tijuana and Ciudad Juarez. Given the sizable overlap between FSW and IDU populations in these cities ^[45], syphilis interventions in these cities should

include increased access to sterile needles as well as educational and behavioral interventions to reduce receptive needle sharing. The associations between syphilis infection and injection behaviors clearly indicates the importance of incorporating injection-risk prevention elements into existing efforts for syphilis eradication. These may include harm reduction measures such as STI testing and treatment at NEPs and providing access to sterile syringes to IDUs at STD clinics.

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Table 1: Bivariate Statistics and Associations by Active Syphilis (titer \geq 1:8) Status for Characteristics of Female Sex Workers (N=914)

	Negative (n=820)	Positive (n=94)	p- value
Sociodemographic Characteristics			
Age	33.5 (9.2)	32.5 (8)	0.44
Age of Initiation into Sex Work, %			0.72
<18	80 (10)	10 (11)	
18+	732 (90)	83 (89)	
Marital Status, %			0.09
married/cohabitated	190 (23)	30 (32)	
Single	402 (49)	46 (49)	
Other	223 (27)	18 (19)	
Has Children, %	767 (94)	86 (92)	0.37
City of Residence, %			0.28
Tijuana	412 (50)	53 (56)	
Ciudad Juarez	408 (50)	41 (44)	
Migrated into this State, %	494 (60)	57 (61)	0.99
Sex Worker Type, %			0.03
street worker	439 (54)	66 (70)	
dance hostess	181 (22)	13 (14)	
Barmaid	132 (16)	11 (12)	
Other	68 (8)	4 (4)	
Condom Use			
Participant brought condoms to the interview, %	93 (12)	8 (8)	0.49
% unprotected vaginal sex	43.5 (30.7)	43.5 (29.5)	0.86
Average USD amount earned for sex WITH a condom	28.9 (26.9)	26.3 (21.8)	0.70
Average USD amount earned for sex WITHOUT a condom	47.4 (74.9)	35.7 (28.6)	0.15
Used condoms for vaginal sex with male clients in past 6 mo, %			0.66
Never/Sometimes	463 (57)	51 (54)	
Often/Always	355 (43)	43 (46)	

Table 1 (con't)	Negative (n=820)	Positive (n=94)	p- value
Substance Use			
Used alcohol before/during sex, %			0.44
Never/Sometimes	631 (77)	76 (81)	
Often/Always	188 (23)	18 (19)	
Used illegal drug before/during sex, %			<0.001
Never/Sometimes	717 (88)	64 (69)	
Often/Always	101 (12)	29 (31)	
Has ever been an IDU, %	128 (16)	34 (36)	<0.001
Has ever shared needles/injection equipment, %	103 (13)	26 (28)	<0.001
Injected cocaine in past month, %	52 (7)	6 (7)	0.99
Injected heroin in past month, %	110 (14)	31 (33)	<0.001
Injected methamphetamine in past month, %	25 (3)	4 (4)	0.53
Injected speedball in past month, %	52 (6)	11 (12)	0.08
Number of IDU sex partners in past month	0.8 (4.1)	0.5 (1.1)	0.32
Male clients in last 6 mo who ever injected drugs, %	262 (39)	27 (31)	0.20
Shared needles with clients in past month, %	17 (2)	3 (3)	0.45
Male Client Characteristics			
Number of male clients in past six months	332 (320.1)	382.7 (371.5)	0.24
Number of regular male clients you had past month	5.8 (9.2)	7.1 (11)	0.12
Times you had vaginal sex with regular male clients	19.2 (23.5)	21.4 (19.5)	0.08
Number of non-regular male clients you had past month	39.9 (48)	34 (40.5)	0.37
Times you had vaginal sex with non- regular clients	43.6 (50.7)	37.7 (42.6)	0.38
Has any U.S. clients, %	547 (67)	79 (84)	<0.001
STI Status			
HIV, %	37 (4)	16 (17)	<0.001
Chlamydia, %	85 (12)	18 (22)	0.01
Gonorrhea, %	32 (4)	18 (22)	<0.001

Univariate Statistics include Mean (SD) and Wilcoxon Test p-value for continuous variables. N (%) and Fisher Exact Test p-value for categorical variables. Categorical variables denoted with %

Table 2: Odd Ratios and 95% Confidence Intervals by Active Syphilis (titer \geq 1:8) Status for Characteristics of Female Sex Workers (N=914)

	OR (95% CI)
Sociodemographic Characteristics	
Age	0.94 (0.83, 1.06)*
Age of Initiation into Sex Work, %	
<18	(ref)
18+	0.91 (0.45, 1.82)
Marital Status, %	
married/cohabitated	(ref)
Single	0.72 (0.44, 1.18)
Other	0.51 (0.28, 0.95)
Has Children, %	0.69 (0.31, 1.5)
City of Residence, %	
Tijuana	1.28 (0.83, 1.96)
Ciudad Juarez	(ref)
Migrated into this State, %	1.00 (0.65, 1.55)
Sex Worker Type, %	
street worker	(ref)
dance hostess	0.48 (0.26, 0.89)
Barmaid	0.55 (0.28, 1.08)
Other	0.39 (0.14, 1.11)
Condom Use	
Participant brought condoms to the interview, %	0.71 (0.33, 1.52)
% unprotected vaginal sex	1 (0.93, 1.07)**
Average USD amount earned for sex WITH a condom	0.96 (0.87, 1.05)**
Average USD amount earned for sex WITHOUT a condom	0.94 (0.88, 1.01)**
Used condoms for vaginal sex with male clients in past 6 mo, %	
Never/Sometimes	(ref)
Often/Always	1.1 (0.72, 1.69)

Table 2 (con't)	OR (95% CI)
Substance Use	
Used alcohol before/during sex, %	
Never/Sometimes	(ref)
Often/Always	0.79 (0.46, 1.36)
Used illegal drug before/during sex, %	
Never/Sometimes	(ref)
Often/Always	3.22 (1.98, 5.23)
Has ever been an IDU, %	3.06 (1.93, 4.86)
Has ever shared needles/injection equipment, %	2.66 (1.62, 4.37)
Injected cocaine in past month, %	1.01 (0.42, 2.43)
Injected heroin in past month, %	3.16 (1.96, 5.08)
Injected methamphetamine in past month, %	1.39 (0.47, 4.08)
Injected speedball in past month, %	1.98 (0.99, 3.94)
Number of IDU sex partners in past month	0.59 (0.16, 2.18)**
Male clients in last 6 mo who ever injected drugs, %	0.72 (0.45, 1.17)
Shared needles with clients in past month, %	1.56 (0.45, 5.42)
Male Client Characteristics	
Number of male clients in past six months	1 (1, 1.01)**
Number of regular male clients you had past month	1.12 (0.94, 1.33)**
Times you had vaginal sex with regular male clients	1.04 (0.96, 1.12)**
Number of non-regular male clients you had past month	0.97 (0.92, 1.02)**
Times you had vaginal sex with non-regular clients	0.97 (0.93, 1.02)**
Has any U.S. clients, %	2.63 (1.49, 4.65)
STI Status	
HIV, %	4.32 (2.3, 8.13)
Chlamydia, %	2.11 (1.19, 3.73)
Gonorrhea, %	6.07 (3.23, 11.43)

* per 5 years and ** per 10 unit increase indicated

Table 3: Characteristics Independently Associated with Active Syphilis (titer \geq 1:8) (N=769)

<u>Characteristic</u>	<u>AOR (95% CI)</u>
Has ever injected drugs	2.42 (1.39, 4.20)
Used illegal drug before/during sex	2.05 (1.15, 3.66)
Has any U.S. clients	2.81 (1.41, 5.62)

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Manuscript 3: Risk Factors associated with Chlamydia and Gonorrhea Infection among Female Sex Workers in two Mexico-U.S. Border Cities

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ABSTRACT

Background: Tijuana and Ciudad Juarez are Mexican cities bordering the US where sex work is tolerated. We identified risk factors associated with Chlamydia and gonorrhea infection among female sex workers (FSWs) in these cities.

Methods: FSWs aged ≥ 18 years without known HIV infection living in Tijuana and Ciudad Juarez who had recent unprotected sex with clients underwent baseline interviews and testing for Chlamydia and gonorrhea using nucleic acid amplification. Correlates of each infection were identified with logistic regression.

Results: Of 798 FSWs (Tijuana: 466; Ciudad Juarez: 332), median age was 32 years, 93.6% had children, and median duration in sex work was 4 years.

Prevalence of Chlamydia and gonorrhea was 13.0% and 6.4%, respectively; 2.5% were co-infected. Factors independently associated with Chlamydia were being younger (AOR: 0.63 per 10 years; 95% CI: 0.48, 0.82), working in Tijuana versus Ciudad Juarez (AOR: 2.34; 95% CI: 1.43, 3.83), and recent methamphetamine injection (AOR: 2.68; 95% CI: 1.18, 6.05). Factors independently associated with gonorrhea were working in Tijuana versus Ciudad Juarez (AOR: 4.75; 95% CI: 1.80, 12.52), using illegal drugs before or during sex (AOR: 5.96; 95% CI: 3.01, 11.80), and having a male injection drug user partner in the last 6 months (AOR: 2.32; 95% CI: 1.16, 4.63).

Conclusions: Drug use among FSWs and their sexual partners was more closely associated with Chlamydia and gonorrhea infection than sexual behaviors. Prevention efforts in these settings should be focused on subgroups of FSWs and their partners who use methamphetamine and inject drugs.

Key Words: Chlamydia, Gonorrhea, Female Sex Workers, Mexico-U.S. border, women

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INTRODUCTION

Chlamydia and gonorrhea share some risk factors, such as female gender, younger age at sexual debut, low contraceptive use, greater number of sexual partners, engaging in commercial sex work, and drug use ^[51, 76-79]. However, few studies have examined specific types of drug use that may be markers of high STI risk. Among women inmates aged 17-21 in the UK, prevalence of Chlamydia infection was 13.2%, and risk factors included drug use (particularly crack cocaine and heroin use), not using condoms during the last sexual encounter, and history of a previous pregnancy^[80].

Recent studies have identified partner-level risk factors associated with Chlamydia and gonorrhea infections. In a sample of 15- to 24-year-olds, such partner characteristics as having STI in the past year and a ≥ 5 year age difference were more predictive of STIs than were an individual's sexual behaviors ^[81]. STI risks may also differ by sexual partner type. Among 553 high-risk heterosexual women in Houston, Texas, condom use was higher in sexual encounters with casual partners, but lower when alcohol, drugs, or both were used ^[82].

Fewer studies have considered partner-level characteristics that may influence STI acquisition in low- and middle-income countries. A study among 4,000 married or cohabiting men aged 17 to 60 years living in Mexico City found that those having extra-relational sex in the last year were more likely to use condoms with their secondary partners ^[83]. In Mexico, STIs are among the top five reasons to visit a doctor and are among the top ten causes for morbidity

among men and women between 15 and 44 years old ^[84]. Rates for Chlamydia in California and Texas were 390.9 and 313.3 per 100,000 respectively ^[85, 86] but are lacking at the state level in Mexico. Ethnic minorities are overrepresented among Chlamydia and gonorrhea cases ^[87]. In 2007, while about 1 of 3 Californians were Latino, 1 in 2 Chlamydia cases were Latino ^[87]. In 2008, the reported incidence of gonorrhea in the Mexican states of Baja California (1.6 per 100,000) and Chihuahua (0.7 per 100,000), which border the U.S., was above the national average (0.5 per 100,000) ^[88], but appeared much lower than that of the bordering U.S. states (California and Texas), where rates were 66.8 and 113.8 per 100,000 respectively ^[86, 89].

As in the U.S., certain population subgroups in Mexico show higher prevalence of Chlamydia and gonorrhea, and prevalence varies by region. Among sexually active adolescents in 204 disadvantaged urban towns in Mexico, prevalence of Chlamydia was 8%, and it ranged from 4% among 19- to 21-year-old boys to 10% among 15- to 18-year-old girls ^[90]. Only one of the 1,241 sexually active participants tested positive for gonorrhea ^[90]. Of 1,100 sexually active women 15 to 45 years old attending family planning clinics in Mérida, Yucatán, Mexico in 1998, 74 (6.7%) tested positive for Chlamydia, and close to half were asymptomatic ^[91]. Women in communities along the border between Arizona (U.S.) and Sonora (Mexico) were found to be at significantly increased risk for Chlamydia infection compared to women attending clinics in non-border locations (9.0% versus 5.4%) ^[92]. Testing positive for Chlamydia was associated

with younger age, a history of new sexual partner(s) in the previous three months, and proximity to the international border ^[92].

Tijuana, Baja California and Ciudad Juarez, Chihuahua lie on Mexico's border with the U.S. and are characterized by high levels of poverty and large populations of migrants and female sex workers (FSWs). Like other cities in Mexico, these cities have developed "zones of tolerance" where sex work is quasi-legal. In both, FSWs are found working in cantinas, bars, hotels, nightclubs, massage parlors, and on street corners. Their clients include men from both sides of the U.S.-Mexico border and from other countries; clients range in age from 18 to 80 years ^[27, 93]. In 2006, it was reported that 4,850 Tijuana FSWs were registered with the Municipal Health Service, while thousands of others are thought to work without a permit ^[1]. Approximately 4,000 FSWs work in zones of tolerance of Ciudad Juarez, where sex work is not regulated by the Health Department ^[1].

Prevalence estimates for Chlamydia and gonorrhea among FSWs in Mexico have been reported in a few studies. Uribe-Salas et al. ^[94] reported that prevalence of HIV, active syphilis, Chlamydia, and gonorrhea was 0.6%, 6.4%, 11.1%, and 3.7% among FSWs in Mexico City. A cross-sectional study among 484 Mexican and Central American FSWs in the Soconusco region of Chiapas, Mexico (along the border with Guatemala) indicated even higher prevalence of HIV, syphilis, Chlamydia, and gonorrhea at 0.6%, 9.4%, 14.4%, and 11.6%, respectively ^[95]. However, data on prevalence and risk factors for Chlamydia and

gonorrhoea are lacking among FSW populations residing near the Mexico-U.S. border.

Major drug trafficking routes for heroin, cocaine and methamphetamine pass through both Tijuana and Ciudad Juarez. We previously reported that FSWs in these cities who injected drugs had higher overall prevalence of STIs and engaged in more unsafe sex with clients compared to FSWs who did not inject drugs ^[45]. FSWs with U.S. clients were significantly more likely to inject drugs, have unprotected sex for more money, and to have recently tested positive for one of four STIs (gonorrhoea, Chlamydia, HIV, active syphilis) compared to other FSWs ^[25]. However, we did not examine individual or partner-level risk factors for STI acquisition, nor did we examine risk factors for gonorrhoea and Chlamydia separately. In the present study, we examine whether FSWs testing positive for gonorrhoea and Chlamydia report higher rates of drug use before or during sex, and if partner-level characteristics are closely associated with these incident STIs. In a resource-limited setting such as Mexico, identifying correlates of STIs is important for targeting funding for STI screening and treatment.

MATERIALS and METHODS

Study Population

From March 2004 through January 2006, FSWs in Tijuana (N=474) and Ciudad Juarez (N=450) were recruited into a behavioral intervention study described previously ^[60]. Recruitment was conducted at municipal clinics, at

NGOs, and by street outreach. Participants were women at least 18 years old who had traded sex for drugs, money, or other material benefit and reported having had unprotected vaginal or anal sex with a client at least once during the previous four weeks.

Measures

Data were collected by questionnaire during a private, face-to-face, spoken interview with a female staff person. The interview lasted 35 to 40 minutes. Measures included five domains: i) demographics, ii) sexual behaviors, iii) substance use, iv) male client characteristics, and v) test results for Chlamydia, gonorrhea, Syphilis antibodies, and HIV antibodies. Data were restricted to the baseline enrollment visit.

Demographic Characteristics

Sociodemographics included age, age at initiation into sex work, marital status, having children, city of residence, place of birth, and type of sex work (street worker, dance hostess, barmaid, other).

Sexual Behaviors

Condom use was assessed by the following: whether participants had condoms with them at the interview; total number of sex acts and of unprotected sex acts in the past six months, broken down according to partner type (spouse or steady; any client; non-regular clients; regular clients); average amount (USD) paid by clients for protected and unprotected sex; and frequency of condom use for vaginal sex with male clients (never or sometimes versus often or always).

Substance Use

Participants were asked: if had they used (a) alcohol or (b) an illegal drug before or during sex during the past month; if they had ever injected illicit drugs, cocaine, heroin, methamphetamine, or speedball; number of IDU sex partners in the past month; number of male clients in the last six months who (to the FSWs' knowledge) had ever injected drugs; and if participants had ever shared needles or injection equipment with anyone.

Male Client Characteristics

We assessed number, type (regular and non-regular), and perceived origin (U.S. or Mexico) of male clients, as well as the number of vaginal sex acts with clients of each type. Regular clients were described as “men who come back to you for repeat visits or men that you have an ongoing relationship with over time.” Non-regular clients were described as “men who do not come back to you for regular visits or men that you have seen only once or twice.”

Chlamydia, Gonorrhea, HIV, and Syphilis

Cervical swabs were prepared and tested with nucleic acid amplification using the Aptima® Combo-2 assay collection device (Genprobe, San Diego, CA) to detect *Neisseria gonorrhoea* and *Chlamydia trachomatis*. Sensitivity and specificity for both organisms ranges from 94–100%.^[96, 97] From a blood sample, HIV antibody was detected on site using the “Determine”® rapid HIV antibody test (Abbott Pharmaceuticals, Boston, MA); reactive samples were confirmed by enzyme immunoassay (EIA) and Western Blot. The rapid plasma reagin (RPR)

test was used to detect syphilis antibody (Macro-Vue, Becton Dickenson, Cockeysville, MD, USA); reactive samples were confirmed by *Treponema pallidum* hemagglutinin assay (TPHA) (Fujirebio, Wilmington, DE, USA). RPR titers $\geq 1:8$ were considered consistent with active infection, as recommended [61]. HIV and STI tests that were not conducted on site were performed at the County Health Department of either San Diego or El Paso.

Statistical Analysis

Bivariate associations by Chlamydia and gonorrhea infection were performed with nonparametric Fisher's Exact Test and Wilcoxon's Two Sample Test, as appropriate. Logistic regression was performed to identify factors associated with Chlamydia and gonorrhea infections. In multivariate regressions, all variables attaining a significance of $p < 0.10$ in bivariate analysis were considered for inclusion; models were reduced manually using stepwise regression and the Likelihood Ratio test ($p < 0.05$). Factors with medium-to-high Spearman correlation ($r > 0.6$) were not included in the same model. A tolerance test was performed on the final model to assess multicollinearity.

RESULTS

Of 924 participants, 126 did not have valid test results for Chlamydia and gonorrhea and were hence excluded. Of the 798 remaining, 466 (58.4%) were working in Tijuana while 332 (41.6%) worked in Ciudad Juarez. Overall, median age was 32 years (IQR: 26, 39); 17.8% had ever injected drugs; and the median number of clients in the past six months was 240 (IQR: 72, 480). Overall, 104

(13.0%) tested positive for Chlamydia infection, and 51 (6.4%) tested positive for gonorrhea infection.

Factors Associated with Chlamydia Infection

FSWs who tested positive for Chlamydia were significantly younger (mean (SD): 34 (9) versus 30 (8) years old; $p < 0.001$) and were more likely to be living in Tijuana than in Ciudad Juarez. We did not find differences between groups with respect to age of initiation into sex work, marital or migration status, sex worker type, condom use practices, or male client characteristics (Table 1).

FSWs who tested positive for Chlamydia had higher lifetime prevalence of injecting drugs (16% versus 29%), and were more likely to have ever shared needles or injection equipment (12% versus 23%) or injected heroin (14% versus 26%) or methamphetamine (3% versus 10%) in the last month. We did not find significant differences with respect to alcohol or illegal drug use before or during sex, injecting cocaine or speedball in the previous month, or number of IDU sex partners in the past month. Not surprisingly, FSWs with Chlamydia infection also had significantly higher prevalence of HIV (15% versus 4%), active syphilis (titer $\geq 1:8$) (18% versus 9%), and gonorrhea (19% versus 4%).

Factors independently associated with Chlamydia were being younger (AOR: 0.63; 95% CI: 0.48, 0.82 per 10 years), working in Tijuana versus Ciudad Juarez (AOR: 2.34; 95% CI: 1.43, 3.83), and having injected methamphetamine in the past month (AOR: 2.68; 95% CI: 1.18, 6.05) (Table 2).

Factors associated with Gonorrhea Infection

Factors associated with gonorrhea infection among FSWs in Tijuana and Ciudad Juarez included substance use, certain male client characteristics, and having other STIs. FSWs with gonorrhea infection were over four times more likely to work in Tijuana than in Ciudad Juarez. We detected no associations between gonorrhea infection and age, age of initiation into sex work, marital status, having children, migration, sex worker type, or condom use practices (Table 3).

FSWs with gonorrhea infection were more likely to have often or always used illegal drugs before or during sex, to have ever injected drugs, and to have ever shared needles or injection equipment. Compared to those without gonorrhea, those testing positive had significantly higher lifetime prevalence of drug injection (43% vs 16%) as well as injection in the past month of cocaine (15% versus 6%), heroin (37% versus 14%), methamphetamine (16% versus 3%), and speedball (14% versus 6%). We did not find associations with alcohol use before or during sex, or number of IDU sex partners.

FSWs with gonorrhea had significantly fewer non-regular clients in the past month but had significantly more vaginal sex with these clients. They were also more likely to report having a male client who had ever injected drugs or a U.S. client. We found no association between gonorrhea and numbers of male clients, vaginal sex with regular male clients, or sharing needles with clients. FSWs with gonorrhea had significantly higher prevalence of HIV (4% versus 22%), active syphilis (titer $\geq 1:8$) (36% versus 8%), and Chlamydia (39% versus 11%).

Factors independently associated with gonorrhea infection were working in Tijuana versus Ciudad Juarez (AOR: 2.34; 95% CI: 1.43, 3.83), use of illegal drugs before or during sex (AOR: 5.96; 95% CI: 3.01, 11.80) and having a male IDU partner in the last 6 months (AOR: 2.32; 95% CI: 1.16, 4.63) (Table 2).

DISCUSSION

In this study of high-risk FSWs residing in two Mexico-U.S. border cities, Chlamydia and gonorrhea infection were more closely associated with drug use among FSWs and their sexual partners than it was with FSWs' sexual behaviors. Specifically, use of illegal drugs before or during sex and having male IDU clients was independently associated with gonorrhea infection, and recent methamphetamine injection was independently associated with Chlamydia infection. Odds of Chlamydia and gonorrhea infection were two- to four-fold higher in Tijuana than in Ciudad Juarez. These findings have implications for targeting STI prevention and treatment to subgroups of FSWs who use illicit drugs in these resource-limited settings, especially in Tijuana.

We found that methamphetamine injection was an independent predictor of Chlamydia infection. Use of methamphetamine has been associated with increased libido and numbers of sexual partners as well as with high-risk sexual behavior ^[98-101]. In a study of heterosexual methamphetamine users in San Diego, CA, participants' main reasons for using methamphetamine use were to get high, to get more energy, and to party ^[100]. Heterosexual women also reported using methamphetamine for weight loss, to feel more attractive, and to

cope with mood ^[100]. In a study of female IDUs in San Francisco, CA, methamphetamine use was associated with anal sex, more sexual partners, and receptive syringe sharing ^[99]. Although methamphetamine use is becoming more common among heterosexual women in countries such as the U.S., the high prevalence of methamphetamine injection in our sample (21%) is unusual. A previous qualitative study of FSWs in Tijuana reported that many women used methamphetamine to stay awake, suggesting a possibly different pattern of use by sex workers ^[27]. Future study of motivations among FSWs for using methamphetamine may help to inform interventions.

While gonorrhea infection was not associated with use of methamphetamine or other drug types, it was independently associated with using an illegal drug before or during sex. A critical review of 16 epidemiologic studies associated drug use with increasing rates of STIs, including gonorrhea ^[102]. High-risk heterosexual women in Houston, Texas were significantly less likely to use condoms if their sexual encounter was with a regular partner and if they used alcohol or drugs ^[82]. Among 155 FSWs who used drugs in New York City, substance use adversely affected their ability to use condoms with clients ^[103]. Some of the authors have initiated a new intervention study that aims to promote skills in negotiating condom use among FSWs in Tijuana and Ciudad Juarez who inject drugs, and we hope this will lead to a significant reduction in HIV/STI incidence.

Having an IDU sex partner in the past month was the only partner-level variable to be associated with incident STIs in our study, and this relationship

was only observed for gonorrhea. A cross-sectional behavioral survey of heterosexual sex partners attending public STI clinics in Tampa, Philadelphia, and San Diego found that one's own or a partner's use of drugs was associated with gonorrhea infection ^[79]. The lack of independent association of Chlamydia and gonorrhea infection with other partner characteristics may be due to inherent limitations in the study design, since few questions on clients and intimate partners were asked.

This study's results support the large body of literature linking younger age with Chlamydia infection. In a systematic review of risk factors for Chlamydia infection among females in the United Kingdom and Ireland, younger age was one of the most important determinants ^[104]. Our findings support increased screening for Chlamydia among young FSWs.

Interpretation of these findings should bear in mind a number of limitations. As with most other studies pertaining to drug use and sexual behavior, we relied on the accuracy of self-report, which may result in underreporting. Further, given that data were gathered as part of a sexual risk behavioral intervention study, only women reporting recent unsafe sex were included, which may have biased associations with condom use towards the null. Finally, since this analysis was cross-sectional, no causal inferences can be drawn; however, since nucleic acid amplification detected active infection, the variables we found to be associated with Chlamydia and gonorrhea may be true risk factors.

Given that both gonorrhea and Chlamydia are cofactors of HIV transmission ^[105], there is a need to scale up interventions to increase testing, diagnosis, and treatment for STIs among FSWs and their partners in these cities. Since Tijuana and Ciudad Juarez are experiencing rising rates of HIV infection among FSWs ^[18, 53], identifying and intervening on risk factors for Chlamydia and gonorrhea has implications not only for STI control, but also for containing the burgeoning HIV epidemic.

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Table 1: Factors associated with Chlamydia Infection among Female Sex Workers in Tijuana and Ciudad Juarez (N=798)

	N	Negative	Positive	p-value	OR (95% CI)
Demographic Characteristics					
Age, years	798	34 (9)	30 (8)	<0.001	0.64 (0.49, 0.82)*
Age of Initiation into Sex Work, %	790			0.72	
<18		66 (10)	11 (11)		1.00
18+		623 (90)	90 (89)		0.87 (0.44, 1.70)
Marital Status, %	794			0.33	
married/cohabitated		164 (24)	19 (18)		1.00
single		343 (50)	59 (57)		1.48 (0.86, 2.57)
other		184 (27)	25 (24)		1.17 (0.62, 2.21)
Has Children, %	794	647 (94)	96 (93)	0.83	0.93 (0.41, 2.13)
City of Residence, %	798			<0.001	
Tijuana		386 (56)	80 (77)		2.63 (1.64, 4.35)
Ciudad Juarez		308 (44)	24 (23)		1.00
Migrated into this State, %	794	428 (62)	70 (68)	0.27	1.30 (0.84, 2.03)
Sex Worker Type, %	798			0.75	
street worker		365 (53)	54 (52)		1.00
dance hostess		155 (22)	27 (26)		1.18 (0.72, 1.94)
barmaid		117 (17)	14 (14)		0.81 (0.43, 1.51)
other		57 (8)	9 (9)		1.07 (0.50, 2.28)
Condom Use					
Participant brought condoms to the interview, %	785	73 (11)	14 (14)	0.40	1.33 (0.72, 2.46)
% unprotected vaginal sex with spouse/steady partners	235	90 (26)	82 (38)	0.22	0.91 (0.81, 1.02)*
% unprotected vaginal sex with any type of client	782	44 (31)	48 (34)	0.45	1.03 (0.97, 1.1)*
% unprotected vaginal sex with non-regular clients	686	36 (34)	37 (37)	0.68	1.00 (0.94, 1.07)*
% unprotected vaginal sex with regular clients	720	52 (35)	53 (37)	0.77	1.01 (0.95, 1.07)*
Average USD amount earned for sex with a condom	783	29 (23)	37 (47)	0.55	1.08 (1.01, 1.15)*
Average USD amount earned for sex without a condom	792	47 (73)	59 (97)	0.48	1.01 (0.99, 1.03)*
Used condoms for vaginal sex with male clients in past 6 mo, %	797			0.92	
Never/Sometimes		400 (58)	59 (57)		1.00
Often/Always		293 (42)	45 (43)		1.04 (0.69, 1.58)

Table 1 (con't)	N	Negative	Positive	p-value	OR (95% CI)
<u>Substance Use</u>					
Used alcohol before/during sex, %	798			0.70	
Never/Sometimes		153 (22)	25 (24)		1.00
Often/Always		153 (22)	25 (24)		1.12 (0.69, 1.82)
Used illegal drug before/during sex, %	796			0.30	
Never/Sometimes		97 (14)	19 (18)		1.00
Often/Always		97 (14)	19 (18)		1.37 (0.80, 2.36)
Ever Injected Drugs, %	798	112 (16)	30 (29)	<0.01	2.11 (1.32, 3.37)
Has ever shared needles/injection equipment, %	798	86 (12)	24 (23)	0.01	2.12 (1.27, 3.53)
Injected cocaine in past month, %	756	38 (6)	8 (8)	0.38	1.40 (0.63, 3.09)
Injected heroin in past month, %	795	99 (14)	27 (26)	<0.01	2.10 (1.29, 3.41)
Injected methamphetamine in past month, %	787	19 (3)	10 (10)	<0.01	3.76 (1.70, 8.34)
Injected speedball in past month, %	785	42 (6)	9 (9)	0.28	1.50 (0.70, 3.17)
Number of IDU sex partners in past month	786	1 (2)	1 (2)	0.74	0.83 (0.28, 2.48)*
<u>Male Client Characteristics</u>					
Number of male clients in past six months	798	324 (314)	301 (333)	0.16	1.00 (0.99, 1.00)*
Number of regular male clients you had past month	798	6 (10)	5 (4)	0.46	0.71 (0.46, 1.10)*
Times you had vaginal sex with regular male clients	721	19 (24)	16 (19)	0.03	0.91 (0.80, 1.04)*
Number of non-regular male clients you had past month	798	35 (42)	28 (37)	0.02	0.95 (0.90, 1.01)*
Times you had vaginal sex with non-regular clients	685	38 (44)	30 (39)	0.02	0.95 (0.89, 1.01)*
Any US clients, %	798	473 (68)	79 (76)	0.11	1.48 (0.92, 2.38)
Male clients in last 6 mo who ever injected drugs, %	663	221 (38)	35 (39)	0.91	1.04 (0.66, 1.64)
Shared needles with clients in past month, %	798	14 (2)	3 (3)	0.48	1.44 (0.41, 5.11)

Table 1 (con't)	N	Negative	Positive	p-value	OR (95% CI)
STI Status					
HIV, %	795	28 (4)	16 (15)	<0.001	4.31 (2.24, 8.27)
Active Syphilis (titer≥1:8), %	793	63 (9)	18 (18)	0.01	2.11 (1.19, 3.73)
Gonorrhea, %	798	31 (4)	20 (19)	<0.001	5.09 (2.78, 9.34)

Univariate Statistics include Mean (SD) and Wilcoxon Test p-value for continuous variables. N (%) and Fisher Exact Test p-value for categorical variables. Categorical variables denoted with %

Injection Drug User (IDU)

* per 10 unit increase

Table 2: Factors associated with Gonorrhoea Infection among Female Sex Workers in Tijuana and Ciudad Juarez (N=798)

	N	Negative	Positive	p-value	OR (95% CI)
Demographic Characteristics					
Age, years	798	33 (9)	31 (7)	0.11	0.73 (0.53, 1.03)*
Age of Initiation into Sex Work, %	790			0.31	
<18		70 (9)	7 (14)		1.00
18+		671 (91)	42 (86)		0.63 (0.27, 1.45)
Marital Status, %	794			0.06	
married/cohabitated		172 (23)	11 (22)		1.00
single		369 (50)	33 (65)		1.40 (0.69, 2.83)
other		202 (27)	7 (14)		0.54 (0.21, 1.43)
Has Children, %	794	697 (94)	46 (90)	0.37	0.61 (0.23, 1.60)
City of Residence, %	798			<0.001	
Tijuana		423 (57)	43 (84)		4.17 (1.92, 9.09)
Ciudad Juarez		324 (43)	8 (16)		1.00
Migrated into this State, %	794	466 (63)	32 (63)	0.99	1.00 (0.56, 1.80)
Sex Worker Type, %	798			0.02	
street worker		383 (51)	36 (71)		1.00
dance hostess		178 (24)	4 (8)		0.24 (0.08, 0.68)
barmaid		124 (17)	7 (14)		0.60 (0.26, 1.38)
other		62 (8)	4 (8)		0.69 (0.24, 2.00)
Condom Use					
Participant brought condoms to the interview, %	785	79 (11)	8 (16)	0.25	1.54 (0.70, 3.40)
% unprotected vaginal sex with spouse/steady partners	235	90 (27)	87 (35)	0.84	0.97 (0.81, 1.15)*
% unprotected vaginal sex with any type of client	782	45 (32)	44 (31)	0.88	0.99 (0.90, 1.08)*
% unprotected vaginal sex with non-regular clients	686	37 (35)	35 (35)	0.79	0.99 (0.90, 1.08)*
% unprotected vaginal sex with regular clients	720	52.5 (35.3)	45 (36)	0.16	0.94 (0.87, 1.03)*
Average USD amount earned for sex with a condom	783	30.1 (27.8)	30 (22)	0.34	0.99 (0.89, 1.11)*
Average USD amount earned for sex without a condom	792	49 (78)	40 (28)	0.69	0.97 (0.90, 1.04)*
Used condoms for vaginal sex with male clients in past 6 mo, %	797			0.99	
Never/Sometimes		430 (58)	29 (57)		1.00
Often/Always		316 (42)	22 (43)		1.03 (0.58, 1.83)

Table 2 (con't)	N	Negative	Positive	p-value	OR (95% CI)
Substance Use					
Used alcohol before/during sex, %	798			0.49	
Never/Sometimes		578 (77)	42 (82)		1.00
Often/Always		169 (23)	9 (18)		0.73 (0.35, 1.54)
Used illegal drug before/during sex, %	796			<0.001	
Never/Sometimes		651 (87)	29 (57)		1.00
Often/Always		94 (13)	22 (43)		5.25 (2.90, 9.52)
Ever Injected Drugs, %	798	120 (16)	22 (43)	<0.001	3.96 (2.20, 7.13)
Has ever shared needles/injection equipment, %	798	96 (13)	14 (28)	0.01	2.57 (1.34, 4.92)
Injected cocaine in past month, %	756	39 (6)	7 (15)	0.02	2.93 (1.23, 6.95)
Injected heroin in past month, %	795	107 (14)	19 (37)	<0.001	3.53 (1.93, 6.46)
Injected methamphetamine in past month, %	787	21 (3)	8 (16)	<0.001	6.49 (2.72, 15.53)
Injected speedball in past month, %	785	44 (6)	7 (14)	0.03	2.62 (1.11, 6.17)
Number of IDU sex partners in past month	786	1 (2)	1 (2)	0.09	1.96 (0.72, 5.38)*
Male Client Characteristics					
Number of male clients in past six months	798	323 (315)	302 (342)	0.44	1.00 (0.99, 1.01)*
Number of regular male clients you had past month	798	6 (10)	6 (6)	0.94	0.95 (0.68, 1.33)*
Times you had vaginal sex with regular male clients	721	18.9 (24)	17 (17)	0.75	0.95 (0.81, 1.12)*
Number of non-regular male clients you had past month	798	36 (42)	19 (23)	0.01	0.85 (0.76, 0.95)*
Times you had vaginal sex with non-regular clients	685	39 (44)	21 (30)	<0.01	0.85 (0.75, 0.96)*
Any US clients, %	798	506 (68)	46 (90)	<0.001	4.38 (1.72, 11.17)
Male clients in last 6 mo who ever injected drugs, %	663	229 (37)	27 (60)	<0.01	2.55 (1.37, 4.73)
Shared needles with clients in past month, %	798	15 (2)	2 (4)	0.30	1.99 (0.44, 8.96)

Table 2 (con't)	N	Negative	Positive	p-value	OR (95% CI)
STI Status					
HIV, %	795	33 (4)	11 (22)	<0.001	5.92 (2.79, 12.58)
Active Syphilis (titer≥1:8), %	793	63 (8)	18 (36)	<0.001	6.07 (3.23, 11.43)
Chlamydia, %	798	84 (11)	20 (39)	<0.001	5.09 (2.78, 9.34)

Univariate Statistics include Mean (SD) and Wilcoxon Test p-value for continuous variables. N (%) and Fisher Exact Test p-value for categorical variables. Categorical variables denoted with %

Injection Drug User (IDU)

* per 10 unit increase

Table 3: Characteristics Independently Associated with Chlamydia and Gonorrhea Infection among Female Sex Workers

<u>Characteristic</u>	<u>AOR (95% CI)</u>
<u>Chlamydia Infection (N=777)</u>	
City of Residence (Tijuana vs Ciudad Juarez)	2.34 (1.43, 3.83)
Age (per 10 years)	0.63 (0.48, 0.82)
Injected methamphetamine in past month	2.68 (1.18, 6.05)
<u>Gonorrhea Infection (N=610)</u>	
City of Residence (Tijuana vs Ciudad Juarez)	4.75 (1.80, 12.52)
Used illegal drug before/during sex	5.96 (3.01, 11.80)
Had male IDU clients in last 6 months	2.32 (1.16, 4.63)

Injection Drug User (IDU)

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CONCLUSIONS

The research for this dissertation has exposed the author to the extensive levels of marginalization, abuse, and neglect that FSWs experienced prior to and during their involvement with sex work. FSWs experience many negative social, physiological, health effects as a consequence of engaging in sex work. Even when there is an exchange of money, drugs, or other goods, abuse, humiliation, stigmatization, oppression or exploitation are pervasive. FSWs who are initiated into sex work as children, whether it is by their family, pimp, organized crime, human trafficking or some other force, live with the detrimental and self-destructive effects of sex work for the rest of their lives. Social and institutional opposition or reluctance to support harm reduction among FSWs maybe rooted in discrimination, sexism, machismo, stigmatization, and culture. FSWs are 'bridge' populations that can transmit HIV/STIs to the general population and cannot be ignored. In this section, I will present the major findings from this dissertation research as well as the implications for prevention, the limitations and strengths of the study, and avenues for future research.

Major findings

In the first manuscript, the main finding was that there are different pathways for entering sex work among younger versus older females in the Mexico–U.S. border region. Initiators who began trading sex prior to age 18 reported higher rates of inhalant use a history of child abuse and being influenced to initiate sex work to pay for alcohol. On the other hand, older initiators reported significantly less education, had migrated to the state where they now lived, and reported being influenced to initiate sex work for better pay or to support children. Contrary to our hypotheses of the dissertation, women who initiated sex work younger did not have higher rates of migration into the state or drug use, for the exception of inhalant use, compared to women who initiated sex work later.

In the second manuscript, we found that among FSWs in these Mexico-U.S. border cities, drug-using behaviors were more closely associated with active syphilis than were sexual behaviors. We identified potential risk factors for active syphilis, which included ever injecting drugs, using illegal drugs before/during sex, and having any U.S. clients. We did not find that FSWs with active syphilis had higher rates of methamphetamine use and higher mean number of IDU sex partners in the past, as hypothesized.

Similar to the second manuscript, the results of the third manuscript indicated that drug-using behaviors, rather than sexual behaviors, were more closely associated with Chlamydia and gonorrhea infection. Factors independently associated with Chlamydia were being younger, working in

Tijuana versus Ciudad Juarez, and recent methamphetamine injection. Factors independently associated with gonorrhea were working in Tijuana versus Ciudad Juarez, using illegal drugs before or during sex, and having a male injection drug user partner in the last 6 months. Our final model did not indicate that FSWs who tested positive for gonorrhea and Chlamydia had a higher number of non-regular male clients or non-paying male sexual partners as had been expected.

Implications for Prevention

Preventing Entry into Sex Work

Identifying the correlates of early initiation into sex work and HIV and STIs acquisition is beneficial in identifying critical points of intervention and prevention among FSWs in these two border cities. Based on the results of the first manuscript, we recommend that prevention efforts take into account the developmental stage at which entry into sex work occurred. Based on the literature, programs aimed at preventing young girls from entering sex work must also consider that girls most at risk are those who have experienced parental substance abuse, absence of parental supervision, early sexual debut, or sexual or physical abuse [20, 21, 29, 30, 81, 82].

In the first manuscript, we also found that less education was associated with entry into sex work for older women. Interventions to prevent entry into sex work need to start early and include outreach education programs for young girls focusing on retention in school and increasing their access to other economic

opportunities later in life. Mexico's education system needs to integrate sexual education including STD prevention, family planning, and sexual abuse.

Not only would an increased education improve their economic prospects, but among young women, more education is also associated with increased self-esteem, a capacity to act on HIV prevention messages, reducing the power imbalance in relationships, and reducing risks in their social and sexual networks^[83]. Education is empowering and has been shown to be a necessary but not sufficient condition to protect young women and girls from HIV infection. Some scholars have considered education to be a 'social vaccine' to prevent HIV spread^[84, 85]. A systematic review of the literature of HIV intervention programs among girls in the education system in southern Africa indicated an association between safer sexual behavior (e.g. protected sex; delay of sexual debut) and both attendance and attainment of a formal education^[84]. Worldwide, students are less likely to become infected with HIV compared to those who do not attend school, regardless HIV/AIDS education in the curriculum^[85]. Globally, research has indicated that girls who have completed a secondary education have a lower risk of HIV infection and practice safer sex compared to girls with only a primary education^[83].

Intervening on inhalant use among adolescents living in Mexico is critical. Girls being retained in school longer may enable educators to identify young girls abusing alcohol or inhalants, who can then be referred to youth-centered alcohol and/or drug treatment centers. Girls who use inhalants and drop out of school become vulnerable to further drug use and sex work, a hard population to reach.

Literature on current sexual education curriculum in Mexico is lacking. Historically and currently, HIV/AIDS prevention education in Mexico has been met with resistance, particularly driven by tradition and the strong influence of the Catholic Church^[86]. Fortunately, recent attention has been placed on the HIV/AIDS epidemic in Mexico and the rest of Latin America. As a result of the first meeting to Stop HIV and STIs in Latin America and the Caribbean at the 2008 International AIDS Conference in Mexico City, Ministries of Health and the Ministries of Education have become more committed to strengthening the response to the HIV epidemic in formal and non-formal educational settings^[87]. In particular, a commitment has been made to update the contents and didactic methods at all educational levels before the end of 2010 in collaboration with the Ministries of Health and the Ministries of Education, considering the views of civil society and communities and including children, adolescents, youth, teachers, and parents^[87].

Families can be encouraged to keep their daughters in school by receiving monetary support, goods, or incentives. The World Bank and other donors such as United Nations Children's Fund (UNICEF) have funded and implemented interventions specifically aimed at improving girls' education outcome in Mexico in collaboration with Mexico's federal agencies such as the Program for Education, Health, and Nutrition (Programa de Educación, Salud y Alimentación (PROGRESA))^[88].

An improved financial situation is key for both older and younger women. Over 90% of the FSWs we studied reported having children. Hence, childcare

programs for women with young children would allow women the flexibility to leave home to work more hours of the day. They would also benefit from family planning programs. Older women need alternative sources of income, such as micro-financing and employment options to gain financial independence.

Those who migrate or are deported to the region need housing resources and alternatives to help delay or prevent entry into sex work. Currently in Tijuana, migrants have access to the *Casa del Migrante, A.C.* or a migrant house that provides food and temporary lodging (15 days) and other services to migrant from Mexico and other Latin American countries that are stranded in Tijuana. This organization however does not target their services to women nor does it provide long-term support.

Some of the women and children who enter sex work do not enter by choice. For example, they may be victims of human trafficking, forced migration, or sex trafficking. Victims of human and sex trafficking are extremely difficult to identify and reach and are found in many parts of the world^[89-91]. Victims of sex trafficking may also be victims of human trafficking, smuggled across international lines, or exploited within their own country by natives or tourists^[92]. In some cases, traffickers take most or all of the victim's income, keep them in bondage, subject them to physical force or sexual violence, smuggle them across international lines, deceive them with a promise of a legitimate job, and force them to work in the sex industry^[93]. Children are a particularly vulnerable. Drugs and alcohol and have been used to control the victims and survivors turn to these to deal with the memories^[92]. In this study, we could not identify girls or women

who were trafficked. According to the legal age for consensual sex in Mexico, the eligibility criteria required that participants be at least 18 years of age. Thus, we screened out child victims of trafficking. Future studies should include girls and younger women to identify potential victims of sex trafficking, and to provide support and resources to safely exit the sex trade.

Preventing STI Acquisition among FSWs

Identifying key risk factors for STI acquisition among FSWs contributes to existing efforts to increase HIV and STI voluntary counseling and testing, prevention (i.e. utilization of condoms), and guides future interventions. With competing risk factors for syphilis, Chlamydia, and gonorrhea among FSWs, identifying the most influential risk factors and identifying critical points of intervention for the prevention of each STI is crucial. Interventions aimed at reducing STI transmission in Mexico will likely impact the HIV/AIDS epidemic in Mexico and the U.S. Since syphilis, Chlamydia, and gonorrhea^[94, 95] are important risk factors for HIV transmission, their eradication would have a strong impact on HIV incidence.

Since risky sex and drug use go hand in hand, our research suggests that STI and harm reduction programs should be better integrated. For example, as the results of the second manuscript indicate, active syphilis was independently associated with injection drug use. Although we cannot conclude that this association is causal, future preventive efforts should consider the potential for parenteral transmission of syphilis among IDUs. These can provide access to

sterile syringes in health clinics where STI testing is offered, and by offering STI testing and on-site treatment at needle exchange programs and encouraging cleaning of “works” or injection equipment. STI eradication programs should also assist FSWs with safer-sex negotiation in the context of drug use.

Like in most countries, STI prevention programs in Mexico typically do not offer harm reduction for IDUs. Harm reduction programs aim to prevent or reduce negative health consequences associated with certain behaviors when the behavior cannot be changed^[96]. The first harm reduction program for drug users were first introduced in Amsterdam, the Netherlands, in 1984 and eventually included needle exchange programs and mobile clinics with drug treatment (methadone) and STI testing and counseling^[97]. Harm reduction efforts such as these now exist throughout the world. Despite the benefits of harm reduction programs such as needle exchange programs, these programs are sometimes misunderstood in public health, particularly among those who favor a “zero tolerance” perspective on illicit drug use^[97]. Although Tijuana has one needle exchange program, it is necessary to significantly increase access to sterile syringes for IDUs since this program is limited in scope. Since this program is under-funded, the ability to offer male and female condoms, as well as on-site STI testing and treatment is limited.

In addition to harm reduction and sexual behavioral change programs, efforts to support substance abuse treatment must be increased. Given the evident association between drug use and STI/HIV, strategies to reduce STI and HIV through reducing or eliminating drug use are essential. Those addicted to

opiates may have access to effective medication therapies, such as methadone and buprenorphine (combination of methadone and opiate blocker naltrexone), to help them overcome their addiction; however effective treatments for cocaine or methamphetamine addiction have not yet been developed^[98]. Mexico has very limited substance use treatment resources. Currently, there are few clinics offering methadone in Mexico and none offering buprenorphine, drugs recommended for drug treatment by the World Health Organization^[99]. Currently, two private clinics in Tijuana provide methadone maintenance^[18]. One of these clinics, Profesionales Contra la Adiccion, S.A. DE C.V., has been in Tijuana for over 10 years and serves 400 clients per week^[18]. Since 2001, there is one government-operated methadone clinic in Ciudad Juarez, the only one in Mexico, offering psychological and social services^[18]. Methadone and buprenorphine programs are cost effective approaches essential to opiate addiction recovery^[99]. These should be expanded and offered for free, subsidized, or at a cost determined on a 'sliding scale'.

Mexican studies evaluating treatment for mental health services often exclude drug abuse given the lack of data^[100, 101]. The Mexican National Comorbidity Survey in 2001–2002 indicated that only 2.9% drug abuse patients sought treatment within the first year of onset while 56.9% sought treatment by age 50^[101]. The median duration of delay for treatment of any substance-use disorders was 10 years^[101]. Investment by Mexico in expanding substance use treatment may be useful in helping to reduce drug-related risk behaviors in sex

workers and their clients alike and may aid in reducing the burden of Chlamydia, gonorrhea, and other STIs in the border region and beyond.

Results from the second and third manuscript imply the need for future prevention efforts among FSWs in conjunction with their sexual partners. The second manuscript indicates that FSWs with U.S. clients had a higher prevalence of active syphilis while results from the third manuscript call for couple-based STI interventions among who use methamphetamine and inject drugs. The latest guidelines from the Centers for Disease Control and Prevention (CDC) emphasize that a variety of strategies need be applied for partner services for the treatment STI including program collaboration, service integration, and expedited partner therapy^[95].

Bacterial STIs, such as syphilis, Chlamydia, and gonorrhea, are often cured with antibiotics. Meanwhile viral STIs, such as HIV, have no cure although symptoms can be treated. Despite the differences in the type of agent, there is much overlap in the risk factors and mode of transmission for both bacterial and viral STI. While STI prevention and treatment may impact the HIV epidemic, in most countries, HIV and STI preventions efforts are directed by different departments and consequently are not well integrated. Promoting HIV and STI programs with other reproductive health services (e.g., pap smears), may increase STI testing, treatment, and reduce stigma. This approach requires cooperation between key organizations such as Mexico's Ministry of Health, the National Center for HIV/AIDS Prevention and Control, and agencies such as the National Institute of Public Health, which provide extensive STI research.

Limitations

The results of the dissertation presented should be interpreted with a number of limitations in mind in regards to bias and internal and external validity.

Misclassification of the Outcomes

Age of Initiation into Sex Work: Women were not directly asked if they initiated sex work before the age of 18, the outcome for aim 1. Age of initiation into sex work was determined by the current age and the number of years working as a sex worker for each participant. Given that participants may not recall the total number of years working as a sex worker, the variable for age of initiation into sex work may be prone to misclassification. Assuming that participants reported their actual age and had no reason to inflate or deflate the number of years working as a sex worker, we would expect bias towards the null. Hence, for the significant associations found with age of initiation into sex work, the true association may actually be stronger.

Active Syphilis: Misclassification of active syphilis may also have influenced the results of the second manuscript. While the literature and the World Health Organization (WHO) generally agree that a titer $\geq 1:8$ is the best cutoff for active syphilis^[41-44], the use of titers may pose another potential bias in the study given that titers alone are not sufficient to determine active syphilis status^[40]. A low titer may indicate a negative syphilis or may be low due to treatment (titers decline with syphilis treatment). Syphilis treatment history was

not available in *Proyecto Mujer Segura*; however, women were asked to self-report their STI status and treatment. Anecdotal evidence suggests that few FSWs were receiving STI treatment, suggesting that we can safely assume that most cases where titers exceeded 1:8 were reflective of active syphilis infection.

Bias

Recall bias: Recall bias can be caused by differences in accuracy or completeness of recall to memory of past events or experiences. Recall bias may exist in the reporting of number of clients or unprotected sexual acts in the last 6 months with each type of sexual partner given that for some women, that number was greater than 100^[7]. We do not believe FSWs had a reason or motive to either inflate or deflate the number of sexual clients or acts; hence this bias would tend to bias associations towards the null.

Socially desirable responding: Socially desirable responding of measures may introduce potential reporting bias. Given the stigma associated with drug use, the validity of self-reported measures, such as current or past drug use and age of first use, may have been compromised and underreported. For example, in the first manuscript, participants may have been reluctant to disclose that they initiated sex work prior to the age of 18 and disclose their use of drugs given the legality and stigma associated with these behaviors. On the other hand, the study used trained female interviewers, many of whom were ex-FSWs who were non-judgmental. This strategy should have encouraged truthful responding. An alternative to face-to-face interviews is Audio Computer Assisted Self

Interviewing (ACASI). This computer based interview tool becoming popular for administering surveys of sex, drug, and other sensitive behaviors given that it results in study participants to providing more honest responses^[102, 103]. Use of this tool would reduce socially desirable responding, but was not possible in this setting because few participants were computer literate.

Selection bias: Stigmatization exists toward FSWs. To participate in this study, women needed to self identify as a FSW. This is a label from which they could potentially be discriminated against. Hence, there may be systematic differences in characteristics between those who were selected for study and those who were not. If those that were missed were lower risk FSWs compared to those were recruited, then our results may be an overestimation of risk behavior. This inconsistency in self-identification would affect the external validity of the study but not internal validity.

Generalizability: The women included in this study were high risk FSWs to enable the testing of a behavioral intervention. Participants were included if they reported having had unprotected vaginal or anal sex with a client at least once during the previous four weeks and excluded if they were knowingly HIV-positive, or practiced consistent use of condoms/dental dam for vaginal, oral and anal sex with all clients during the previous two weeks. As a result, the odds ratios we observed for STI outcomes are likely to be higher than what we would expect to observe for the general FSW population in Tijuana and Ciudad Juarez. Similarly, we would also expect the STI prevalence we report to be inflated compared to

the general FSW population in these cities. Hence, the external validity is greatly impacted by the nature of the high-risk population.

On the other hand, it is possible we may have under-estimated the prevalence of active syphilis. Although the participants in this study were high risk FSWs, participants who were knowingly HIV-positive were excluded. Given the high rates of co-infection of HIV and syphilis, this exclusion criterion may have also excluded some women with active syphilis. This would have affected the internal validity of the syphilis prevalence we reported among this population and bias associations away the null. However, since less than half of the FSWs in this study had ever had an HIV test, the number of women with syphilis who were excluded may not be substantial.

Strengths

Unique Dataset

FSWs have been documented to have high rates of STIs and HIV in many parts of the world. However, little work has been done to characterize the prevalence of these infections along the Mexican-U.S. border. *Proyecto Mujer Mas Segura* was the first study among FSWs in this region. This study had collected data from over 900 FSWs in both Tijuana and Ciudad Juarez combined. This is a considerable sample size that allows exploration of the rich dataset including many of the known risk factors cited in the literature for both early initiation into sex work and for STI acquisition.

Assessing Risk

Chlamydia and gonorrhea were tested with nucleic acid amplification, which means that incident, not prevalent, infections are being detected. Hence, in this study, we potentially identified risk factors, rather than correlates, assuming that these infections were not been present longer than the recall period of 2 months. However, in Mexico, with limited access to health care, increasing prices of STI exams, and low rates of voluntary STI testing, we cannot be certain of this assumption among FSWs.

Future Research

Proyecto Mujer Segura has provided a strong base of information on the high risk FSWs in Mexico-U.S. border cities to guide future research. As in the case of other resource constrained countries, in order to reduce child prostitution, it would be necessary to provide alternatives sources of income to young FSW or young women at risk for initiating sex work, increase their school retention rates, and provide psychological and social support. This would need to be a multifaceted effort and would require the collaboration of organizations such as *Desarrollo Integral de la Familia* (DIF; Family Development Program) that work with Mexico's youth in addition to health and education departments of Mexico, as described in the implications for prevention. A randomized controlled trial would be the ideal study design to assess whether or not retention in school is effective in reducing rates of entry into sex work.

Based on the results of manuscript 2, we cannot draw causal inferences about the risk factors or establish temporal associations between drug use and active syphilis. To do so, a prospective cohort study among FSW-IDUs without active syphilis would allow us to establish the association between potential risk factors for incident syphilis infections, such as needle sharing.

The analyses of manuscript 3 were limited in the ability to detect the impact of partner level characteristics on Chlamydia and gonorrhea infection. A prospective cohort study among FSWs and their primary regular partner would allow us to determine individual and partner behaviors and other risk factors for STI infection and re-infection.

FSWs are overrepresented in reported STI cases. Because of the limited resources of the Mexico-US border region and stigmatization toward FSWs, this population has not been reached in the past. Research conducted on risk reduction interventions and prevention programs among FSWs by *Proyecto Mujer Segura* and injection drug users through *Proyecto El Cuete* have provided Mexico's health departments critical research to address the needs of these high risk, marginalized populations. A new behavioral intervention study, *Proyecto Mujer Mas Segura* aims to decrease the sharing of syringes and injection paraphernalia and to promote skills in negotiating condom use among FSW-IDUs in Tijuana and Ciudad Juarez. The goal is to significantly reduction in the incidence of HIV and STI including syphilis, gonorrhea, Chlamydia, trichomoniasis, and bacterial vaginosis.

This dissertation work has contributed to the literature on the FSW population in Tijuana and Ciudad Juarez. Results can be used to guide future intervention studies to prevent or delay entry into sex work. It has also exposed the need for drug use harm reduction and STI and HIV prevention among FSWs and their sexual partners. Our results indicate the need for Mexican health and education agencies to collaborate further to address the needs of this marginalized population. Interventions and services need to be tailored to specific needs and FSWs' realities in this setting. The dissertation work has provided a foundation for future research and deepened the author's commitment to addressing the needs of high-risk populations, particularly those along the Mexico-U.S. border.

APPENDIX

Preliminary Analysis

Prior to developing hypotheses for the first manuscript, *Correlates of Early versus Later Initiation into Sex Work in Two Mexico–U.S. Border Cities*, preliminary exploratory analyses was performed. Preliminary analysis was conducted to determine the temporal sequence between age initiation into sex work and age initiation into drug use among 474 female sex workers in Tijuana. Data was collected between September 2004 and March 2006. Mean age differences between age initiation into sex work and age initiation for each individual drug were compared with paired t-tests. Significant results indicated that, for the exception of speedball, FSWs initiated the use drugs prior to initiating sex work. For example, marijuana was on average was first used 7.5 years prior to initiation into sex work while crystal methamphetamine was first used only 5 months prior (Table 1).

Most of the FSWs in this study were street workers (43%), 22% had ever injected drugs, and 70% had ever used any drug. On average, FSWs were 33 years old (SD=9) and had been working as a sex worker for 6 (SD=7) years. Age initiation into sex work ranged from 8 to 54 years old.

Table 1: Mean age difference between initiation of drug use and sex work, Tijuana, Mexico

DRUG	N	%	Mean Age Difference	SD	P-VALUE*
Marijuana/Hashish	231	48.7	-7.5	8.7	<.0001
Heroin	110	23.2	-3.3	8.4	<.0001
Inhalants	52	11.0	-6.8	8.6	<.0001
Crystal Meth	248	52.3	-0.4	8.8	0.51
Ecstasy	21	4.4	0	9.5	0.99
Cocaine	162	34.2	-4.1	8.1	<.0001
Speedball	47	9.9	0.1	8.9	0.02
Crystal Meth & Heroin	21	4.4	1.3	6.7	0.38
Tranquilizers	127	26.8	-2.6	8.5	0.001
Other Drugs	14	3.0	-6.5	11.2	0.05

* Paired t-test p-values indicate significant mean age difference from zero

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